AMS APPLIED MICROSYSTEMS

MP55
PUNCH CONTROLLER
REFERENCE MANUAL

ONLY ONE
UNIT SOLD
S/N: 0586

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INTRODUCTION

The Model MP55 Controller is a special purpose computer designed to control a sheet metal processing machine. The machine converts stock material into parts with a variety of notch and hole patterns.

The MP55 Controller has been designed to work with a distinct type of machine. This machine makes refrigerator panels.

The controller itself is designed to make it easy for the operator to program. The operator only has to enter the type of panel construction, the finished length and the desired hole spacing. The computer then calculates the required notch and hole patterns based on this information and some internal dimensional constants.

The operation of the machine itself is straight forward. The position of the strip of metal is sensed by a photo sensor and an incremental shaft angle transducer which generates an exact number of pulses to the computer for an exact amount of material movement. The computer then counts the pulses and activates the outputs when the programmed movement has occured. In a two speed machine, the computer switches from fast speed to slow speed at an early warning point so that a more accurate operation can be made. In a non-stop machine, no slowdown takes place and the die is accelerated up to strip speed when the operation takes place.

The MP55 is programmed using a display and keyboard similar to an electronic calculator. The display acts as a prompt for the operator by indicating what data is to be entered. The procedure for entering data is discussed in detail in a later section called ENTERING A NUMBER.

HARDWARE DESCRIPTION

The MP55 hardware consists of the following elements: an LED display, a 16 key keypad, 6 illuminated pushbutton switches, two external switches, a rotopulser and 6 output lines. The layout of the keypad, pushbuttons and LED display are shown in Figure 1.

