EUROGAGE II

COMPUTERIZED FREELENGTH CONTROL SYSTEM

Built by:

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1.0 DESCRIPTION OF FEATURES

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

Some of the features of the new Eurogage include:
-bigger, brighter LCD(screen)
-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 new Moyer Eurogage.

1.2 **Length Measurement:** The new Moyer Eurogage 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 Eurogage 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 on the knob set at the 12:00 o'clock position, or midway of its travel. The Eurogage checks each adjustment to determine if the correct amount of adjustment was made. If adjusted 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 Eurogage 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. The new Eurogage internally calculates the best pitch adjustment, yielding minimal free length variation. The gage continually optimizes the calculation for pitch control to compensate for changes in the wire or the coiling process. Adjustable targeting reduces rate variation in various applications. Contact Moyer for additional information.

1.3.2 **%TOL (Barrier Avoidance):** In "%TOLERANCE" mode, the position of the

adjust knob and the "%TOL" value determine the amount and frequency of adjustment. A spring length that exceeds the pre-determined 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 3 groups, and sorting the bad springs into 2 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 -0.006", -0.005" to 0.005", and 0.006" to 0.015". 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 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 Eurogage:** This is the main control unit where all accessory equipment, such as sorting chutes, pitch controllers, etc. connect. It contains all operational controls such as on/off, configure, and set up. Portions of the Eurogage 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 Eurogage uses a noncontact 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 Eurogage's "PROBE" output socket.

2.3 **Moyer Rotary Probe Assembly:** An optional rotary probe can plug directly into the Eurogage. The probe rotates out of the way before 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 of the manual 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. There are 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 Eurogage "ADJUST" output socket.

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

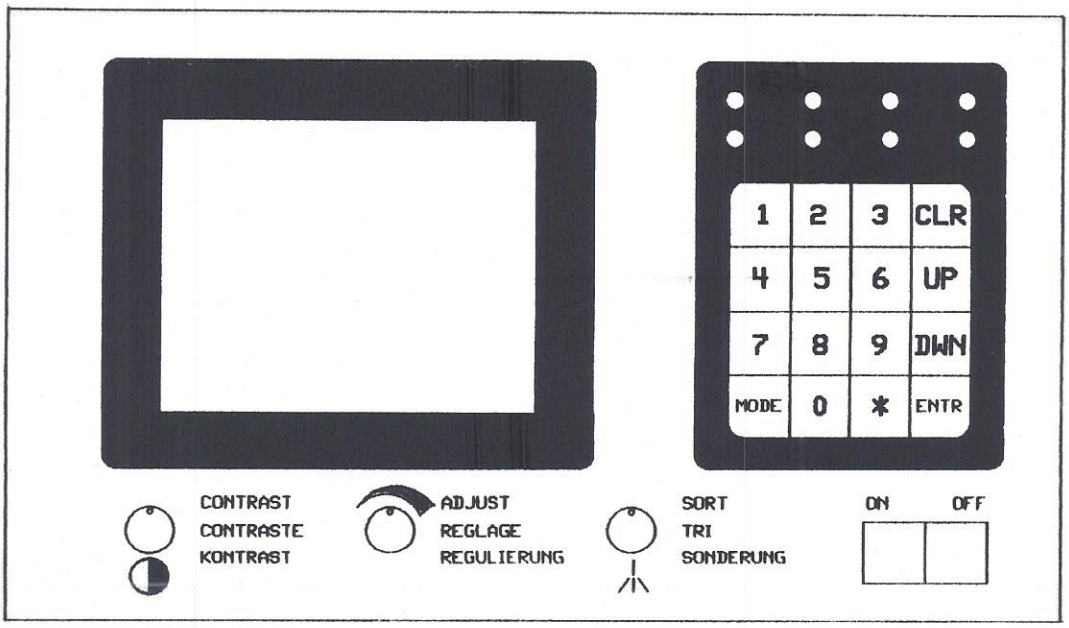
2.9 **Moyer Three Way Sorting Chute:** This chute sorts springs into three groups: short, long, and good. The chute comes complete with all the necessary cabling and plugs for connecting to the Eurogage's "SORT" output socket. This chute is available in these throat sizes: 3.375" x 4.000", 3.375" x 8.000", 7.450" x 8.000", 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. This chute is available in the following throat sizes, 3.375" x 4.000", 3.375" x 8.000", 7.450"x 8.000", and 7.450" x 16.000". The chute connects to the gage via two cables. These cables connect to the Eurogage's "SORT" and "AUXOUT" sockets. You can even use your Moyer five-way sorting chute as a three-way chute on older gages that lack fiveway 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 **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 occurs: (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 Eurogage's "AUXOUT" 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 "AUXOUT" socket.

