Enhanced

MEAN MACHINE

COMPUTERIZED FREELENGTH CONTROL SYSTEM

Built by:

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1.0 DESCRIPTION OF FEATURES

1.1 Length Control System: The Mean Machine Gage is a microprocessor-based controller and probe for measuring the spring free length deviation from a target mean free length while coiling. When used with a pitch controller and sorting chute, the Mean Machine Gage makes pitch adjustments based upon statistical data to correct for free length variation, and sorts the springs according to selected free length tolerances into three or five categories.

Some of the features of the Mean Machine Gage include:

-length display on a meter

-auto zero

-simple push buttons set up and programming

-patented feedback calculation

-A temperature-stabilized probe

-three and five-way sorting capability

-broken tool detection

-a quota shut down

-statistical printouts

-RS232 data output

The Mean Machine Gage enables the operator to make scrap reduction simple.

1.2 Length Measurement: Each spring is measured many times prior to cut off. These measurements are sorted from longest to shortest. The length is calculated from the average of the center of these measurements. This patented measuring method increases the accuracy of spring length measurements and reduces the effects of electrical noise and mechanical vibration.

1.3 Pitch Correction: The operator selects from two pitch control methods: "OPT", or "BA+".

1.3.1 OPT: In this mode the gage makes a proportional adjustment based upon the variation from the target mean free length. The adjust knob is set for an initial setting by the operator. A good place to start is with the dot on the knob set at the 12:00 position or midway of its travel. All the way counterclockwise provides minimum adjustment. All the way clockwise provides maximum adjustment.

Each pitch adjustment is checked to determine if the correct adjustment was made. If the correction was too great, the amount of pitch adjustment decreases a little. If the correction was too small, the amount of pitch adjustment increases a little. The gage also monitors the three sigma of the last 30 springs coiled. Each pitch adjustment is limited to a fraction of this 3 sigma value. This is called flyer rejection and improves centering.

The adjust knob setting is only a target setting. The best internal pitch adjustment calculation is automatically maintained to reduce free length variation to obtain the best yield. The Mean Machine stabilizes in 50 to 100 coiled springs to provide the best good spring yield. The gage continually optimizes the pitch correction calculation to compensate for changes in the wire or the coiling process.

1.3.2 BA+ (Barrier Avoidance): In this mode, the amount of adjustment and frequency of adjustment is based upon the position of the adjust knob and the adjust % value configured in Configure 2 mode. A fixed adjustment to center the process is triggered whenever the spring length exceeds the % of sort tolerance set in Configure 2. The amount of adjustment is determined by the setting of the adjust knob. With the adjust knob turned all the way counterclockwise the gage makes very small adjustments. With the knob turned all the way clockwise, the gage makes very large adjustments. The smallest amount of adjustment is usually the best to center the process.

"BA+" is selected over "OPT" only when running low performance material or on coilers with mechanical problems. Use "OPT" first, as this automatic 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 becoming 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) with respect to the overall tolerance.

Example: The gage is set for five way sorting at 33%. If the total "good" spring tolerance is +/- 0.012", then the 0.024" overall total tolerance is divided into three good spring groups of 0.008" each. Shorts are anything shorter than -0.012", longs and anything longer than 0.012" and the remaining groups are -0.012" to -0.004", -0.004" to 0.004" and 0.004" to 0.012". As in the case of 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 can be easily ground.

2.0 DESCRIPTION OF ACCESSORIES

2.1 Mean Machine Gage: This is the main control unit that all accessory equipment such as sorting chutes, pitch controllers, etc. connects to. It contains all operational controls such as on/off, configure, and set up. Portions of the Mean Machine gage are protected under U.S. patent #4,719,586 and copyrights.

2.2 Temperature Stabilized Probe: The Mean Machine Gage uses a noncontact capacitive measuring probe. The internal temperature of the probe is kept at a constant, 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 extends from the probe for connecting to the Mean Machine Gage's "PROBE" output socket.

2.3 Rotary Probe Assembly: An optional rotary probe holder with a heavy duty rotary noncontact capacitive measuring probe can plug into the Mean Machine Gage with the use of an optional control. The probe rotates out of the way before cutoff, which eliminates the spring hitting the tip end. A brush wipe can be added for cleaning 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 14 of the manual for recommended tip sizes and standoff distances from tip to spring.

2.5 Probe Holder: The probe holder holds the temperature-stabilized probe. 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.

2.6 Pitch Controller Assembly: The complete assembly includes a pitch drive motor and necessary hardware to make automatic adjustments to the pitch control mechanism on coilers. There are several sizes and types of pitch controllers available. Standard systems are available for most coilers. Special controller systems are designed as needed. A cable connects the pitch drive motor to the Mean Machine Gage's "ADJUST" output socket.

2.7 Read Switch Assembly: The assembly includes a steel pickup, proximity switch with cable having a three pin plug for connecting to the Mean Machine Gage's "READ" socket, and hardware for mounting the switch inside the coiler. The pickup mounts on any shaft that makes one revolution per spring. The read switch is positioned to detect the pickup. A read signal is sent to the Mean Machine Gage after the spring is coiled, but prior to cut off.

New read switches are using an offset plug to avoid damaging the read switch due to plugging it into one of the other (117V HOT) outputs. Adapters are available from Moyer if needed.

2.8 Stainless Steel Three Way Sorting Chute: The chute sorts springs into three groups, short, long, and good. It comes complete with all the necessary cabling and plugs for connecting to the Mean Machine Gage's "SORT" output socket. Three way chutes are available in three sizes, 4"x4", 4"x8" and 7"x10".

