AIRBAG CUTTING SYSTEM II

AN OPERATION SUPPLEMENT MANUAL FOR THE

CINCINNATI CL-707 CNC LASER SYSTEM
INTRODUCTION

The Airbag Cutting System II is a CINCINNATI CL-707 laser system modified to cut airbag shapes from fabric. The laser system uses different cutting heads, material supports, and control software. In addition, it uses different CNC programs than a metal-cutting CL-707.

The system design includes equipment to load the airbag material from rolls onto the pallet in the load frame. This manual refers to the loader by the manufacturer’s name: “Hauser”.

This manual describes a CL-707 Airbag Cutting System with 8’ x 20’ (2.5 x 6 meter) pallet area.

Cutting Heads

The laser system can use two types of cutting heads: Contact and Tactile.

Contact Head

A modified contact head uses a large curved surface (in place of ball rollers) to apply pressure on a stack of airbag material. Adjustable counterbalance springs support most of the cutting head weight, so the remaining weight pressing on the material is only a few pounds. For this type of cutting head, the CNC control maintains a z-axis position relative to the position where the cutting head finds the material.

When the z-axis drive moves the cutting head down from the top position, the z-plate (mounted to the cutting head) rests on the yoke plate driven by the ball screw. When the cutting head reaches the material, the z-plate stops but the yoke plate continues to move down to a fixed position, creating a gap between the yoke plate and the z-plate. Operating with this gap allows the counterbalance springs to control how much weight the cutting head applies to the material.

A proximity switch indicates when the gap between the z-plate and the yoke plate is too large. If the material height increases, the cutting head follows the material and increases the gap between the plates. The gap can increase a small amount without exposing the proximity switch.

If the material height raises the head enough to expose the proximity switch, an alarm stops the program. No alarm occurs if the cutting head follows a lower material height and reduces the gap to zero. The z-axis ball screw position determines the minimum cutting head position.

Tactile Head

This modified non-contact head uses a tactile follower riding on the material to provide a conductive surface for the capacitive height sensor. The CNC controls the z-axis as a closed servo loop, maintaining a fixed standoff distance from the nozzle to the tactile follower surface. This type of cutting head automatically adjusts to the material height on the upper or lower pallet, and the tactile follower maintains a constant pressure on the material.

The CL-707 Operation, Safety and Maintenance Manual describes how to set the z-axis springs when using the contact or non-contact head. (See Changing Heads in Section 7 of the CL-707 Operation, Safety and Maintenance Manual.)

Material Supports

To support airbag material, the pallets have sections of aluminum honeycomb replacing the standard steel work support grids. The honeycomb openings provide hollow vertical columns for fumes to travel down to the exhaust plenum.

CAUTION
Aluminum honeycomb cannot support heavy loads.
DO NOT WALK ON THE PALLETS.

Pallet Control

The long pallet design requires high-speed drives to minimize cycle time during pallet exchange. To avoid shifting the lightweight low-friction material, the design uses low acceleration and deceleration rates for the pallet drives.

To warn operators, the control activates an audible alarm before moving the pallets and during pallet motion. The delay between starting the alarm and moving the pallet is a configurable parameter.

Fume Control

The 8’ x 20’ foot cutting area is too large to maintain uniform and continuous airflow into the entire fume plenum. To maximize the effectiveness of fume removal, the plenum has controllable dampers to open and close different sections under the cutting area. When cutting material, the CL-707 control only opens dampers for the section(s) closest to the cutting head position.
The CL-707 control Configuration window includes these settings for fume control: Number of Zones, Zone On-Delay (sec), and Zone Off-Delay (sec).

**CL-707 CONFIGURATION**

The Airbag Cutting System uses the 8’ x 20’ machine size (98.5 x 240 inch pallet area):

On the Auxiliary Configuration page, the Airbag Cutting System uses the parameters for “Fume Collection System”:

The Airbag Cutting System uses the Optical Probe, Airbag System, and Remote Message Interface settings on the Configuration Options page:
MATERIAL REQUIREMENTS

The CL-707 Airbag Cutting System can process two types of airbag material:

Stacked material

The laser system can cut through a stack of fabric to produce several parts for each contoured path. As the laser cuts the fabric, it also melts each layer of airbag material to the layer above or below it along the cut. To help separate attached pairs of fabric layers, the material stack has a layer of another material above each pair of fabric layers. Since the laser-cutting process does not attach the other material to the airbag fabric, the operator can unload connected pairs of airbag fabric from the machine. A separate process uses the connected pairs of fabric to produce an airbag.

