

# Merlín

by  
*Moyer*



# Merlin

## COMPUTERIZED FREELIGHT CONTROL SYSTEM

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# 1.0 DESCRIPTION of FEATURES

**1.1 Length Control System:** The **MERLIN GAGE** reduces scrap by probing and controlling the springs' free length. Use the **MERLIN GAGE** with a Moyer pitch controller to maintain a consistent free length. Add a Moyer sorting chute to sort the springs according to length.

Some features of the new **MERLIN GAGE** include:

- brighter Color LCD display
- patented feedback calculation \*
- temperature stabilized probe \*
- three and five way sorting capability \*
- broken tool detection
- probe-touch detection \*
- quota shut down
- rotary probe control \*
- statistical printouts
- real time SPC analysis
- simple menu set up and programming
- freeze screen function for high speed production \*
- has been run at over 84,000 parts per hour
- real time Histogram with continual update \*

\*Moyer innovations

Scrap reduction is easy with the Moyer MERLIN gage.

**1.2 Length Measurement:** The Moyer **MERLIN GAGE** applies a patented measuring method. A multi-sampling process increases the accuracy of length measurement. A digital filtration process reduces the effects of electrical noise and mechanical vibrations.

**1.3 Pitch Correction:** Select from two pitch control methods: "AUTO," or "%TOL".

**1.3.1 AUTO:** "AUTO" mode is an intelligent control method. In "AUTO" mode, the **MERLIN GAGE** proportionally adjusts the pitch based upon the variation from the target mean free length. The adjust knob is initially set by the operator. A good place to start is with the dot set at the 12:00 position, or midway of its travel. The **MERLIN GAGE** checks each adjustment to determine if the correct amount of adjustment was made. If correction was too much, the amount of pitch adjustment automatically decreases a little. If the correction was too small, the amount of pitch adjustment automatically increases a little. The gage also monitors the three sigma of the last 50 springs coiled. The new Moyer **MERLIN GAGE** limits each pitch adjustment to a fraction of this 3-sigma value. This "flyer rejection" improves centering. The adjust knob setting is only a target setting. **MERLIN** internally calculates the best pitch adjustment, yielding minimal free length variation. The gage continually optimizes the pitch control calculation to compensate for changes in the wire or the coiling process. Adjustable targeting reduces rate variation in various applications. Contact Moyer for more information.

**1.3.2 %TOL (Barrier Avoidance):** In "%TOLERANCE" mode, the position of the adjust knob and the "%TOL" value determines the amount and frequency of adjustment. A spring length that exceeds the predetermined percent of tolerance triggers an adjustment to center the process. The position of the adjust knob determines this amount of adjustment. A small amount of adjustment is recommended to optimize centering in this mode. Select "% TOL" over "AUTO" only when running low performance material or on coilers with mechanical problems. Use "AUTO" first, as auto mode usually provides a better yield.

**1.4 FIVE WAY SORTING:** This feature allows sorting the good springs into three groups, and sorting the bad springs into two groups. It is a very popular feature as it allows for grinding to closer tolerances than ever before. Good group tolerances can be even (33% each), or center weighted (25% long, 50% center, & 25% short) about the overall tolerance.

Example: The gage is set for 5 way sorting at 33%. If the total "good" spring tolerance is +/- 0.015", then the 0.030" total tolerance is divided into three good spring groups of 0.010" each. Shorts are anything shorter than -0.015", longs are anything longer than 0.015", and the remaining groups are -0.015" to -0.005", -0.005" to 0.005", and 0.005" to 0.015". As with three way sorting, the two outer groups, long and short, may have very long and very short springs. Consequently, the outer groups are sometimes thrown away or manually 100% inspected. The three inner groups are easily ground.

Sort limits are shown on a bar-graph on the "setup" screen and on the "run" screen.

## 2.0 DESCRIPTION of ACCESSORIES

**2.1 Moyer MERLIN GAGE:** This is the main control unit where all accessory equipment, such as sorting chutes, pitch controllers, etc. connect. The gage contains all operational controls such as on/off, configure, and set up. Portions of the **MERLIN GAGE** are protected under U.S. patent #4,719,586 and copyrights. (We've got more of them coming!)

**2.2 Moyer Temperature-Stabilized Probe:** The **MERLIN GAGE** uses a non contact capacitive measuring probe. The probe maintains a constant internal temperature ( Moyer innovation), thus reducing drift due to fluctuating outside temperatures. This measuring device has a micrometer at one end and a threaded barrel at the other end. A cable with a six-pin plug connects to the **MERLIN GAGE's** "PROBE" output socket.

**2.3 Moyer Rotary Probe Assembly:** An optional rotary probe can plug directly into the **MERLIN GAGE**. This probe rotates out of the way before the cutoff, eliminating the possibility of spring-probe contact. Add an optional brush wipe to clean the tip after each spring.

**2.4 Probe Tip:** The probe tip threads onto the end of the probe. The O.D. of the probe tip is chosen to be slightly larger than the O.D. of the spring. Refer to the chart on page 13 for recommended tip sizes and standoff distances from tip to spring. Our standard size tips are 1/8", 1/4", 3/8", 1/2", 5/8", 3/4", and 1"

**2.5 Special Probe Tips:** Probe tips that are not one of our 7 standard sizes, are available upon request.

**2.6 Probe Holder:** This bracket is adjustable so the probe tip can be in a fixed position on the coiler and centered in front of the coiled springs.

**2.7 Pitch Controller Assembly:** The complete assembly includes a pitch drive motor and necessary hardware. We have several sizes and types of pitch controllers available. Standard systems are available for most coilers. Moyer engineers will design special controller systems per request. A cable connects the pitch drive motor to the **MERLIN GAGE** "ADJUST" output socket.

**2.8 Read Switch Assembly:** The assembly includes a target mounted on a lock collar, proximity (read) switch, and hardware for mounting the switch inside the coiler. The target mounts on any shaft that makes one revolution per spring. The cable with a three pin plug connects to the **MERLIN GAGE's** "READ" output socket. Position the read switch to detect the target just before cut-off.

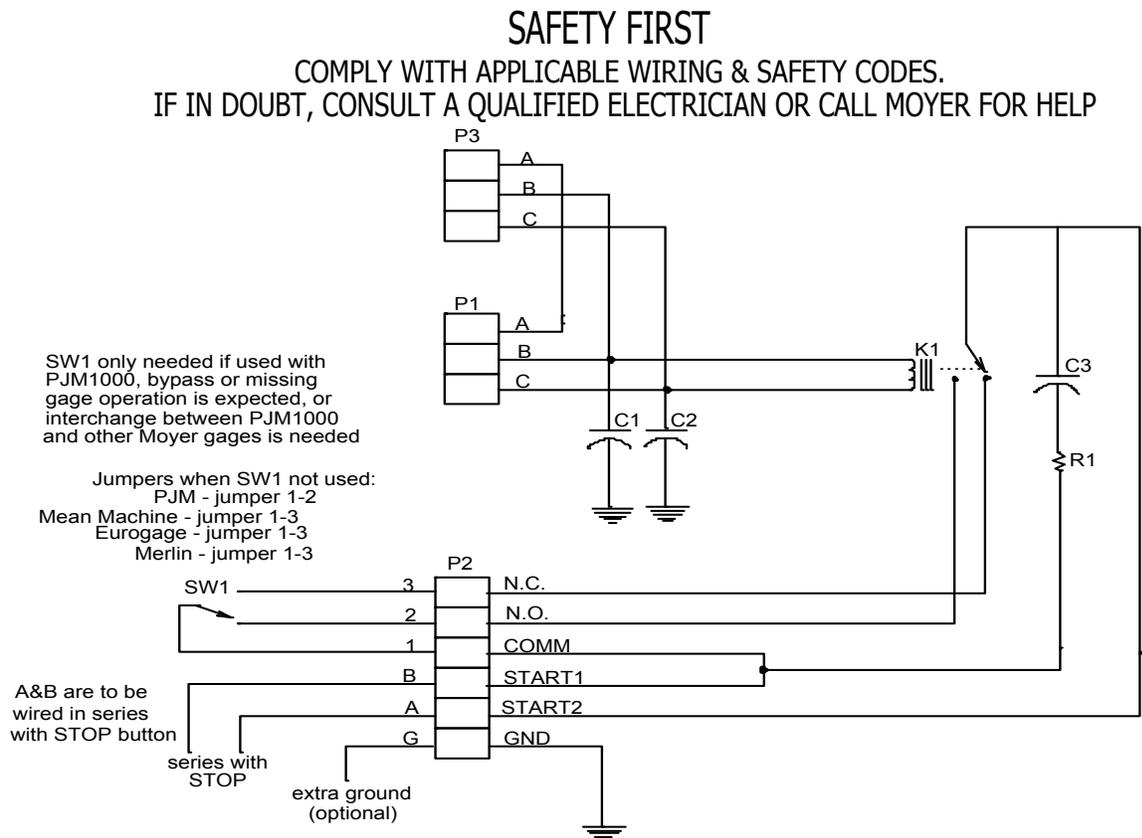
**2.9 Moyer Three Way Sorting Chute:** This chute sorts springs into three groups: short, long, and good. The chute comes complete with all the necessary cabling and plugs for connecting to the **MERLIN GAGE's** "SORT" output socket. The Three Way chute is available in these throat sizes: 3.375" x 4.000", 3.375" x 8.000", 7.450" x 10.000", and 7.450" x 16.000".

