**HSL-WISVCUP
APM Bodymaker
Servo Cupfeed Control**

The Systems Engineering HSL-WISVCUP APM (Alcoa Packaging Machinery) Bodymaker Servo Cupfeed control package replaces the existing mechanically driven rotary cupfeed cam with a servo motor driven cupfeed cam providing the following benefits:

◊ **Reduced Maintenance:** Replaces wear prone mechanically driven positive cupfeed cam with a servo driven cupfeed cam eliminating the gearbox, drive shaft, cupfeed stop clutch, timing chain and timing gears.

◊ **Increased Production:** Fine adjustability of the cupfeed cam allows more accurate timing of the cam reducing the number of cup miss-feeds. Rapid re-start at the occurrence of a die jam or tear-off is provided by automatic synchronization of the cupfeed cam (cam does not have to be re-timed).

◊ **Extended Tool Life:** Expensive tooling is protected by the immediate stop of the cupfeed cam at detection of a tear-off or die jam preventing the feeding of an additional cup into a scrap contaminated tool set. Increased accuracy in cupfeed timing reduces number of miss-feeds which reduces number of tear-offs and die-jams as well.

◊ **Quick Pay-off:** With the potential reduction in tooling damage that can be realized, the HSL-WISVCUP typically pays for itself in just a few months.
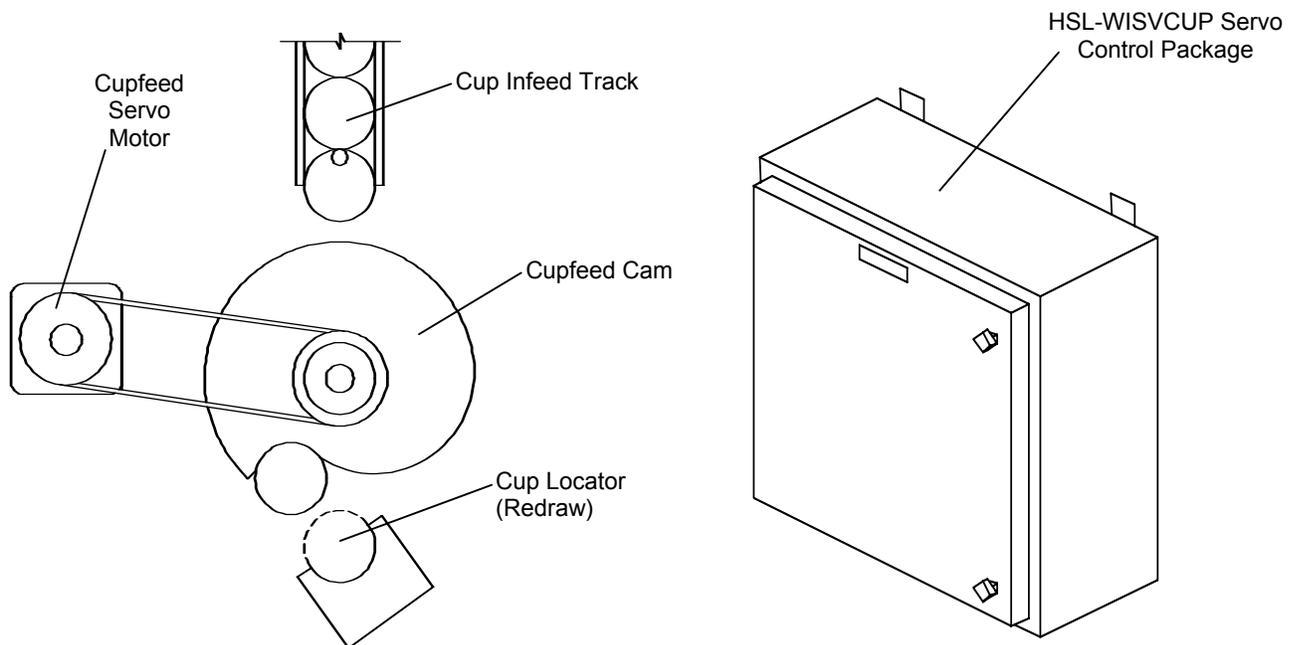
Features

- Replaces wear prone mechanically driven positive cupfeed cam with a servo driven cupfeed cam control used in conjunction with the APM servo cupfeed cam upgrade.

