MP350P-FD Controller

Reference Manual

Table of Contents

Chapter 1: Introduction and Product Description

The AMS **MP350P-FD** controller is a length control system used on cut-to-length machines that produce sheet metal parts from coil stock for the HVAC industry. The **MP350P-FD** controller is the most advanced control system available and will greatly enhance the performance and productivity of these machines. Other control systems use general-purpose electronic counters as the length control device. These systems can be difficult to use and offer little added benefit beyond material measurement and piece counting. The AMS controller is a custom designed microcomputer that is designed exclusively for cut-to-length machines, which enables the **MP350P-FD** to offer many features not available on simple electronic counters.

In seeking to design a new generation electronic length control system, AMS Controls had the following goals in mind:

- Improve the length accuracy
- Improve the machine productivity
- Reduce the amount of material waste
- Provide in-line punching control
- Easy for the operator to use
- Adaptable to a wide variety of machines

All of these goals have been achieved with the design of the **MP350P-FD** Controller.

Accuracy

On most cut-to-length machines without servo drives, accuracy depends upon the repeatability of the machine to run at a constant speed and to delay the same amount of time for each operation. With electronic length controllers, accuracy is lost when machine fluctuations occur. The **MP350P-FD** controller, however, constantly monitors the performance of the machine and compensates for these variations resulting in improved accuracy. For flying cutoff machines, the exclusive Speed Compensation feature allows accurate punches and cuts at any line speed. For feed-to-stop machines, the Adaptive Slowdown feature and the Overshoot Compensation feature greatly improve machine accuracy.

Productivity

Productivity can be improved with the AMS controller in three ways. First, the improved accuracy with the **MP350P-FD** allows machines to be run at higher line speeds. Secondly, for feed-to-stop machines, the Adaptive Slowdown feature insures a minimum feed time for any length run and any hole spacing. Thirdly, for all types of machines, the multiple order feature allows many jobs to be programmed at one time (even while other orders are being processed and run), so delays between orders can be eliminated.

The AMS Controller eliminates a large amount of material waste by only requiring a single manual cut at the beginning of a new coil. This cut can be made while the machine is stopped, as opposed to a flying crop cut, which further reduces waste.

Easy to Use

The **MP350P-FD** controller is a sophisticated computer running a very complex program. This does not, however, mean that a computer expert is required to operate it. The controller has a liquid crystal display (LCD) that prompts the operator for information in plain English and with words that are familiar. On one display, the operator can see the order that is being run, his progress through the order, and the speed of the line.

Easy to Install

The **MP350P-FD** has logic built into it to handle most machine control functions. The user does not need to add Programmable Logic Controllers (PLCs) or relay logic circuits to get the correct machine sequence and safety features.

The AMS controller can control a variety of different machines. For each type of machine, a different set of machine parameters must be programmed into the controller. To simplify this procedure, the type of machine is programmed via a set of switches. The controller reads these switches to determine the type of machine it is connected to. It can then limit the list of parameters that must be programmed to only those that apply to this type of machine.

About this Manual

This manual gives detailed information on the installation, operation, and maintenance of the **MP350P-FD** Controller. Instructions for installing the AMS Controller on most machine types are included. AMS engineers can help on installation conditions not covered by this manual. Instructions on how to operate the controller are included. This covers how to program orders and run them. It also covers the best way to handle a variety of special circumstances that can come up with most machines of this type. Another section of the manual includes a guide to follow if problems should arise.

Note: AMS Controls reserves the right to change the operation and/or directions within the manual without notice or approval.

The Setup sheet in the back of this manual provides a place to record information about your particular installation. Be sure to record this information and keep this manual in a safe place for later referral. If calling AMS for technical assistance, be sure to have this manual in front of you as well as the model number and serial number of the controller and software version number (displayed when the controller is turned on).

System Description

An Electronic Length Control System is the controlling mechanism for machines that produce individual parts from a coil of stock material. A block diagram of one such system is shown in Figure 1-1. Many other configurations are also possible.
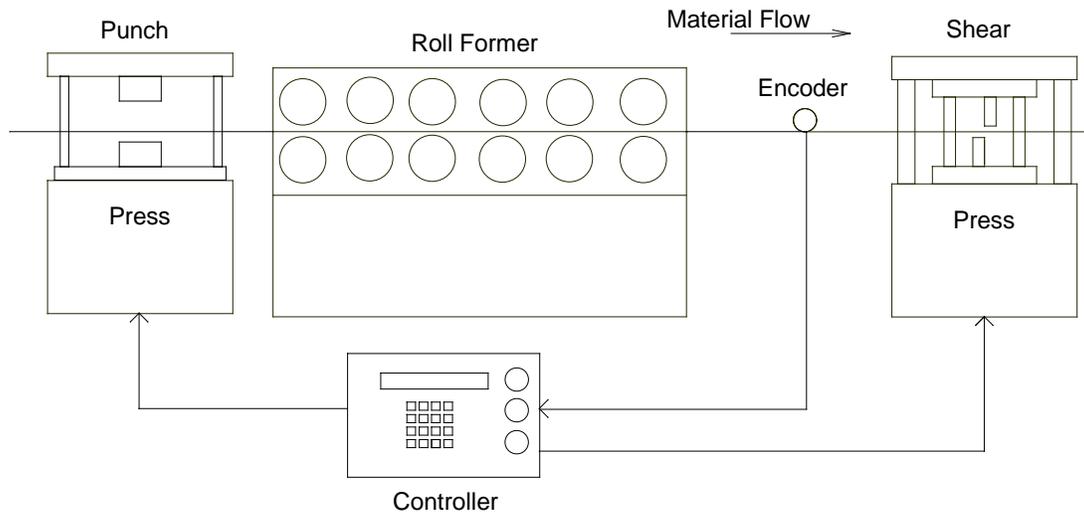
Figure 1-1. Electronic Length Control System Block Diagram

The controller performs the following functions:

- Controls the material movement through the machine.
- Measures the amount of material moving past the cutoff press.
- Cycles the punch presses at programmed points.
- Cycles the cutoff press at the programmed length.
- Stops the machine when the correct number of parts is produced.

The measuring device is an optical shaft encoder, also called a pulse generator. A wheel with a known circumference is attached to the encoder and rides on the material. As the material moves through the machine, the wheel rotates and the encoder generates electrical pulses proportional to the amount of material moved. The controller counts these pulses to determine how much material has moved through the machine. When the material reaches a point where a punch is needed, the controller cycles the punch press. When the material past the cutoff press is equal to the length of the part programmed, the controller cycles the shear press and increments the quantity that is DONE. When the quantity DONE is equal to the programmed quantity, the controller stops the machine, unless other items are programmed to run immediately.

There are two basic categories of automatic cutoff machines: flying cutoff machines and feed-to-stop machines. With flying press machines, the material does not stop for each cut or punch and the cutoff and punch dies move along

with the material during the press cycle. With a feed-to-stop machine, the controller stops the material for each cut and punch and the dies remain at fixed locations. The common practice for this type of machine is to shift into a creep speed just before the cutoff point to increase the precision of the cut and reduce the jolt that can occur if the material is abruptly stopped. The controller controls both the speed shift and the stopping action.

MP300 SERIES Controller Hardware Description

Microcomputer

The **MP350P-FD** is the control element of an advanced length control system. It is equivalent to a personal computer (PC) packaged in a rugged industrial enclosure. Programs are stored in PROM (Programmable Read Only Memory) memory, instead of a disk. These programs were written by AMS to perform the specific task of length control and the PROM is factory programmed.
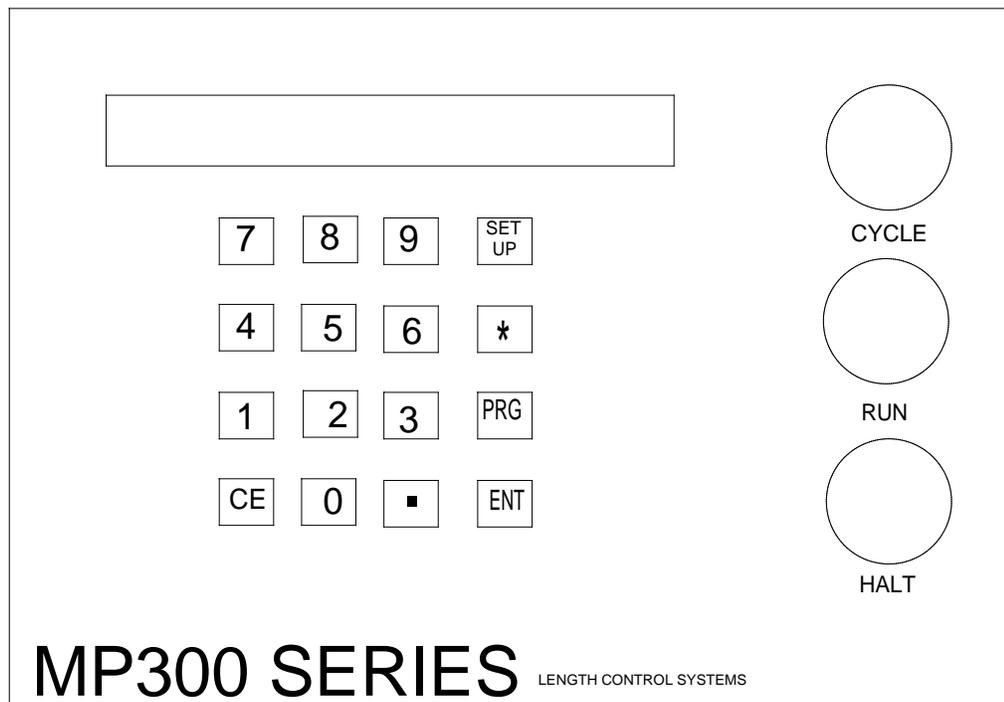
Figure 1-2. MP300 SERIES Front Panel

The user does not have to write programs for the controller and only has to enter data on what to produce. This data is stored in RAM (Random Access Memory). In a normal PC, this memory is erased when power to the PC is removed. In the **MP350P-FD** controller, a battery maintains this memory when the controller is off and user data does not have to be re-entered each time power is removed. RAM is used to store machine setup data and job information data.

Operator Interface

Replacing the monitor and keyboard of a PC, the **MP350P-FD** controller has a LCD (Liquid Crystal Display) screen and a small keypad. The LCD has two lines of display with 24 character positions on each line. The keypad, shown in Figure 1-3, has 16 keys for basic numeric entry. Any non-numeric data required is achieved by scrolling through the available options on the display and selecting the correct one. For example, units of measurement are displayed in inches, centimeters, or millimeters. When selecting this parameter, pressing any number key will cause the display to toggle between "English", "Metric CM", and "Metric MM". Pressing the ENTER key when the correct variable is displayed will select that option. This method keeps the data entry simple and avoids spelling errors.

There are three control push button switches on the panel of the controller for CYCLE, RUN, and HALT functions. These are large industrial grade controls that activate machine functions. The CYCLE switch is used to cycle the SHEAR and to zero the length counter. This function is active in the manual mode on all types of installations. In the automatic mode, the CYCLE switch is only active on non-stopping machines to allow for the operator to cut out bad material without stopping the line. The RUN switch is used to put the controller in the automatic mode and to start production. The HALT switch will stop production and place the controller in the manual mode.

Controller Keys and Functions

To help the operator become familiar with the keys on the controller, a brief description of the function of each key will be given.
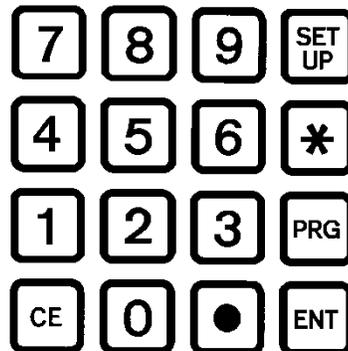

Figure 1-3. MP300 SERIES Keypad

SET UP

This key is used to assign the next job to run, to increment the quantity of an order to make another part, to view the three footage totalizers, to adjust the machine setup parameters, to view the Input and Output status screen, run a memory test, and perform a Manual Calibration.

Asterisk (∗)

This key is a STATUS key and will allow the operator to view the current job number in progress, the number of parts assigned to a job with the number left to run, and the current position of the metal past the shear.

PRG (Programming)

The PRG key is used to assign a job number and define the quantity and length of part to be run.

CE (Clear Entry)

This is a "Clear Entry" key. The main use of this key is to correct the entered data when a mistake is made. Pressing this button will clear out the previously entered data so that the data can be entered again from the beginning.

ENT (Enter)

This key can be defined as a "take it" key, as the data that was entered into the display is not accepted by the controller until the Enter key is pressed.