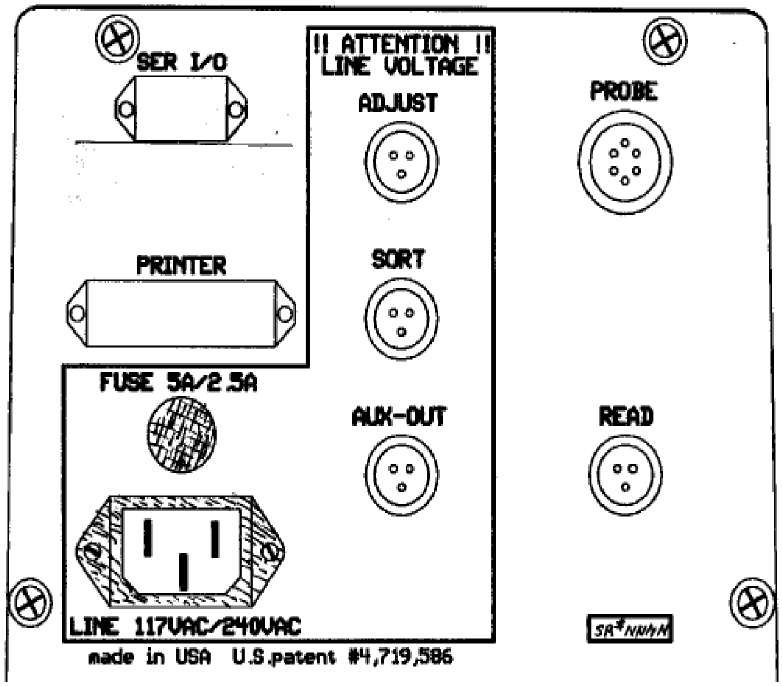
2.9 Stainless Steel Five Way Sorting Chute This chute sorts springs into five groups. The total good spring length tolerance is divided into three good groups. This chute is available in three different sizes, 4"x4", 4"x8", and7"x10". The chute connects to the gage via two cables. A three pin cable connects to the Mean Machine Gage "SORT" output socket and a two pin cable connects to the "AUX OUT" output socket.

2.10 Coiler Kill Kit (safety): The coiler kill kit includes two three pin sockets and relay mounted on a pc board and a three pin cable. It is designed to turn off the coiler if one of the following occurs: (1) a number of consecutive bad springs are coiled, (2) broken tooling or wire has been detected, or (3) a quota of good springs is coiled.

The three pin cable connects to the Mean Machine gage's "AUX OUT" output socket.

When using a five-way chute with a coiler kill, the two pin plug from the chute is connected to one of the sockets on the coiler kill board. The three pin plug from the coiler kill cable is plugged into the "AUX OUT" socket.

3.0 NAMES AND FUNCTIONS OF CONNECTORS AND SWITCHES



__3.1 PRINTER__ The 25 pin connector on the Moyer printer cable plugs into this receptacle. (Moyer printer cable and Mean Machine Gage can be used with most Epson and C.Itoh compatible printers)

__3.2 SER I/O__ Used to connect a data collection device directly into the Mean Machine Gage. A nine pin connector plugs into this socket.

__3.3 FUSE 5A/2.5A__ Uses either a 5-amp 250 volt fast blow or 3amp 250v slow blow fuse.

__3.4 117 VAC LINE__ The main power connector that requires using the supplied grounded plug. In plants with extreme electrical noise, extra grounding may be required. (117VAC 60hz model)

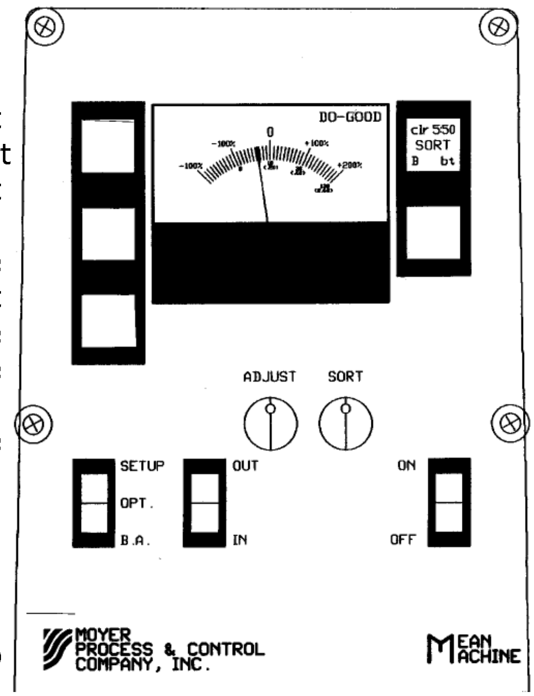
__3.5 ADJUST (117/240 VAC)__ The three pin plug from the pitch drive motor plugs into this socket.

__3.6 SORT (117/240 VAC)__ 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 OUT (117/240 VAC)__ 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 PROBE__ The six pin plug from probe cable plugs into this socket.

__3.9 READ__ The three pin plug from the read switch cable plugs into this socket.



3.10 Adjust Knob In "OPT", it is used to control the amount of pitch adjustment. In "TEST", it is used to test the gage and probe for proper functional operation.

3.11 Sort Knob In "OPT", it is used to set sort time. All the way counter clockwise provides zero sort time and all the way clockwise provides maximum sort time. It is used to enter numeric information.

3.12 Meter In "SET-UP", it zeros the gage on the mean free length and sets the sort points. In "OPT",it displays the length from the mean of each spring. The meter is divided into percentages and the sort limits are always referenced to 100%. The operator can catch a spring, look at the meter, and correlate the gage readings to the manual reading. The lower numbers on the meter set the time between samples for SPC data and for numerical value for SPC printout.

3.13.1 "A" Push Button The lefthand red button is used in "OPT" to set the sort short limit and change the sort mode. In configure, it changes from metric to English, sets language, and is used to set printer type and control limit type. In "TEST" it is used to check the serial port.