**2.10 Moyer Five Way Sorting Chute:** This chute sorts springs into five groups. The total good spring length tolerance is divided into three good groups. The Five Way chute is available in the following throat sizes, 3.375" x 4.000", 3.375" x 8.000", and 7.450"x 10.000". The chute plugs into the gage via two cables. These cables connect to the **MERLIN GAGE's** "SORT" and "AUX1" sockets. You can also use your Moyer five-way sorting chute as a three-way chute on newer as well as older gages that lack five way sorting capability. Moyer sorting chutes are made of durable stainless steel and quarter-inch aluminum; and they offer the most modern designs available.

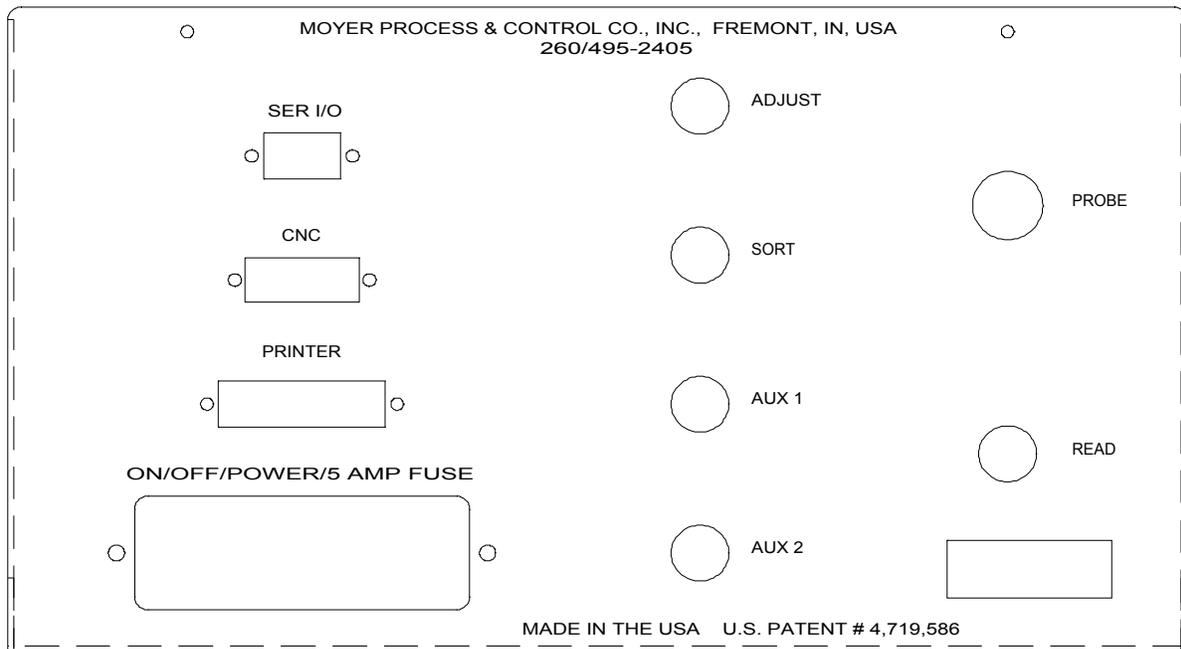
**2.11 Moyer High Speed Two Way Sorting Chute (no speed limit):** Our two way chute simply sorts good and bad. The chute is air driven to allow for use on high speed coilers. The Moyer top mount flapper design lengthens flapper life as well as eliminating the risk of a bottle neck of springs in the throat. Two ways come in two sizes, 6" x 6" and 3" x 3".

**2.12 Coiler Kill (safety):** The coiler kill kit includes two 3 pin sockets and relay mounted on a pc board, and a 3 pin cable. It turns off the coiler if one of the following conditions occur: (1) a specific number of consecutive bad springs are coiled, (2) broken tooling or wire has been detected, or (3) a quota of good springs are coiled. The 3 pin cable connects to the **MERLIN GAGE's** "AUX1" output socket.

When using a five-way chute with coiler kill, connect the two pin plug from the chute to one of the sockets on the coiler kill board. Connect the 3 pin plug from the coiler kill cable to the "AUX1" socket.



### 3.0 NAMES and FUNCTIONS of BACK PANEL



3.1 **PRINTER:** The 25 pin plug on the Moyer printer cable plugs into this socket. The printer cable and **MERLIN GAGE** can be used with most Epson or IBM compatible printers.

3.2 **CNC:** A 15pin plug from your CNC coiler goes here.

3.3 **SER I/O:** This is used to connect a data collection device directly into the **MERLIN GAGE**. A nine pin connector plugs into this socket.

3.4 **ON OFF/FUSE/115-230 VAC LINE:** This is the power switch (on/off), fuse holder ( 5 amp 250 volt fast blow), and main power socket that requires using the supplied grounded plug. In plants with extreme electrical noise, extra grounding is recommended

3.5 **ADJUST:** The three pin plug from the pitch drive motor plugs into this socket.

3.6 **SORT:** The three pin plug from the air valve, three way sorting chute, or the five way sorting chute plugs into this socket.

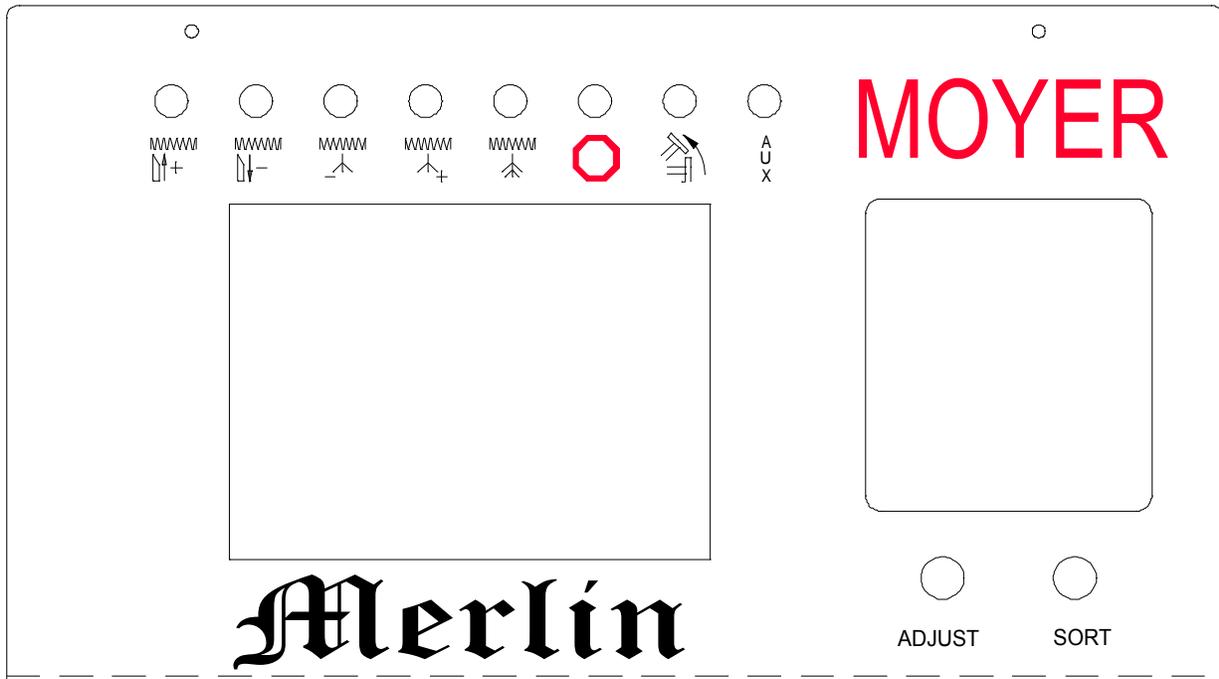
3.7 **AUX 1:** The two pin plug from the five way sorting chute or the three pin plug from the coiler kill cable plugs into this socket.