Inputs

The main input into the controller is the group of signals from the encoder. A simplified diagram of this circuit is shown in Figure 1-4. The encoder outputs are differential line drivers which work well in electrically noisy environments. With the twisted pair cable, electrical noise is induced equally on both the normal and the complement signals. The differential line receiver in the **MP350P-FD** controller looks at the difference in the two signals only. This causes the noise on the two lines to cancel each other and thus greatly increases the noise immunity of the encoder circuit.
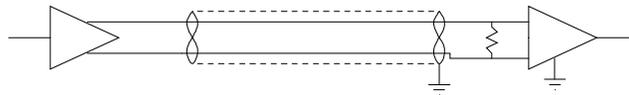
Figure 1-4. Simplified Encoder Channel Circuit

There are eight discrete inputs into the **MP350P-FD** controller. They sense continuity between an input and a common connection. A typical diagram of an input circuit is shown in Figure 1-5. This circuit requires a 24 VDC biasing circuit that is provided either by the user or by the AMS controller, depending on the controller configuration. **Note that no voltage source should be connected to any input.** Doing so can severely damage the controller. Relay contacts, limit switches, or control switches are the most common inputs used. The input may also be the collector of an open collector NPN transistor, which has its emitter connected to the common terminal. Current in each input circuit is limited to 15 milliamperes.
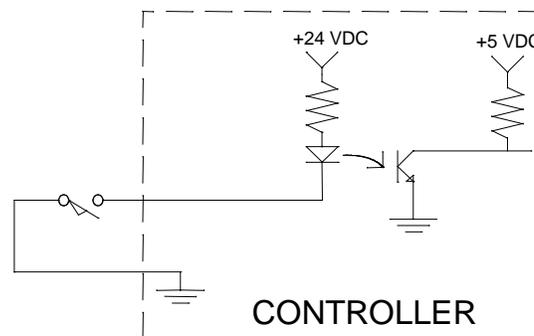

Figure 1-5. Typical Input Circuit

Outputs

The Standard DC output of the **MP350P-FD** controller is a 4-Ampere open collector transistor. This is available in all configurations and for all outputs. A diagram of this circuit is shown in Figure 1-6. The biasing voltage for the load can be from 12 to 24 volts. If this voltage source comes from outside of the controller, the common of this supply must be connected to the common of the controller. The suppressing diode shown reduces the noise generated by inductive loads when the transistor turns off. The load can be either a DC solenoid or a DC Relay.
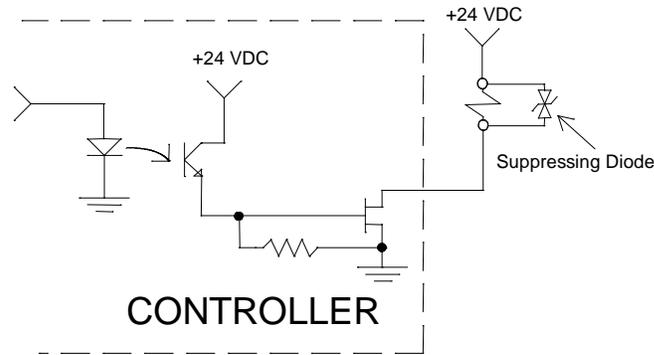
Figure 1-6. Standard DC Output

AC Relay Output

The AC RELAY OUTPUT is a 5 ampere dry circuit relay contact that is available on all outputs of the AC Consolette model and on the FORWARD output only of the SL Consolette model. Normally open contacts are available on all outputs. A normally closed contact is available on the FORWARD output only.

Solenoid Driver

The SL Consolette model has two special solenoid driver circuits for the Shear and Vee Notch outputs. An external solenoid driver board Model #3840 may be added if necessary for the End Notch output. These circuits provide a 60 VDC pulse to a 24 VDC solenoid for a short duration that greatly decreases the response time of the solenoid. On flying die applications, the response time of the valves directly affects the accuracy. This circuit, when directly connected to the valve solenoid, makes the valve delay more repeatable. The circuit is designed to limit the duration of the high voltage pulse to avoid damage to the solenoid. This output should not be connected to relays, which could be damaged by the high voltage.

Special Features

The **MP350P-FD** Controller has been designed to offer advanced features for length control that are not available on simple electronic counters. These features offer better accuracy and reduce the amount of waste that can occur. They also eliminate the need for additional control circuits to control the machine.

Speed Compensation

An electronic counter in an electronic length control system produces an output on an exact interval of material movement by faithfully counting all of the

encoder pulses. On an ideal machine, an electronic counter will produce accurate parts. However, an ideal machine does not exist and varying machine conditions will produce varying part lengths.

The best example of this would be a phenomenon that occurs on flying die machines. On such a machine, the counter produces a shear pulse at a regular interval of encoder pulses. The material, however, is actually cut at a time after the shear pulse (due to delays in the press). It takes time for valves to energize, cylinders to fill, and dies to move. During this delay, the material moves a distance that is proportional to the speed of the material and the duration of this delay. The actual shearing operation is displaced from the point at which the counter activates the shear.
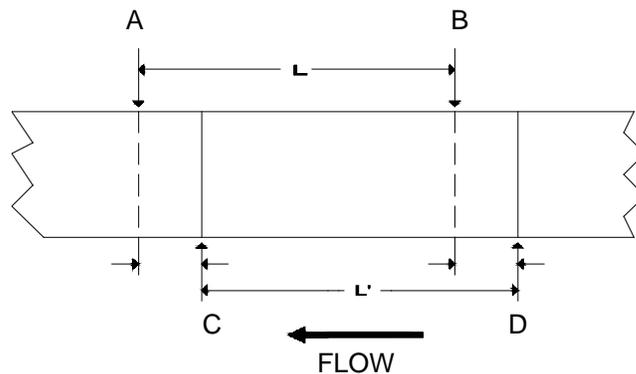
Figure 1-7. Typical Sheared Part Layout

Figure 1-7 shows what actually happens in a typical part sheared with a flying die. The counter activates the shear at an interval of the part length L at points A and B. Due to the press delay, the material is actually cut at points C and D. The resulting part length L' can be calculated as follows:

$L' = L - T_1 S_1 + T_2 S_2$, where

- L is the programmed part length
- T_1 is the delay time at the leading edge
- S_1 is the line speed at the leading edge
- T_2 is the delay time at the trailing edge
- S_2 is the line speed at the trailing edge

If the speed and delay remain constant, then T_1S_1 will equal T_2S_2 and L' will equal L. If either parameter changes from one cut to the next then the resulting lengths will also vary.

For most pneumatic and hydraulic presses, the delay time is usually constant for constant applied pressure. However, speed variations are common and are a main source of inaccuracy on flying die machines.

The **MP350P-FD** controller eliminates this problem with its Speed Compensation feature. The controller constantly monitors the line speed and calculates a modified shear target in proportion to the line speed and a known delay time. Figure 1-8 shows an example of how Speed Compensation works with a varying line speed.

The parts are at intervals of 1000 encoder counts. Instead of the normal shear outputs at 1000, 2000, 3000, etc., the **MP350P-FD** calculates targets of 985, 1970, 2985, 3995, etc. in proportion to the changing line speed. If the delay remains constant, then the parts produced should be the correct length.
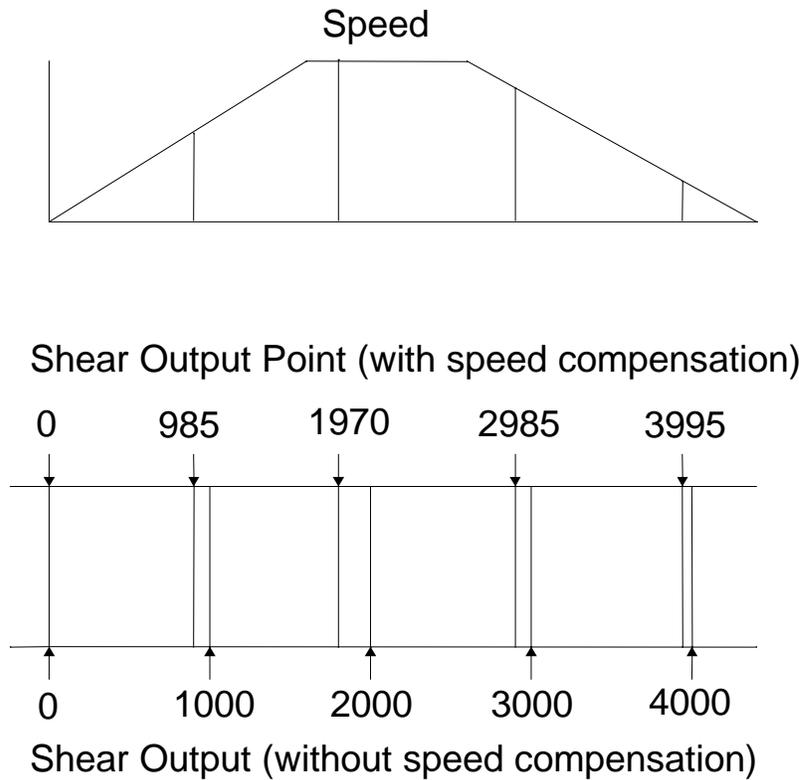
Speed

Shear Output Point (with speed compensation)

0	985	1970	2985	3995

0	1000	2000	3000	4000

Shear Output (without speed compensation)

Figure 1-8. Speed Versus Shear Target

Adaptive Compensation for Stopping Machines

Feed-to-stop machines are often used instead of flying die machines because the dies are simpler and the machines are normally more accurate. Higher accuracy is normally achieved by slowing the line speed down to a creep speed just before the target. This is done to minimize the effect of a delay in stopping that occurs when the stop signal is given by the controller.

Similar to the flying die situation, it takes a finite amount of time for valves to close brakes to engage, and motors to stop turning. With simple counters, an

overshoot past the target always occurs. Shifting into slow speed minimizes the amount of overshoot.

If the delay time and slow speed are constant, then lengths will be constant and consistently long. The amount in advance that the machine is set into slow speed is determined by the maximum speed of the machine and how quickly the material can decelerate from high speed to slow speed.

The **MP350P-FD** controller improves the performance of feed-to-stop machines by compensating for the stopping delay time and automatically setting the slowdown distance. With a technique similar to Speed Compensation, the controller uses the speed to calculate an advanced target to stop the machine so that it coasts into the exact shear point. The AMS controller measures the amount of overshoot or undershoot on each move and adjusts its internal parameters to match the characteristics of the machine. The user can specify a tolerance so that accuracy is assured.

The AMS controller also has a feature called Adaptive Slowdown that minimizes the feed time of feed-to-stop machines. Figure 1-9a shows the movement profile of a typical feed-to-stop machine. These systems use a fixed length slowdown distance that must be sized for the longest part length run. Short parts then spend a long time in slow speed because the material never reaches full speed when the slow shift point is reached. The controller with Adaptive Slowdown uses the measured line speed and deceleration characteristics of the machine to calculate the optimum point to shift into slow speed.

The result, shown in Figure 1-9b, is less time spent in slow speed on short parts, which leads to more productivity. The **MP350P-FD** controller continuously monitors machine parameters to automatically adjust for machine changes.
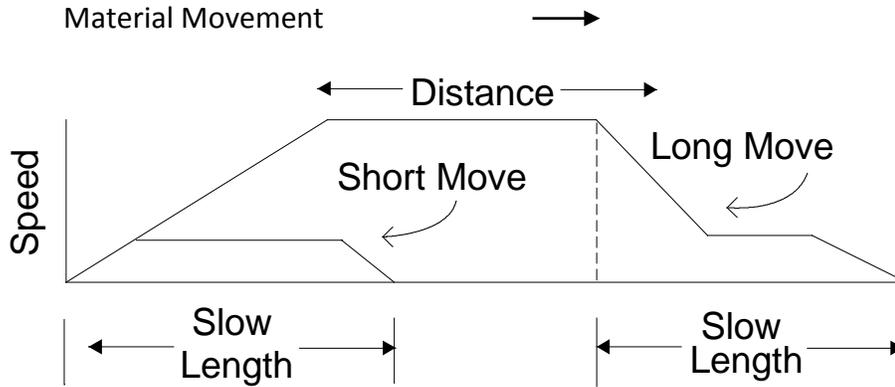
Material Movement →

Figure 1-9a. Speed Profile without Adaptive Slowdown
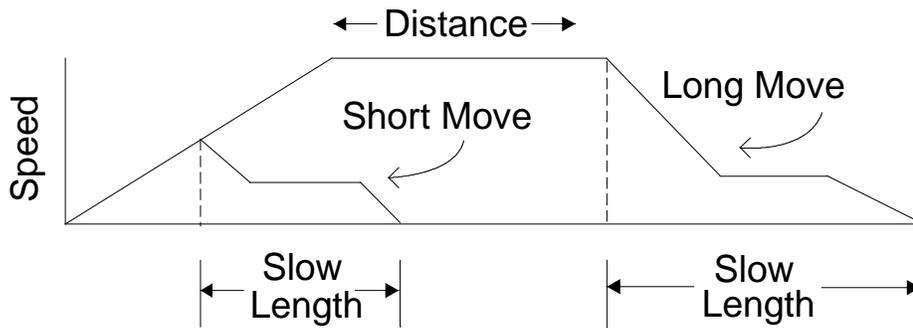
Figure 1-9b. Speed Profile with Adaptive Slowdown

Built-in Programmable Logic Controller

When designing a cut-to-length machine with an electronic counter for the length control device, a Programmable Logic Controller (PLC) or relay logic is normally added to generate the proper sequence of the machine and add standard safety features. AMS has eliminated the need for a PLC by building comprehensive control logic into the **MP350P-FD** controller. This logic implements the following features:

- Four output configurations for speed control
- Run-Halt control from either the front panel or external contact
- Manual cycle of the Presses only allowed in the Halt mode
- Jog in manual only
- Motor starter interlock circuit

- Automatic Shear or Press operation only in Run mode
- Halt on emergency stop or overload

The result is that the **MP350P-FD** controller can be adapted to most machines with a minimum amount of external electrical components. The only "programming" that a user must do is select the proper TYPE of machine through some switch settings. The controller then implements the proper logic based upon the TYPE.