3.13.2 "B" Push Button The right-hand red button is used in "OPT" to set the long sort limit and abort statistical studies. In configure, it changes sort mode, turn broken tool detection on and off, and used to change the baud rate and coiler dwell. In "TEST" it is used to test the printer port.

3.13.3 "C" Push Button The lefthand green button is used in "OPT" to indicate that an adjustment is being made to make the spring longer. In configure, it indicates printer type, control limit type or line frequency.

3.13.4 "D" Push Button The right hand green button is used in "OPT" to indicate that an adjustment is being made to make the spring shorter, start both MSC and SPC studies, used with the sort knob to set dimensional units for the print out and used to clear good spring counts and time on the print out. In configure, it is used to indicate baud rate, and coiler dwell type.

3.13.5 "E" Push Button The yellow button is used in set-up to zero the gage, with the "D" button to clear good spring counts and time on the print out. In "OPT", it indicates a read and is used to simulate a read switch trigger. In configure it is used with the "A" button to change printer type & control limit type, and is used with "B" button to change baud rate & coiler dwell type. In "TEST" it is used to test the meter and auto zero for functional operation

3.14 In/Out Switch In set-up mode, this switch will run the pitch tool in and out manually. When used in OPT or BA+, it enables or disables the flow of data sent to the serial output. Used with the sort time knob in configure to set time delay for MCS and SPC.

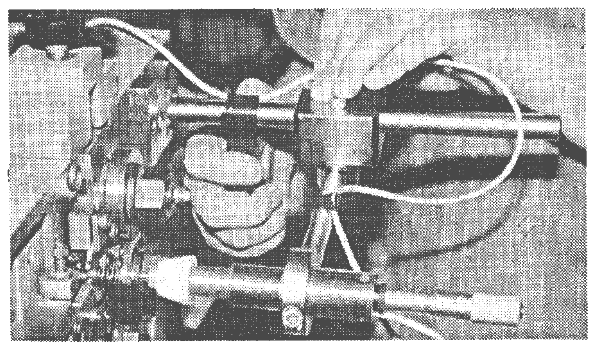
3.15 Setup Switch In normal operation the Setup switch selects the "Setup" mode, in "OPT", selects the optimize run mode (an automatic center seeking control), and in "B.A.", selects the barrier avoidance run mode (the old type of control sometimes call "bang bang" control). In configure, the selects configure 1, 2, &3, from top to bottom.

4.0 RECEIVING and INSTALLING THE Mean Machine Gage

<u>4.1 Unpacking</u> Before accepting the shipment from the carrier, inspect all cartons for signs of damage. If you suspect that a carton is damaged, open the carton in front of the carriers representative and check the contents. Each component will be shipped with approved packing. Go thru each carton carefully and check against the packing list to be sure no parts are lost in the packaging materials. In all cases, report any missing parts or damage to the carrier and Moyer Process and Control Co.,Inc. immediately.

<u>4.2 Installation</u> WARNING: Do not connect power cord until instructed.

<u>4.2.1 Gage Placement</u> Place the Mean Machine Gage in a location so the operator has good access and visibility to the front of the gage. Avoid putting the gage where it will be subjected to excessive shock, falling, oven heat and the like. Place the gage where its use will not subject the operator to danger from moving machine parts. Normal coiler vibration should not be considered excessive.

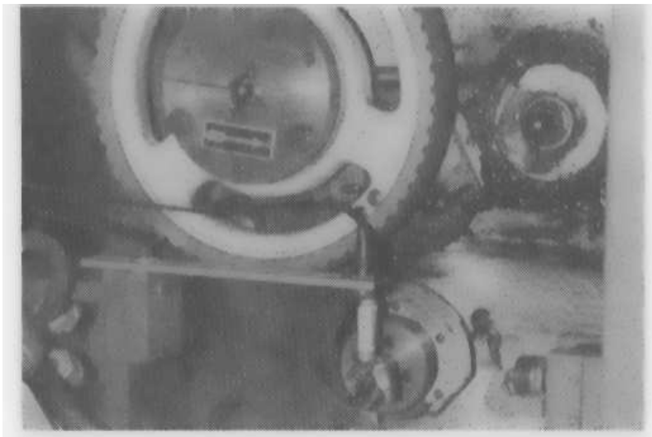


<u>4.2.2 Installing the Probe & Holder</u> Coil a spring by hand until wire feed quits. Put the probe thru the 1" hole on the probe holder. Slide the probe forward so the collar is gripping the probe at the back, close to flange of the outer cylinder toward the micrometer. The micrometer should be readable. Tighten the collar around the probe using the 1/4-20 screw.

Locate the base of the probe holder on the coiler in an area that won't interfere with the fall of the springs after cut off, or with the operator during tooling changes, and so 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 all burrs, then mount the probe holder base to the coiler.

Select a probe tip that is slightly larger than the O.D. of the spring. Make sure that the brass spring is in the probe tip before screwing it onto the probe. Screw the probe tip tightly onto the probe (finger tight sufficient.) Refer to section 5.2.2 of the manual 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 tape the probe cable to the probe holder. Connect the six pin plug to back of the gage in the socket marked "PROBE". Route the probe cable so that it is out of harms way. Note: The probe must be held rigid. Any movement of the probe will affect the free length measurement.

The Moyer temperature stabilized probes are interchangeable between any Graphic Gage, Mean Machine or PJM 1000 gaging system. They require no calibration, matching, or tuning for a particular gage.



4.2.3 Installing the Read Switch The read switch assembly consists of a steel pickup and a proximity switch in a mounting bracket. Mount the pickup to any shaft that makes one complete revolution per spring. Mount the prox switch and bracket so that nothing will hit it and the pickup will pass 0.030" to 0.080" from the flat on the switch once each spring. Position the prox switch and pickup so that the read signal will be made 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 cut off. On escapement coilers and high speed coilers, the read must take place as soon as the wire quits feeding.