3.8 **AUX 2:** The two pin plug from the rotary probe air valve plugs into this socket.

3.9 **PROBE:** The six pin plug from the probe plugs into this socket.

3.10 **READ:** The three pin plug from the read switch plugs into this socket.

## 3.1 NAMES and FUNCTIONS of FRONT PANEL



**3.11 Adjust Knob:** In run mode, it controls the amount of pitch adjustment. In test mode, it is used in testing the gage and probe for proper functional operation.

**3.12 Sort Knob:** In run mode, it sets the amount of time the sort device is activated. Changing the sort time also changes rotation time when the rotary probe is used. In test mode, it is used in testing the gage and probe for proper functional operation.

**3.13 Color LCD (Liquid Crystal Display):** The Color LCD displays data and menus for running production, set-up, configure, and hardware tests. The new MERLIN GAGE boasts a 4.5" x 3.5" bright color screen to give you the information you need without the hang-up of continually switching screens. The new display uses white on blue colors, making it easier than ever before to read.

**3.14 Key Pad:** The Key Pad is used to select options from menus, and to enter options and numbers. The bottom row of keys change displays and brings up menus. Moyer's 20-key control pad offers easy-to-use versatility not found on many competitors' gages.

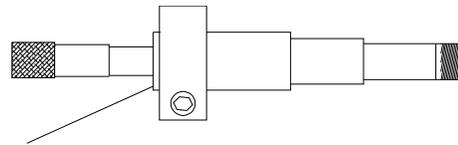
## 4.0 RECEIVING and INSTALLING the MERLIN GAGE

4.1 **Unpacking:** Before accepting the shipment from the carrier, inspect all cartons for damage. If a carton is damaged, open the carton in front of the carrier and check the contents. Each part will be shipped with approved packing. Check carefully that no parts are lost in the packing materials. In all cases, report any missing parts or damage to the carrier and to Moyer Process & Control immediately.

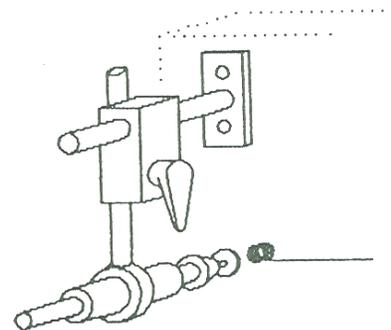
4.2 **Installation: WARNING:** Do not connect power cord until instructed.

4.2.1 **Gage Placement:** Place the **MERLIN GAGE** so the operator has good access to and visibility of the front of the gage. Avoid subjecting the gage to excessive shock, oven heat or other hazardous environments. Place the gage where its use will not subject the operator to danger from moving parts. Normal coiler vibration is not considered excessive.

4.2.2 **Probe & Holder:** Coil a spring by hand until wire feed quits. Mount the probe in the probe holder. Slide the probe forward so the collar is holding the back of the probe, close to the micrometer. Be sure you can read the micrometer. Tighten the collar around the probe.



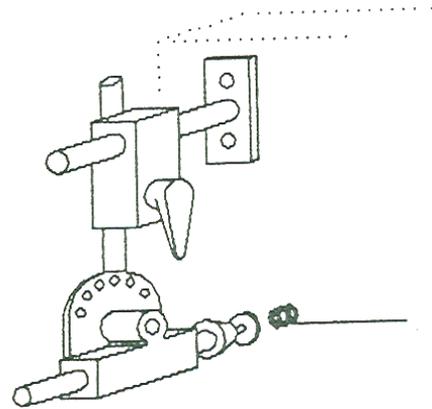
Place the base of the probe holder on the coiler so it won't interfere with the fall of the springs after cutoff, or with the operator during tooling changes. Make sure the probe measuring end is in front of the coiled spring. Mark the location of the holes on the coiler thru the probe holder base. Drill and tap holes on the coiler as marked for 1/4-20 screws. After tapping, file the coiler face to remove burrs, then mount the probe holder to the coiler.



Select a probe tip slightly larger than the O.D. of the coiled spring. Make sure that the brass spring is in the probe tip before screwing it onto the probe. Screw the tip tightly onto the probe (finger tight sufficient). Refer to section 5 for tip size selection and distance between the end of the spring and the probe tip. Using the probe holder sliding block, position the probe tip in front of the coiled spring. Make sure the tip is on the same axis of the spring and the tip covers the O.D. of the spring. Tighten the 1/4-20 cap screws on the probe holder sliding block. Be sure to fasten the probe cable to the probe holder. Connect the six pin plug to **MERLIN GAGE's** "PROBE" output socket. Route the probe cable so it is out of harm's way. Note: The probe must be held rigid. Any movement of the probe will affect the free length measurement.

All Moyer temperature stabilized probes are interchangeable with any **MERLIN GAGE, Eurogage, Mean Machine or PJM1000 gage**. They require no calibration, matching, or tuning for a particular gage.

**4.2.3 Rotary Probe Assembly:** Mount the air regulator assembly in an easy to service location. Mount the air valve on top of the coiler close to the base of the probe holder. Connect the air regulator assembly to the air valve with the supplied 1/4" air line. Attach air to the regulator. Attach the outside air input to the rotary actuator, on the side of the valve that air is going out, with the supplied 5/32" air line. Adjust the regulator for 28psi. Attach the other side of the actuator to the other side of the valve. The probe should be in the up position.

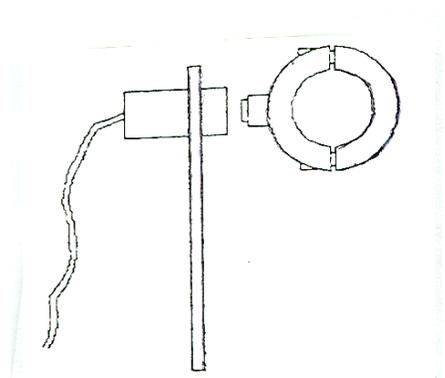


Connect the 3pin cable from the Rotary Probe air valve into the "AUX2" socket on the gage. Turn on the power. The probe should go to the down position. The air pressure should be low enough that you can easily move the probe up and down against the air pressure. After five seconds, the probe should rotate up. Connect the 6pin cable from the probe into the "PROBE" socket on the gage. Use spiral wrap to secure the various wires out of the way. Allow for service by putting enough length in some of the loops for adjustment and removal.

Manually cycle the coiler (without making a spring) to check the correct operation of the read switch. The probe should start moving just after the wire stops feeding to ensure it is out of the way at cut off. Always stop the coiler after cut off to avoid having a heavy spring hit the probe. Set the sort knob to a value that is equal to the time the coiler takes to make a spring.

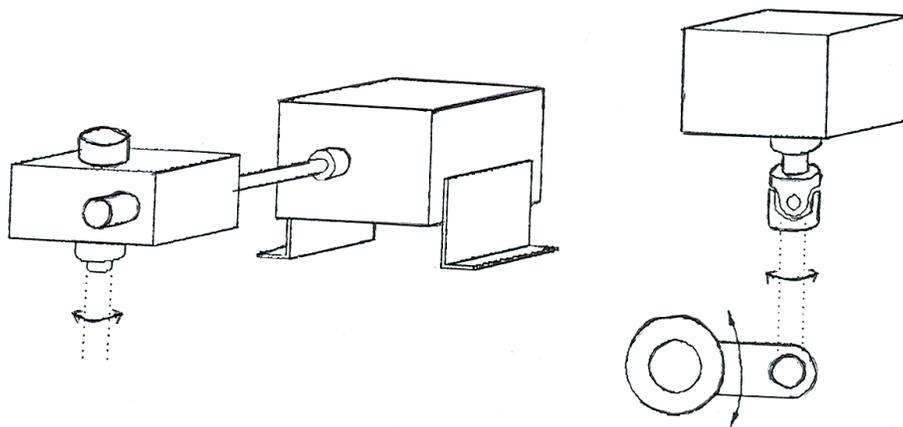
If the probe seems to vibrate too much, place a small bag filled with 2-4 lbs. of steel shot over the end of the base to dampen the vibration. When new, the probe requires a slightly higher air pressure to operate. After a 2000 to 4000 cycle break in, the air pressure can be reduced. Too much air will cause excessive vibration. Too little air can cause erratic action and poor repeatability. Between 20psi and 40psi is usually fine.