Chapter 2: Installation

Controller Power

Depending on the model of the controller, an AMS controller may require 24VDC or 115VAC. All input power should be within the specification limits.

Power to the controller should be switched independently of other devices through a separate on/off switch. This power should not be interrupted by the emergency stop circuit. In an emergency-stop condition, the controller should be able to track any movement of the material, therefore allowing production to resume after the condition is reset without any loss in accuracy.

Emergency Stop Circuit

Every machine should have some type of emergency stop circuit for the safety of the operator and for the protection of equipment.

Shear Control Circuit

Optimal performance of the shear circuit can be met by customizing the AMS controller to a particular type of press and feed control by the appropriate setting of the "TYPE" setting switches. The controller can be configured to work with flying-cut or feed-to-stop applications. Outputs are available for SHEAR DOWN and SHEAR UP or SHEAR DIE BOOST.

AMS controllers are designed to connect directly to 24VDC solenoids for optimal performance. A solenoid driving device, such as the AMS 3840 power module, can provide more accurate firing of the press. See Figure 2.4 for wiring possibilities.
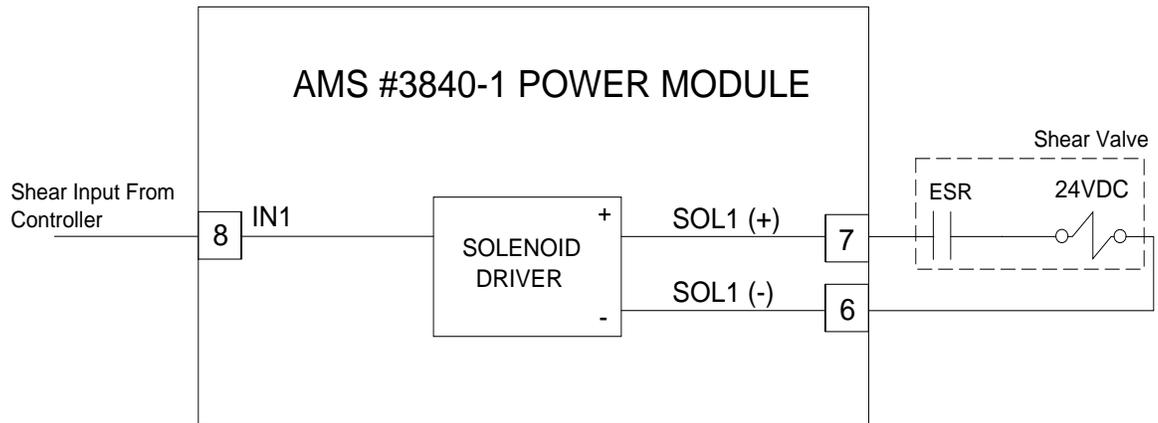
Figure 2.4

If the solenoid for the shear output is not 24VDC, then an attempt should be made to replace the solenoid with a compatible 24VDC type. If this is not possible, then a 24VDC relay or an AMS 3840 Power Module will have to be installed between the AMS output and the solenoid.

AMS controllers have a timed shear output with a switch input override feature. The duration of the **SHEAR DWELL** or **SHEAR DOWN** output is programmable from 0 to 9.999 seconds. Please refer to timing diagram - Figure 2.5. If the AMS controller detects a switch closure at the **SHEAR COMPLETE** input during the dwell time, the shear output will turn off immediately (Figure 2.6). This is especially useful on mechanical presses that will need the shear-complete switch mounted in a location that will return the press to top-dead-center. The SHEAR DWELL UP time will time out as programmed regardless of the complete input.
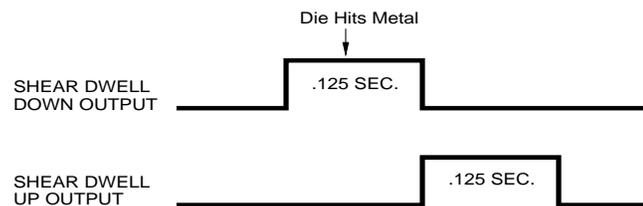
Figure 2.5
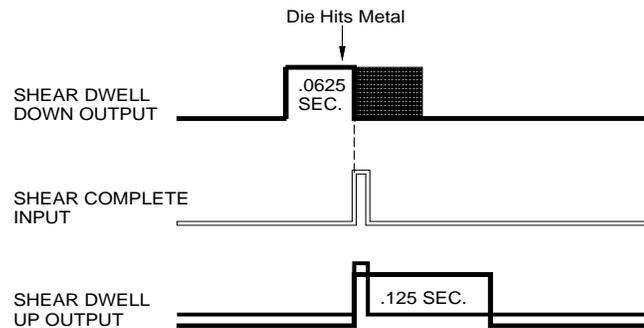
Figure 2.6

Press Control Circuit

The terms and definitions for the press control parameters are identical to its shear control counterparts. The press parameters will include PRESS DWELL DOWN and PRESS DWELL UP <u>or</u> PRESS DIE BOOST depending on the machine's configuration. The press outputs can also signal the AMS 3840 power module or isolation relays for higher voltage solenoids. The **PRESS DWELL DOWN** can be programmed from 0.001 to 0.999 seconds. There are no punch complete inputs on the **MP350P-FD** so there must be a programmed dwell down time for each punch.

Chapter 3: Machine Configuration

Initial Power Test

Before plugging in the connectors to the controller, turn on the power and check for the proper voltage at the connectors. For the panel mount version, be sure that the polarity of the 24 VDC is correct, terminal 1 is +24VDC, and terminal 2 is common. On the two console models (AC and SL), check for 120 VAC from pin J to both pins K and L of the 3812 cable. Also check for 0 VAC between pins K and L of the 3812 cable. This will ensure that the unit is properly grounded.

With the proper voltage checked at the connectors, turn the power off and plug in the connectors. Reapply power and look for the display to light up after a few second delay. The display should be similar to the one in figure 3-1, below.

    AMS Controls, Inc.

    MP350PFD 2/20/97 Vx.xx
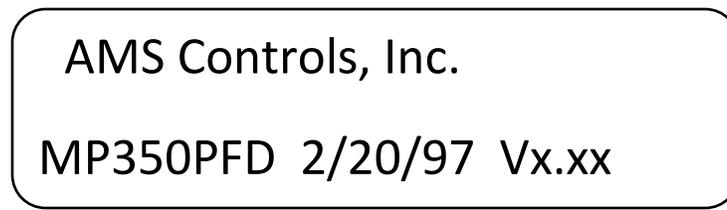
Figure 3-1. Initial Display at Power Up.

Make a note of the Version Number that is shown in the lower right-hand corner of the display. Write the Software Version number on the data sheet that is shown in the Appendix of this manual. If you call AMS Controls with problems or questions, you may be asked for this number.

Configuration Programming

Before the controller is initially powered up, the customization dipswitches on the back of the controller must be set. Refer to Chapter 7 for a description of the switches for the model of controller to be installed. If the switches are changed with power on, the power must be cycled so the controller can recognize the new switch positions. Memory will be cleared once the switches are changed and power is cycled. Once the new parameters are entered be sure to record them for possible re-entry.   In addition to setting the customization switches, the user can further customize the **MP350P-FD** by programming parameters in the Configuration mode. If the customizing switches have been changed, the **MP350P-FD** will erase all memory and go immediately into the Configuration mode.

The Configuration mode can be entered from the Status Screen by pressing the "SET UP" key until the following screen is displayed, and then by pressing the "4" key.

1= Next Job 3= Footage

2= Inc Qty   4= Configure
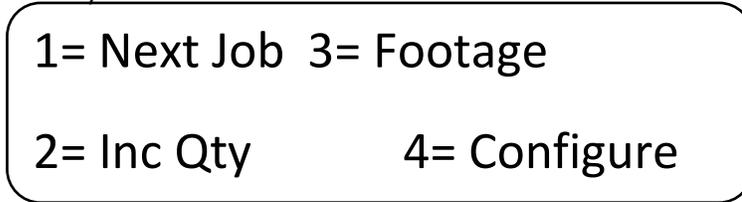
Figure 3-2. Next Job, Inc Qty, Footage, Configure Screen

Some of these parameters are general and apply to all switch settings while others apply only to certain switch settings. In this section, all of the possible setup parameters will be defined. The SETUP SHEET in the back of the manual provides a place for the setup parameters used in your application to be recorded.

General Parameters

When the controller is first energized, the memory has been cleared, or the Configure option is selected, the Configuration Screen will be displayed on the controller. The setup parameters can then be edited and saved in the controller. Press the "ent" key or the "setup" key to toggle through the setups.

Configure   Type 17

Halt Mode   Bundle Halt

Figure 3-3. Configuration Screen

Halt Mode

Halt Mode determines when the controller will execute an automatic line halt. The user has the choice of going from one job to the next without stopping, stopping after the completion of a bundle, or stopping after the completion of a job. The HALT MODE has three options

1. BUNDLE HALT (default)
2. AFTER JOB
3. DON'T HALT

23

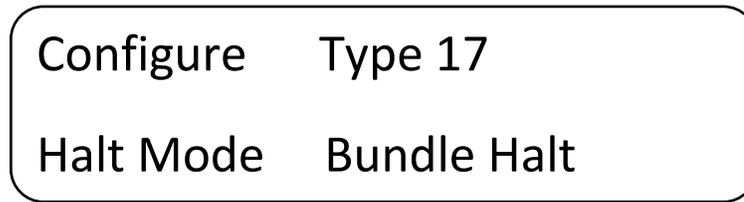In the BUNDLE HALT mode, the controller will not halt the machine at the completion of a job if the next consecutive job number has been programmed with a quantity and a length. This feature can be used to create automatic bundle stops by simply skipping a job number when a bundle stop is required.

When the AFTER JOB mode is selected, the controller will halt the machine after each job is completed.

In the DON'T HALT mode, the controller will not halt the machine at the end of a job as long as there is another job ready to run. The jobs need NOT be programmed with consecutive Job Numbers. The controller will not halt until ALL jobs are done.

To toggle through the choices, use any number key, and when the correct choice is visible, press ENT to record your selection.

Refresh Done Job?

If NO is selected here, when a job is finished, its remaining quantity is left at zero; if YES is selected, the remaining quantity is reset to the original quantity programmed, so that the job can be run again without manually reprogramming it.

To select the desired mode of operation, press any number key to toggle the display between NO and YES. When the correct choice is visible, press ENT to record your selection.

Halt No Parts to Run

If YES is selected, the controller will halt when all remaining parts have been loaded into the controller's memory. At this time it is desirable to program more orders so that scrap is not produced. If NO is selected the controller will not halt when all parts are loaded into memory and thus may produce scrap when more orders are run.

Corner Pattern

Pressing any number key toggles between STANDARD and SPECIAL. STANDARD mode allows the MP350P-FD to make standard HVAC ductwork, inserting both Corner notches and End notches in the proper locations. SPECIAL mode allows the controller to be set up like an MP350P. The Corner notch output (output 6) can be set up as a punch press which can be programmed to fire multiple times in various patterns within each part produced. See Chapter 4, Operation Procedure for details of programming for the two different modes.

Shear Dwell Down

SHEAR DWELL DOWN is the time it takes for the shear to move from the top of the stroke to the bottom of the stroke. The range of time allowed is 0.000 to 9.999 seconds and can be set to the nearest millisecond. If a SHEAR COMPLETE switch is wired in, the SHEAR DWELL can be set to zero. When the SHEAR COMPLETE switch closes, the SHEAR DWELL time will be overridden and the output will be turned off immediately. If a SHEAR DWELL time is used it should be long enough for the press to go pass the shear complete switch.

Shear Dwell Up

SHEAR DWELL UP is the time necessary for the shear to return from the bottom to the top of its stroke. On Flying Die machines, SHEAR UP and SHEAR DOWN times are combined into one called "SHEAR DWELL".

Note:

To ensure that a feed-to-stop line is not restarted until the shear complete switch has closed, it is possible to enter a SHEAR DWELL TIME OF ZERO. With a zero entered the controller will interpret this as "do not restart the line until the complete switch closes." If the complete input is not made within 10 seconds, then the line is halted, an error message is displayed "COMPLETE DETECT FAILURE". A non-stop line with a SHEAR DWELL of zero will run normally as long as the shear complete is activated after a shear. If the compete is not activated within 10sec, the line is halted.

A programmed time greater than zero gives a timed output according to the SHEAR DWELL TIME or turns on until a SHEAR COMPLETE is seen, whichever comes first.