- Interfaces directly with cupfeed cam servo motor, machine mounted main crank resolver, and existing control system to accurately cam cupfeed with main crank in all modes and all speeds.

- Immediate cupfeed cam stop at detection of short can or tear-off protects valuable tooling by preventing the feeding of an additional cup.

- Completely automatic synchronization of cupfeed cam with main crankshaft when clutch is engaged to reduce downtime and reduce operator intervention.

- Optional high-speed logic function add-on performs additional high-speed control functions of APM bodymaker including cupfeed solenoid control, air strip control, brake wear compensation, as well as die protection (short can/tear-off detection).

- Alarm detection: cupfeed following fault, cupfeed servo motor o'temp, cupfeed motor amplifier fault.

- Provided with DOS based "HSLSCUP" set-up software package. This allows the user to set the servo cupfeed set-up parameters via easy to use menus, as well as download the respective application programs and set-up data.

- Based on high performance M4510 PLC/PLS/Motion control module which allows easy trouble-shooting and user customization using the SYSdev programming package.

General Description

The HSL-WISVCUP APM Bodymaker servo cupfeed control package is an electronic upgrade used in conjunction with the APM servo positive cupfeed cam upgrade. The package provides complete motion control of the servo cupfeed cam plus detection of the following alarms: cupfeed motor over temp, amplifier fault, cupfeed cam following fault, etc. The package interfaces directly to the machine mounted cupfeed servo motor, cupfeed timing sensor, main crank resolver, as well as the host PLC via discrete DC I/O.

The control package is not a dedicated "black box", but instead is implemented using the high performance Systems M4510 PLC/PLS/Motion controller which allows easy customization by either SEA or the end user. The M4510 is programmed using the optional "SYSdev" (DOS based) software programming package which allows programming in any combination of Ladder Logic or high-level (subset of "C"), as well as perform on-line monitoring and trouble-shooting. The 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.

Cupfeed Cam Servo Motor Control

The cupfeed cam motor control is implemented with a high-speed (0.5msec update) PID servo loop. The main crank position is used as the reference for the servo loop with the cupfeed cam position used as the feedback. Both crank position and cupfeed cam positions are generated using resolvers with a resolution of 12-bits (0-4095). The PID servo loop nulls the error (difference) between the main crank and cupfeed positions to zero (or as minimal as is practical). Full access to the PID gains allows the servo loop to be tuned to provide the optimum balance between acceptable error and minimum running current.

At the detection of a short can or tear-off, the cupfeed cam is immediately stopped to prevent the feeding of an additional cup which protects valuable tooling. The cupfeed cam automatically synchronizes with the main crank when the machine is re-started to minimize downtime by eliminating manual re-timing by the operator.

The cupfeed servo motor is enabled via a contactor that is interlocked with the machine guards and e-stop safety string to provide the same level of safety typically provided with the main clutch.

Alarm Detection

The package detects the following alarms: *Cupfeed Following Fault*, *Cupfeed Servo Motor O'Temp*, and *Cupfeed Motor Amplifier Fault*.

Cupfeed Following Fault: This alarm occurs when the cupfeed cam following error (difference between main crank position and cupfeed cam position) exceeds a user defined preset. This indicates either binding in the cupfeed cam, miss-tuning of the PID gains, broken belt, etc.

Cupfeed Amplifier Fault: This fault is generated by the Servo Amplifier directly. Sources of this fault include: amplifier output short circuit, amplifier over-voltage, and amplifier over temperature.

Cupfeed Motor Over Temp: Activated by the thermostat in the cupfeed servo motor, this fault occurs when the temperature of the motor exceeds 155 degrees C.

"HSLSCUP" Setup Program

The "HSLSCUP" setup program allows the user to easily view the HSL-WISVCUP data or alter the HSL-WISVCUP setup variables using an IBM PC or compatible.