Woven material

The CL-707 laser system can also cut another type of airbag material with two layers already woven together. The laser cuts the material to separate the woven shapes from the rest of the fabric. Since the material is flexible and the laser must cut the part shape near the woven seams, the laser system uses an optical sensor to determine the location and orientation of the woven pattern.

Since airbag material with woven parts has only two layers of fabric, the laser system only produces one airbag for each contoured path in the program.

The top layer of material includes dark threads (for high contrast) woven at regular intervals parallel with the x- and y-axes of the pattern. The dark threads provide reference lines for the optical sensor. The laser system moves the optical sensor to scan across the thread locations. When the sensor detects the dark thread, the laser control records the x and y coordinates. From the measured location of the threads, the CL-707 software determines how to move, rotate, and scale the work coordinate system. The CNC program uses the modified work coordinate system to accurately cut the airbag shapes relative to the woven pattern.

To produce the most accurate parts, the material should have at least three reference threads in each direction near each part. The CNC program should call the probe macro to scan a set of threads near each part and command a different coordinate system for each part.

For material with woven parts, the distance from the nozzle to the probe (and a minimum scan distance) determines the maximum and minimum coordinates where the material supplier can place the dark threads. (See Figure.)

The loading equipment must locate material with woven parts reasonably close to the intended location. For small target coordinates, the probe will scan one inch on each side of the expected location. For longer target coordinates, the total scan length can be more than two inches. For example, to find a thread 100 inches from the material cutoff edge with 4% scale correction, the sensor will scan between 96 and 104 inches from the cutoff edge (100 +/- 4).

To maximize nesting efficiency, the material only needs the dark threads near the scanned locations, then the nesting software can nest parts outside the range specified for the scanned threads.
PROGRAMMING

This section describes specific programming instructions for the airbag cutting system. For standard CL-707 programming instructions, see the CL-707 Programming Manual (EM-423).

Arc Feedrate

The maximum feedrate for contouring arcs on the 8’ x 20’ CL-707 is

\[ F = 25000 \times \sqrt{r \times t} \]

Where \( F \) = feedrate, \( r \) = arc radius and \( t \) = radius tolerance. The same constant (25000) applies to inch or metric programming. Feedrate units are inches/min when \( r \) and \( t \) units are inches and mm/min when \( r \) and \( t \) units are mm. Programming software should compare each calculated arc feedrate with the material feedrate and use the lower value.

CNC Program

The airbag manufacturer can use programming software to create CNC programs for the laser system. Programming software typically uses a CAD file to determine the laser cutting moves for each airbag shape.

For material with woven parts, the CAD file should also include the reference thread locations. The programming software should specify the thread locations in the probe macro call. The CNC program can call the probe macro once for an entire pallet, once for each group of parts, or once for each part. The CNC program should cut the airbag shape(s) using the coordinate system established by the probe macro.

Example program lines:

For stacked material

:1000
G20
G189 X_ Y_
G89 Pfilename.lib
G00 X_ Y_
G84

For material with pre-sewn parts

:2000
G20
G189 X_ Y_
G65 P9735 I_ J_ U_ V_ W_ X_ Y_
G89 Pfilename.lib
G00 X_ Y_
G84

G189 Macro Program

CL-707 airbag programs use the G189 macro to command process parameters and establish the initial work coordinate system:

\[ \text{G189} \ X_ \ Y_ \]

\( X = \) Machine \( X \) coordinate of work coordinate \( X0 \)

\( Y = \) Machine \( Y \) coordinate of work coordinate \( Y0 \)

If the G189 macro call does not specify \( x \) or \( y \), G189 uses the coordinates saved in variables \#534 and \#535 by the last G189. If \#534 and \#535 are undefined, G189 uses a default location hard-coded in the G189 program.