Coil a spring by hand slowly to insure that the pickup does not hit anything. Cut off the spring. Connect the read switch three pin plug to the "READ" socket on the back of the gage. With no other accessories plugged into the gage, plug in the power cable and turn the gage on in "OPT" mode. Coil a spring by hand and check the read signal. Some of the lights should blink when a read signal is received by the gage. Verify that the blink is at the correct point in the coiling cycle. Turn the gage off.

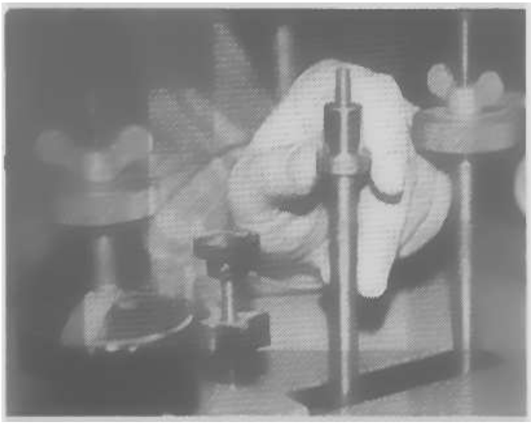
4.2.4 Installing the Pitch Control Motor Due to the variety of coilers, the following procedure may vary and the type of mounting hardware may be different. However, the basic principals still apply. If you have any question regarding this, contact customer service for assistance. Telephone: (219) 495-2405 Fax: (219) 495-1290.

4.2.4.1b Dual Coiling Point Systems The pitch controller assembly consists of pitch motor, mounting bracket, universal, and threaded rod (often supplied with the coiler). Usually the pitch motor replaces the fine pitch adjustment knob. Remove the existing knob, detent, and universal. Check the pitch rod threads for cleanliness and rough spots. If necessary clean threads by using a die to ensure smooth movement.

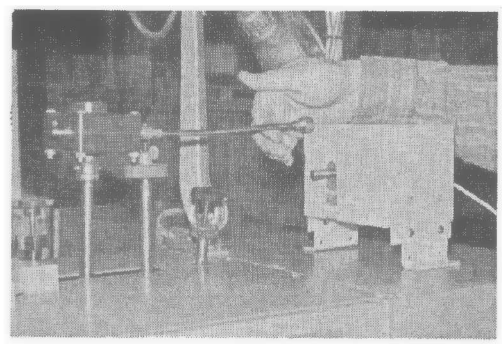
Install the universal on the end of the threaded rod. Reinstall the threaded rod back on the elliptical pitch adjustment bushing. Position the pitch control motor so its output shaft aligns with the end of the threaded rod. Be sure that there is room for the system to adjust through its entire range.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

4.2.4.1a Single Coiling Point Systems The pitch controller assembly consists of pitch motor, flex shaft, adaptor nut and gear box. On some coilers the pitch motor is directly connected to the pitch pull rod. Remove the locking nut from the pitch rod on the coiler. Check the pitch rod threads for cleanliness and rough spots. If necessary, clean threads by using a die to ensure smooth movement of the adaptor nut on the pitch rod.

Screw the adaptor nut onto pitch rod. Connect the flex shaft to the gear boxes input shaft. Set the gear boxes hollow shaft over the nut on the pitch rod. Place the flex shaft so that the end that attaches to the motor will be in the proper position to mount it to the pitch drive motor. Tighten the two set screws in the gear box hollow shaft to the nut. Adjust the height of the pitch drive motor using the two legs on the base of the pitch drive motor housing so the flex shaft is parallel to the coiler. Fasten the flex shaft to the pitch drive motor.

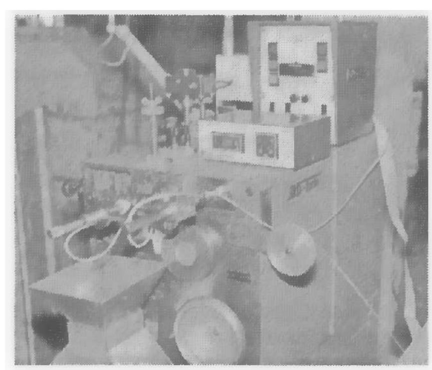


Position the motor so the flex shaft does not hit anything and has a very slight curve. This curve helps the flex shaft act as a torque arm. Using the mounting holes in the two pitch drive motor legs, mark the coiler. Slide the pitch drive motor housing out of location and drill clearance mounting holes for 10/32 screws. Be sure to use lock washers or locking nuts to prevent hardware from coming loose and falling into the coiler mechanism.



4.2.4.2 Check Out Connect the three pin plug from motor to the "ADJUST" socket on the back of the gage. Turn the gage on. Put the gage in "SET UP". Check for correct motor direction by pressing the "IN" and "OUT" rocker switch. If the motor turns the wrong direction, reverse the switch on the bottom of the motor. When a gear box is used, motor direction can also be reversed by mounting the flex shaft to the other input shaft on the gear box. Turn off the gage.

4.2.5 Installing the 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 the springs, after cut off, fall into the throat portion of the chute without bouncing out.



Fabricate a mounting bracket that connects the chute to the coiler in the correct position.

Connect the three pin plug on the three way chute to the socket on the back of the gage marked "SORT".

The five way chute has two cables to connect to the gage. Connect the three pin plug into the socket on the back of the gage marked "SORT". Connect the two pin plug into the socket on the back of the gage marked "AUX OUT".

When using a five way chute with coiler kill, the two pin plug connects to one of the sockets on the coiler kill pc board. The three pin socket on the coiler kill board is attached to the "AUX OUT" socket using the supplied cable.