**4.2.4 Read Switch:** The read switch assembly consists of a target mounted on a block and a read switch mounted on a bracket. Mount the target to any shaft that makes one complete revolution per spring. Mount the switch and bracket so nothing will hit it and the target will pass 0.030" to 0.080" from the flat on the switch. Position the read switch and target so the read signal will be sent after the wire quits feeding but before cut off.



**NOTE:** On most segment type coilers, the read signal should take place at the midpoint between end of feed and cutoff. On high speed coilers, escapement coilers, or when using the rotary probe, the read must take place as soon as the wire quits feeding.

Coil a spring by hand slowly to insure that the target does not hit anything. Cut off the spring. Connect the read switches plug to the **MERLIN GAGE's** "READ" output socket. With no other accessories plugged into the gage, plug in the power cord and turn the **MERLIN GAGE** on. Coil a spring by hand and check the read signal. Some of the LED's will blink when the **MERLIN GAGE** receives the signal. Verify that the blink is at the correct point in the coiling cycle. Turn the **MERLIN GAGE** off.



**4.2.5 Pitch Control Motor:** NOTE: Due to the variety of coilers the following procedure may vary; and the type of mounting hardware may be different from the hardware listed. However, the basic principals still apply. If you have any questions, contact customer service for assistance. Telephone: (219) 495-2405 Fax: (219) 495-1290.

**4.2.5.1a Single Coiling Point Systems:** The pitch control assembly includes a pitch motor, flex shaft, adaptor nut and gearbox. On some coilers, the pitch motor connects directly to the pitch rod. Remove the locking nut from the pitch rod. Check the rod threads for cleanliness and rough spots. If necessary, clean threads using a die to ensure smooth movement of the nut on the rod.

Screw the adaptor nut onto the pitch rod. Connect the flex shaft to the gear box's input shaft. Set the gear box's hollow shaft over the nut on the pitch rod. Position the flex shaft for mounting to the pitch motor. Tighten the two set screws in the gear box's hollow shaft to the adaptor nut. Adjust the height of the pitch motor using the two legs on the base of the housing so the flex shaft is parallel to the coiler. Fasten the flex shaft to the pitch motor.

Position the pitch motor so the flex shaft does not hit anything and has a slight curve, about 15° to 20°. This curve helps the flex shaft act as a torque arm. Using the mounting holes in the two motor legs, mark the coiler. Drill and tap the holes for 10/32 screws. Be sure to use locking washers or nuts to prevent hardware from coming loose and falling into the coiler mechanism. Proceed with 4.2.5.2.

**4.2.5.1b Dual Coiling Point Systems:** The pitch control assembly consists of a pitch motor, a universal joint, and a threaded rod (often supplied with the coiler). Usually the pitch motor replaces the fine pitch adjustment knob. Remove the existing knob and universal. Check the pitch rod threads for cleanliness and rough spots. If necessary clean threads by using a die to ensure smooth movement.

Install the universal on the end of the threaded rod. Reinstall the threaded rod on the elliptical pitch adjustment bushing. Position the pitch motor so it's output shaft aligns with the end of the threaded rod. Be sure there is room for the system to adjust through it's entire range. Attach the pitch motor to the coiler using the proper screws, and tighten the universal to the pitch motor shaft using the set screws.

4.2.5.2 **Checkout:** Connect the 3pin plug from pitch motor to the **MERLIN GAGE's** "ADJUST" output socket. Turn the gage on. Place the gage in setup by pressing the "SETUP" key. Check for correct motor direction by pressing the "1" (in) and "2" (out) keys. If the motor turns the wrong direction, reverse the switch on the motor. When a gear box reducer is used, motor direction can also be reversed by mounting the flex shaft to the other input shaft on the gear box reducer. Unplug the power cord.

4.2.6 **Sorting Chute:** Position the chute so the back of the funnel is as close to the front of the coiler as possible. This is usually beneath the cut off mechanism. Align the chute so after cut off, the springs fall into the throat of the chute without bouncing out.

Make a mounting assembly to connect the chute to the coiler. A bracket is included on the chute. Due to the variety of coilers in the industry, an adapting bracket may be required. Moyer now offers a chute stand that has adjustable height from 24" to 42" and can rotate horizontally as well as vertically.

The 3pin cable from the three way chute plugs into the **MERLIN GAGE's** "SORT" output socket.

The 3pin cable from the five way chute plugs into the **MERLIN GAGE's** "SORT" output socket. Connect the 2pin plug to the **MERLIN GAGE's** "AUX1" output socket.

When using a five way chute with coiler kill, connect the two pin plug to one of the sockets on the coiler kill board. Connect the three pin socket on the coiler kill board to the **MERLIN GAGE's** "AUX1" output socket using the supplied cable.

## CHUTE MAINTENANCE AND SERVICE

### GENERAL MAINTENANCE

-Ensure that the rubber stripping on the end of each flap is present. This stripping helps absorb the shock of operation and increases the life of flaps.

-Lubricate the bronze bushings that the flapper shaft passed through with a general purpose lubricant such as 3-in-1 or WD40. This should be done every 500 hours of operation under normal use, or every 250 hours of operation if used with an in-line oven.

-Adjust solenoids as soon as you hear a loud buzzing when the flap is activated. This buzzing is a result of a solenoid out of adjustment. If immediate attention is not given, the solenoid will burn out and the gage may be damaged.

### ADJUSTMENT OF AC SOLENOIDS

-Before shipment, the solenoids are adjusted for proper operation. During normal use, these solenoids might come out of adjustment. This out of adjustment condition has one of two consequences. One, the flapper will not fully close when the solenoid is energized. Two, there will be a loud buzzing when the solenoid is energized. This condition of the solenoid buzzing will seriously shorten the life of the solenoid and associated circuitry both in the gage and the chute. If either of these two conditions exists, the following adjustments should be made.

-Adjustment of three way chute solenoids and the long and short solenoids can be accomplished using the sort output of a Mean Machine, Eurogage or Merlin gage. Adjustment of the very long and very short solenoids of a five way chute can be accomplished by using the same output and a jumper wire on the Mean Machine and Eurogage. The Merlin gage can check the chute in the hardware test as is.

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## WARNING

THERE IS A RISK OF ELECTRIC SHOCK WHICH MAY CAUSE PERSONAL INJURY OR DEATH. REMOVAL OF COVER AND ADJUSTMENTS SHOULD BE DONE BY QUALIFIED PERSONNEL

## CAUTION

DAMAGE TO SNUBBER CIRCUIT BOARD MAY RESULT BY INADVERTENTLY SHORTING SOLENOIDS TO GROUND

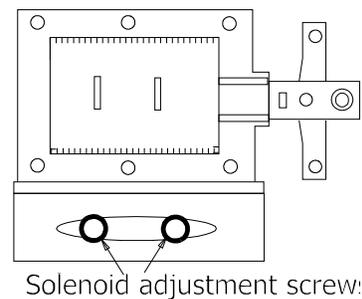
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### CHUTE SOLENOID ADJUSTMENT

1. Remove the solenoid cover. Loosen solenoid adjustment screws (see fig1) on the solenoid to be adjusted

2. To energize the solenoid;
  - Plug the 3pin cable into the sort output of the gage.
  - Put the gage into HARDWARE TEST mode (See gage manual)
  - For MERLIN and EUROGAGE-Hold the “ENT” key and rotate the sort knob until the solenoid is energized.
  - For MEAN MACHINE-rotate the sort knob until the solenoid is energized

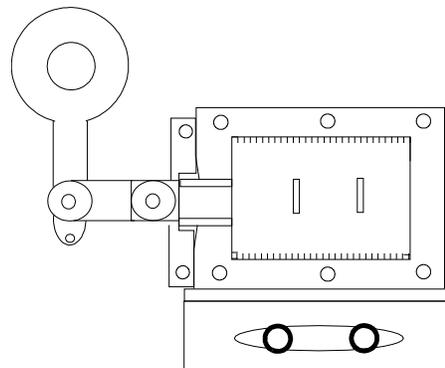
Fig 1



3. Move the solenoid in the horizontal plane until the flap **just makes contact** with the opposite side, but not enough to cause a loud buzzing of the solenoid. Some slight tilting of the solenoid may be necessary to achieve this condition. For proper adjustment, ensure that no part of the solenoid is touching the solenoid plate. Remove any excess plastic material from the solenoid with a small fine tooth file.

