HSL-CUP4
CUPPER
HIGH SPEED CONTROL PACKAGE

The Systems Engineering HSL-CUP4 Cupper High Speed Control Package is an electronic upgrade which provides:

◊ **Reduced Tooling Damage:** by accurately detecting die jams/cup jams and immediately de-activating the clutch to prevent additional stroking.

◊ **Repeatable Air Strip Control:** to prevent air stripping and blow-out problems and thus reduce the occurrence of die jams or cup jams.

◊ **Accurate Clutch Control:** Incorporates TDC brake wear compensation algorithm to stop press at TDC regardless of actual brake response.

◊ **High Speed:** Package operates at speeds in excess of 300 Strokes Per Minute.

Features

- Performs high speed control functions of Cupper to speeds in excess of 300 Strokes Per Minute (machine mechanically permitting). This includes clutch control, air strip control, as well as die protection (die jam and cup jam detection).

- Performs the following control functions:

    - Rapid response control of clutch/brake system for emergency stops (die protection) as well as precise TDC stops. **Note: The clutch solenoid outputs of the HSL-CUP4 are not intended as safety contacts for the cupper clutch and must not be the only interrupt to the clutch solenoids.**
    - Accurate die jam (no cup drop) and cup jam detection for up to 16-out presses.
    - Highly repeatable air strip control to reduce cup stripping and die jam problems.
    - Brake wear compensation (Auto TDC timing programming) algorithm to stop press at TDC regardless of brake response.
    - Brake response determination allows displaying of actual brake response (in degrees).
    - Brake response alarm to indicate when brake stopping response (in degrees) has exceeded user preset limit.
    - Lubricator speed reference (0-10volt analog output) provides reference to lubricator proportional to speed of cupper (user scalable).
    - Alarm detection: die jam detection, cup jam detection, scrap jam detection, timing signal fail detection, clutch output failure detection, no ram motion alarm, resolver failure detection, and brake response too long.
    - Data Acquisition: Total number of strokes and total number of die jam/cup jam faults for each station (for both current and last shift).

- Can be used on virtually all types of Cupping Presses.

General Description

The HSL-CUP4 Cupper high speed control package is an electronic upgrade for Cupping Presses which performs the high speed control functions of the cupper including: rapid response clutch/brake control, accurate die jam/cup jam detection, and precise air strip control. In addition, the package provides a brake wear compensation feature which automatically adjusts the TDC timing signal to stop the press at TDC regardless of brake stopping response.

Alarm detection is provided including: die jam/cup jam detection, scrap jam, timing signal failure, brake response too long and more. Data collection includes: total stroke count, total die jam/cup jam fault counts, and die jam/cup jams per station fault counts (both for the current shift and previous (last) shift). In addition, the package also provides a lubricator speed reference output which is proportional to the cupping press speed.

The package is not a dedicated “black box”, but instead is implemented using the high performance Systems M4500 PLC/PLS module which allows easy customization by either SEA or the end user. The M4500 module is programmed using the DOS-based SYSdev programming package which allows the module to be programmed in any combination of Ladder logic or High-level (subset of “C”), as well as perform on-line monitoring and trouble-shooting. The M4500 module incorporates a built-in PLS which interfaces directly with the machine mounted resolver and provides all machine timing, eliminating the need for an external PLS.

Clutch / Brake Control

The clutch/brake solenoids of the Cupper are activated by the HSL-CUP4 through the electro-mechanical two hand safety control circuitry provided externally by the user. The fast 0.5millisecond throughput of the HSL-CUP4 along with the fact that the PLS is fully integrated in the M4500 module, allows extremely fast and repeatable de-clutching and braking response to be achieved. Normally the clutch is controlled via inputs to the HSL-CUP4 that are mapped from outputs on the host PLC. However, detection of any of the alarms (die jam, cup jam, scrap jam, etc.) results in an immediate de-clutch of the solenoids.

Air Strip Control

The HSL-CUP4 provides a repeatability of 0.5 milliseconds for the air strip control thus reducing can stripping and blow-out problems. An "Air Strip (Low)", "Air Strip (Mid)", and "Air Strip (High)" timing signals are provided to activate the air strip when running in the respective speeds. These air strip timing signals can be adjusted independently to optimize air strip at all speeds.

Brake Wear Compensation

The HSL-CUP4 incorporates a brake wear compensation or automatic TDC timing feature which stops the press at TDC regardless of the actual braking response of the clutch/brake. The stopping compensation is accomplished by automatically adjusting the TDC timing signal based on the previous stop. Any overrun is detected and a new TDC timing signal is computed such that the machine will stop at the desired location on the next stop. Three TDC signals are provided: one for low, mid, and high speed. The mid and high TDC timing signals incorporate the brake wear compensation feature. The appropriate TDC timing signal (mid or high) is adjusted based on the speed of the machine when the TDC stop was initiated.

In addition to the brake wear compensation, the HSL-CUP4 also calculates the actual brake response (in degrees). This is the number of degrees from where the clutch was de-activated (TDC timing location) to where the crankshaft actually ended up stopping. This can then be displayed by the operator or maintenance personnel to determine the condition of the brake.