3.0 NAMES AND FUNCTIONS OF SWITCHES



3.11 **Contrast Knob:** This adjusts the contrast of the LCD display.

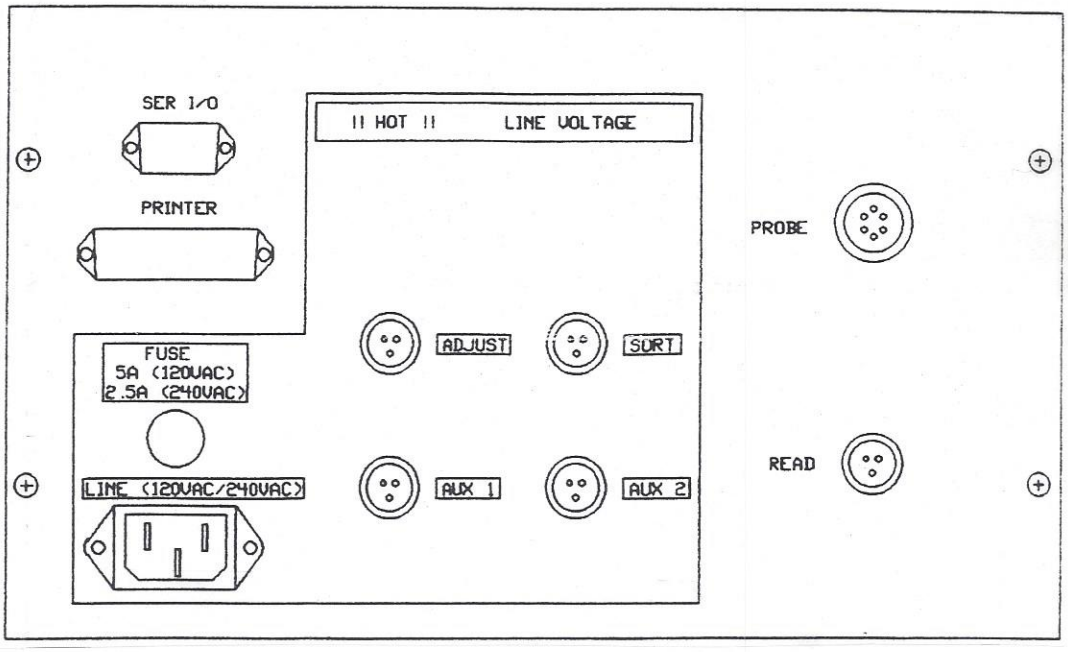
3.12 **Adjust Knob:** In run mode, it controls the amount of pitch adjustment. In test mode, it is used in testing the gage and probe for proper functional operation.

3.13 **Sort Knob:** In run mode, it sets the sort time. 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.

3.14 **LCD (Liquid Crystal Display):** The LCD displays data and menus for running productions, set-up, configure, and hardware tests. The new Eurogage boasts a big 3.5" x 6" screen to give you the information you need without the hang-up of continually switching screens. The new display also has brighter illumination and sharp contrast; making it easier than ever before to read.

3.15 **Key Pad:** The Key Pad is used to select options from menus, and to enter options and numbers. The MODE key changes displays and brings up menus. Moyer's 16-key control pad offers easy-to-use versatility not found on many competitors' gages.

3.0 NAMES AND FUNCTIONS OF SOCKETS



3.1 **PRINTER:** The 25 pin plug on the Moyer printer cable plugs into this socket. The printer cable and Eurogage can be used with most Epson or IBM compatible printers. For your convenience, we keep Seiko Instruments' Inc. DPU-411-21BU printers in stock.

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

3.3 **FUSE 5A:** 5 amp 250 volt fast blow.

3.4 **117 VAC LINE:** This is the 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 probe cable plugs into this socket.

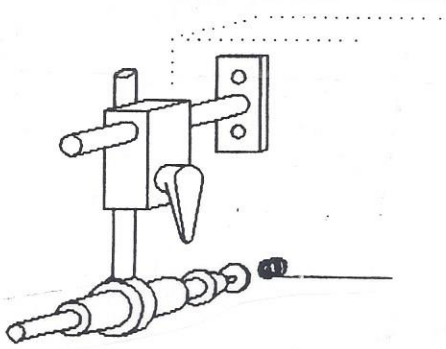
3.10 **READ:** The three pin plug from the read switch cable plugs into this socket.