Fig 2

NOTE: When Flap is fully closed, rocker arm should be in the 6:00 position and the linkage should be horizontal.



## 5.0 USING the MERLIN GAGE

The **MERLIN GAGE** must be taken through a series of steps before first use:

Step #1: Configure the **MERLIN GAGE**.

Step #2: Setup the **MERLIN GAGE**.

Step #3: Run the **MERLIN GAGE** during production.

Step #4: Analyze the results and improve the process.

### 5.0.1 GENERAL INSTRUCTION

**SELECTING SCREENS:** For the setup screen, press the "SETUP" key. For the configure screen, press the "CONFIG" key. For the run screen, press the "RUN" key. For the stats screen, press the "STAT" key.

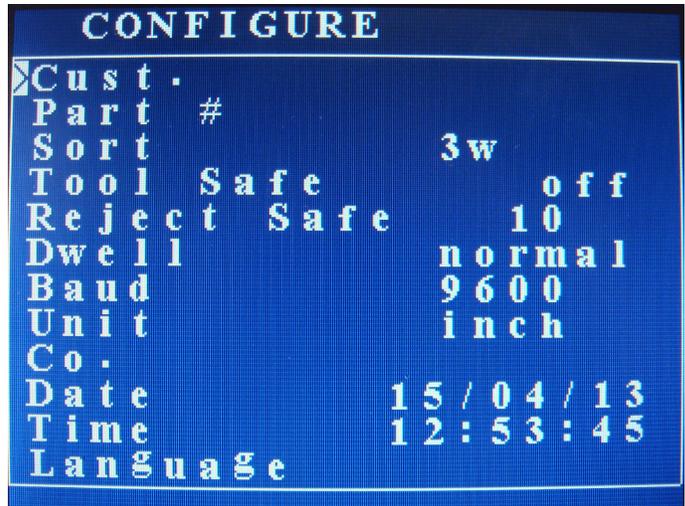
**SELECTING OPTIONS:** Move the "->" cursor to select the option you want. NOTE: This does not execute the option. The "->" cursor moves from option to option. You must select an option with either the up and down arrow keys. The "ENT" key executes the selected option.

**ENTERING NUMBERS:** For entering or changing a number, a reverse video block (blinking block) cursor will highlight the last digit of the number. The "CLR" key will remove that digit and move the remaining digits one place to the right, while filling the left with '0'. The '0' thru '9' keys will shift the number one place left and insert the digit pressed. The up and down arrow keys increase and decrease the number by one. You must press the "ENT" when you finish changing a numeric value. The **MERLIN GAGE** will hold its memory if turned off. The **MERLIN GAGE** will only erase a previous setup if you turn it on while pressing and holding the "SETUP" key on the key pad.

**ENTERING TEXT:** For entering or changing a letter or word, a reverse video block (blinking block) cursor will highlight the last letter of the word. The "CLR" key will remove that letter and move the block cursor one place to the left. The right arrow key (->) and left arrow key (<-) will move back and forth through each letter of the key pushed, each time pushed. After choosing a letter or number, press the right arrow key to move the cursor one place to the right, then enter the next letter or number. You must press the "ENT" when you finish entering your text. The **MERLIN GAGE** will hold its memory if turned off.

## 5.1 CONFIGURING YOUR MERLIN GAGE

5.1.1 **ENTERING CONFIGURE:** Turn the gage on. Press and release the “CONFIG” key to enter this screen. The gage is now in the CONFIGURE menu. You can select an option by using the up and down arrow keys to move the cursor to that item. This menu allows you to set or change the following options:



5.1.2 **Cust.:** Enter the customer name by moving the cursor to this option and pressing the “ENT” key. Use the letters listed on the keypad and the right arrow key(→) and the left arrow key(←) to enter the customer name. EX: to enter the name XYZ, Inc., press the “9” three times to see the “X”. Now press the (→) key to move one space to the right. Press the “9” four times to see the “Y”. Again, press the (→) key. Then press the “0” key four times to see the “Z”. Up to 17 characters can be entered. Press the “ENT” key when done.

5.1.3 **Part#:** To enter the part number of the job running, move the cursor to this option and press the “ENT” key. Use the numbers and letters on the keypad to enter the part number, and the (→) key to move one space right and the (←) key to move one space left. EX: to enter part number AR126, press the “2” key two times for the A. Then press the (→) key to move one space right. Press the “7” key three times for the R, then press the (→) key to move one space right. Press the “1” key for the number 1, then the (→), and so on until you have the complete part number entered. When finished, press the “ENT” key to lock in the entry.

5.1.4 **SORT:** Select between 3way, 5way 33%, 5way 50%, or 2way AIR, by moving the cursor to “SORT” and pressing the “ENT” key. Continue pressing until the option you want appears on the screen.

5.1.5 **TOOL SAFE:** Turn the broken tool detection on and off by moving the cursor to “TOOL SAFE” and pressing the “ENT” key.

5.1.6 **REJECT SAFE:** Select the automatic shut off (coiler kill) number by moving the cursor to “REJECT SAFE” and pressing the “ENT” key. Enter the number of consecutive bad springs you want to shut the coiler off. To turn this option off, enter 0.

5.1.7 **DWELL:** Select between normal (segment coiler), short (non-segment coiler), and CNC (CNC coiler) by moving the cursor to DWELL and pressing the “ENT” key.

5.1.8 **BAUD:** Set this by moving the cursor to BAUD and press “ENT”. Use the number keys to enter the baud rate needed. Be sure to use the correct baud rate for the device you have.

5.1.9 **UNIT:** Select between inch and millimeter by moving the cursor to UNIT and pressing the “ENT” key. All data and settings convert, so you need not reset the MERLIN gage.

5.1.10 **Co.:** Enter your company name by moving the cursor to Co. and pressing the “**ENT**” key. Use the letters listed on the numbered key pad and the (→) and left arrow (←) keys to enter your company name. EX: to enter the name XYZ, Inc., press the “9” three times to see the “X”. Now press the (→) key to move one space to the right. Press the “9” four times to see the “Y”. Again, press the (→) key. Then press the “0” key four times to see the “Z”. Up to 17 characters can be entered. Press the “**ENT**” key when done.

5.1.11 **DATE/TIME:** Change the date or time by moving the cursor to “DATE” or “TIME” and pressing the “**ENT**” key. Enter new values as needed.

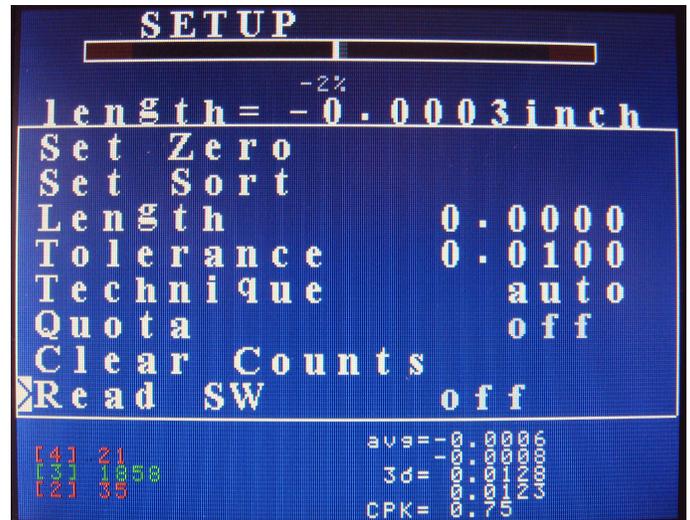
5.1.12 **LANGUAGE:** Merlin can display data on the screen and to the printer in four languages. Select between English, French, German, and Japanese by moving the cursor to “LANGUAGE” and pressing the “**ENT**” key.

## 5.2 SETTING YOUR MERLIN GAGE

**5.2.1 ENTERING SETUP:** For the first setup or for setting up a new job, press and hold the “SETUP” key and turn the gage on. Continue holding until the MERLIN GAGE displays the “SETUP” options menu. Let the MERLIN GAGE warm up for approximately three minutes.