5.0 USING THE MEAN MACHINE GAGE

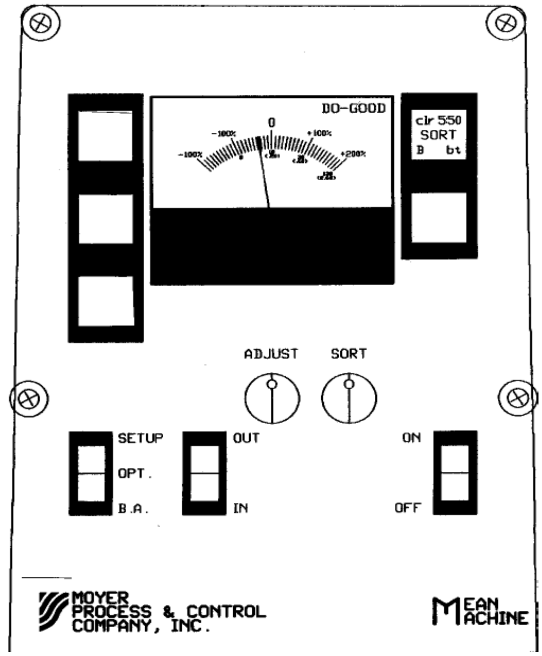
The gage must be taken through a series of steps before first use. Step #1 is to configure the gage. In configure, the least often changed gage options are set. Step #2 is to set up the gage. This step is used to set the sort limits and enter parameters on the spring you are coiling. Step #3 is running the gage during production. The last step is to analyze the results and improve the process.

5.0.1 GENERAL INSTRUCTION

MODES & SELECTING OPTIONS The mode of operation of the Mean Machine gage depends on both the position of the Setup Switch and the manor in which the gage was turned on. If the gage is not reacting as you expect, you may be in a different mode than you think. In most cases the common options are indicated by text or symbol on the switches themselves. Different modes are common to different corners of the switch cap text.

ENTERING NUMBERS There are 3 scales on the meter for numbers. -200% to +200%, 0 to 2.60, and 0 to 130. They are used at different times for different reasons. By way of example, if you are entering a tolerance of .2mm, you would use the 0 to 2.60 scale on the bottom of the meter, where as if you are entering 20 seconds for you MCS time, you would use the 0 to 130 scale on the bottom of the meter. When entering a number, it will be necessary to press a particular push button or rocker switch while moving the needle of the gage to your desired value using the "SORT" pot.

5.1 Configuring the Mean Machine Gage



5.1.1 ENTERING CONFIGURE Place the setup switch in setup position. Hold the "E" (yellow) button and turn on the gage, then release the button. The gage is now in "configure #1". This allows for configuring the gage for the following options:

- -3 or 5 way sorting operation
- -RS232 baud rate. (1200/9600 bps)
- -Printer type. (Epson/C-ITOH)
- -MCS time & SPC time (for stats)

5.1.2 SORTING The "A" (left red) and "B" (right red) buttons are used to select the 3 way, 5 way 33%, and 5 way 50% sorting options. By pressing the "A" or "B" buttons, the 3 or 5 way options are toggled. If "A" is lit, the gage is set for 5 way 33%. If "B" is lit, the gage is set for 5 way 50%. If "A" and "B" are not lit, the gage is set up for 3 way sorting.

5.1.3 PRINTER(package #4 only) The gage is capable of sending Epson or C.ITOH printer codes to the parallel port. The printer type is toggled by holding the "E" (yellow) button and pressing the "A" (left red) button. The "C" (left green) light indicates the gages printer type. When the "C" button is lit, the printer type is Epson. If the "C" button is not lit, the printer type is C.ITOH.

5.1.4 BAUD RATE(package #4 only) The baud rate is changed between 9600 and 1200 by holding in the "E" (yellow) button and pressing the "B" (right red) button. The "D" (right green) light indicates the gages RS232 baud rate. When the "D" button is lit, the RS232 baud rate is 9600. If the "D" button is not lit, RS232 baud rate 1200.

5.1.5a MCS DELAY(package #4 only) Change the time interval between samples while taking a (MCS), hold in the "IN" button, turn the sort knob until the desired time is indicated on the lower scale of the meter. EX: If it is desired that the coiler take MCS samples every 16 seconds, set the needle of the meter on "16" on the lower scale of the meter.

5.1.5b SPC DELAY(package #4 only) Change the time interval between samples while taking (SPC) study, hold in the "OUT" button, turn the sort knob until the disired time is indicated on the lower scale of the meter. EX: If it is desired that the coiler take SPC samples every 3 min., set the needle of the meter on "3" on the lower scale of the meter.

5.1.6 CONFIG #2 Place the setup switch in "OPT" mode. The gage is in "Configure #2" mode. This allows for configuring the gage for the following options:

- -Units of measurement. (Metric/Imperial)
- -Broken tool detection option. (toggle on/off)
- -Control limit choice. (natural / modified natural)
- -Coiler dwell type. (segment / short)
- -Coiler kill number option.

5.1.7 UNIT:(package #4 only) In order to change the unit of measurement for the data that is sent to the RS232 and parallel ports, the "A" (left red) button is used to toggle the units between metric and imperial (inches). By pressing the "A" button, the metric/imperial option is toggled. If "A" is lit, the measurements are metric. If "A" is off, the measurements are imperial (inches).

5.1.8 TOOL SAFE: The "B" (right red) button is used to select the broken tool and probe touch detection option. By pressing the "B" button, broken tool detection is toggled on and off. If "B" is lit, this option is turned on. If "B" is not lit, the option is off. (optional CK Kit required)

5.1.9 LIMIT:(package #4 only) Control limit type is toggled between "Natural" and "Modified Natural" by holding in the "E" (yellow) button and pressing the "A" (left red) button. The "C" (left green) light indicates the gages Control Limit type. When the "C" button is lit, the control limit type is "Modified Natural". If the "C" button is not lit, the control limit type is "Natural".