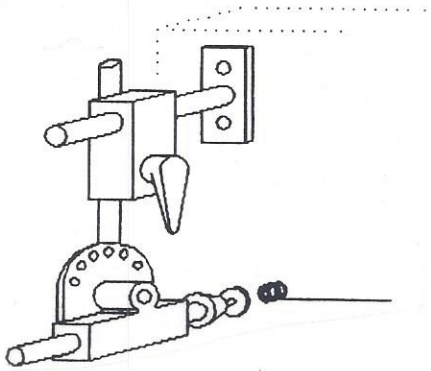
4.0 RECEIVING and INSTALLING the Eurogage

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 Eurogage 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.



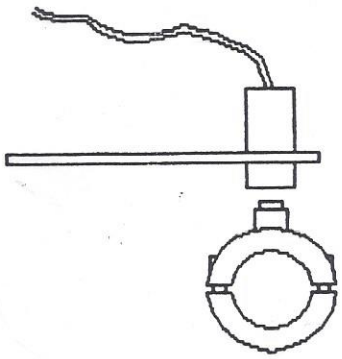


4.2.2 **Probe & Holder:** Coil a spring by hand until wire feed quits. Put the probe thru the 1" hole on the probe holder. Slide the probe forward so the collar is holding the probe at the back, close to the micrometer. Be sure you can read the micrometer. Tighten the collar around the probe using the 1/4-20 screw.

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 that is 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 probe 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 Eurogage'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.

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

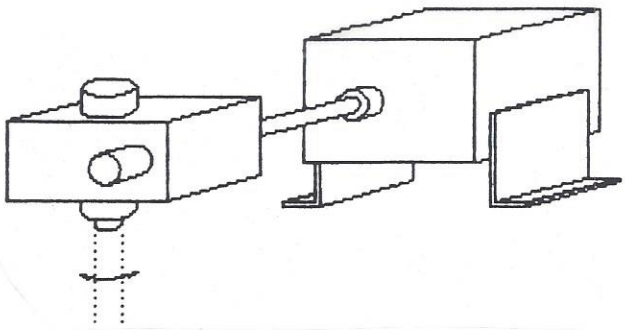


4.2.3 **Read Switch:** The read switch assembly consists of a magnet mounted on a lock collar or block and a read switch mounted on a bracket. Mount the magnet to any shaft that makes one complete revolution per spring. Mount the switch and bracket so nothing will hit it and the magnet will pass 0.030" (0.7mm) to 0.080" (2mm) from the flat on the switch. Position the read switch and magnet 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 escapement coilers, high speed 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 magnet does not hit anything. Cut off the spring. Connect the read switchs three pin plug to the Eurogage's "READ" output socket. With no other accessories plugged into the gage, plug in the power cord and turn the Eurogage on. Coil a spring by hand and check the read signal. Some of the LED's will blink when the Eurogage receives the signal. Verify that the blink is at the correct point in the coiling cycle. Turn the Eurogage off.

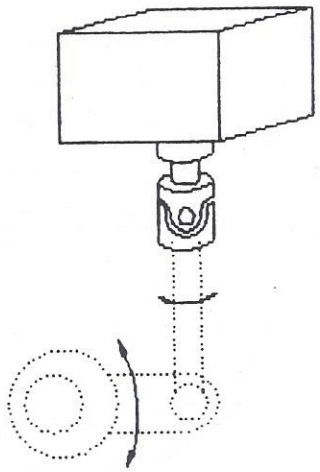
4.2.4 **Pitch Control Motor:** NOTE: Due to the variety of coilers the following procedure may vary; and the type of mounting hardware may be different from the hardware listed. However, the basic principals still apply. If you have any questions, contact customer service for assistance. Telephone: (219)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



4.2.4.1a **Single Coiling Point Systems:** The pitch control assembly consists of 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 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 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 nut. Adjust the height of the pitch motor using the two legs on the base of the pitch motor 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 very slight curve. This curve helps the flex shaft act as a torque arm. Using the mounting holes in the two pitch motor legs, mark the coiler. Drill and tap the 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. Proceed with 4.2.4.2.



4.2.4.1b **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, 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 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.