For a standard-hand machine, the G189 macro establishes the origin of the default work coordinate system near machine coordinates \( X240 \ Y98.5 \) (inches). The work coordinate axes move in the opposite direction from the machine axes.

For an opposite-hand machine, the G189 macro establishes the origin of the default work coordinate system near machine coordinates \( X0 \ Y0 \). The work coordinate axes move in the same direction as the machine axes.

CNC Programs should not use any commands that override or modify the work coordinate system (G28, G50 through G59, G68, G69, G92 etc.).
Differences between CL-707 G189 and CL-7 or CL-7A G189

The CL-707 G189 macro does not use CL-7 G189 arguments $Z$ (material thickness per loader stroke) and $R$ (number of material rolls). To command parameters for a specific material thickness or number of rolls, the CL-707 CNC program commands G89 with a material library filename. The CL-707 G189 macro commands a default set of parameters in file “G189Default.lib”. To specify cutting parameters for the loaded material, the CNC program commands G89 with a user-specified library file name after calling G189.

CL-707 control software provides the other functions performed by a CL-7 G189 macro. For example, CL-707 software controls the z-axis position.

Unlike a CL-7, the CL-707 G189 macro does not use common variable #149 for the number of loader strokes. The CL-707 operator can input the number of loader strokes in a dialog box opened from the Variables menu.
Probe Macro Program 9735

Before cutting material with woven parts, the CNC program calls macro program G189, then calls probe macro 9735. Using the work coordinate system established by G189, the probe macro call specifies the expected location of dark threads woven into the material.

G65 P9735 I_ J_ U_ V_ W_ X_ Y_ (K_) (Z_) (A_ B_ C_ D_ E_ R_ S_ T_)

I = Distance between threads in the x direction
J = Distance between threads in the y direction
U = X coordinate of the minimum x-axis thread (minimum U=1.0 inch)
V = Y coordinate of the minimum y-axis thread (minimum V=1.0 inch)
W = Width of one thread pattern
X = X coordinate of the maximum x-axis thread (minimum = U+12 inches)
Y = Y coordinate of the maximum y-axis thread (minimum = V+6 inches)

Optional Inputs:
K = Ratio of the ½ the scan distance to the target coordinate. If the macro call does not specify K, the macro uses K=.01 for +/- 1% scans. If the macro call specifies K above .05, the macro uses K=.05 (maximum 5% stretch / shrink).

Z = Z-axis status after each scan. The scanning subprogram raises the z-axis (with M47) after each scan unless the 9735 macro call specifies a negative value for Z (for example, Z-1).
A = X coordinate of the –Y scan near U, used when [X-U] > [Y-V]
B = X coordinate of the –Y scan near X, used when [X-U] > [Y-V]
C = Y coordinate of the +X scan
D = X coordinate of the +Y scan
E = Y coordinate of the –X scan, used when [Y-V] > [X-U]
R = X coordinate of the –X scan, used when [Y-V] > [X-U]
S = Y coordinate of the –X scan near V, used when [Y-V] > [X-U]
T = Y coordinate of the –X scan near Y, used when [Y-V] > [X-U]

Specify all macro arguments (except K and Z) in the active units (G20 inches, G21 mm).

Note: When a CL-707 program calls a macro program with G65, the block must include a space between the end of the macro program number and the first argument. For the probe macro, the G65 block must include a space between “P9735” and “I”.

G65 P9735 required arguments
(This example uses one macro call per nest.)
The macro program uses inputs \( I \) and \( J \) to calculate scanning locations. The macro program maintains a minimum distance between each scanning move and the nearest dark thread running parallel with the scan. The minimum distance is 0.10 inch plus a percentage of the distance from the scanning move to the material cutoff position (work coordinate \( X_0 \) or \( Y_0 \)). The macro also checks if the \( X \) input is within 0.1 inches of a thread location predicted by \( U \) and the spacing distance \( I \) (and similarly checks \( Y \) based on \( V \) and \( J \)).