5.1.10 DWELL: The Coiler dwell type is changed between short (non-segment) and normal (segment) by holding in the "E" (yellow) button and pressing the "B" (right red) button. The "D" (right green) light indicates the gages Coiler Dwell type. When the "D" button is lit, the Coiler Dwell type is "Short". If the "D" button is not lit, Coiler Dwell type is "Normal".

5.1.11 REJECT SAFE Use the "IN" button and sort knob to set the number of bad springs in a row to shut off the coiler. Hold in the "IN" button, turn the sort knob until the desired number is indicated on the 0 to 130 scale of the meter. A coiler kill number of "0" disables the option.
EX: If it is desired that the coiler be shut down after coiling 10 springs in a row which fall outside the set sort limits, set the needle of the meter on "10".

5.1.12 BA ADJUST POINT: The combination of the "OUT" button and sort knob allows the BA adjust point to be changed. While holding in the "OUT" button, turn the sort knob until the desired percent of sort is indicated on the 0 to 130 scale of the meter. A typical value is 50%.

5.1.13 CONFIGURE #3: Place the mode switch in "BA+" position. The gage is in "Configure #3" mode. This mode will allow for configuring the gage for the following options:
-Language
-Power Line Frequency (60hz/50hz)

5.1.14 LANGUAGE:(package #4 only) The "A" (left red) and "B" (right red) buttons are used to select the language. By pressing the "A" or "B" buttons, the Languages are toggled. If "A" is lit, the gage is set for French. If "B" is lit, the gage is set for German. If "A" and "B" are not lit, the gage is set up for English.

5.1.15 POWER FREQUENCY: Toggle the power frequency between 60hz and 50hz by holding in the "E" (yellow) button and pressing the "A" (left red) button. The "C" (left green) light indicates the gages power frequency. When the "C" button is lit, the frequency is 50hz. If the "C" button is not lit, the frequency is 60hz.

5.1.16 EXIT CONFIGURE: Turn the gage off to exit configure. All the parameters are stored, and are not cleared until the gage is turned on while in the setup mode and specifically changed.

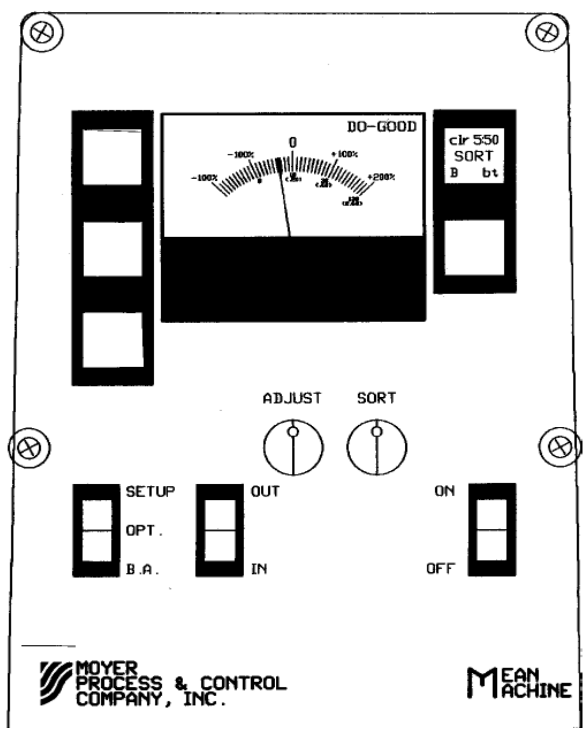
5.2 Setting Up the Mean Machine Gage

5.2.1 ENTERING SETUP: For the first set up, or for setting up a new job, turn on the power while the setup switch is in the "SETUP" position. This is the only way that the gage can "forget" an old setup, and is needed for step 5.2.4 to work properly. Let the gage warm up for approximately three minutes.

5.2.2 GAP: Place probe the recommended standoff distance from spring using the chart below as a starting point. NOTE!! These standoff distances are to be used only as a referance, as they assume industry standard tolerances. Your standoff distances may (and often will) differ greatly.

Spring O.D.	Recommended Tip size	Initial Standoff
0.062" to .125" [1.6mm to 3.2mm]	1/8" [3.17mm]	.065" [1.65mm]
0.125" to .250" [3.2mm to 6.4mm]	1/4" [6.35mm]	.125" [3.17mm]
0.250" to .375" [6.4mm to 9.5mm]	3/8" [9.52mm]	.200" [5.08mm]
0.375" to .500" [9.5mm to 12.7mm]	1/2" [12.7mm]	.275" [6.98mm]
0.500" to .625" [12.7mm to 15.9mm]	5/8" [15.9mm]	.350" [8.89mm]
0.625" to .750" [15.9mm to 19.1mm]	3/4" [19.1mm]	.450" [11.4mm]
0.625" to 1.00" [15.9mm to 24.4mm]	1" [25.4mm]	.650" [16.5mm]

5.2.3 ZERO: Press the "E" or "ZERO" button. The gage will automatically zero the electronics and the meter should center.



5.2.4 GAP CHECK: Turn the probe micrometer clockwise the desired sort distance. (If you are 5 way sorting, use the outer long sort distance, the gage will automatically produce inner sort distances.) The meter should read between 80% and 110%. If the meter reads below 80%, the probe is too far away. If the meter reads more than 110%, the probe is too close to the spring. If either case is true, move the micrometer zero point in if under 80%, out if over 110%, and start over at step 5.2.3. In cases where the spring can not clear the probe tip when cut off, it may be necessary to increase the gap, disregarding the 80% minimum meter value, otherwise proceed.

5.2.5 SORT LONG: Press the "B" (right red) button. The meter will move on or very close to 100%. Your sort long distance is now set.