4.2.4.2 **Checkout:** Connect the three pin plug from pitch motor to the Eurogage's "ADJUST" output socket. Turn the gage on. Place the gage in "SET UP" by pressing the "MODE" 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.

4.2.5 **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 of the chute without bouncing out.

Make a mounting bracket that connects the chute to the coiler in the correct position. A mounting bracket is included with Moyer sorting chutes. Due to the variety of coilers in the industry, an adapting bracket may be required. Moyer Process & Control now offers a chute stand. This stand has adjustable height from 24" to 42" and can rotate horizontally as well as vertically.

Connect the three pin plug on the three way chute to the Eurogage's "SORT" output socket.

The five way chute has two cables to connect to the gage. Connect the three pin plug to the Eurogage's "SORT"output socket. Connect the two pin plug to the Eurogage's "AUX OUT" 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 Eurogage's "AUXOUT" output socket using the supplied cable.

5.0 USING THE EUROGAGE

The Eurogage must be taken through a series of steps before first use:
Step #1: Configure the Eurogage. In configure, the least often changed gage options are set.
Step #2: Setup the Eurogage. Set the sort limits and enter the parameters for the spring you are coiling.
Step #3: Run the Eurogage during production.
Step #4: The last step is to analyze the results and improve the process.

5.0.1 GENERAL INSTRUCTION

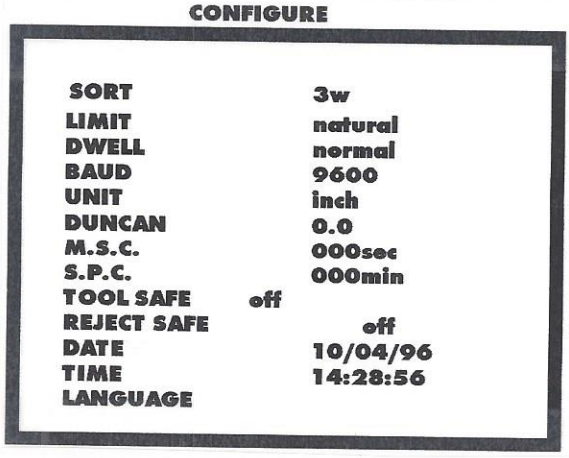
The "MODE" key allows you to change from screen to screen while running the gage.

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" or "DOWN" key. The "ENTR" key executes the selected option.

ENTERING NUMBERS: For entering or changing a number, an underline cursor will highlight the last digit of the number. The "CLR" or "ESC" 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" keys increase and decrease the number by one. You must press "ENTR" when you finish changing a numeric value. The Eurogage will hold its memory if turned off. The Eurogage will only erase a previous setup if you turn it on while pressing and holding the "MODE" key on the key pad.

5.1 CONFIGURING YOUR EUROGAGE

5.1.1 **ENTERING CONFIGURE:** Turn the gage on. The "RUN" screen comes up. Press and release the "MODE" key to enter the "SETUP" screen. Press andrelease the "ENTR" key. The gage is in the"CONFIGURE" menu. You can select an option by using the "UP" or "DOWN" keys to move the cursor to that item. This menu will allow you to set or change the following options:



5.1.2 **SORTING:** Select three-way, three-way non-release, five-way 33%, or five-way 50% by moving the cursor to the option and pressing the "ENTR" key.

5.1.2.1 **LIMIT:** Select the control limit type by moving the cursor to the option and pressing the "ENTR" key. Modified control limits often produce better looking charts. In the event that CPK is less than one, limits revert to natural.

5.1.3 **DWELL:** Select between short (non-segment) and normal (segment) by moving the cursor to the option and pressing the "ENTR" key.

5.1.4 **BAUD:** Select an RS232 baud rate between 1200 and 9600 by moving the cursor to the option and pressing the "ENTR" key.

5.1.5 **UNIT:** Select the unit of measurement by moving the cursor to the option and pressing the "ENTR" key. All data and settings convert; so you need not reset the Eurogage.

5.1.6 **DUNCAN:** Select the Duncan value by moving the cursor to that option, entering a value and pressing the "ENTR" key. The Duncan option optimizes the Eurogages performance in handling two and three part patterns. Try a value between 1.0 and 0.8.

5.1.7 **MCS SPC:** Select the MCS time & SPC time by moving the cursor to the option and pressing the "ENTR" key. Then enter the time you want.