Using the measured thread locations, the macro program shifts, rotates, and scales the work coordinate system to match the woven pattern. When the macro finishes, work coordinates \( U, V, X, \) and \( Y \) coincide with the actual thread locations. The modified coordinate system compensates for offset, rotation, and uniform extension/contraction in the material. The macro does not correct for skew (\( X \) not perpendicular to \( Y \)) or localized distortion (wrinkles).

The 9735 macro commands a default set of process parameters with “\( G89 \) \( P9735\)Default.lib”. To command process parameters for the loaded material, the CNC program should command \( G89 \) with a user-specified library file name after calling \( G65 \) \( P9735 \).

### Thread scanning locations

For each macro call, the macro scans threads at five locations and commands a different work coordinate system before returning to the CNC program to cut the part(s). When the 9735 macro call does not specify scan locations, the probe scans across the threads at default locations. If the dark thread at a default location does not provide enough contrast with the background material, the programmer can specify a different scan location.

Arguments \( A, B, \) and \( E \) only apply when the scanned area is longer in the \( X \) direction (or square). Arguments \( R, S, \) and \( T \) only apply when the scanned area is longer in the \( Y \) direction.

Since the macro maintains a minimum distance from a parallel thread, the actual scan location may be different from either the default location or the specified location.

Macro program 9735 uses scanning locations based on the approximate locations shown in the figures below.
Example program

:1000
G20
G189 X_ Y_
G65 P9735 I_ J_ U_ V_ W_ X_ Y_ (FIND THREADS FOR FIRST PART)
G89 Pfilename.lib
M98 P1001 (SUBPROGRAM TO CUT 1ST PART)
G65 P9735 I_ J_ U_ V_ W_ X_ Y_ (FIND THREADS FOR 2ND PART)
G89 Pfilename.lib
M98 P1002 (SUBPROGRAM TO CUT 2ND PART)
(etc.)

Notes:

- Each 9735 macro call specifies thread locations in the default work coordinate system established by G189.
- The subprogram could command “G89 Pfilename.lib”.
- After calling P9735, the CNC program could include the commands to cut each part, instead of calling a subprogram.
Scan Sequence

The first scanning move begins at the minimum scan distance (common variable #520) from the programmed thread coordinate. If the first scan does not find the thread, the scanning program moves the scan location by the distance stored in common variable #536 and repeats the scan. For example, if scanning in the Y direction, the second scan is offset from the first scan in the X direction by #536. If the second scan does not find the thread, the program uses a longer scan at the same location. If the third scan does not find the thread, the program moves back to the original location and repeats the scan with the longer scan length. If the last scan does not find the thread, the program stops with M02. See figure below.

Macro Programs

The CL-707 airbag system uses these CINCINNATI macro programs:

<table>
<thead>
<tr>
<th>Macro Program</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>9720</td>
<td>Calibrate Probe</td>
</tr>
<tr>
<td>9721</td>
<td>Scan (subprogram for 9720)</td>
</tr>
</tbody>
</table>

CINCINNATI Laser Optical Probe manual (EM-487) describes how to calibrate the probe using macro 9720. For the airbag system, the 9720 macro call should include argument A1. The airbag system uses a laser optical probe without an actuator, and the calibration macro skips the actuator M-codes, when called with A1.
OPERATION

Loading Programs

The CL-707 airbag cutting system has a control feature to allow remote selection and automatic loading of the next CNC program. When the laser system completes a CNC program, the CL-707 loads a program with a specific file name at a specific network location.

To use this feature, the programmer renames the next CNC program with the file name reserved for remote loading, and places the renamed program in the network folder configured for remote loading. The new program text appears in the CL-707 Run Window, but not in a text-editing window. The operator presses “Cycle Start” and the program begins.

To load a different CNC program, the operator opens the program in an edit window and uses “Load CNC Program” from the File menu (or “Quick File Load”, or Ctrl+R). However, when running with “Operator” log on privileges, the software will prompt the operator to type the Supervisor password in a dialog box before loading the program.