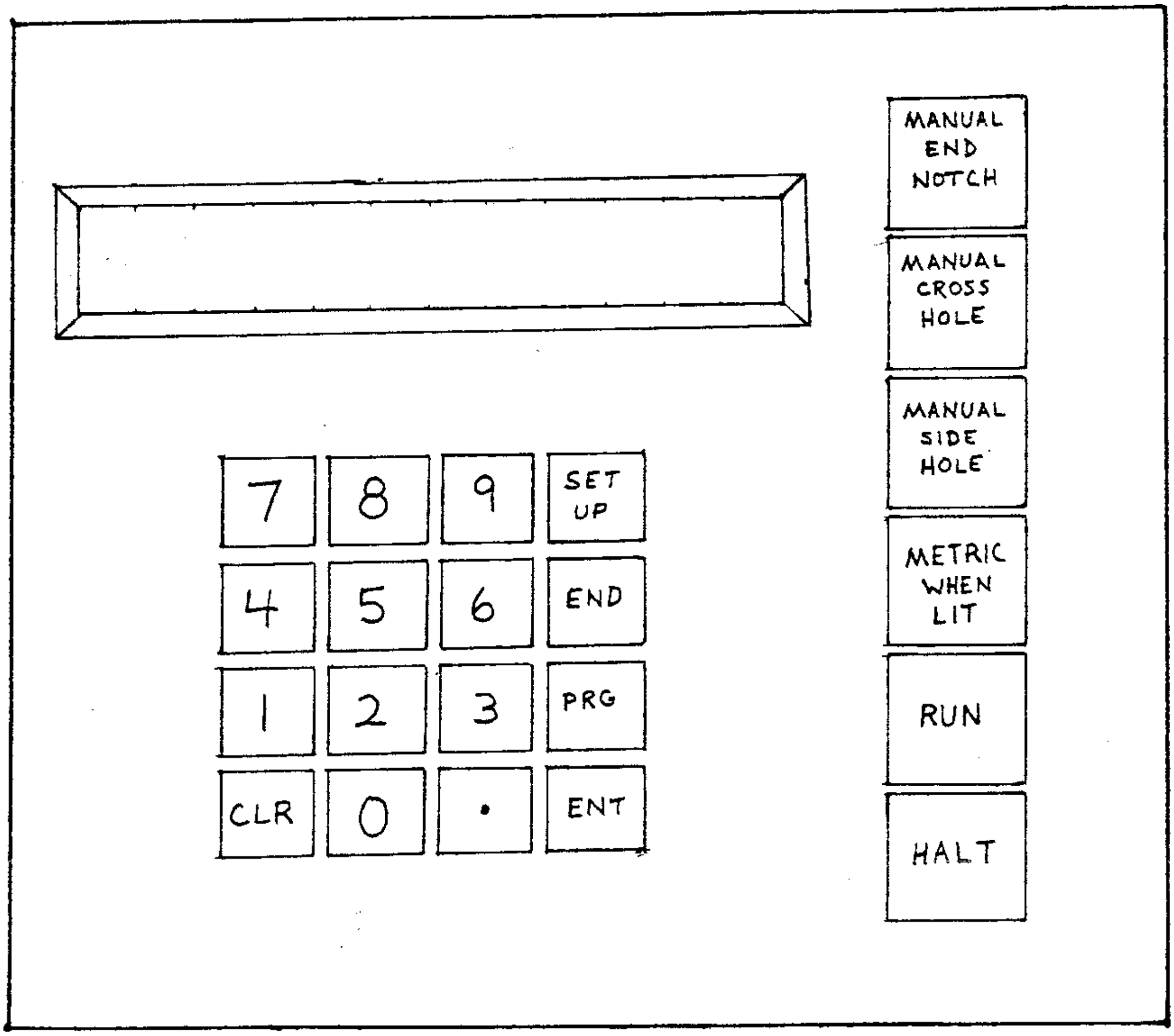

Figure 1. MP55 Front Panel

DISPLAY

The display on the front panel is a 12 character, 7-segment LED display that is used to show data and prompt the operator for information.

KEYPAD

The function of each key is as follows:

SETUP

The SETUP key is used to enter the SETUP mode. The SETUP mode is used to enter semi-permanent data about the machine such as the die spacing, cycle duration, die size, flow direction, etc....

END

The END key is used to exit the PROGRAM or SETUP mode and return to the HALT or RUN mode display.

PRG

The PRG key is used to enter the PROGRAM mode to enter batch data on the parts to be run.

ENT

The ENT key is the data ENTER key and it is used by the operator to indicate to the computer to take the data that is present in the display window.

CLR

The CLR key is the data CLEAR key and is used to erase a key entry before the ENTER key.

PUSHBUTTON SWITCHES

The function of each illuminated pushbutton switch is as follows:

MANUAL END NOTCH

The MANUAL END NOTCH pushbutton switch is used to manually cycle the END NOTCH output when the line is in the HALT mode. The lamp indicates when the END NOTCH output is on in both the halt and RUN modes.

MANUAL CROSS HOLE PUNCH

The MANUAL CROSS HOLE PUNCH pushbutton is used to manually cycle the CROSS HOLE PUNCH output when the line is in the HALT mode. The lamp indicates when the CROSS HOLE PUNCH output is on in both the HALT and RUN modes.

MANUAL SIDE HOLE PUNCH

The MANUAL SIDE HOLE PUNCH pushbutton is used to manually cycle the SIDE HOLE PUNCH output when the line is in the HALT mode. The lamp indicates when the SIDE HOLE PUNCH output is on in both the HALT and RUN modes.

METRIC WHEN LIT

The METRIC WHEN LIT pushbutton is used to switch between metric and English units of measurements. When the lamp is lit, data is entered and displayed in centimeters. When the lamp is not lit, the data is displayed and entered in inches.

RUN

The RUN pushbutton is used to initiate an automatic run of the machine. The green lamp indicates when the controller is in the RUN mode.

HALT

The HALT pushbutton is used to abort an automatic run of the machine. The red lamp indicates that the controller is in the HALT mode.

EXTERNAL SWITCHES

There are two external input switches into the MP55: JOG FWD and JOG REV. These inputs are only looked at by the computer in the HALT mode. When closed, the FWD or REV outputs respectively will turn on. The SLOW output will remain on so that all jogging (or inching) of the machine is done at slow speed.

ROTOPULSER

Material movement is sensed by the MP55 through the rotopulser (rotary pulse generator) which is an incremental optical shaft angle encoder. This device generates a precise number of pulses for each revolution of its shaft. On the shaft is a precision measuring wheel which rides on the material. As the material moves through the machine, it turns this wheel and thus causes the rotopulser to generate pulses. The computer counts these pulses and by knowing the counts per revolution of the rotopulser and the circumference of the wheel, the computer can detect the amount of material that has moved through the machine.