Boost Dwell (With Shear Boost Only)

The BOOST DWELL time is the time after the shear that the die continues it's forward velocity to keep from causing damage to the leading edge of the material while the die returns. Refer to figure 3-4 for a visual description of the boost parameters. The range of acceptable values is 0.000 seconds to 9.999 seconds. The total Die Boost output "on" time is the Die Boost Reaction time + Shear Dwell + Die Boost Dwell. With a zero Boost Dwell, the Boost output will still equal the Shear Dwell time.
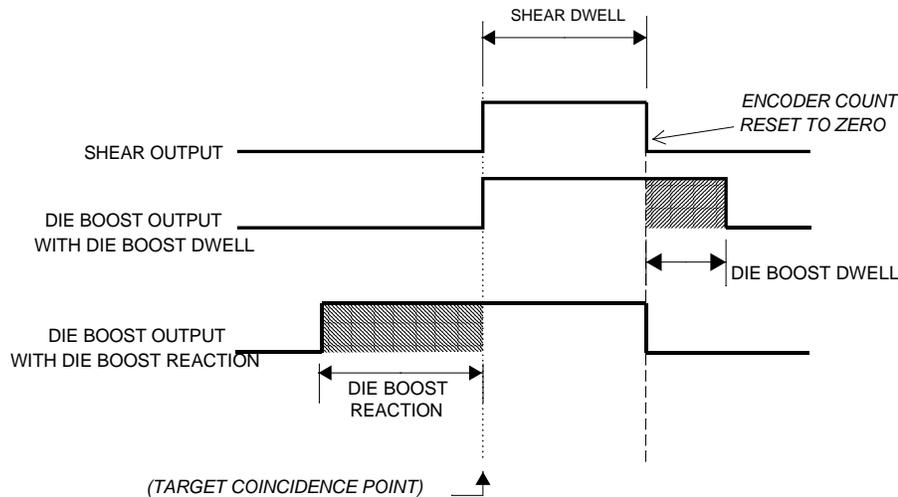
Figure 3-4. Die Boost Timing

If the leading edge of the part gets caught on the die, the SHEAR BOOST DWELL time should be increased If the die moves too far out causing the material to become misfed, the SHEAR BOOST DWELL time should be decreased.

Shear Kerf

The SHEAR KERF is defined as the amount of material removed when the shear cycles. Some cutoff dies have two cutting edges that blank out a slug of material. Shears that have a cutting action similar to a pair of scissors would use a kerf value of zero. For other types of dies or saws, the SHEAR KERF should be set to the length of the slug removed. This length is added to the length of each part programmed so that the resulting part length will be correct. The maximum SHEAR KERF is 10.0000 inches.

Lock Lead

This defines the length of the tab, which extends from the leading edge of the part caused by the end notch press. The LOCK LEAD will not be factored in to the part length when making blank type pieces (no end notches).

Lock Trail

This defines the length of the tab, which extends from the trailing edge of the part caused by the end notch press. LOCK TRAIL plus LOCK LEAD should equal the total slug of material removed when the end notch press fires. The LOCK TRAIL will not be factored in to the part length when making blank type pieces.

Delay After Shear

This parameter allows the operator to create a separation between parts. The line remains stopped for this amount of time after the shear has cycled. Increase this time to produce a longer pause between parts up to a maximum of 60.0 seconds. For no pause, enter zero.

Important Notice:

The customer is responsible for adequate safety devices as well as visual and audible indicators to prevent personnel from potential hazards. The long time delay that is allowed <u>must not</u> be confused for a machine-off condition.

Corner Dwell Down

Enter the length of time that the corner notch punch output signal should remain on. This sets the time duration of each press cycle in seconds. CORNER DWELL DOWN is the time it takes for the press to go from the top of its stroke to the bottom. The range of time allowed is 0.001 to 9.999 seconds, and can be set to the nearest millisecond.

Corner Dwell Up

CORNER DWELL UP is the time it takes to return from the down position to the up position. On flying die machines these parameters are combined into one called CORNER DWELL. The CORNER DWELL time that is entered into the controller is actually the CORNER DOWN time, and an equal amount of time is then allotted for the up time.

Corner Boost Dwell (With Boost Only)

The CORNER BOOST DWELL is the time after the press fires that the die boost output remains on to further push the die forward. This ensures that the press die is out of the way before the boost returns. When a CORNER BOOST REACTION time is programmed the CORNER BOOST OUTPUT is turned on for the CORNER BOOST REACTION time plus the entire PRESS CYCLE time plus the CORNER BOOST DWELL time. The range of acceptable values is 0.000 seconds to 9.999 seconds.

Shear-Corner

The SHEAR-CORNER DISTANCE is the physical length between the shear press and the center of the corner notch press. The largest acceptable value is 1000.0 inches. This distance can be set by manually firing the shear and corner notch. Then jogging the material out to measure the distance.

End Dwell Down

Enter the length of time that the end notch punch output signal should remain on. This sets the time duration of each press cycle in seconds. END DWELL DOWN is the time it takes for the press to go from the top of its stroke to the bottom. The range of time allowed is 0.001 to 9.999 seconds, and can be set to the nearest millisecond.

End Dwell Up

END DWELL UP is the time it takes to return from the down position to the up position.

Shear-End

The SHEAR-END DISTANCE is the physical length between the shear press and the center of the end notch press. The largest acceptable value is 1000.0 inches. This distance can be set by manually firing the shear and end notch. Then jogging the material out to measure the distance.

Bend Allowance

BEND ALLOWANCE is the length that is subtracted from each side of the duct. This is used to compensate for gain due to each bend and the difference between real and nominal measures. For example, when making a   shaped part (wrap-around type), there will be three corner notches for the three bends. At each bend the **MP350P-FD** controller will subtract the BEND ALLOWANCE from both the height section and the width section. So on a part with three bends, the controller subtracts a total of 6 BEND ALLOWANCES from the overall part length. This is shown in figure 3-5.
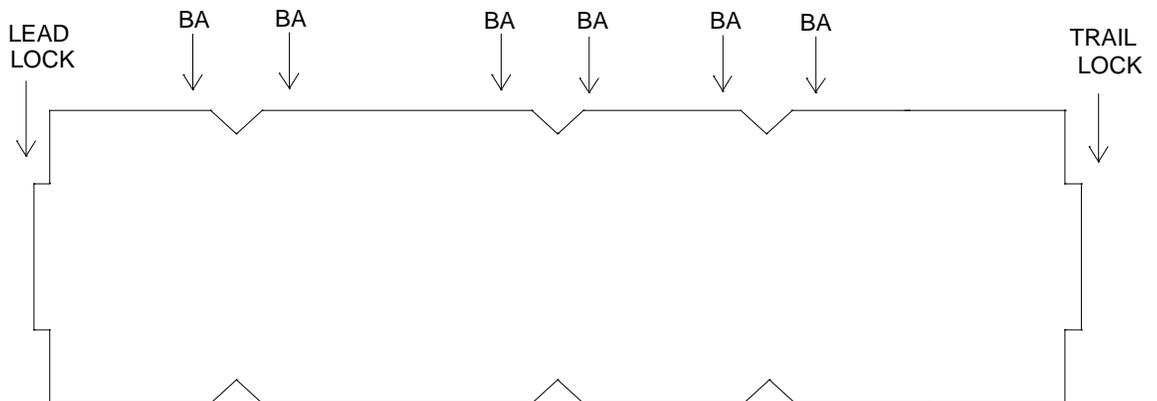

Figure 3-5. Bend Allowance

Scrap Length

When a new coil is loaded with the material threaded through the shear, the **MP350P-FD** controller may not be able to immediately produce the next order without incurring some scrap. The next potential part may be past a required punching station and therefore cannot be made. To solve this problem, the AMS controller will insert shear only parts until the next normal part is beyond the first required punch operation. The length of these shear only parts is determined by the SCRAP LENGTH parameter.

The user can set this parameter to produce usable parts or lengths that are at least easy to handle. If a SCRAP LENGTH of zero is entered, the controller will produce scrap pieces at the part length of the current order.

Speed Logic (Two Speed Only)

The **MP350P-FD** has four outputs, which control the speed and direction of the machine. To accommodate more than one wiring possibility, the **MP350P-FD** may be run with one of two different SPEED LOGIC settings: FORWARD-SLOW or FAST-SLOW. The controller outputs are defined differently for each logic setting. The outputs, their definitions, and their states in various conditions are shown in tables 3-1 and 3-2. Any number key toggles between FORWARD/SLOW and FAST/SLOW. Select the appropriate SPEED LOGIC to match your machine wiring configuration.

Machine State					
	Run Fast	**Run Slow**	**Jog Fwd**	**Halt**	**Jog Rev**
Output 1 (For)	ON	ON	ON	OFF	OFF
Output 2 (Slow)	OFF	ON	ON	ON	ON
Output 3 (Rev)	OFF	OFF	OFF	OFF	ON

Table 3-1. Status of Outputs in Forward-Slow

Machine State					
	Run Fast	**Run Slow**	**Jog Fwd**	**Halt**	**Jog Rev**
Output 1 (For)	ON	OFF	OFF	OFF	OFF
Output 2 (Slow)	OFF	ON	ON	OFF	ON
Output 3 (Rev)	OFF	OFF	OFF	OFF	ON

Table 3-2. Status of Outputs in Fast-Slow

Minimum Slow Distance (Two Speed Only)

On two-speed machines, the AMS controller calculates the distance before the shear or punch that the machine should shift into slow speed, if the DECEL FACTOR MODE is set to Auto. This is based upon the speed of the material and the deceleration characteristics of the machine. A minimum amount of slow distance can be manually set by the MINIMUM SLOW DISTANCE parameter. It is added to the calculated slow distance to extend the time spent in slow speed. It is best to set this parameter to a few inches initially until the system has been calibrated and the controller has had a chance to get accustomed to the behavior of the machine. When the machine is running good parts repeatedly, reduce the MINIMUM SLOW DISTANCE as much as possible to increase the production rate.

The prompt used is MIN SLOW DIST and is programmed in inches, centimeters, or millimeters. The largest allowable value of MINIMUM SLOW DISTANCE is 50 inches.

Tolerance (Feed-to-Stop Only)

This is the maximum allowable error in the positioning of an operation. You must be careful to set this value within the limits of the machine. TOLERANCE should be set small enough to get acceptable parts but wide enough to avoid production interruptions.

On feed-to-stop machines, the **MP350P-FD** controller can check for the material to be within a specified tolerance before activating the press. If the material has not stopped within this tolerance, the controller will halt and an error will be displayed. If the tolerance is set at 0.03 inches, the length past the shear must be equal to the programmed length plus or minus 0.03" before the shear will be cycled. The controller allows values from 0.0005 inches to 10.0000 inches. The default value for TOLERANCE is 1.0000 inches.

Encoder Direction

Pressing any number key toggles between CW (Clockwise) and CCW (Counter-Clockwise) for the direction of the encoder. If you run the line forward and the display counts negative, change the ENCODER DIRECTION.

Resolution

The RESOLUTION parameter defines the length of material movement for each increment of the encoder. It is a function of the circumference of the measuring

wheel and the number of counts per revolution of the encoder. The formula for calculating RESOLUTION is as follows:

$$\text{Resolution} \; = \; \frac{\text{Circumference}}{4 \; \text{x} \; \text{Encoder Count}}$$

For an AMS encoder, the encoder count is the model number of the encoder. A Model 256 is a 256 count encoder. A Model 1000 is a 1000 count encoder. The most common wheel used has a circumference of 12 inches. For this size wheel, RESOLUTION would be as follows:

MODEL	RESOLUTION
256	0.01171875
500	0.006
1000	0.003

It is not necessary to precisely measure the circumference or calculate the formula to any great precision. Nominal values can be used with precise results achieved during calibration. Values between 0.00004000 inches and 0.04000000 inches are acceptable.

Filter Constant

The FILTER CONSTANT can be adjusted in order to improve accuracy. A low value should be used on machines with very stable line speeds. A high value (greater than 50 Hz) should be used when rapid fluctuations in line speeds occur. Some trial may be necessary to achieve an accurate value. The default value is 32 Hz, which is considered to be a proper value for stable lines. The **MP350P-FD** controller will allow values from 1.0 Hz to 200.0 Hz.

Units

Length measurements can be programmed and displayed as inches, centimeters, or millimeters. This parameter toggles between either ENGLISH for inches, METRIC mm, and METRIC cm. The ENGLISH parameter will also measure in feet and feet/minute while the METRIC parameters will also measure in meters and meters/second. Press any number key to toggle through the choices, and then press ENT to record your selection.

Initial Machine Tests

Manual Shear

The shear can be manually activated using the CYCLE switch on the front panel. This causes the SHEAR output to turn on for the SHEAR DWELL time or until the SHEAR COMPLETE input switch closes. Make adjustments to the SHEAR DWELL time or the position of the SHEAR COMPLETE switch until the shear cycles properly.

Manual Press

The punch presses can be manually activated using the MANUAL END NOTCH and MANUAL CORNER NOTCH inputs. This causes the Punch outputs to turn on for the CORNER and END DWELL times. Make adjustments to the CORNER and END DWELL times until the presses cycle properly.

Jogging

If the jogging inputs are used, the inputs and outputs can be verified using the I/O screen, see "Input/Output Status" section in this manual. On two-speed machines, jogging is always done in slow speed. Also see the "SPEED LOGIC" section for more details.

Manual Calibration

A Manual Calibration mode can be entered by pressing SETUP until the screen in figure 3-6 appears and then by selecting the number for "Manual Calibrate". This is used to override the calibration values and to review the values calculated by the **MP350P-FD** for future reference.