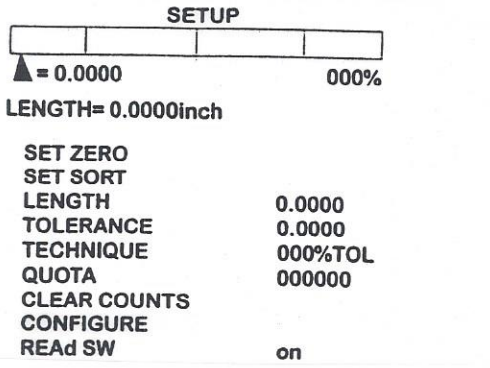
5.1.8 **TOOL SAFE:** Select the broken tool detection option by moving the cursor to "TOOL SAFE" and pressing the "ENTR" key.

5.1.9 **REJECT SAFE:** Select the coiler kill number by moving the cursor to the option and pressing the "ENTR" key. Enter the number of consecutive bad springs you want to shut the coiler off . 0 will disable the option.

5.1.10 **DATE TIME:** Select the date and time by moving the cursor to the option and pressing the "ENTR" key. Enter new values as needed.

5.2 SETTING YOUR EUROGAGE

5.2.1 **ENTERING SETUP:** For the first setup, or setting up a new job, press and hold the "MODE" key, and turn on. Continue holding until the Eurogage displays the "SETUP" options menu. Release the "MODE" key. Let the Eurogage warm up for approximately three minutes.



Make sure the "REAd SW" option is turned off prior to setup.

5.2.2 **GAP:** Place the probe the recommended distance from spring using the chart as a guidline:

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:** Move the cursor to the zero option and press "ENTR" The Eurogage will automatically zero the electronics and the scale % should display 000%.

5.2.4 **GAP CHECK:** Turn the probe micrometer clockwise the desired sort distance. If the % of scale is between15% and 50%, proceed to 5.2.5. If it is below 15%, the probe may be to far away from the spring. Move the micrometer in closer to the spring, rezero and go back to step 5.2.3. If it is more than 50%, the probe may be too close to the spring. Move the micrometer farther away, rezero and go back to step 5.2.3.

5.2.5 **SORT LONG:** Select "SET SORT" option and press the "ENTR" key. This will lock in the sort long length. If you are five-way sorting, the Eurogage automatically divides 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 length. Press the "ENTR" key again. Your sort distances are now calibrated. Return the micrometer to the zero position.

5.2.7 **LENGTH:** Select the "LENGTH" option and press "ENTR" to change the length value. The Eurogage considers a perfect spring as having no length. To display and print the actual length of the spring, enter that length in the length value, otherwise enter 0. To

change the tolerance on the fly, the read switch 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:** Select the "TOLERANCE" option and press "ENTR" to change the sort tolerance value. This tells the Eurogage how the length variation relates to the signals from the probe.

5.2.9 **TECHNIQUE:** Select "TECHNIQUE", either Auto or %, and press "ENTR" to change the type of pitch correction. You will probably use "AUTO" the most. Don't be afraid to experiment with it to see how it works.

5.2.10 **QUOTA:** Select "QUOTA" and press "ENTR" to set or change a shut off production quota. When the coiler kill is wired to the coiler, this will automatically shut off the coiler when the required number of parts have been coiled.

5.2.11 **CLEAR COUNTS:** Select "CLEAR COUNTS" and press "ENTR" to clear or reset the good and bad spring counters to 0.

5.2.12 **CONFIGURE:** Select "CONFIGURE" and press "ENTER" to view or change any of the configure options or parameters (refer to the previous section for more detail).

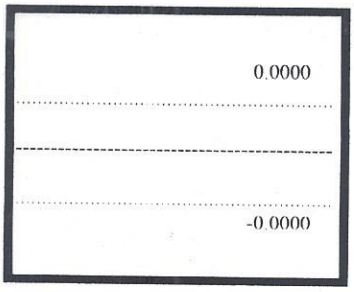
5.2.13 **READ SWITCH:** Select read switch option to turn the read switch on and off. With this option turned on, the operator as the ability to make changes to everything in the setup screen, except the zero and sort points, and everything in the configure screen.

5.2.14 **SORT TIME:** Set the "SORT" knob for the amount of time you wish to activate the chute. For example, if you are running at 45 parts per minute, a correct setting would be at mid scale.

5.2.15 **PITCH ADJUST:** Set the "ADJUST" knob to control the pitch adjustment time. Start with the dot on the knob at mid scale if using "AUTO" feed back. Otherwise, start it at a low value.