OUTPUT LINES

The MP55 has 6 outputs. These are 5 ampere, open collector transistors that switch load current to the DC ground. The function of each is as follows:

FWD

The FWD output is used to turn the machine drive rolls in the forward direction.

REV

The REV output is used to turn the machine drive rolls in the reverse direction.

SLOW

The SLOW output is used to change the speed of the drive rolls. When the SLOW output is on, the rolls will turn at slow speed when either the FWD or REV outputs are on. When the SLOW output is off, the rolls will turn at fast speed either the FWD or REV outputs are on. The SLOW output is always on when FWD is off or in the HALT mode. The SLOW output will be off when the FWD is on and the distance to the next press function is greater than the programmed SLOWDOWN DISTANCE (see SETUP).

END NOTCH

The END NOTCH output is used to cycle the end notch press.

CROSS HOLE PUNCH

The CROSS HOLE PUNCH output is used to cycle the cross hole punch.

SIDE HOLE PUNCH

The SIDE HOLE PUNCH output is used to cycle the side hole punch.

The control of all of the above mentioned hardware is provided by a microprocessor and its associated memory components. The operating program of the computer is contained in read-only-memory (ROM). User data, such as setup parameters and batch data, is contained in random-access-memory (RAM) that normally would not retain the information when power is off except that there is a rechargable ni-cad battery in the unit that provides power to the RAMs when the unit is shut off. This battery is constantly charged when the unit is in operation.

MODES OF OPERATION

There are five modes of operation in the MP55: SETUP, PROGRAM, RUN, HALT, and ERROR. It is possible to be in two modes at the same time. This will become clearer upon explanation of the two "types" of modes. One type can be called the display mode, and the other can be called the machine mode. The display modes are SETUP, PROGRAM, RUN, or HALT. This refers to what the computer is showing on the display and what keys it will respond to. The machine modes are RUN and HALT and they refer to what the machine is doing. The ERROR mode can be entered from either type of mode depending on the nature of the error. By making this distinction between the two types of modes, an operator can, for example, put the machine in the RUN mode and then put the display in the PROGRAM mode and thus program new data while previously programmed batches are being run.

SETUP MODE

The SETUP mode is used to enter machine parameters and some seldom changed part parameters. The mode is entered by pressing the SETUP key and is exited by pressing the END key or by stepping through all of the parameters. Figure 2 and Figure 3 provide a physical picture of the paramaters. Table 1 shows a table of these parameters with the prompts used and the range of allowed values. A place to write in the proper values for your machine is provided. The setup parameters and their function in the machine are as follows:

DETECTOR TO END NOTCH DISTANCE

The DETECTOR to END NOTCH DISTANCE is the distance from the center of the end notch die to the photo sensor.

DETECTOR TO CROSS HOLE PUNCH DISTANCE

The DETECTOR to CROSS HOLE PUNCH DISTANCE is the distance from the center of the cross hole punch die to the photo sensor.

DETECTOR TO SIDE HOLE PUNCH DISTANCE

The DETECTOR to SIDE HOLE PUNCH DISTANCE is the distance from the center of the side hole punch die to the photo sensor.

SLOWDOWN DISTANCE

The SLOWDOWN DISTANCE is the length required for the machine to dependably shift from fast speed to slow speed so that the material is moving at slow speed when a press operation occurs. If the distance is set to zero, then the computer set the line up as a flying die machine with no stop at a press cycle.

LEADING EDGE TAB WIDTH

The LEADING EDGE TAB WIDTH (C1) is the length from the leading edge of the end notch tab to the trailing edge of the end notch tab.

END NOTCH DIE WIDTH

The END NOTCH DIE WIDTH (C2) is the length from the leading edge of the end notch die to the trailing edge of the end notch die.

CROSS HOLE LOCATION

The CROSS HOLE LOCATION (C3) is the length from the center of the cross hole punch to the leading, or trailing, edge of the sheet.

END NOTCH TIME

The END NOTCH TIME sets the time duration of the end notch press cycle.