> 1 = I/O 2 = Memory Test
>
> 3 = Manual Calibrate
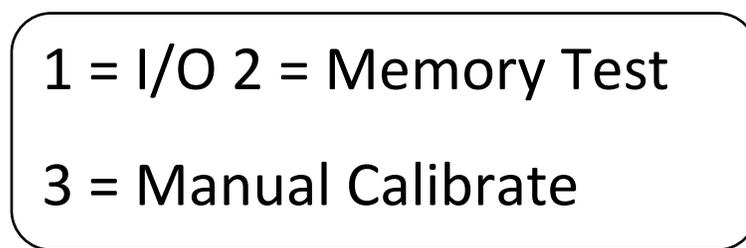
Figure 3-6. I/O, Memory Test, and Manual Calibrate Screen

Not all of the following parameters that are listed in the Manual Calibrate screens will be used on every machine type. A generic configuration sheet can be found in the back of the manual in Appendix A, and lists all the manual calibration parameters regardless of whether they apply to your situation or not. When in the Manual Calibration mode press the ENT button to move to the next parameter and SETUP to move back to the previous parameter.

Shear Reaction Time

The SHEAR REACTION time is the time delay between the time that the shear signal occurs and the time that the die contacts the material. This factor is used on flying die machines only. The maximum value is 0.5000 seconds. This parameter <u>must</u> be set correctly to achieve consistent part lengths.
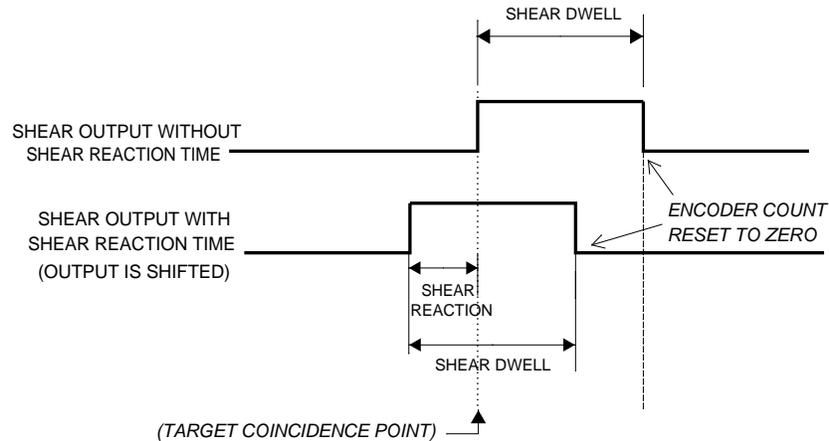

Figure 3-7. Shear Reaction Time

Calculate the SHEAR REACTION time using the following steps: 1) Set the SHEAR REACTION time to zero.
2) If there is a SHEAR DIE BOOST, disable it, by disconnecting the wire on the output of the controller.
Note: If necessary, slow the line speed down to prevent the metal from getting jammed up in the shear die.
3) Cycle the shear.
4) Run two parts.
5) Mark the parts "1st Part and 2nd Part".
6) Use the following formula for the new SHEAR REACTION time.

$$\text{Shear Reaction Time} = \left[\frac{(\text{1st Part } - \text{ 2nd Part})}{\text{Line Speed}} \right] \times 5$$

7) Enter the new SHEAR REACTION time into the controller
8) Run two more parts.
9) Measure the two parts and verify their lengths (both parts should be the same length).
10) Once the SHEAR REACTION time is set, rewire the SHEAR DIE BOOST output.

As shown in Figure 3-7, the SHEAR REACTION time will compensate for the time that it takes the shear to react to the shear signal. A SHEAR REACTION time will start the shear output prior to the target coincidence point and keep the shear on for the length of time of the SHEAR DWELL. This will effectively shift the shear output forward in time, which causes the output to start and end earlier than if no SHEAR REACTION time is entered.

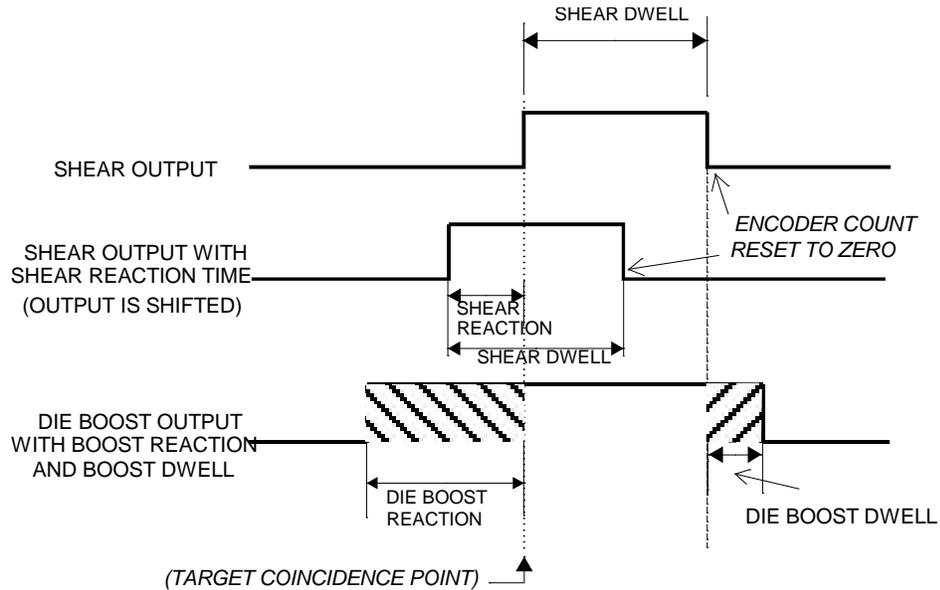Figure 3-8. Die Boost Timing

Boost Reaction

As shown in Figure 3-8, the DIE BOOST will have an effect on both the beginning and the end of the shear output. The DIE BOOST REACTION time will turn the BOOST on early to allow the die to match the line speed. The DIE BOOST DWELL will continue to push the die after the SHEAR DWELL time to allow the shear to retract without scraping the part.
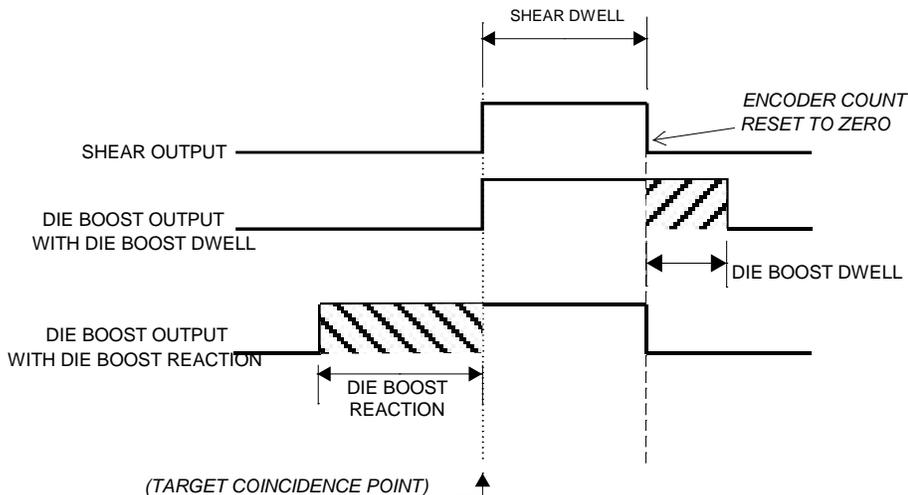

34

Figure 3-9. Die Boost Timing with Shear Reaction.

As shown in Figure 3-9, when a DIE BOOST REACTION time larger than the SHEAR REACTION time is added, the DIE BOOST output is turned on before the time of the SHEAR REACTION. The DIE BOOST DWELL will still be added to the end of the SHEAR DWELL without the SHEAR REACTION effect.

If the leading edge of the part gets caught on the die, the SHEAR BOOST DWELL time should be increased If the die moves too far out causing the material to become misfed, the SHEAR BOOST DWELL time should be decreased.

Corner Reaction Time

The CORNER NOTCH REACTION time is the time delay between the time that the punch signal occurs and the time that the die punches the material. This factor is used on flying die machines only. The maximum value is 1.000 seconds.

Once the Shear Reaction time and Correction Factor are set calculate the CORNER REACTION time using the following steps:
1) Set the CORNER REACTION time to zero.
2) Program a "U" shape 30" x 30" part.
3) Cycle the shear.
4) Run the line.
5) Stop after the second corner notch is punched.
6) Jog the material out and measure the leading edge to the first notch (minus the programmed LOCK LEAD size).
7) Measure the first notch to the second notch.
8) Use the following formula for the new CORNER REACTION time:

$$\text{Reaction Time} = \left[\frac{(\text{LE to 1st Corner}) - (\text{1st to 2nd Corner Notch})}{\text{Line Speed in FPM}} \right] \times 5$$

LE to 1st Corner = Leading Edge to 1st Corner Notch minus the programmed LEAD LOCK size.

Note: Prior to using the procedure to calculate the CORNER REACTION, the SHEAR REACTION and CORRECTION must be calculated.

Corner Boost Reaction

Like the Shear Boost, the Corner Notch Boost also has a programmable reaction time. The CORNER BOOST will have an effect on both the beginning and the end of the press output. The CORNER BOOST REACTION time will turn the BOOST on early to allow the die to match the line speed. The CORNER BOOST DWELL will continue to push the die after the CORNER DWELL time to allow the die to retract without scraping the part.

When a CORNER BOOST REACTION time larger than the CORNER REACTION time is added, this will turn the CORNER BOOST output on before the time of the CORNER REACTION. The CORNER BOOST DWELL will still be added to the end of the CORNER DWELL without the CORNER REACTION time effect.

Stopping Reaction Time

On feed-to-stop machines, a STOPPING REACTION time parameter is used. This represents the time delay from the time that the controller turns off the movement outputs until the material actually stops. A larger reaction time will stop the line earlier; a smaller reaction time stops the line later. The user has a choice of three STOPPING MODES: AUTO, MANUAL, or OFF.

AUTO: The **MP350P-FD** controller turns off the movement outputs prior to the actual shear or punch point to allow for the momentum and inertia of the machine. A new STOPPING REACTION time is calculated after each stop based on the average stopping time for several cycles. This parameter may be overridden in the Manual Calibration mode but the value will be modified on the next part that is run. The maximum value is 5.000 seconds.

MANUAL: The **MP350P-FD** controller turns off the movement outputs prior to the actual shear or punch point as above. However, when in MANUAL, the controller does not recalculate a new STOPPING REACTION time after each stop. Whatever value is manually entered remains constant. The maximum value is again 5.000 seconds.

OFF: A STOPPING REACTION time is not calculated and is not used at all by the **MP350P-FD** controller. The movement outputs are turned off when the material past the shear point is equal to the programmed length of the part. This should cause parts to come out long due to the momentum of the machine and material during stopping. Also, when the STOPPING MODE is set to OFF a tolerance test is not performed.

The default mode for STOPPING REACTION time is AUTO, which is the recommended mode of operation.

Deceleration Factor

On two-speed machines, the MP350P-FD controller uses a DECELERATION (DECEL) FACTOR when changing from fast to slow speeds. The DECEL FACTOR should be used in conjunction with the MINIMUM SLOW DISTANCE to determine the ideal time to change from fast to slow. The user has the option to select from three DECEL FACTOR MODES: AUTO, MANUAL, or OFF.

AUTO: A DECEL FACTOR is automatically maintained by the **MP350P-FD** controller. It is expressed in inches-per-second-per-second (In/Sec^2) and is used in the Adaptive Slowdown calculation. The parameter can be overridden but will automatically update on the next movement.

MANUAL: A DECEL FACTOR may be manually entered into the controller. The value is used in the Adaptive Slowdown calculation. Some trial and error may be necessary when in the MANUAL mode to find a DECEL FACTOR that works properly. Ideally, the machine should shift from fast to slow at some distance prior to the target (shear or punch point) long enough so that it reaches a constant slow velocity before the movement outputs are turned off.

If the machine tends to shift into slow too soon, increase the DECEL FACTOR. If the machine tends to shift into slow too late, decrease the DECEL FACTOR. While in the MANUAL mode, the **MP350P-FD** controller will not calculate a new value for the DECEL FACTOR after each stop.

OFF: No DECEL FACTOR is used and the controller will not make an Adaptive Slowdown calculation. The machine will shift from fast to slow when the material has reached the MINIMUM SLOW DISTANCE before the target. For example, if the MINIMUM SLOW DISTANCE has been set to four inches, the machine will shift from fast to slow 4 inches before the shear or punch point. This may or may not be enough distance for the machine to decelerate properly.

The DECEL FACTOR mode defaults to OFF but may be used in MANUAL or AUTO to increase productivity.

Correction Factor

The CORRECTION FACTOR adjusts for errors in the size and tracking of the measuring wheel. It is expressed as a percentage, with 100% being no correction. Increasing the CORRECTION FACTOR causes the parts to become longer and decreasing the value shrinks the parts.