5.2.6 SORT SHORT: Return the micrometer to the zero position and continue turning to the short sort distance. Push the "A" (left red) button and wait until the meter stops moving. The meter should read very close to -100%. Your sort short distance is now set.

5.2.7 TOLERANCE/COUNTERS:(package #4 only) Hold in the "D" (right green) button and turn the sort knob until the needle of the meter indicates the sort limits using the 0 to 130 (.000"-.130") scale (or 0.00 to 2.60 (0.00mm-2.60mm) if metric). Pressing on the "E" or "ZERO" button while holding in the "D" button, will zero the counters. This will provide proper scaling for the data output on the serial port & printer. NOTE: If you are only resetting the counters at shift change, be sure to reset the TOLERANCE too.

EX: If you have set your sort limits at +\- .010 inch, set the meter needle on "10", then release the "D" button.

5.2.8 SORT TIME: Set the "SORT" knob for the amount of time the air or flappers on a chute are to be activated. For example, if you are running at 80 parts per minute, a correct setting would be at mid scale.

5.2.9 PITCH ADJUST: Set the "ADJUST" knob to control the pitch adjustment time. Start with the dot on the knob at mid scale if using "OPT" (automatic feed back). Otherwise start it at a low value.

5.2.10 RUN: Cut off the spring used to set up. Measure this spring and correct the probe for its actual length. Place the mode switch in the "OPT" position and begin coiling springs. Watch the pitch controller to make sure it is correcting in the right direction by watching the length of the springs. Catch a spring close to the length you want as indicated on the meter. Compare its actual measured length to your target length. Correct the probe if necessary by moving the micrometer the amount that the spring differs. Repeat if necessary.

5.2.11 PITCH CORRECTION: Occasionally you may want to increase or decrease the amount of correction for further scrap reduction. The 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 changed. Please be sure to read that section.

5.2.12 STATS:(package #4 only) To do a Machine Capability Study (MCS), press and hold the "D" button for just over one second (printer required). When the MCS is done the gage will automatically continue taking Statistical Process Control Study (SPC) samples. To pause the SPC press and release the "B" button. The printer feeds one line to indicate a pause. To continue a paused study press and release the "D" button. To abort the studies before done, press and hold the "B" or "CLR" button until the printer ejects the page.

5.2.13 SERIAL DATA:(package #4 only) To turn the serial port on and off when using a data collector system the "IN/OUT" rocker switch is used. Start sending data thru the serial port by pressing the "IN" switch, stop the flow of data by pressing the "OUT" switch.

6.0 Statistical Terms

6.1 Normal Distribution: A normal distribution is represented by a bell shaped curve which has few points (or measured spring lengths) at either end and the majority of the points (spring lengths) in the middle. 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 in order to be called a normal distribution. The Mean Machine Gage measures the "Normality" of the production using the Geary's test for normality, or "Z". This can be important as calculated process limits at mean + 3 sigma and mean - 3 sigma are only valid if the process forms a normal distribution. In most all cases a properly running coiler and gage will coil parts 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. It is also called Sigma. The Mean Machine gage calculates this spread several different ways. It calculates and displays the spread of the last 30 springs each time a spring is measured in order to make a smarter adjustment. It also calculates the process spread in the Machine Capability Study using both the classic sum of the squares method (3sigma(v) on the printout) and the simpler approximation using Ranges (3sigma(r) on the printout). One is effected more by trend than the other, so together they are helpful in determining adjustment effectiveness.

6.3 Mean or Average: The Mean or Average of a process is the value calculated by adding up all the lengths and dividing by the number of lengths added together. The Mean Machine gage calculates the Mean of the last 30 springs each time a spring is measured in order to make a smarter adjustment. It calculates and displays the mean of the last five springs (Xbar) for the operator, and it calculates the Mean of each five spring sample for the Xbar and R Chart print outs. This is called Xbar which means average of X values. The X represents an individual measurement in statistics. The Mean of the parts are 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 Mean Machine Gage calculates and displays the range of the last 5 springs (R), and prints the Range, or R, of each five part sample in its studies.

6.5 Control: A process being in or out of statistical control generally refers to its predictability, not the amount of adjustment made to the process. 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. In control means predictable.

One of the most important aspects of Statistical techniques is that they offer a way to determine if a process is of predictable quality and is consistent. By analyzing samples taken at various times from a production of springs, a determination can be made if something has changed and/or if the parts are still the same. As some statistical terms are related, more information about control is given in "6.6 Charting".

6.6 Charting: The gage is capable of using natural, modified natural, and modified control limits. For purpose of explanation, we will assume natural 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. The concepts of Xbar & R charting are as follows :

6.6.1: Sample statistics (Xbar and R) taken from a random distribution of parts have a relationship to the statistics of the distribution from which they were taken. Or another way of saying this is that the overall quality of a distribution of parts from which samples are taken can be determined by sample statistics.

6.6.2: After enough samples have been taken from a distribution of parts, limits (UCLx, LCLx, & UCLr) can be calculated. 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 Mean Machine Gage will seldom, if ever, allow a noticeable trend or shift to occur so it will only be mentioned here. If further study is desired a good book on industrial quality control is best used here.

If all the Xbar and R values calculated from samples taken from the production distribution fall within the calculated control limits (UCLx, LCLx, & UCLr) then the process is "IN CONTROL". It is in fact predictable and 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 Studys (package #4 only)

7.1 MCS Overview: The machine capability study is a short term study using statistics to determine if a machine is running parts which 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 Mean Machine gage produces a print out titled "Machine Capability Study". It has the following features:

(1) A place at the top to record information about the job.

(2) Place to write the date.

(3) Elapse time of the gage since setup.