Auto Restart

If a condition interrupts the CNC program while cutting, and the operator resumes the program with Cycle Start, the CL-707 control moves the cutting head to the start of the interrupted block. The operator can also use Tracing mode to resume the program at another block. For more information, see Program Recovery in Section 7 of the CL-707 Operation, Safety and Maintenance Manual.

Progress Indicators

The CNC Run Window on the CL-707 airbag system includes a graphical plot and a bar graph showing the progress of completed blocks. The plot shows all x- and y-axis moves and changes the color of completed moves as the program runs. The bar graph represents the percentage of completed blocks.

Reporting Production Results

The standard CL-707 control maintains a text file to report production results. Whenever the operator loads a CNC program, the control software updates a text file named “PRODUCT.LOG” in the “D:\CNCLSR32” folder on the CL-707 hard drive. The software adds a line to the text file to record the CNC program filename, along with the date and time when the program was loaded. When the program commands process parameters with “G89 Pfilename.lib”, the software adds another line to the “PRODUCT.LOG” file to report the library filename. When the program finishes, the software updates the “PRODUCT.LOG” file to report the elapsed time.

The CL-707 control software can also exchange program status information with user software through the Remote Message Interface. For details, contact CINCINNATI INCORPORATED.
MATERIAL LOADER (HAUSER) INTERFACE

The CL-707 frame has limit switches to indicate when each pallet is in the cutting position (IN) or the load/unload position (OUT). Each limit switch has a set of contacts connected to a voltage provided by the Hauser controller. Each limit switch returns the voltage to a Hauser input when the pallet is IN or OUT. The CL-707 Maintenance, Diagnostics, I/O Watch window displays the pallet status with these labels:

<table>
<thead>
<tr>
<th>CL-707 Input Label</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper pallet IN LS.</td>
<td></td>
</tr>
<tr>
<td>Upper pallet OUT LS.</td>
<td></td>
</tr>
<tr>
<td>Lower pallet IN LS.</td>
<td></td>
</tr>
<tr>
<td>Lower pallet OUT LS.</td>
<td></td>
</tr>
</tbody>
</table>

The Hauser controller has eight outputs connected to a voltage provided by the CL-707 controller. Hauser software activates the outputs to return the voltage to CL-707 inputs for these functions. The CL-707 electrical schematic drawing identifies the input terminals. The CL-707 Maintenance, Diagnostics, I/O Watch window displays the inputs with these labels:

<table>
<thead>
<tr>
<th>CL-707 Input Label</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>MHS / spreader load complete</td>
<td>End of spread cycle</td>
</tr>
<tr>
<td>Sheet / airbag loader - pallet move OK</td>
<td>OK to move pallets</td>
</tr>
<tr>
<td>MHS unload compl / No. of Spreads b4</td>
<td>Number of loader strokes, bit 4 (16’s)</td>
</tr>
<tr>
<td>MHS minor fault / No. of Spreads b3</td>
<td>Number of loader strokes, bit 3 (8’s)</td>
</tr>
<tr>
<td>MHS loader fault / No. of Spreads b2</td>
<td>Number of loader strokes, bit 2 (4’s)</td>
</tr>
<tr>
<td>MHS loader is OK / No. of Spreads b1</td>
<td>Number of loader strokes, bit 1 (2’s)</td>
</tr>
<tr>
<td>MHS loader is ON / No. of Spreads b0</td>
<td>Number of loader strokes, bit 0 (1’s)</td>
</tr>
<tr>
<td>Sheet loader /airbag ESTOP</td>
<td>Status of remote Emergency Stop Button</td>
</tr>
</tbody>
</table>

When the Hauser reads inputs for one pallet IN and the other OUT, it can load material on the OUT pallet. When the Hauser finishes loading the pallet, it sets outputs to the CL-707 for End of Spread and Number of loader strokes. When the Hauser control approves pallet motion, it sets the output for “OK to move pallets”.

The Hauser automatically loads material onto the upper or lower pallet at their different elevations. The CL-707 airbag system does not raise the bottom pallet in the load frame.