Calculate the CORRECTION FACTOR using the following steps:
1) Run ten parts of equal lengths, 120" for example.
2) Measure the ten parts.
3) Find the average length by adding up all ten parts and dividing by ten.
4) Use the following formula for the new CORRECTION FACTOR, using the average of the ten parts for "actual measured length.":

$$\text{New CF} = \left(\frac{\text{Programmed Length}}{\text{Actual Measured Length}} \right) \times \text{Old CF}$$

CF = Correction Factor

Input/Output Status

This mode allows you to view the current status of all the **MP350P-FD's** inputs and outputs. This can be very helpful in troubleshooting the system during and after an installation. To view the I/O screen, press the SETUP key until the screen in figure 3-6 of page 3-12 appears, then select the number for I/O.

The number of the active input and/or output will appear on the display.
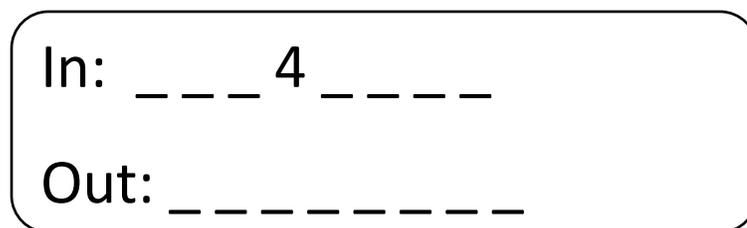
```
In: _ _ _ 4 _ _ _ _

Out: _ _ _ _ _ _ _ _
```

Figure 3-10. Input/Output Status Screen

Memory Test

This causes the controller to enter a self-test mode in which it verifies all internal memory "chains." If no errors are reported, all memory can be considered good.

Clearing Memory

Do not clear the memory unless you have written down all Setup, Pattern, and Order information for re-entry.

If you are experiencing controller problems, it is not recommended that you clear the memory unless you have made extensive troubleshooting checks (see the section in the back of the controller manual titled **"In case of a Problem"**). The steps listed include: making sure you have checked the encoder, the shear, the calibration procedure, rechecked setups, used the built-in diagnostic features, checked the incoming power, and cycled power off and on.

You can clear all storage in the **MP350P-FD** (including Setup and Order data) by following this sequence:

1) Make sure that the Security Switch is unlocked.
2) Turn off power to the controller.
3) Wait five seconds.
4) Press the "5" key and turn the controller's power back on.
5) Hold down the "5" key for at least 5 seconds after you turn the power on.
6) Let go of the "5" key and let the controller power up normally.

Chapter 4: Operating Procedure

Entering Orders

An order consists of a Job Number, a Quantity, a part type, and a height and width. Several orders can be entered into the controller at one time. The ability to program more than one job at a time gives the user the potential to change sizes without stopping the machine. This saves time on short runs.

The efficiency of a multiple batch controller can be lost if the controller is not easy to program and understand. The AMS controller solves this problem with its clear and concise method of programming.

Programming the **MP350P-FD** controller is a simple matter of keying in data in answer to a flashing prompt. The ENT key is a "take it" command from the operator to the controller, meaning the currently displayed value is stored into memory when the ENT key is pressed. The ENT key can also be used to move the cursor from one field to another when reviewing data already programmed. Note that you <u>must</u> use the ENT key to enter new or altered data into memory.

Changes are made by simply writing over the old value. Pressing the first numeric key causes the old value to be erased and the new numbers to shift in from the right. In case of a mistake during an entry, press the CE (Clear Entry) key to erase the entry and start over. A new correct value can then be keyed in. When the correct value is displayed, press the ENT key to move to the next field.

The **MP350P-FD** can be set up to operate in two different modes. By setting the setup parameter CORNER PATTERN to STANDARD, the controller may be programmed to make regular HVAC duct work. By setting the CORNER PATTERN to SPECIAL, the controller may be programmed as an **MP350P**, allowing the Corner notch output to be used as a single punch which can be programmed to fire multiple times within a part at any point desired.

Standard Part Programming

Job Number

Enter the Programming Mode by pressing the PRG key. The first data item to enter is the Job Number, indicated by the flashing display. The controller will assume that you wish to program the next job number after the last one that was programmed. If Jobs 1 through 10 have been programmed, the Job Number displayed will be Job 11. This is merely a suggestion by the controller. You may enter any Job Number from 1-999. If you entered Job 1 through 10, you may review, and correct Jobs previously programmed. Press the ENT key to confirm the present Job Number.

The Job Number can be used to create bundle stops. The **MP350P-FD** controller can be made to go from one job to the next without halting the line provided that the Job Numbers are consecutive. If you wish to insert bundle stops, skip a job number between bundles. In the following example, bundles have been set up on intervals of 10 jobs, even though there are fewer than 10 jobs per bundle. The machine will halt after completing jobs 5 and 13. Refer to the Setup parameter HALT MODE for more details on setting bundle stops.

Job	Qty	Type	HT	WD
1	10	L	35.00"	38.00"
2	12	L	27.00"	36.00"
3	16	U	12.00"	24.00"
4	16	—	24.00"	0.00"
5	10	O	12.00"	12.00"
11	8	L	28.00"	30.00"
12	9	O	6.00"	8.00"
13	6	O	10.00"	12.00"

Quantity

After the Job Number is entered, the Quantity will be flashing. Simply key in the desired quantity and press ENT to confirm the number. If you enter a quantity of 0 on a previously programmed job, that job will be erased.

The Quantity can be set from 1 to 9999 pieces. If the quantity entered is **exactly** 9999, when this item is run, the controller will run this length until it is stopped manually, without decrementing quantity. This feature is provided for those who need to simply fill a bin with parts of a fixed length.

Type

After the Quantity is programmed, the Type field will be flashing. Press any number key to toggle through the four available types: ⎯, L, U, O, representing flat, single bend, double bend, and wrap-around type parts. Press the ENT key to enter the desired selection. Note that each type will produce sufficient parts for one-four sided piece of ductwork. Flat parts are produced four at a time, L-shaped parts are made in pairs, U-shaped parts are accompanied by a single flat cover part, and wrap-around type parts produce one–four sided piece of duct.

Height

After the Type is programmed, the Height field will be flashing. Enter here the finished height of the duct to be made. Enter the height in whatever Unit format was selected when the **MP350P-FD** controller was installed. The longest length the AMS controller will accept is 999.99".

When entering lengths, no leading or trailing zeros are required. The following entries (in Decimal Inch mode) each produce the same 10-inch part:
10
010
10.
10.00
10.000

Width

After the Height is entered, the Width will be flashing. Enter the finished width of the duct to be made.

NOTE: To produce blank sheets with no notches, select the flat sheet (⎯) Type of duct and program a Height dimension for the sheet length with a Width of 0.00"

When these 5 items have been entered, more jobs may be entered or the star (∗) key may be entered to accept the jobs just programmed.

Special Part Programming

Job Number

Enter the Programming Mode by pressing the PRG key. The first data item to enter is the Job Number, indicated by the flashing display. The controller will assume that you wish to program the next job number after the last one that was programmed. If Jobs 1 through 10 have been programmed, the Job Number displayed will be Job 11. This is merely a suggestion by the controller. You may enter any Job Number from 1-999. If you entered Job 1 through 10, you may review, and correct Jobs previously programmed. Press the ENT key to confirm the present Job Number.

The Job Number can be used to create bundle stops. The **MP350P-FD** controller can be made to go from one job to the next without halting the line when the Halt Mode is set to Bundle Halt, provided the Job Numbers are consecutive. If you wish to insert bundle stops, skip a job number between bundles. In the following example, bundles have been set up on intervals of 10 jobs, even though there are fewer than 10 jobs per bundle. The machine will halt after completing jobs 23 and 34. Refer to the Setup parameter HALT MODE for more details on setting bundle stops.

Job	Quantity	Length	Option
21	2	180.000	Even
22	30	174.000	Rand
23	42	162.000	No P
31	25	150.000	No P
32	17	90.000	Rand
33	25	122.500	No P
34	50	135.000	Even

Quantity

After the Job Number is entered, the Quantity will be flashing. Simply key in the desired quantity and press ENT to confirm the number. If you enter a quantity of 0 on a previously programmed job, that job will be erased.

The Quantity can be set from 1 to 9999 pieces. If the quantity entered is **exactly** 9999, when this item is run, the controller will run this length until it is stopped manually, without decrementing quantity. This feature is provided for those who need to simply fill a bin with parts of a fixed length.

Length

After the Quantity is programmed, the Length field will be flashing. Enter here the finished length of the part to be made (do not count the shear kerf; the controller will automatically add in this amount, if any). Enter the length in whatever Unit format was selected when the **MP350P-FD** controller was installed. The longest length the AMS controller will accept is 3500.000".

When entering lengths, no leading or trailing zeros are required. The following entries (in English mode) each produce the same 10-inch part:
10
010
10.
10.00
10.000

Punch Option

After entering a length, the user is prompted to enter a Punch Option. Pressing any number key toggles between three options:

1. No P - No punches
2. Rand- A random punching pattern
3. Even- Evenly spaced punches

No P (No Punches)

Select this option to make shear only parts when no additional punches are required.

Rand (Random Punches)

Select Rand to make parts with one or more randomly spaced punches. The display will look similar to the one shown in figure 4-1.

```
 _____
/                                \
|  Punch      Length              |
|                                 |
|  1              ********"        |
|                                 |
_____/
```
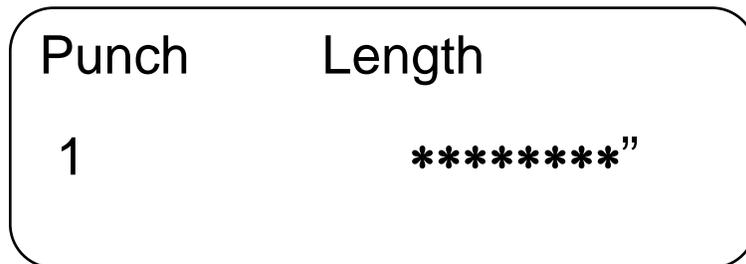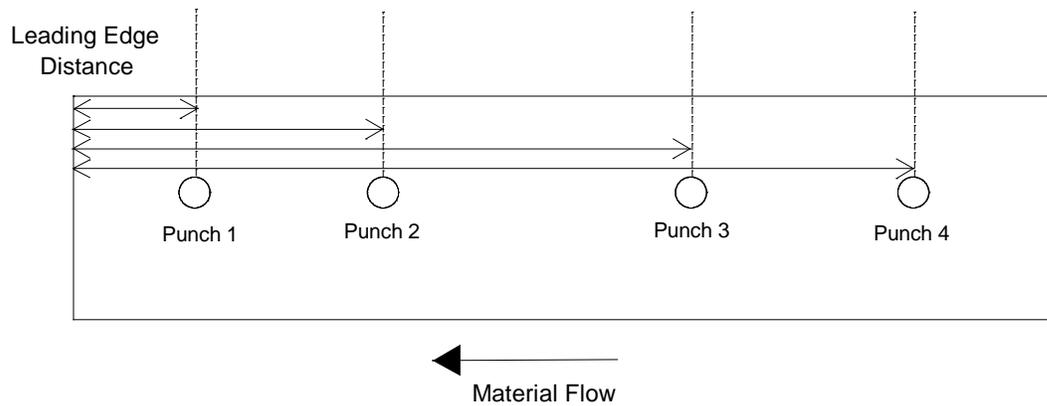
Figure 4-1. Random Punching Display

Figure 4-2. Random Punching Pattern.

Press ENT to confirm Punch #1, the first punching operation. Now enter the length at which the first punching operation should be made. This length (and all punch lengths) is measured from the leading edge of the part. For example, when entering the length for Punch #2 (the second punching operation), of 24 inches, the punch will occur 24 inches from the leading edge of the part, not 24 inches from Punch #1. Repeat for as many punches needed (up to 300) for this part length. When all of the punches have been entered, press the asterisk (∗) key to enter more jobs.

Even (Evenly Spaced Punches)

Select Even to make parts, which have evenly spaced punches throughout the part length. The display will look like the one shown in Figure 4-3.
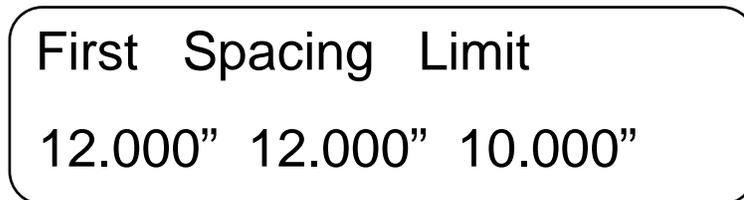
Figure 4-3. Even Spacing Display

While "First" is flashing, enter the length at which the first punching operation should occur. After pressing the ENT key, Spacing will start to flash. Enter the desired center to center punch spacing. For example, if 12 inches is programmed for Spacing, punches will automatically be placed on 12-inch centers. After Spacing is entered, "Limit" will start to flash. Enter the distance from the trailing edge on the part beyond which no punches are desired. For

example, if 25 inches is programmed for the "Limit", no punches will be placed within 25 inches from the end of the part.
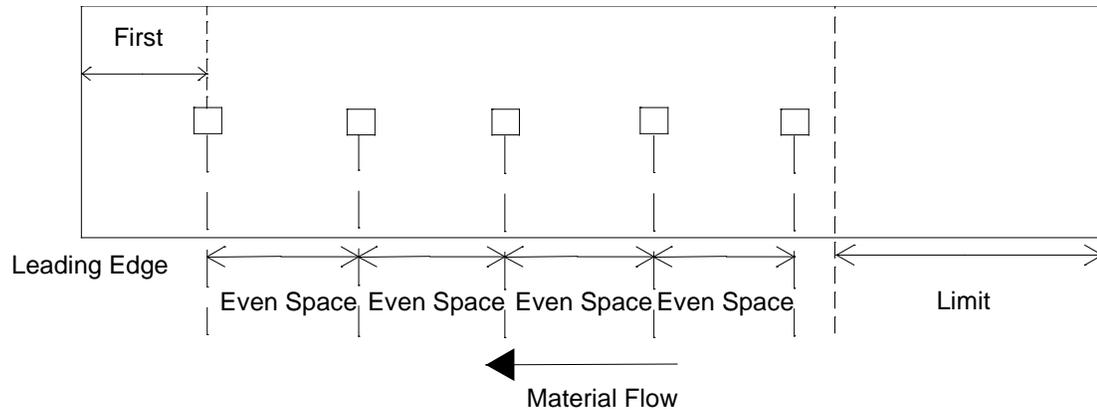

Figure 4-4. Even Space Punching Pattern

See figure above for a visual description of "Even Space" and "Limit". After the Limit is entered press the (∗) key to enter more jobs.