5.3 RUNNING YOUR EUROGAGE

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



X	0.0000	SORT	.00 000	CPK	00.00
x	0.0000	GOOD	0000000	RATE	00000
R	0.0000	LONG	0000000	ETA	000.0
3o	0.0000	SHORT	0000000	YEILD	000.0

5.3.2 **PITCH CORRECTION:** Occasionally you may want to increase or decrease the amount of correction for further scrap reduction. The Eurogage has built-in self-improvement, so coil 50 to100 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.

5.3.3 **STATS:** To do a Machine Capability Study (MCS), press and hold the "*" key for just over one second (printer required). When the MCS is done, the Eurogage will automatically continue taking Statistical Process Control Study (SPC) samples. To pause the SPC, press and release the "ESC" or "CLR" key. The printer feeds one line. To continue a paused study, press and release the "*" or "STAT" key. To abort the studies before they are finished, press and hold the "ESC" or "CLR" key until the printer ejects the page.

5.3.4 **SERIAL DATA:** When using a data collector system, use the "UP" and "DOWN" keys to turn the serial port on and off. Start sending data thru the serial port by pressing the "UP" key. Stop the flow of data by pressing the "DOWN" key.

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 Eurogage 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 Eurogage calculates this spread several different ways. It calculates and displays the spread of the last 30 springs each time it measures a spring. This enables the Eurogage to make intelligent adjustments. The Eurogage also calculates the process spread in the Machine Capability Study. The Eurogage 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 Eurogage calculates the mean of the last 30 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 Eurogage 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 Eurogage 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 Eurogage 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 Eurogage 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 Eurogage 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) 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 Eurogage 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 Eurogage. It is plotted against the machine capability studies' control limits to see if the process is remaining in control and is predictable. The Eurogage 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 Eurogage 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.

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.

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 Eurogage's internal correction value. If the Eurogage 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 Eurogage 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 Eurogage 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 +/-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 Eurogage, 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 Eurogage, 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 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 only acceptable parts.

9.0 Hardware Test / Troubleshooting

If trouble should ever arise with the Eurogage, there are several methods that one can use to locate and correct problems. The Hardware Test mode of the Eurogage is one method for troubleshooting the gage. This mode will allow an operator to test the LED's, switches, AC outputs, printer and serial port, and the probe. To use the Eurogage's Hardware Test mode, follow these steps:

9.1 **Entering Test:** Turn off the gage. Press and hold the "MODE" and "0" key while turning the Eurogage on. Release the "MODE" and "0" key after 2 seconds or when the screen displays "HARDWARE TEST". The Eurogage is now setting up the graphic character set and calculating delay values. While it is doing this, the screen will display "PLEASE WAIT" and a character in the upper right corner on the screen will be changing very fast. Use this time to adjust the "CONTRAST" knob from limit to limit. Now adjust it for a proper viewing contrast.

9.2 **Output Check:** Turn the "SORT" knob from limit to limit. The "SORT =" display on the screen should change as you do this. Select the "test outputs" menu item. **WARNING!! If the control motor is plugged in, use care to avoid damaging the coiler.**

Use the "SORT" knob to select an output to test. Then press the "ENTER" key. The proper LED should light and the output should activate while the "ENTER" key is pressed.

9.3 **Zero Check:** While watching "ADJUST =" display on the screen, turn the "ADJUST" knob from limit to limit. The displayed value should increase from about 0 to about 4095. At some point (if a probe is attached), you should manually center the "PROBE" display value using the "ADJUST" knob. At that time, the "P-P =" should be between 98 and 102, and the "noise" should be very low (10 or less, 1 or 2 are not uncommon). The "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). The "P-P=" should drop below 85. Using the "ADJUST" knob, set the "PROBE" value to about 8100, then touch the probe tip. The "PROBE" value should go below -8100, and "P-P =" should drop below 85.

9.4 **Printer Check:** Select "test printer" and press "ENTER" to test the printer output, cable, and printer with "AbCd0123456789.".

9.5 **RS232 Test:** Select "test rs232" and press "ENTER" to test the RS232 (serial) output, cable, and terminal with "AbCd0123456789.".

If you get this far, it is probably NOT your Eurogage, but it could be an incorrect Configure or Setup. Please call Moyer Process & Control if you have any questions.

!!!WARNING!!!
BEWARE OF
COPY-"CAT"
GAGES.
ONLY MOYER
GAGES PROVIDE
MOYER QUALITY!