CROSS HOLE PUNCH TIME

The CROSS HOLE PUNCH TIME sets the duration of the cross hole punch press cycle.

SIDE HOLE PUNCH TIME

The SIDE HOLE PUNCH TIME sets the duration of the side hole punch press cycle.

CORRECTION FACTOR

The CORRECTION FACTOR is a constant that allows for the correction of the length of a part due to wear of the measuring wheel.

SETUP DATA SHEET

PARAMETER	PROMPT		RANGE
DETECTOR-END NOTCH	det.-P1	_____	0-999.99 IN
DETECTOR-CROSS HOLE PUNCH	det.-P2	_____	0-999.99 IN
DETECTOR-SIDE HOLE PUNCH	det.-P3	_____	0-999.99 IN
SLOWDOWN LENGTH	LE SLO	_____	0-999.99 IN
LEADING EDGE TAB WIDTH	C1	_____	0-999.99 IN
END NOTCH DIE WIDTH	C2	_____	0-999.99 IN
CROSS HOLE LOCATION	C3	_____	0-999.99 IN
END NOTCH TIME	P1	_____	.01-99.99 SEC
CROSS HOLE TIME	P2	_____	.01-99.99 SEC
SIDE HOLE TIME	P3	_____	.01-99.99 SEC
CORRECTION FACTOR	Corr	_____	.25-4.00000