Loading Material

X-axis Direction

The Hauser can spread material to any length, but always cuts off material at the same location. The cut edge that is common to every loaded pallet is at the end closest to the Hauser. When the CL-707 moves the pallet to the cutting position, that end is near machine coordinate \(X = 240\) inches on a standard-hand CL-707. The CNC program uses G189 to make that position correspond to work coordinate \(X_0\).

Y-axis Direction

For different width material, the Hauser should always load material with one edge at the same y-axis location on the pallet. When the CL-707 moves the pallet to the cutting position, that location is near machine coordinate \(Y = 98.5\) inches on a standard-hand CL-707. The CNC program uses G189 to make that position correspond to work coordinate \(Y_0\).

The G189 macro call specifies \(X\) and \(Y\) machine coordinates for the location of work coordinate \(X_0, Y_0\). If the CNC program does not call G189, the probe macro (9735) begins with work coordinate \(X_0 Y_0\) at the same machine coordinates as the last program that called G189.
Number of Loader Strokes:

The Variables menu has a selection for “Fabric Loader Mode”. That selection has two options for specifying the number of material loader strokes. When the selected option is “Remote”, the control applies the number sent by the Hauser control.

The ‘Manual’ selection allows the operator to override the Hauser count and specify the number of strokes.

CNC LASER CENTER Status Bar:

At the bottom of the control screen, the status bar displays the number of loader strokes applied to the current program:

Notes:

If the Variables menu indicates “Manual” for the Fabric Loader mode, then the status bar displays the number of loader strokes in braces. For example: {26 loader strokes}.

At startup, the CL-707 controller begins operation with the last Fabric Loader mode selected before shutdown.
PARAMETER LIBRARY WINDOW

A laser system dedicated to cutting airbag material has different operating requirements than a standard laser system. An operator may use the same CNC program for different layers of stacked material. The system must apply correct parameters for the total thickness on the pallet when the program runs. To help meet this requirement, the CL-707 uses special parameter library files for airbag material.

The Options page of the CL-707 control Configuration screen has a check box for “Airbag System” and the Library window has a check box for “Layered Fabric”. When both are checked, the Library window includes a table of process parameters for different layers of the same material. The table has different Power, Gas Pressure, and Feedrate parameters for each number of Hauser strokes (1 to 31). The Cut page of the Parameter Library window only displays cutting parameters that are independent of the number of layers. The Library window does not display the Ramped Pierce or Rapid Pierce tabs.

When the CNC program calls G89 with a library filename, the control uses process parameters based on the number of loader strokes.

If the Cut page of the Parameter Library window specifies “Dynamic Power Control”, the software uses the cutting feedrate in the table as the 100% Dynamic Power feedrate. The DPC page of the Library window does not display a Feedrate parameter, and the control applies the same DPC minimum parameter to any number of loader strokes.

These examples show the Process Parameter Library window configured for airbag material:

Cut Parameters Tab

Layered Fabric Tab

Dynamic Power Control Tab

Pierce Parameters Tab
RESERVED VARIABLES

The following table identifies the reserved common variables. CNC programs should not use these variables for other functions.

To view the variables, open the Local/Global page in the Variables window on the Laser System Control menu. The macro programs set variables for distance and feedrate in the active units of the program (inch or mm). The units of the other variables do not change.