(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 ("OPT" mode) and "B" means manual feedback ("BA+" mode). 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 relative lengths of the sample, sorted from longest to shortest, with respect to the target length. The sample is the last five unsampled springs coiled, at the instant the sample is taken. The Mean Machine gage will not allow individual spring lengths to be sampled 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 to be considered 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" ("UMLx" or "UMNLx") is the upper control limit for Xbars.

(20) "LCLx" ("LMLx" or "LMNLx") 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 fine spacing of Xbar values and the added 50% interval with count used to monitor adjustment effectiveness.

(26) "Range chart" is a standard Range chart with fine spacing.

(27) "Histogram" is a true histogram as opposed to a fre-quency distribution. It has ideal interval spacing and the median two datum are indicated by "MM" for easy interpretation. The numbers represent what sorted category the spring belonged to.

(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" (they mean the same thing)

7.3 SPC Overview: A process capability study is the long term study of the sample data taken by the Mean Machine gage and plotted against the machine capability studies control limits to see if the process is remaining in control and is predictable. The Mean Machine gage titles its 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 Mean Machine gage is designed to provide some very useful information 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 then the gage is probably over controlling. If this ratio is less than 0.80 then the gage is probably under controlling.

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 then the gage is probably over controlling. If the count is 8 or less then the gage is probably under controlling. The broken lines are titled "50%" because half of the 20 Xbar values should fall between them.

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 gages internal correction value. If the gage thinks it is over controlling this value will be getting smaller. If the gage thinks 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 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 gage clockwise to increase the control level. Wait fifty or more springs and run another Machine Capability Study to see the results.

The exact amount to increase or decrease the "Pitch" knob setting is a combination of 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 indicated.

If the process is not centered then 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. Things to check would include, but not be limited to:

(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, it is safe to say 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 +/-0.002 inch, but if the print requires +/-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 Mean Machine 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 just sort or reject springs outside of these tolerances. Some rejected springs may be salvageable , but the limits ensure all nonsorted springs are good.

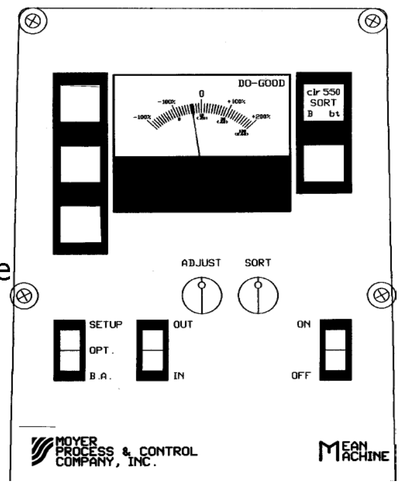
(2) EMPLOY SORTING TO SUBDIVIDE THE PROCESS. The Mean Machine Gage with the proper chute, may sort your springs into five groups. If the amount of grind is a very important print requirement, and if relatively wide length tolerances have been established to hold the loads, and if the amount of length variation is too much for a consistent grind, it may be adequate to sort the springs into five groups. Each group can be ground separately. In this case five way sorting has been used to reduce the variation in the free length of a sub process of unground springs for controlling the quality of grind. Consequently, one big hard to manage process has been split into several smaller easier to manage 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. Usually 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 stackup 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 no unacceptable parts.

9.0 Hardware Test / Troubleshooting

If trouble should ever arise with the Mean Machine gage, there are several methods to use to locate and correct problems. The Hardware Test mode is one method for troubleshooting the gage. This mode will allow an operator to test the lights, switches, meter, AC outputs, printer and serial port, and probe. To use the gages hardware Test mode, follow these steps:



9.1 Entering Test: Turn off the gage. Unplug chute and pitch controller. Put the gage in "Set-up". Press and hold "D" (right green) button and turn on gage. The meter should go to 50% on the meter and start up moving slowly. Please wait while the gage is doing this. The gage is determining the best way to take multiple measurements on your coiler. If you hold the "D" button, the meter will stop at the best GSDEL value (get size delay). If you let up on the "D" button, the meter will likely move suddenly if the gage is done calculating GSDEL. This will take about 60 seconds.

9.2 P-P Test: Again press the "D" button. The meter should dislay a P-P value on the meter of 95% to 105%. This P-P value represents the peak to peak drive on the mm3r1 board. It must function correctly for the probe touch detection to work properly. Touch the Probe guard (the outer brass ring of the probe tip). The meter should drop below 85%.

9.3 Output Check: Turn the sort knob to scale each light in order. The lights should scale with red button light first (right or left), then green, yellow, green, and last the red button on the opposite side. WARNING!! If you want to connect outputs or loads to the gage, do so with the "ZERO" light on. That will ensure the power is off at the "ADJ", "SORT", and "AUX" sockets. The red lights test sort (the left or the right side of the chute will activate), the green test adjust in and adjust out (controller motor will go forward and then backwards if hooked up), yellow tests the read switch output on this step you will just see the light activate. This lets you check all the AC outputs on the back and the lights on the front of the gage.

9.4 Meter Check: Turn the adjust knob from end to end while pressing the "E" (yellow) button and watching the meter. This checks the smoothness and end point accuracy of the meter movement.

9.5 Zero/Probe Check:(probe must be attached) While watching the meter, rotate the adjust knob from limit to limit. Be sure the meter is at opposite ends of the scale when the adjust knob is at opposite ends or rotation. This checks probe amps. As best you can, center the meter using the adjust knob, then wave your hand close the the probe tip. The meter should move to the right as your hand gets closer to the probe tip. This checks the probe.

9.6 Printer Check: Press and release the "B" (right red) button. This tests the printer output. (printer required)

9.7 RS232 Test: Press and release the "A" (left red) button. This tests the RS232 output. (computer, printer, or other RS232 device required)

If you get this far, it is probably NOT your gage, but it could be an incorrect Configure or Setup. Feel free to call with any questions.