Table 1. Setup Mode Data

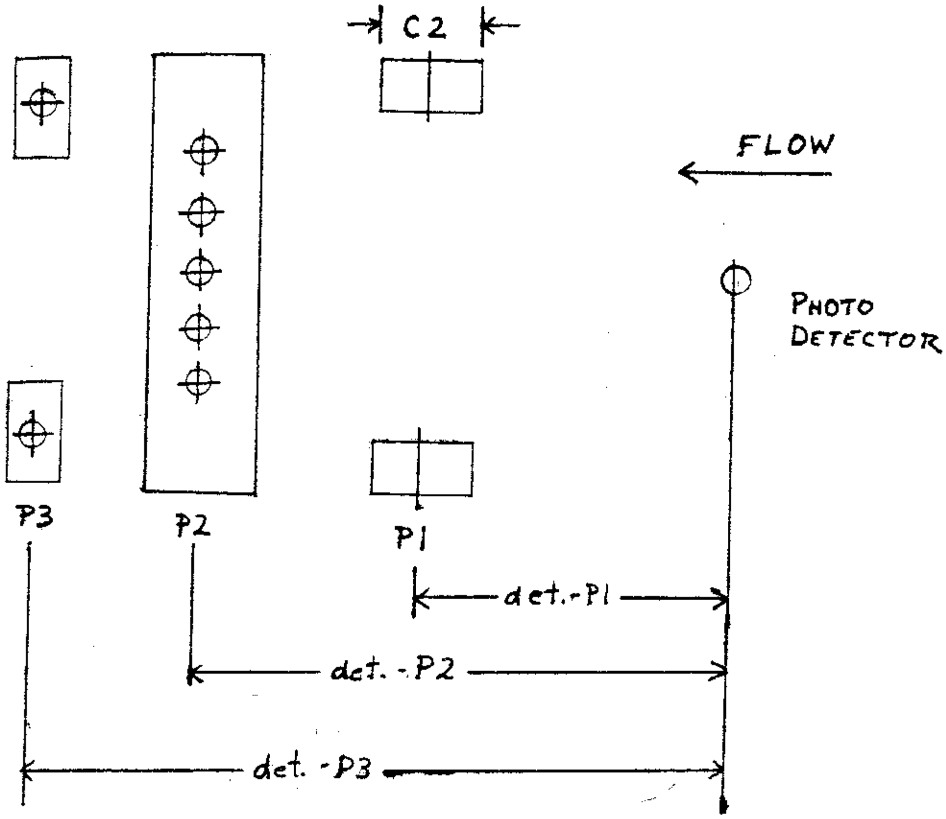

Figure 2. Machine Layout

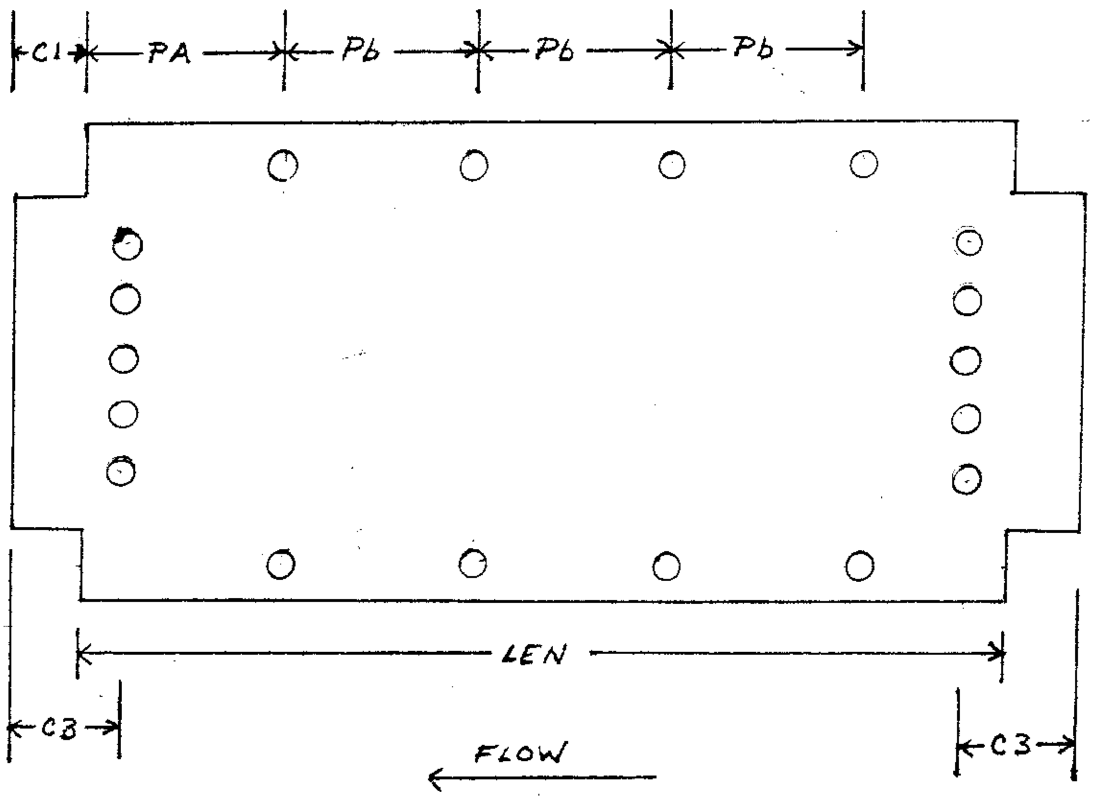

Figure 3. Sample Part

PROGRAM MODE

The PROGRAM mode is used to enter batch information on the type of part to run.

The PROGRAM mode is entered by pressing the PRG key and is exited by pressing the END key. The first entry required is the type number. The display will prompt for the TYPE, which can be from 1 to 8. The display will then go through a sequence of prompts, asking for the data required for each particular type. See Table 2 below for the possible types.

TYPE	END NOTCH	CROSS HOLES	SIDE HOLES
1	YES	YES	YES
2	YES	NO	NO
3	YES	YES	NO
4	YES	NO	YES
5	NO	YES	YES
6	NO	YES	NO
7	NO	NO	YES
8	NO	NO	NO

Table 2. Pattern Types

In types 2,3,6 and 8 the operator is only asked for the finished overall length (LEN). In types 1,4,5 and 7 the operator is asked for the finished overall length (LEN), first side hole location (PA), and side hole spacing (Pb). This is the only information required. The computer can add the leading and trailing allowances and calculate the entire notch pattern from this information.

RUN MODE

The RUN mode is used to actually produce the parts. The mode is entered by pressing the RUN key and is exited by pressing the HALT key.

Pressing the RUN key enables the computer to cycle the appropriate outputs when the programmed length is encountered.

While in the RUN mode two numbers will be seen on the LED display. The number on the left side of the display indicates the location of the next operation. The number on the right side indicates the current position.