**\*\* Make sure the “ReadSW” option is turned off prior to setup.\*\***

**5.2.2 GAP:** Place the probe the recommended distance from the spring using the chart below:



Spring O.D.	Recommended Tip Size	Initial Standoff
0.062" to 0.125" [1.6mm to 3.2mm]	1/8" [3.17mm]	.065" [1.65mm]
0.125" to 0.250" [3.2mm to 6.4mm]	1/4" [6.35mm]	.125" [3.17mm]
0.250" to 0.375" [6.4mm to 9.5mm]	3/8" [9.52mm]	.200" [5.08mm]
0.375" to 0.500" [9.5mm to 12.7mm]	1/2" [12.7mm]	.275" [6.98mm]
0.500" to 0.625" [12.7mm to 15.9mm]	5/8" [15.9mm]	.350" [8.89mm]
0.625" to 0.750" [15.9mm to 19.1mm]	3/4" [19.1mm]	.450" [11.4mm]
0.750" to 1.000" [15.9mm to 25.4mm]	1." [25.4mm]	.650" [16.5mm]

**5.2.3 SET ZERO:** Move the cursor to the “SET ZERO” option and press “ENT”. The MERLIN gage will automatically zero the electronics and the scale % should display 0%.

**5.2.4 GAP CHECK:** Turn the micrometer clockwise the sort tolerance. If the % is between 15% and 50%, proceed to 5.2.5. If it is under 15%, the probe may be too far away from the spring. Move the micrometer closer, and go back to step 5.2.3. If it is over 50%, the probe may be too close to the spring. Move the micrometer farther away, and go back to step 5.2.3

**5.2.5 SORT LONG:** Move the cursor to the “SET SORT” option and press the “ENT” key. This will lock in the sort long length. If you are five way sorting, the MERLIN gage will automatically divide the total tolerance into three good groups.

**5.2.6 SORT SHORT:** Return the micrometer to the zero position and continue turning counter clock-wise to the sort short tolerance. Press the “ENT” key. The sort distances are now locked in. Return the micrometer to the zero position.

**5.2.7 LENGTH:** Select the “LENGTH” option and press “ENT” to change the length value. The MERLIN gage considers a perfect spring as having no length. To display and print the actual length of the spring, enter that length here, otherwise enter zero. To change the length on the fly, the “Read SW” option must be on. Changing the value changes the actual sort tolerance to your new value. This can produce inaccuracies. Always check production to verify quality.

5.2.8 **TOLERANCE:** With the “Read SW” option off, select this option and press “ENT” to change the sort tolerance value. This tells the Merlin gage how the length variation relates to the signals from the probe. To change the tolerance on the fly, the “Read SW” option must be on. Changing the value with the “Read SW” on changes the actual sort tolerance to your new value. Large changes can produce inaccuracies. Always check production to verify quality.

5.2.9 **TECHNIQUE:** To change the type of pitch correction, select between “auto” or “%” by pressing the “ENT” key. In “auto”, adjustments are made based on the last spring coiled. In “%”, adjustments are made based on the percent entered. If 25% is entered, adjustments will be made when the length of the spring exceeds 25% of your sort tolerances.

5.2.10 **QUOTA:** To enter or change the quota shut off, move the cursor to “QUOTA” and press “ENT”. Enter the quota by pressing the number keys, then press “ENT”. The coiler kill kit will automatically shut off the coiler when the programmed number of parts have been coiled.

5.2.11 **CLEAR COUNTS:** Select “CLEAR COUNTS” and press “ENT” to reset the counters

5.2.12 **Read SW:** Select this option and press “ENT” to turn the read switch on and off. With the “Read SW” option turned on, the operator has the ability to make changes to everything in all screens, except the zero and sort points. The read switch is automatically turned on when switching from the setup screen to the run screen. When changing from the run screen to the configure or stats screen, the gage will automatically continue sorting and adjusting whether this option is on or off. When switching from the run screen to the setup screen, the gage will continue to sort and adjust only if this option is turned on.

5.2.13 **SORT:** Set the “SORT” knob for the amount of time you wish to activate the chute. For example, if you are running 46 parts per minute, a correct setting would be at mid scale.

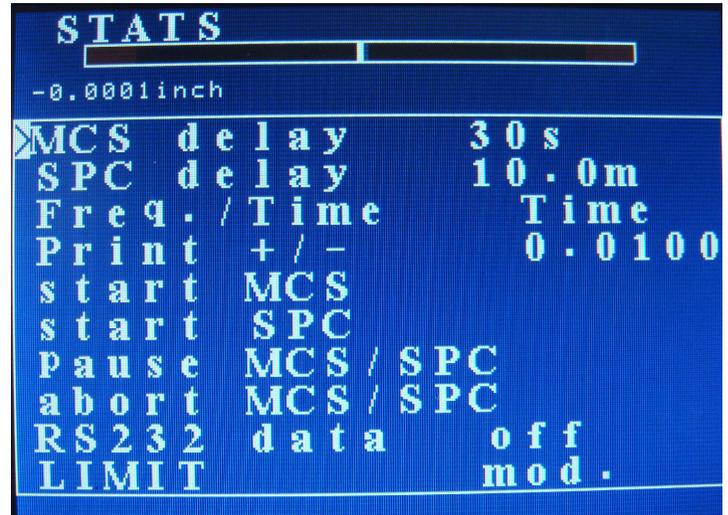
5.2.14 **ADJUST:** Set the “ADJUST” knob to control the pitch adjustment time. Start with the dot on the knob at mid scale if using AUTO technique. Otherwise, state it at a low value.

5.2.15 Check for correct motor direction by pressing the “1” (IN) key and the “2” (OUT) key. If the motor turns the wrong direction, reverse the switch on the motor. These keys will work in any of the four screens.

## 5.3 STATS SCREEN

5.3.1 **ENTERING STATS:** After setting the Merlin, press and release the “STAT” key. The gage is now at the STATS menu. Choose an option by using the up and down arrow keys to move the cursor to that item.

5.3.2 **MCS delay:** To set the time or frequency for each Machine Capability Study, move the cursor to this option and press the “ENT” key. Enter the time in seconds or frequency by using the numbered keys on the key pad and press the “ENT” key again.



5.3.3 **SPC delay:** To set the time or frequency of each Static Process Study, move the cursor to this option and press the “ENT” key. Enter the amount of time in minutes or frequency same as above.

5.3.4 **Freq. / Time:** The MERLIN gage has the capability of changing between frequency of parts, or how many parts are ran before a sampling is taken, and time, or how many seconds and minutes passes before a sampling is taken. Toggle between **Freq.** and **Time** by moving the cursor to this option and pressing the “ENT” key.

5.3.5 **Print +/-:** Move the cursor to this option and press the “ENT” key. Enter your print tolerances here as you wish them to reflect on your study. Print tolerances may or may not be the same as sort tolerances depending on CPK requirements

5.3.6 **start MCS:** To start a machine capability study, move the cursor to this option and press the “ENT” key. This study can also be started by pressing and holding the “\*” key for just over one second while in the run screen.

5.3.7 **start SPC:** When the Machine Capability Study is complete, the gage will automatically start the Statistical Process Control study. This study can also be started by pressing the “\*” key for under one second while in the run screen.

5.3.8 **Pause MCS/SPC:** To pause or stop either the MCS or SPC study, move the cursor to Pause study and press the “ENT” key. This will cause the printer to feed one line and stop. To resume the study, press the “ENT” key again. The study will continue from the current data. This study can also be paused while in the run screen by pressing the “CLR” key.

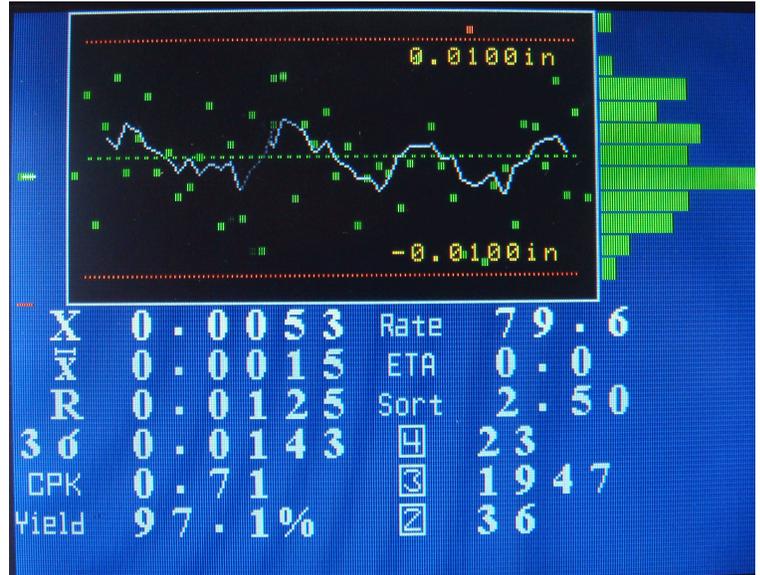
5.3.9 **Abort MCS/SPC:** To completely stop either the MSC or SPC study, move the cursor to this option and press the “ENT” key. The printer will feed one full page and stop. This study can also be stopped while in the run screen by pressing and holding the “CLR” key.