The servo cupfeed set-up variables include: Cupfeed Cam Stop Position at Short Can, Max Error for "Out of Sync" Disable, Max Error for Enable Cupfeed Synchronization, Max Error for "Following Error" Alarm. The servo cupfeed tuning variables consist of: the Proportional Gain, Integral Gain, and Derivative Gain. These variables allow the cupfeed cam to be tuned for optimum operation (minimum current and error).

Diagnostics variables which can be viewed thru "HSLSUP" include: the main crank offset, actual main crank position, cupfeed cam home position, cupfeed cam offset, actual cupfeed cam position, and main crank-to-cupfeed cam absolute error. Tuning variables that can be viewed include: the instantaneous absolute error, positive peak error, and negative peak error. As part of the diagnostics, a servo motor test feature can be enabled through "HSLSCUP" which allows the servo amplifier, servo motor, and wiring between the two to be verified separately from the normal machine operation.

In addition to setting the variables, "HSLSCUP" can be used to download the HSL-WISVCUP application program to the M4510 as well as download and upload the setup data to the M4510.

Optional HSL-WI6 High-Speed Logic

In addition to performing the standard cupfeed cam control, the HSL-WISVCUP can be upgraded to perform the additional high-speed logic functions of the bodymaker by purchasing the optional HSL-WI6 package.

This provides the following:

- Accurate Cupfeed solenoid control implementing the required sequencing for die protection enable with the cupfeed cam.

- Accurate short can (tear-off) detection to a resolution of ¼" can length. Short can detection incorporates immediate stop of the cupfeed solenoid and cam to prevent the feeding of an additional cup.

- Highly repeatable air strip control to reduce can stripping and blow-out problems. Air strip incorporates variable start-up timing to provide additional air strip for the first number of strokes when the tooling is cold.

- Brake wear compensation (auto BDC timing) algorithm to stop press at BDC 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 a user preset.

- Trimmer speed reference (0-10volt analog output) provides reference to trimmer proportional to speed of bodymaker (user scalable).

- Data Acquisition: Total number of good cans produced and total number of short can faults (for both the current shift and last shift).

- Built-in 2-line X 40-character sealed display with 24 key membrane keypad allows local viewing of collected data (good can count, short can count, brake response) by operator and set-up of some user variables (passcode protected) by authorized personnel.

- Built-in PLS provides all machine timing, eliminating need for additional PLS.

The HSL-WI6 consists of an additional I/O board, pre-wired field wiring arm, D4591 keypad/display, HSL-WI6 User's Manual, and the "HSLWI6" program which is loaded into the M4510.

Specifications

Power Requirements:
  Voltage: 100-130VAC, 50/60HZ
  Current: 2.5 Amps @ 115VAC

  Voltage: +24VDC
  Current: 0.5 Amps

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

Main Crank Resolver Interface:
  Resolver Type: Systems Electronics Group
  RSV34-MS1 or equivalent
  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

Equipment Description

The HSL-WISVCUP/NM package includes a 24" X 24" X 10" NEMA 12 enclosure which should be mounted in close proximity to the existing bodymaker control system. The HSL-WISVCUP/NM is provided to Alcoa Packaging Machinery as part of their complete servo cupfeed cam upgrade package (the servo motor, cupfeed cam, and mounting brackets are provided as part of APM's upgrade kit):

Part Number	*Description*
HSL-WISVCUP/NM	APM bodymaker servo cupfeed control package including the following:

  1ea. HSL-WISVCUP/NM Enclosure (24" X 24" X 10") with M4510
       PLC/PLS/Motion Controller, B25A20 Servo Amplifier, and
       PS300W-96V Servo Power Supply.
  1ea. Bi4-M12-AP6X-H1141 Timing Sensor.
  1ea. WK 4T-6 Sensor Cable.
  1ea. HSL-WISVCUP User's Manual
  1ea. HSL-WISVCUP Program Disk
  1ea. M4500 User's Manual

HSL-WISVCUP Options *(purchased separately)*

Part Number	*Description*
HSL-WI6	High-Speed Logic Option (cupfeed solenoid control, air strip solenoid control, brake wear compensation, and die protection)