Die Protection (Die Jam / Cup Jam)

The "Cup Drop Window" timing signal, along with the machine mounted cup drop sensors, is used to verify that the cups do drop correctly from the machine. The cups must drop inside the "Cup Drop Window" in order to avoid a *Die Jam* alarm and the cups must not drop outside the "Cup Drop Window" in order to avoid a *Cup Jam* alarm. Die protection is provided for up to 16-out presses. The clutch is immediately de-activated for a TDC stop at the detection of either alarm.

Alarm Detection

In addition to the *Die Jam* and *Cup Jam* alarms, the package detects the following alarms*: Scrap Jam*, *Timing Signal Fail*, *Clutch Output Failure*, *No Ram Motion Detected*, *Resolver Failure*, and *Brake Response Too Long*. The

Alarm Detection (cont'd)

Scrap Jam alarm occurs if scrap is detected backed up at the grounded scrap discharge. The *Timing Signal Fail* occurs when any of the timing signals generated in the PLS section fail to change state periodically while the machine is running. The *Clutch Output Fail* alarm occurs if either clutch output fails *"on"* or *"off"*. *No Ram Motion* occurs if no motion is detected after the clutch is activated. The *Resolver Failure* alarm occurs if motion is detected after the clutch is de-activated. The above alarms immediately de-activate the clutch when any one occurs with the respective alarm message displayed on the HSL-CUP4. These alarms are summed into one output that indicates to the host PLC that an alarm did occur.

Data Collection

The following data is collected for both the current shift and the previous (last) shift: Total number of strokes, total number of die jams/cup jams, and total number of die jams/cup jams per station. This data can be viewed locally on the display of the HSL-CUP4 by either the operator or production control personnel. This information is updated ("current" shift transferred to "last" shift) based on the change of state of a discrete input.

HSL-CUP4 Keypad / Display

The keypad / Display of the HSL-CUP4 is designed to mount in the door of the enclosure that the HSL-CUP4 subpanel is mounted in (maximum cable length of 8 feet). The keypad contains 24 keys consisting of data display commands, setup commands, and a numeric keypad. The display of the HSL-CUP4 is a 2-line by 40-character backlit LCD display which displays the selected data and setup menus. The keypad / display can be used by the operator or production control personnel to view the collected data and can be used by authorized personnel (passcode or key switch protected) to adjust the timing and all setup parameters.

IMPORTANT SAFETY WARNING

The HSL-CUP4 is intended as a high-speed logic gate to provide consistent and accurate clutch control. It is not designed as a redundant, dual-processor clutch brake safety module. The HSL-CUP4 must not be the only means of controlling the cupper clutch mechanism. Good design practice dictates the use of safety interlocks on any device that starts or stops automatically that can cause personnel injury to operating or maintenance personnel. The HSL-CUP4 must be used only in conjunction with industry approved safety interlock contacts, implemented in accordance with ANSI B11.1 safety requirements, otherwise serious personnel injury may result.

Specifications

Power Requirements:
Voltage: 100-240VAC, 50/60HZ
Current: 0.5 Amps @ 115VAC
0.25 Amps @ 230VAC

Temperature Ranges:
Operating: 0 to 55°C
Storage: 0 to 70°C

Resolver Interface:
Resolver Type: Systems Electronics Group RSV34-MS1 or equivalent (also can be paralleled with existing resolver/PLS)

Resolver Cable: Systems Electronics Group RSV-RSCBLE-XX

Control Inputs:
Voltage Range: 10-30VDC
Input "On" Voltage (min): 10.0 volts
Input "On" Voltage (max): 30.0 volts
Input "Off" Voltage (max): 5.0 volts
Input Current (max): 15 milliamps @ Vin=30V
Optical Isolation: 1500 Vrms

Outputs:
Voltage Range: 10-30VDC
Output "On" Voltage (min): VCC-2.00 volts
Output "On" Voltage (max): VCC-0.25 volts
Output "Off" Voltage (max): 1.5 volts
Output "On" Current (max-cont): 0.5 Amps DC
Output "On" Current (100msec): 3.0 Amps DC
Optical Isolation: 1500 Vrms

Ordering Information

The HSL-CUP4 package is provided for back-panel mounting inside the existing user's control cabinet. In addition, a NEMA 12 enclosure can be purchased to house the HSL-CUP4 if the required space is not available in the existing user's cabinet. The part number for the optional NEMA 12 enclosure is HSL-CUP4-ENCL. The order number for the HSL-CUP4 is as follows:

Part Number	***Description***
HSL-CUP4	Cupper high speed control package consisting of a pre-wired sub-panel (17" X 17" X 8") for mounting in the existing user's control cabinet including the following: 1ea. M4500 PLC/PLS module (with required I/O boards) 1ea. D4591 Display / Keypad 1ea. HSL-CUP4 User's Manual 1ea. HSL-CUP4 Keypad Quick Reference Manual 1ea. HSL-CUP4 Program Disk 1ea. M4500 User's Manual

HSL-CUP4 Options (*purchased separately)*

The following items can be purchased separately as required or desired:

Part Number	***Description***
HSL-DSP	Remote RPM/Position Display
HSL-CUP4-ENCL	NEMA 12 enclosure for HSL-CUP4 (20" X 20" X 10")
RSV34-MS1	Resolver (required if machine is not already equipped with resolver)
RSV-RSCBLE-XX	Resolver Cable

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