5.3.10 **RS232:** Turn the serial output on, move the cursor to RS232 and press the “ENT” key.

5.3.11 **LIMIT:** Select the control limit type by moving the cursor to LIMIT and pressing the “ENT” key. Modified control limits often produce better looking charts. If the CPK is less than one, the LIMIT reverts to natural.

## 5.4 RUNNING YOUR MERLIN GAGE

5.4.1 **RUN:** Press the “RUN” key to return to the main run screen, or turn on the thread switch. Cut off the spring used to setup. Measure this spring and correct the probe for its actual length. Start coiling spring. Catch a spring close to the length you want as shown on the screen. Compare its actual length to your target length. Correct the probe if needed by moving the micrometer the amount the spring differs. Repeat if necessary.



5.4.2 **PITCH CORRECTION:** Occasionally you may want to increase or decrease the amount of correction for further reduction of scrap. The **MERLIN GAGE** has

built-in self-improvement, so coil 50 to 100 springs before you change the “ADJUST” knob setting. You will find the section on Statistical Process Control very helpful in determining if the adjust knob setting needs to be changed. Please be sure to read that section.

5.4.3 **STATS:** To do a Machine Capability Study, press and hold the “\*” key for just over one second (printer required). When the MCS is done, the **MERLIN GAGE** will automatically continue taking Statistical Process Control study samples. To pause the SPC study, press and release the “CLR” key. The printer feeds one line. To continue a paused study, press and release the “\*” key. To abort the studies before they are finished, press and hold the “CLR” key until the printer feeds through one page.

- 5.4.4 **DEFINITIONS:** Explanations of the RUN Screen
- X Represents the last coiled spring length
  - $\bar{x}$  Represents the average length of the spring
  - r Represents the measured range from spring to spring
  - 3 $\sigma$  Three times sigma calculated using the sum of the squares
  - SORT The amount of time the sort output is staying activated
  - 00 Number of out of tolerance spring in a row
  - GOOD Count of good springs coiled since counts last cleared
  - LONG Count of long springs coiled since counts last cleared
  - SHORT Count of short springs coiled since counts last cleared
  - CPK An index of process quality
  - RATE Speed of the coiler, per minute
  - ETA Estimated time the job will be completed (quota must be set)
  - YIELD Percent of good springs coiled, based on total springs run

## 6.0 Statistical Terms

**6.1 Normal Distribution:** A bell-shaped curve that has few points (or measured spring lengths) at either end and most of the points (spring lengths) in the middle represents normal distribution. If a line is drawn through the middle to the base line, the two parts should be similar in shape and nearly equal in area to be a normal distribution. The new **MERLIN GAGE** measures the "Normality" of the production using the Geary's test for normality, or "Z". This is important. Calculated process limits at mean + 3 sigma and mean - 3 sigma are valid only if the process forms a normal distribution. In most cases, a properly running coiler and gage will coil springs whose lengths form a normal distribution.

**6.2 Standard Deviation or Sigma:** Standard deviation is a term used in statistics to describe the spread of data within a distribution. As manufacturers, we want this spread to be as little as possible from the middle or mean. Sigma is the Greek letter that denotes standard deviation (spread). The **MERLIN GAGE** calculates this spread several different ways. It calculates and displays the spread of the last 50 springs each time it measures a spring. This enables the **MERLIN GAGE** to make intelligent adjustments. The **MERLIN GAGE** also calculates the process spread in the Machine Capability Study. The **MERLIN GAGE** uses both the classic sum of the squares method (3sigma(v) on the printout) and the simpler approximation using Ranges (3sigma(r) on the printout). The 3sigma(v) calculation is effected by trend; where the 3sigma(r) calculation is not. Together, they provide an important way of judging the effectiveness of adjustment.

**6.3 Mean or Average:** The Mean or Average of a process is the value calculated by adding all the lengths and dividing by the number of lengths. The **MERLIN GAGE** calculates the mean of the last 50 springs each time it measures a spring. This is necessary for intelligent adjustment. It calculates and displays the mean of the last five springs (Xbar) for the operator. The **MERLIN GAGE** calculates the mean of each five spring sample for the Xbar and R Chart print outs. This is called Xbar (the average of X values). The X represents an individual measurement in statistics. The mean of the parts is calculated and printed in a Machine Capability Study (MCS) and Statistical Process Control study (SPC).

**6.4 Range or R:** Range, or R, is another way of measuring the spread of data sampled from a distribution. The range of a sample is the difference between the longest measurement in the sample and the shortest measurement in the sample. The **MERLIN GAGE** calculates and displays the range of the last 5 springs (R). It prints the range(R) of each five part sample in its studies.

**6.5 Control:** The control of a process refers to whether or not that process is predictable. It has nothing to do with adjustment. In fact, if one thinks of the gage and coiler as one machine, an adjustment is something an operator does to the probe micrometer or coiling point, not something that the gage does to the pitch mechanism. Gages don't actually adjust, they maintain and operators adjust. Statistical techniques offer a way to determine if a process is of predictable quality and is consistent. You can determine if something has changed and/or if the parts are still the same by analyzing the samples taken at different times during a production of springs. More information about control is given in "6.6 Charting".

6.6 **Charting:** The **MERLIN GAGE** is capable of using natural, modified-natural, and modified control limits. Take, for example, natural control limits. "UCLx" is the upper control limit of the Xbar values. "LCLx" is the lower control limit of the Xbar values. "UCLR" is the upper control limit of Range values.

6.6.1 Sample statistics are taken to determine the overall quality of the parts in production.

6.6.2 After enough samples have been taken from a distribution of parts, you can calculate the control limits: UCLx, LCLx, and UCLr. Also the statistics mean and standard deviation of the distribution of parts can be estimated. This is part of what a Machine Capability Study does.

6.6.3 As additional samples are taken from the distribution, their statistics should never exceed the limits calculated by the Machine Capability Study. This is part of what a Statistical Process Control study does.

6.6.4 Additional analysis is also often done by looking for trends and shifts in the actual chart. Because of its closed loop adjustment technique, the **MERLIN GAGE** will seldom, if ever, allow a noticeable trend or shift to occur. If further study is desired, a good book on industrial quality control is recommended.

If all the Xbar and R values fall within the calculated control limits (UCLx, LCLx, & UCLr), then the process is "IN CONTROL". It is in fact predictable. It will probably continue to run the same (with all Xbar and R values within the control limits), as long as nothing changes. Conversely, something has probably changed if an Xbar or R value has exceeded a control limit.

## 7.0 Statistical Studies

**7.1 MCS Overview:** The machine capability study determines if a machine is running parts that have a normal distribution, are in control, and are capable of meeting the print requirements. When a machine capability study is done, data is collected into subgroups. The data is then analyzed using Xbar and R charts.