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>#131</td>
<td>( X ) work coordinate of probe when control received the probe signal</td>
</tr>
<tr>
<td>#132</td>
<td>( Y ) work coordinate of probe when control received the probe signal</td>
</tr>
<tr>
<td>#140</td>
<td>( X ) work coordinate of nozzle when control received the probe signal</td>
</tr>
<tr>
<td>#141</td>
<td>( Y ) work coordinate of nozzle when control received the probe signal</td>
</tr>
<tr>
<td>#519</td>
<td>Work coordinate rotation angle, degrees</td>
</tr>
<tr>
<td>#520</td>
<td>Minimum scan distance</td>
</tr>
<tr>
<td>#521</td>
<td>Maximum scan distance</td>
</tr>
<tr>
<td>#522</td>
<td>Scan feedrate</td>
</tr>
<tr>
<td>#523</td>
<td>Average probe radial offset</td>
</tr>
<tr>
<td>#524</td>
<td>X-axis offset from lens center to probe</td>
</tr>
<tr>
<td>#525</td>
<td>Y-axis offset from lens center to probe</td>
</tr>
<tr>
<td>#526</td>
<td>Scan z-axis standoff distance</td>
</tr>
<tr>
<td>#527</td>
<td>Pierce standoff during scan</td>
</tr>
<tr>
<td>#528</td>
<td>Minimum hole diameter</td>
</tr>
<tr>
<td>#529</td>
<td>Units constant (1.0=metric, 25.4=inch)</td>
</tr>
<tr>
<td>#530</td>
<td>Work coordinate x-axis offset</td>
</tr>
<tr>
<td>#531</td>
<td>Work coordinate y-axis offset</td>
</tr>
<tr>
<td>#532</td>
<td>Work coordinate x-axis scale factor, decimal</td>
</tr>
<tr>
<td>#533</td>
<td>Work coordinate y-axis scale factor, decimal</td>
</tr>
<tr>
<td>#534</td>
<td>( X ) machine coordinate of last work ( X0 )</td>
</tr>
<tr>
<td>#535</td>
<td>( Y ) machine coordinate of last work ( Y0 )</td>
</tr>
<tr>
<td>#536</td>
<td>Distance between scan attempts (1/2 weave spacing)</td>
</tr>
</tbody>
</table>
ERROR MESSAGES

Probe macro programs check input values and calculated results for allowable range. If a program finds an error, it executes a block with M02 (Program End) and displays an error message in the Run window.

Probe Scanning Subprogram Error Messages

<table>
<thead>
<tr>
<th>Message</th>
<th>Possible Causes</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Move Distance Too Small</td>
<td>The program commanded a move distance less than variable #520.</td>
<td>Check macro call or set #520 to 0.50 inches (12.7 mm).</td>
</tr>
<tr>
<td>Move Distance Too Large</td>
<td>The program commanded a move distance larger than variable #521.</td>
<td>Check macro call or set #521 to 24.0 inches (609.6 mm).</td>
</tr>
<tr>
<td>Started Too Close To Target</td>
<td>The scanning move found a thread within 1 mm (.039 inches) of the starting point.</td>
<td>Check macro call inputs. Check probe function (repeat the calibration procedure).</td>
</tr>
<tr>
<td>Target Not Detected</td>
<td>The thread was outside the scan range. The sensor did not detect the light change.</td>
<td>Check macro call inputs. Check probe function (repeat the calibration procedure). Change #536 to 1/2 the weave space, or edit the macro call to specify a different scan location.</td>
</tr>
</tbody>
</table>

Probe Macro 9735 Error Messages

<table>
<thead>
<tr>
<th>Message</th>
<th>Possible Causes</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spacing Too Small</td>
<td>Thread spacing I is not 2 inches longer than K * X, or J is not 2 inches longer than K * Y.</td>
<td>Check macro call (increase I or J).</td>
</tr>
<tr>
<td>X-axis Length Too Small</td>
<td>X and U are closer than one thread space or less than 12 inches (304.8 mm) apart.</td>
<td>Check macro call or specify the next larger thread location.</td>
</tr>
<tr>
<td>Y-axis Length Too Small</td>
<td>Y and V are closer than one thread space or less than 6 inches (152.4 mm) apart.</td>
<td>Check macro call or specify the next larger thread location.</td>
</tr>
<tr>
<td>No Thread Near X</td>
<td>X is more than 0.1 inches (2.54 mm) from an expected thread location, based on the pattern defined by U and I. Check U, I, and X in the macro call.</td>
<td></td>
</tr>
<tr>
<td>Div By Zero Trap</td>
<td>Y is more than 0.1 inches (2.54 mm) from an expected thread location, based on the pattern defined by V and J. Check V, J, and Y in the macro call.</td>
<td></td>
</tr>
<tr>
<td>Measured coordinates caused the program to attempt division by zero when calculating the rotation angle.</td>
<td>The program calculated the slope of a line to be 90 degrees from the expected slope.</td>
<td>Check probe function (repeat the calibration procedure).</td>
</tr>
</tbody>
</table>