Reviewing Programmed Jobs

It is possible, at any time, to review the jobs, which have been programmed. While in the PROGRAM MODE, PRESS the SETUP key to step through the jobs in descending order, or press the PRG key to step through the jobs in ascending order.

Exiting the Program Mode

The (∗) key is used to exit the PROGRAM mode and revert to the normal running display. It is also used to exit the SETUP mode.

Referencing Controller to the Material

The **MP350P-FD** controller measures relative movement of the material through the machine and has no way of measuring the absolute amount of material that is past the shear. In order to cut accurate lengths, the controller must know how much material is past the shear at some point in time and then it can make relative measurements thereafter. This is a process called referencing.

Referencing is simply loading material into the machine past the shear and closing the MANUAL SHEAR input switch. At the bottom of the shear stroke, the length counter is set to zero and the controller is referenced. If there are FILLED

parts, in the controller's memory, the shear must be cycled _twice_ to reference the AMS controller. The controller will remain referenced as long as the encoder stays in contact with the material and the material does not move while the controller is turned off.

On some flying die machines, it is not possible to cycle the shear while the material is stopped. Some presses have mechanical "kickers" that push the die forward as the press comes down, refer to figure 4-5. Some mechanical presses push the die forward in addition to pushing down. For these machines, referencing must be done on the fly with a crop cut after the machine has been started. This is also done with the CYCLE switch.
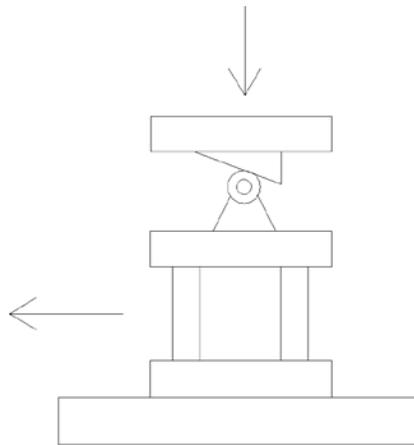
Figure 4-5. Flying Die with Mechanical Kicker

On Feed-To-Stop machines, the **MP350P-FD** controller re-references itself to the material on each automatic cut at the bottom of the shear cycle. This is done to improve accuracy.

The material can overshoot or undershoot the shear point on each feed. With simple electronic counters, an overshoot on one cut followed by an undershoot on the next cut will cause the second part to be short by the sum of the overshoot plus the undershoot. By re-referencing the controller during each cut, the controller will limit the error to either an undershoot or an overshoot which effectively cuts the error in half.

Running the Machine

Status Display

The Status Display looks like the one shown in Figure 4-6.

```
┌─────────────────────────────────────┐
│  #  1        100 Pcs   128.000"      │
│                                      │
│  S 120    63 Left   22.472"          │
└─────────────────────────────────────┘
```
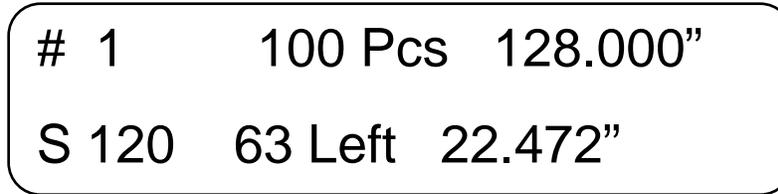
Figure 4-6. Typical MP350P-**FD** Status Screen

The top row shows the job number of the current order, programmed quantity of the current order, and the height and width of the part to be made. The bottom row shows the machine speed in feet per minute (or meters per minute), the quantity remaining in the order, current type programmed, and the current length past the shear.

Figure 4-7 shows the status display for the **MP350P-FD** when the CORNER PATTERN is in the SPECIAL mode**.**

```
┌─────────────────────────────────────┐
│  # 1   4   12.00"   14.00"           │
│                                      │
│  s 120  4   Typ=L   22.472"          │
└─────────────────────────────────────┘
```
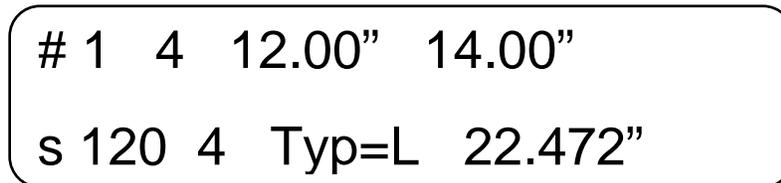
Figure 4-7. **MP350P-FD** Status Screen when running
        Special CORNER PATTERN

The top row shows the current Job Number, the programmed quantity of the current order and the length of the part to be made. The bottom row shows the machine speed in feet per minute (or meters per minute), the quantity remaining in the order, and the current length past the shear.

Setting the Next Job to Run

If the Job Number shown in the upper left hand corner of the Status Display is not the job that you wish to run next, press SETUP and then select the number for NEXT JOB. The controller will prompt the operator "Set Next Job to Run After Current One".

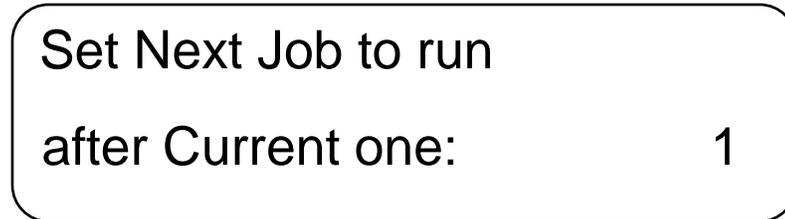Set Next Job to run

after Current one: 1

Figure 4-8. Set Next Job to Run Screen

Enter the desired Job Number and press ENT. If the machine is halted when the NEXT JOB function is entered, then the new Job Number that was entered will begin as soon as the machine is placed in RUN.

If the original Job Number is still displayed even though a new NEXT JOB number has been entered, one or more parts from the original job have already been stored in the controller's memory and must be made next to avoid making scrap. After these parts are made, the machine will halt and the new NEXT JOB will be ready for production.

If the operator desires to halt the current job that is running and immediately begin making parts from a different job, these steps must be followed.

1. Halt the machine.
2. Manually cycle the shear _TWICE_ to eliminate the parts, which have already been FILLED.
3. Set the NEXT JOB TO RUN as described above.
4. Press the RUN input switch.

Doing this may cause one or more scrap pieces to be generated.

If the machine is running at the time, the operator is asked to "Set the Next Job to Run After the Current Job." If the operator enters a valid Job Number, he/she will then be asked "Change Job Now (YES/NO)". If NO is selected, the controller will complete the current job and then be ready to run the new NEXT JOB that the operator selected. If YES is selected, the controller will complete the parts

from the current job, which have already been loaded into the queue and then immediately change to the new NEXT JOB that the operator selected.

Starting the Machine

After the NEXT JOB is set, the machine is placed in the RUN mode by pressing the RUN button on the front panel. The **MP350P-FD** controller will begin making parts to the programmed dimensions and decrement the quantity remaining for each piece cut.

When the quantity remaining reaches zero, the controller may or may not begin production on the next consecutive job number without halting; depending upon the HALT MODE that was selected while configuring the machine. If the next sequential job is not programmed, the controller will halt the machine.

Halting Production

At any time, the operator can halt the line by pressing the Halt button. The movement outputs will be turned off immediately but the **MP350P-FD** controller will remain in the RUN mode until the material has stopped. This allows for an automatic cut to be made as the material decelerates.

The controller will remain in the RUN mode until the material has stopped or 3 seconds have elapsed. Normally, the operator would halt the machine just after a shear is made and a cut would not occur during deceleration. If the RUN contact is opened while a press is operating, the movement outputs will remain on until the press has completed its cycle (SHEAR or PRESS DWELL time).

Monitoring Production

The **MP350P-FD** controller has three footage totalizers available for monitoring production. The totalizers show the amount of footage that has gone past the shear as well as the total number of parts cut since the last time the totalizer was cleared.

To access the footage totalizers from the normal running display press SETUP, until the following display appears:

```
1 = Next Job    3 = Footage

2 = Inc Qty 4 = Configure
```
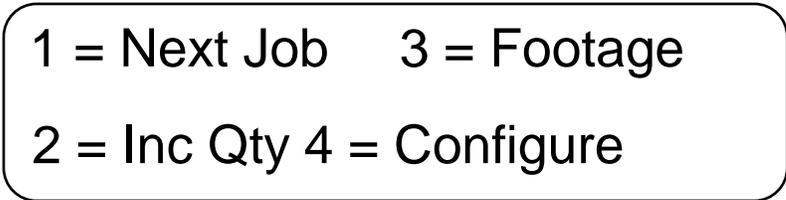
Figure 4-9. Next Job, Inc Qty, Footage, Configure Screen.

Pressing the number for FOOTAGE will allow the totalizer screens to be viewed and/or cleared. Pressing the ENT key steps the user through the three totalizers.

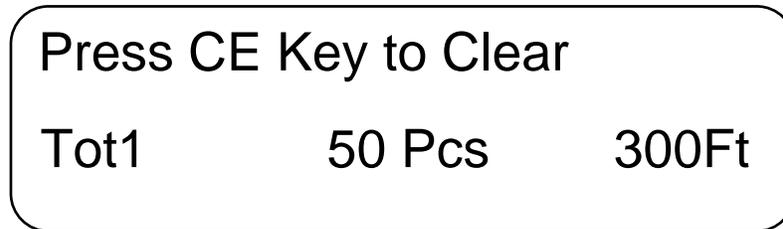Press CE Key to Clear

Tot1   50 Pcs   300Ft

Figure 4-10. Totalizer 1 Screen.

The three totalizers are independent of each other and can be used for any purpose. One suggestion for their use would be to use one for totalizing footage used on a coil, one for footage used on a customer's order, and one for the total footage run during a shift.

Clearing these totalizers back to zero at the proper time would be the responsibility of the operator. The controller will prompt the user to "Press CE key to Clear" as the totalizers are being displayed. If Metric units are being used instead of English, the totalizers will display the totals in meters.

Special Procedures

Changing Coils

The following procedure should be used when changing coils to ensure proper accounting of the material used on a coil and an accurate first part after the new coil is loaded:

– If the coil has been completely consumed or the material has been cut free of the stock reel, as is the case with most roll formers, feed the material through the shear in the forward direction and dispose of the scrap piece.

– On a cut-to-length machine with no roll former involved, all of the unused material can be rewound on the mandrel for later use. In this case, back the material out through the entrance end of the shear until it is out from under the encoder.

– After the machine is empty, press the CYCLE switch on the front panel. This registers all material used to the totalizers.

– Press SETUP and then the number for FOOTAGE. Press ENT to step though the totalizers used to record the amount of material used.

– Record the amount of material used.

- Press CE to clear the totalizer.
- Thread the next coil into the machine until a clean edge is past the shear and the material is under the encoder.
- Press the CYCLE switch to reference the new coil.

Handling Material Flaws

With most roll formers and cut-to-length machines, material problems are common. The **MP350P-FD** controller has features that aid the operator when these flaws occur.

The best method of handling material flaws depends on when the flaws are detected and the duration of the flaw. If random small flaws occur, they are not likely to be detected until after the controller has cut the part. In this case, the only thing that the operator can do is make another part to replace it. This is easily done with the INCREASE QUANTITY function.

While viewing the Status Display, press SETUP and then the number for INC QTY. This will cause the quantity "LEFT" on the Status Display to stay the same (not decrease) when the next part is made.

If a small flaw is detected before the shear, the operator may wish to crop the flaw out to minimize the amount of scrap material. On flying die machines, the CYCLE switch is active while the machine is running. The crop starts the production of the part over again and the operator can repeat this process until the good material occurs. In the case of feed-to-stop machines, the machine must be halted before the CYCLE switch is active. The operator would most likely jog the material forward until the flaw is past the shear and then press the CYCLE switch a second time.