**7.2 MCS Features:** The **MERLIN GAGE** produces a print out titled "Machine Capability Study". It has the following features:

- (1) Customer name and job number, entered through the configure and stat screen
- (2) Date in day/month/year (military) format.
- (3) Time of day using a 24 hour clock.
- (4) "Mode": the first 2 digits of mode represent the position in which the adjust knob was set. 0 equals full counter clockwise and 99 equals full clockwise. The letter "P" means proportional "auto" feedback and "B" means "%TOL" feedback. The last two digits represent the internal gage adjustment value.
- (5) "Good" is the number of good springs coiled since the counters were cleared.
- (6) "Yield" is the % of good springs coiled since the last sample was taken.
- (7) "Ranked Data" is the actual lengths of the sample, sorted from longest to shortest. The sample is the last five springs coiled. The **MERLIN GAGE** will not sample individual spring more than once, and the samples are always contiguous (taken one after another), even at the fastest possible coiling speeds. This is important if Xbar and R charting is to be effective.
- (8) "Xbar" is the average length of the sample.
- (9) "Range" is the spread of the sample lengths.
- (10) "Overall yield" is the % of good springs coiled since the set up.
- (11) "Study yield" is the % of good springs coiled during the study.
- (12) "Mean" is the average of the 100 springs sampled in the study.
- (13) "3sigma(v)" is three times sigma calculated using the sum of the squares (variance) and represents long term variation.
- (14) "Min\_x" is the shortest measurement in the study.
- (15) "Max\_x" is the longest measurement in the study.
- (16) "Z" is the Geary's test for normality value. If a distribution is normal, it should be between +1.96 and -1.96.
- (17) "Avg\_dev" is the average deviation calculated from the study.
- (18) "3sigma(r)" is three times sigma calculated using ranges and represents short term variation.
- (19) "UCLx" is the upper control limit for Xbars.
- (20) "LCLx" is the lower control limit for Xbars.
- (21) "Rbar" is the average of the sample ranges.
- (22) "UCLr" is the upper control limit for the ranges.
- (23) "CPK" is an index of process quality.
- (24) "r/v" is the ratio of sigma(r) over sigma(v). It is a handy tool to monitor adjustment effectiveness.
- (25) "Xbar chart" is a standard Xbar chart. It has micro-spacing of Xbar values and the 50% interval with count used to monitor adjustment effectiveness.
- (26) "Range chart" is a standard Range chart with micro-spacing.
- (27) "Histogram" is a true histogram as opposed to a frequency distribution. It has ideal interval spacing and the median two datum are indicated by "MM" for easy interpretation.

(28) The last line of the study analyzes the study for centering, control, and normality. Because some customers did not like the word 'normal' we use the word 'Gaussian' (their meanings are the same).

7.3 **SPC Overview:** A process capability study is the long term study of the sample data taken by the **MERLIN GAGE**. It is plotted against the machine capability studies' control limits to see if the process is remaining in control and is predictable. The **MERLIN GAGE** titles it's process capability study "Process Xbar & R Chart". It contains the same data and features as the Machine Capability Study, except control limits do not change. It uses the limits as calculated in the most recent Machine Capability Study.

## 8.0 Interpretation of Statistical Printouts

The **MERLIN GAGE** provides some very useful information on the screen and via the printer. This section explains standard SPC data as well as some Moyer additions. There are examples in the Appendix.

**8.1 Adjust setting:** The best setting of the "Adjust" control can be determined from the printouts. The ratio  $r/v$  ( $\sigma(r)/\sigma(v)$ ) should be greater than 0.80 but less than 1.00. If this ratio is greater than 1.00, the gage is probably over controlling. If this ratio is less than 0.80, the gage is probably under controlling. (**A MOYER INNOVATION**)

The number of times "X" is printed between the two broken lines on the Xbar chart is printed at the right end of the second broken line in the Xbar chart printout. It should be 9, 10, or 11. If the count is 12 or greater, the gage is probably over controlling. If the count is 8 or less, the gage is probably under controlling. The broken lines are titled "50%" because half of the 20 Xbar values should fall between them. (**A MOYER INNOVATION**)

Examine the last two digits of the mode column. Check to see if this value is getting larger, getting smaller, or staying the same. This value represents the **MERLIN GAGE's** internal correction value. If the **MERLIN GAGE** thinks that it is over controlling, this value will be getting smaller. If the gage thinks that it is under controlling, this value will be getting larger.

If the  $r/v$  ratio and the number of Xbars between the 50% confidence lines on the Xbar chart indicate the gage is over controlling, and the last two digits of the mode column is staying the same or getting bigger, then turn the "Adjust" knob on the front of the **MERLIN GAGE** counter clockwise to reduce the control level. Wait fifty or more springs and run another Machine Capability Study to see the results.

If the  $r/v$  ratio and the number of Xbars between the 50% confidence lines on the Xbar chart indicate the gage is under controlling, and the last two digits of the mode column is staying the same or getting smaller, then turn the "Adjust" knob on the front of the **MERLIN GAGE** clockwise to increase the control level. Wait fifty or more springs and run another Machine Capability Study to see the results.

The amount to increase or decrease the "Pitch" knob setting comes from experience and trial and error. It should also be noted that too little control can sometimes result in Xbar values above the UCLx line or below the LCLx line on the Xbar chart. Too much control can sometimes result in R values which are above the UCLr line on the Range chart. Once you've generated a Machine Capability Study which shows a proper level of adjustment, it is then time to examine a few other items on the study.

**8.2 Control Test:** If the bottom line indicates that the process is in control and centered, then no corrective action is required.

If the process is not centered, a severe feedback problem exists. For some reason, the feedback from the gage is not centering the process over a large number of parts. You may have a defective linkage, loose set screw, damaged pitch rod thread, bent pitch rod or pitch tool, bad flex shaft, or even a broken gage. Refer to the trouble shooting section in the back of the manual to help locate the problem.

If the process is centered but not in control, and you have tried varying the adjustment control with no help, then the process is truly out of control.

Out of control conditions usually require some corrective action. Try checking the following:

- (1) wire quality
- (2) worn, loose, or incorrect tooling
- (3) unpowered payoffs
- (4) incorrect feed roll pressure
- (5) machine problems

When a process is out of control, there is a cause for it. If that cause is corrected or eliminated, the process will run with an improved quality. Therefore, Xbar & R charting is a powerful tool for process improvement.

**8.3 Capability Test:** If the statistics indicate that the parts are all within the quality requirements, the process is considered "Capable" of producing all good parts. A process may be "Capable" but not in "Control", or it may be in "Control" but not "Capable". A coiler may coil predictable springs with a maximum length variation of only  $\pm 0.002$  inch, but if the print requires  $\pm 0.001$  inch, it is not capable. If an out of control process is capable, try using modified control limits (if allowed).

What if the process is not capable?

(1) Employ sorting to eliminate non-conforming parts. The **MERLIN GAGE**, with a chute or air valve, is capable of sorting springs into three or five groups according to length. Sorting to eliminate nonconforming parts is common. If the load is a very important print requirement, and if length tolerances have been established which will ensure good loads, it may be adequate to sort or reject springs outside of these tolerances. Some rejected springs may be salvageable, but the limits ensure all non-sorted springs are good.

(2) Employ sorting to subdivide the process. The **MERLIN GAGE**, with the proper chute, may sort your springs into five groups. If the amount of grind is an important print requirement, if relatively wide length tolerances have been established to hold the loads, and if the amount of length variation is too much for a consistent grind, you probably should sort the springs into five groups. Each group can be ground separately. In this case, five way sorting has been used to group even the good springs according to the variation of the free length. This provides three groups of springs to be ground with very little free length variation. Consequently, one difficult process can be broken up into three easy processes.

(3) Attempt to tighten or improve the process at another step. This action may require using half tolerance wire, a powered dereeler, in-line heat treating, a set removal operation, heat setting, or a Moyer Computerized Grinder Length controller. Manual or automatic 100% sorting should be considered a last resort and only rarely necessary.

**NOTE:** Problems can arise from sorting and are often due to the nature of truncated normal distributions. Sometimes problems are real, such as when stack up arises because too many parts are close to, but not exceeding the print tolerance. Problems may be imaginary, such as when final inspection calculates process limits using usual techniques and estimate that some parts must be out of tolerance. However, extensive manual inspection finds only acceptable parts.



## 10.0 REINITIALIZING THE MERLIN GAGE

A time may come when the gage needs to be reinitialized, or reset. This can happen when the gage has information overload. Reinitializing the gage will reset all internal settings without resetting your saved information.

--Make sure gage is turned off and power cord is plugged in.

--Press and hold the "4" key and turn the power on. Continue holding for a few seconds longer, then release. This is **Hardware Test Mode**.

--Move the cursor up and down to make sure it works. Turn the sort and adjust knobs back and forth while watching the screen. Make sure the numbers for the SORT, ADJUST, and PROBE are changing. Turn power off.

--Press and hold the "SETUP" key and turn the power on. Release after you see the SETUP screen appear. DON'T PANIC. The screen may look a little funny. This is the Setup Mode.

--Move the cursor through and toggle each option. At the options where data is entered, clear it all out and re-enter the information.

--Change to the "CONFIG" screen and the "STAT" screen by pressing their key and do the same as in the setup screen. Turn power off when finished.

--The gage is now ready to be setup and used.

**!!!WARNING!!!**  
Beware of  
Copy-"cat"  
gages.  
Only Moyer Gages  
provide Moyer Quality!



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