ERROR MODE

The MP55 computer can detect certain operational errors and it displays a message that shows 'Error N' where N is the error number. The MP55 will only respond to the CLR key in order to clear the error message. The description of each error is as follows:

Error 0	Number entered is out of range
Error 1	Zero entry is not allowed
Error 6	Type number error
Error 9	More than 200 operations in work stack

SPECIFICATION

Resolution	.012 in. with 12 in. wheel
Accuracy	Output turned on within 1 count (does not include errors of the machine)
Maximum Line Speed	200 FPM
Maximum Length Part	9999.99 inches
Pattern Types	8 (1-8)
Input Power	115 VAC +/-10%, 50-60 Hz, 1 Amp max, 5-24 VDC, 1 amp (excluding loads)
Outputs	6 (FWD, REV, SLOW, P1, P2, P3)
Physical Size	6 in. X 9 in. X 10 in. with a 1 in. flange on the front panel
Weight	13 pounds

LENGTH CALIBRATION

The computer detects the movement of material through the machine by means of an optical shaft encoder which is also called a rotary pulse generator or rotopulser. It is a device that generates electrical pulses as the shaft is rotated. It can detect the direction of rotation and it generates a precise number of pulses for each revolution of its shaft. The computer detects these pulses and counts the net number of up and down pulses in order to know the shaft position.

The computer only knows the angular displacement of the shaft. In order to translate this angular movement into actual material movement, a precision measuring wheel is attached to the shaft of the encoder. The wheel rides on the material and is carefully aligned so that in one revolution of the shaft, an amount of material equal to the circumference of the wheel moves through the machine.

The resolution of the system (smallest measured increment) is equal to the circumference of wheel divided by the number of counts generated in one revolution of the encoder shaft. If the circumference of the wheel is 10 inches and there are 1000 pulses per revolution on the encoder, then the resolution would be 10 inches/1000 or 0.01 inches. If a 12 inch wheel were used then the resolution would be 0.012 inches.

In this system, the computer has a setup parameter called the correction factor. The correction factor is used to set the nominal resolution of the system and to compensate for small errors due to measuring wheel diameter errors. The initial value of the correction factor is computed by dividing 0.01 by the system resolution. Thus, a 10 inch wheel would have an initial correction factor of 0.01/0.01 or 1.00000 and the 12 inch wheel would have a correction factor of 0.01/0.012 or .83333.

Using this initial value of correction factor, the system can then be fine tuned in order to give optimum accuracy. Length inaccuracies consist of two distinct elements, the repeatability error and the linearity error. The repeatability error results from variations in the mechanics of the machine from one operation to the next. This variation would be the same for 1 inch long parts or 100 inch long parts. The linearity error is due to slight errors in the size of the measuring wheel. This error grows as the length of the part grows. It is not noticable on short parts and can get quite significant on long parts. These two error elements must be separated in order to properly calibrate the system.

The repeatability error can be determined by running a large number of short parts and measuring the total variation in length from the shortest part to the longest part. This total variation should be within the machine's specified tolerance. Further tests should not be attempted until this variation tolerance is met. Once the variation is determined, a part as long as possible should be run and its length carefully measured. A new value for correction factor can be calculated as follows:

NCF = OCF X PL/AL

where NCF is new correction factor

OCF is old correction factor

PL is the programed length

AL is the actual measured length

As an example, with the old correction factor at 1.00000, a 100 inch part was programed with the result being a 100.25 inch long part made. The new correction factor (NCF) would be:

NCF = 1.0000 X 100/100.25 = .99751

This new value for correction factor should be entered into the computer. If the resultant error was less than the allowable tolerance, the previous step should not be done.

At this point, the machine should be reasonably well calibrated. However, a portion of the linear error detected could have been due to a repeatability error. Further calibration can be done be running a large sample of long parts and carefully measuring each part and finding the mean value. The previous calculation can be repeated using the mean value as the measured length to further refine the correction factor. If in the previous example, the correction factor of .99751 were entered and a new run of 100 inch parts resulted in a spread of 1000.00 to 100.06, the mean value would be 100.03 and the new calculation would be:

NCF = .99751 X 100/100.03 = .99721

This should then yield parts that are within the specified allowable length variation, centered around the length programed. Further adjustments can be made using this same procedure should the wheel begin to wear.