There are times when material flaws can be extensive and last for a large portion of a coil. A user may find that this material is easier to handle if it is cut into short lengths rather than relying on the operator to crop repeatedly. There may also be secondary outlets for such material if they can be cut to standard lengths of perhaps 8, 10, and 12 feet. If this is the case, jobs for this purpose can be programmed with high job numbers reserved for this purpose beforehand, then the operator can switch production to these jobs when extensive flaws occur. After the flaw has been cleared, the operator can use the NEXT JOB function to resume normal production.

Chapter 5:   Specification

Parameter	Panel Mount	AC Consolette

Mechanical

Size	8"X12.5"X2.25"	8"X12.5"X7.5"
Weight	7lbs.	15lbs.

Electrical

Input Voltage	24VDC ±5%	115VAC ±10%, 50-60Hz
Input Current	.5 Amp.	1 Amp.

(Note: The following parameters apply equally to all versions.)

Output Characteristics

Std DC

Type	Open Collector Transistor
Maximum Current	4 ADC
Maximum Applied Voltage	35 VDC

AC Relay

Type	Form A Dry Circuit Relay
Maximum Current	5 Amp.
Maximum Applied Voltage	240VAC

Solenoid Driver

Type	High Voltage Internal Driver
Minimum Load Resistance	12 Ohms
Maximum Voltage Generated	65 VDC
Maximum Actuation Time	0.25 Seconds

Encoder Input

Type	Quadrature with Complements
Voltage	5VDC
Maximum Encoder Load	200 milliamperes

Operation

Number of Batches	999
Maximum Part Length	3,500.000 inches
	88,900 millimeters
Maximum Parts/Batch	9999
Units of Measurement	inches, centimeters, or millimeters
Footage Totalizers	3
Maximum Footage/Totalizer	1,000,000 feet
	1,000,000 meters

Features

Display	48 characters in 2 rows
Keys	16
Controls	3 (CYCLE, RUN, HALT)

Chapter 6: Changes to the MP350P-FD Software

The following is a list of the software changes and procedures that have been made to the AMS Controls MP350P-FD controller. This document will just be a list of the changes that have been made.

Software Changes For Version 14.00

The limits for the Setup Parameter "Delay After Shear" were expanded from 0 to 9.99 seconds to 0 to 60.0 seconds (SCN 314)

Shear Dwell time of 0 is allowed. Shear Complete switch must be used with controller if dwell time of 0 is entered (SCN 317).

Occasionally during the controller's initial power up, the LCD would not initialize itself properly resulting in both lines of text being displayed on the top line of the LCD (SCN 427).

An error was found and corrected where the Run output would stay on until the CE key was pressed if a Missed Shear or Missed Punch error occurred. (SCN 486)

From a memory cleared condition, the controller would fire the shear without a dwell time being entered, the shear would fire for an internally set default time of 10 seconds. The internal default was changed so the shear can not be fired without a shear dwell time being entered (SCN 487).

Chapter 7: Setting the Customizing Switches

The **MP350P-FD** controller is a universal device capable of controlling several types of ductwork machines. In order to do this, some outputs and inputs have different functions depending upon the type of machine on which the controller was installed. Also, each type of machine has its own unique set of machine parameters that must be programmed. Parameters for one type of machine may have no meaning for a different machine. For example, a "Feed-to-Stop" machine needs a MINIMUM SLOW DISTANCE when slowing down for a shear. This parameter would be useless on a single speed "Flying Cutoff" machine, and may confuse the operator.

In order to make the **MP350P-FD** controller applicable to many types of machines and still be easy to use, a set of customizing switches are included which define the type of machine being controlled. Once the machine type has been determined, the function of the outputs and inputs is fixed and the machine parameters are limited to only those required for that type of machine. Although adding a step to the first part of the installation, this approach simplifies the controller thereafter.

Before applying power to the controller, the customizing switches must be set. These switches can be found on the back of a panel mount style controller, or by removing the cover of a consolette style controller. The switches are located near the center of the of the printed circuit board. There are seven segments to the switch assembly numbered from 1 through 7 and are set to either the ON or OFF positions to match the requirements of the installation.

Chapter 8:   Controller Switch Settings

Shear Type (Switch 1)

OFF	Feed-to-Stop Shear
ON	Non-Stop Shear

Switch 1 should be set to the ON position for shears, which operate on the fly (Non-Stopping). Set Switch 1 to OFF for shears, which operate on Feed-to-Stop machines.

Shear Die Boost (Switch 2)

OFF	Shear Die Boost Active
ON	No Shear Die Boost

Machines, which do not stop for each shear and have a device to push the die forward as it is being cut, would set Switch 2 to the OFF position. Set Switch 2 to ON for machines with Non-Stopping or Feed-to-Stop shearing operation which do <u>not</u> use a Die Boost.

With a Hump Table machine, the shear is fixed but the material does not stop for the shear cycle; it forms a hump behind the shear where it clamps. This machine would require a setting for Flying Die with <u>no</u> Die Boost (Switches 1 and 2 both ON).

Single or Dual Speed (Switch 3)

OFF	Single Speed Shear
ON	Two Speed Shear

Machines, which shift into slow speed prior to the shear, require Switch 3 to be set to the ON position. Set Switch 3 to OFF for machines, which operate at a single speed.

(Switch 4)

Not used, must be set to off.

Punch Type (Switch 5)

OFF	Feed-to-Stop, Corner and End Notch
ON	Non-Stop, Corner and End Notch

Switch 5 should be set to the ON position for punch presses, which operate on the fly (Non-Stopping). Set Switch 5 to OFF for punch presses, which operate on Feed-to-Stop machines.

Corner Notch Die Boost (Switch 6)

OFF	Corner Notch Die Boost Active
ON	No Corner Notch Die Boost

Machines which do not stop the material for each operation of the corner notch and have a device to push the die forward as it is punching require Switch 6 to be set to the OFF position. Set Switch 6 to ON for machines with Non-Stopping or Feed-to-Stop punching operation which do not use a Die Boost.

Single or Dual Speed Punching (Switch 7)

OFF	Single Speed Corner and End Notch
ON	Two Speed Corner and End Notch

Machines, which shift into a slow speed prior to each punching operation, require Switch 7 to be set to the ON position. Set Switch 7 to OFF for single speed machines.

Chapter 9: In Case of a Problem

The **MP350P-FD** is a very reliable product, but things can go wrong.

The user can clear most problems, but AMS experts are always ready to help if needed.

We have many years of experience with all types of length controls and coil processing equipment. Our experience shows that problems are grouped into:

- **Machine problems** (most common)
- **Operator mistakes**
- **Incorrect Setup data**
- **Corrupted controller memory**
- **Cable damage**
- **Controller fault** (least common)

Troubleshooting is just a logical series of steps, which leads to the likely cause of a problem. The only tools you need are an accurate scale or steel tape, and perhaps a multimeter.

This guide is a "self help guide" for the user to help troubleshoot the system. Follow these suggestions in the order listed.

Troubleshooting Guide

When did the Problem Start?

Did the machine work properly at one time? If not, have you done the Calibration procedure?

If the machine **did** work properly at one time, what has changed since then?

Did the problem start after routine maintenance? After electrical panel work? After a material change? After an operator change? Trace backwards in time to find out what's different.

Check the Machine

Check the **Encoder** to make sure it tracks the material perfectly.

The encoder **wheel** must be at right angles to the material. The wheel must rotate exactly parallel to the direction of material movement.

The wheel must be in firm contact with the material. **No slippage** is allowed!

Re-run the length **Calibration** procedure after any changes to the encoder mounting.

Check the encoder **cable** connections. They may have worked loose from material movement or vibration. Make sure there are no nicks or cuts in the cable.

Check the **shear** (or punch) press to make sure that it returns fully to its home position after each cycle. The press will make accurate cuts **only** if it starts from a known position for each cycle.

Re-run the length **Calibration** procedure after any changes to either press.

Visually check **other** parts of the machine for loose fasteners, excessive wear, proper lubrication, proper material feed, and roll former adjustment.

Re-run the length **Calibration** procedure after any changes to the machine.

Collect Data

Often the problem is that the machine is making out-of-tolerance parts. To deal with this type of problem, carefully measure the parts made and compare these numbers with those that were programmed. Also take note of the order in which the shear cut the parts.

Write down these measurements for possible later reference.

If length and punch placement seem to vary at random, check the encoder mounting very carefully. The encoder must move with the material, and cannot be allowed to slip. If dimensions are off in a consistent pattern, run the **Calibration** procedure.

Re-check Setups

Re-check Setup values with originally recorded values. When you installed the **MP350P-FD** controller, you should have recorded the Setup values on the form provided in the manual for your machine TYPE. Make sure that none of these values has changed.

Run the Calibration mode

When you do the Calibration, take great care to make accurate measurements. Be sure that you know how to reduce measuring error as much as possible with the scale or steel tape you use. A loose tip on your steel tape can add a large error into your measurements.

Use Built-in Diagnostic features

The **MP350P-FD** has a display mode showing the controllers input and output operations. Press SETUP until the screen shown below appears.
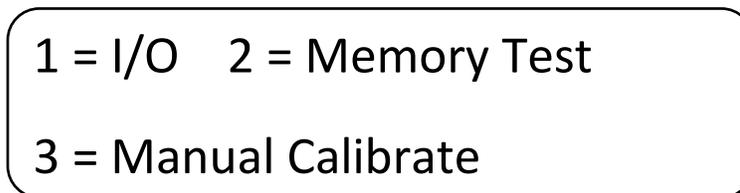
```
1 = I/O    2 = Memory Test

3 = Manual Calibrate
```

Figure 5-1. Input Output, Memory Test Screen.

Press the number for I/O and the screen that is shown in figure 5-2 will appear.
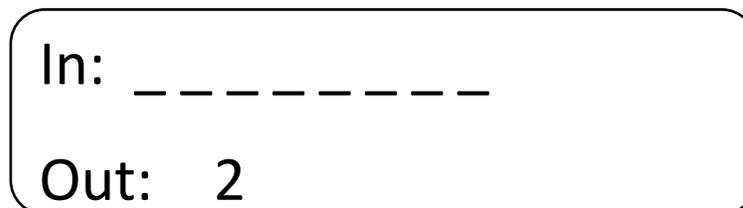
```
In:  _ _ _ _ _ _ _ _

Out:   2
```

Figure 5-2. In / Out Screen.

This screen will allow you to monitor the controller's inputs and outputs. Watch this display while the machine is running to check for slowdown, stopping, die accelerator, and press actuation points.

On the main Status display, you can watch line speed and distance past the shear. Compare what you see here to what should be happening as the machine runs.
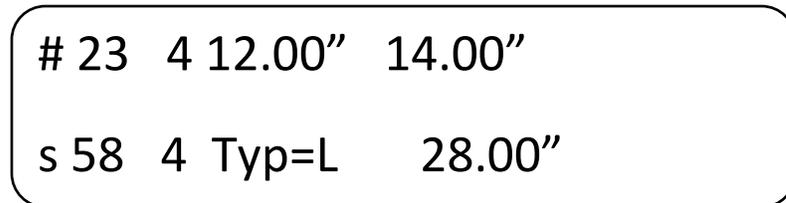
```
# 23   4 12.00"   14.00"

s 58   4  Typ=L      28.00"
```

Figure 5-3. **MP350P-FD** Status Screen

Check incoming Power

Check incoming power for proper voltage. If you suspect fluctuations, watch the needle indication with an analog meter to see if they show up.

More advanced line monitors are available for stubborn cases that you can't see with ordinary meters. Use a recording line monitor to find problems that seldom show up. Your local power company may be able to help with this.

Cycle Power

Cycle power off and on. Try this if the controller "locks up" (won't respond to the keyboard). This **may** restore normal operation after an electrical surge. If not, clear the **MP350P-FD's** memory.

Clear Memory

Clearing memory will erase all Setup and Order information in the **MP350P-FD's** memory.

Do not clear the memory unless you have written down all Setup and Order information for re-entry, and you have tried everything else above.

You can clear all storage in the **MP350P-FD** (including Setup and Order data) by following this sequence:
1) Make sure that the Security Switch is unlocked.
2) Turn off power to the controller.
3) Wait five seconds.
4) Press the "5" key and turn the controllers power back on.
5) Hold down the "5" key for at least 5 seconds after you turn the power on.
6) Let go of the "5" key and let the controller power up normally.

Electrical Noise

The **MP350P-FD** should **not** lock up frequently. If it does, you should suspect that electrical noise is present.

Noise problems can be very hard to locate. The best way to avoid noise is by using good cable layout and wiring methods. Also, noise suppressor devices such as **varistors** are needed in some cases. Refer to the AMS Application Note **"Noise Suppression Methods" for** details.

FAX Setup and Parts data to AMS

FAX Setup and Parts data to AMS with a full description of the problem. Unless you think your problem is very simple, you might as well FAX this information to us before you call. We'll probably ask you for it anyway.

Include the Model, Serial, and Software Version numbers.

Be sure to send a copy of the Setup Data Sheet, and all information about the problem. **FAX** us at **1-314-344-9996.** Don't forget to include your name and phone number so we can call you back.

Call AMS

If you can't fix the problem with the help of this manual, call AMS and speak with our experts. Call us toll-free at **1-800-334-5213**.

Have your **Model, Serial, and Software Version numbers** ready when you call.