3A80763G01

SERVICE MANUAL

SYSTEM
6321C08G01
6321C08G02
6321C08G03
6321C08G04

June, 1991

IMPORTANT SAFETY INSTRUCTIONS

1. Please read **ALL** of these instructions, before operating the equipment.
2. Do not locate this equipment where moisture could cause a shock hazard.
3. Operate this equipment using only the specified type of power source. This equipment *must be grounded*, using a properly installed, 3-wire cable that is terminated either by a 3-pin grounding-type power plug, or by connection to a properly grounded distribution box. It is hazardous to defeat the purpose of this grounding.
4. Locate the power cord where it cannot be walked on. Ensure that nothing is allowed to rest on this power cord.
5. In general, extension cords should not be used. However, when their use cannot be avoided, ensure that the cord is rated to carry the required current, and that the current capacity of the power outlet is not exceeded.
6. Do not attempt to service this product yourself. Opening or removing covers may expose you to dangerous voltage points or other risks. Refer all servicing to qualified personnel.
7. Disconnect this product from its power source, and refer servicing to qualified service personnel, when these conditions occur:
   - When the power cord is damaged or becomes frayed.
   - If the product has been exposed to rain, water, or other liquid.
   - If the product does not operate normally when the operating instructions are followed. Adjust only those controls described by these operating instructions. Improper adjustment of other controls may result in equipment damage and may require extensive work, by a qualified technician, to restore the product to its normal operating condition.
   - If the unit has been damaged.
   - If the product exhibits a distinct change in performance, indicating a need for service.

Chapter 1 Introducing The HL-93 Co-Ordinate Drive Tracing System

Chapter 2 Installation And Alignment

Chapter 3 Tracing System

Chapter 6 Maintenance And Troubleshooting Schematics (Cont'd)

Chapter 7 Parts List

WARNING

The equipment described in this manual is designed to operate from a three-wire, grounded power source. Failure to provide the correct power source and grounding connections, as detailed in the installation instruction, may result in conditions hazardous to the operator and/or service personnel.

Chapter 1: Introducing The HL-93

Chapter 1

INTRODUCING THE HL-93

CO-ORDINATE DRIVE TRACING SYSTEM

INTRODUCTION

The HL-93 Linatrol Co-ordinate Drive Tracing System automatically controls the motion of a cutting tool, by following a line or silhouette pattern.

It is intended for use on small cutting machines, and can be used in the tracing mode for automatic cutting or under manual control for stripping operations. The HL-93 can also be used with a numerical control system.

THE HL-93 SYSTEM

The HL-93 system comprises a Tracing Head Assembly (with interconnecting 'B' cable), a Control/Amplifier Unit, and two Drive Units (complete with interconnecting cables).

Tracing Head

The Tracing Head is an opto-electronic device which uses a unique circular scanning system to trace either line or silhouette patterns.

Control/Amplifier Unit

The Control/Amplifier Unit houses the power supplies for system operation, and contains the electronic signal processing, control and drive output circuits.

The front panel carries two groups of controls; Tracer operating controls, Gas and Torch Lift controls.

Drive Units

The Drive Unit comprises an electrical drive motor assembly having integral tachometer, gearbox and, when necessary, an encoder to provide position information to a CNC system. Two Drive Units are required per system.

SYSTEM FEATURES

System features include automatic line acquisition, tool off-pattern interlock, a four-position direction switch for manual operation, speed control, gas and torch controls, kerf adjustment, and CW or CCW tracing.

Operator Controls

The operator controls listed below can be configured to meet your specific requirements.

- Power On/Off and Emergency Power Off,
- Trace Direction,
- Speed Control and Speed Range,
- Direction (Strip operation),
- Drive On/Off,
- Mode (Strip/Trace/Start),
- Cutting Oxygen,
- Kerf Adjustment,
- Preheat,
- Torch Lifts,
- All Up.

controls, and the Gas/Torch Lift controls.

It also contains detailed operating instructions for both Trace and Strip modes. Detailed descriptions of the operation of the Chassis Board and Tracing Circuit cca are also provided.

Chapter 5 Drive Units. This chapter describes the X and Y co-ordinate drive units. The description is mainly mechanical since the drives are controlled from the Control/Amplifier Unit.

Chapter 6 Maintenance And Troubleshooting Schematics. This chapter outlines the regular maintenance routines and troubleshooting procedures required to maintain the system in optimum operating condition.

Schematic diagrams are provided to support the isolation and correction of faults in the electronic and control circuits.

Chapter 7 Parts List. A complete listing, on an assembly basis, of shop-replaceable parts. The list is complemented by exploded-view illustrations where appropriate.

Chapter 2: Installation And Alignment

Chapter 2

INSTALLATION AND ALIGNMENT

INTRODUCTION

Installation of the HL-93 Co-ordinate Drive Tracing System is carried out in three stages:

- Mechanical installation of the Tracing Head, the Control/Amplifier Unit, and the Drive Subsystem, consisting of two individual Drive Units
- Electrical Connections between the system units and connections to the primary power supply
- System checkout and alignment.

It is recommended that you familiarize yourself with the equipment and these instructions, before starting the installation.

MECHANICAL INSTALLATION

The parts which make up the HL-93 system are:

- Tracing Head Assembly (includes B-cable),
- Control/Amplifier Unit,
- X Drive Assembly (transverse axis), including integral D-cable)
- Y Drive Assembly (longitudinal axis), including integral E-cable.

Unpack the units carefully and inspect for transit damage. Check that the parts supplied match the parts ordered.

Tracing Head Assembly

The Tracing Head is usually mounted above the tracing table on the Torch Carriage, which moves with the cutting torches in both axes. Accurate tracing is obtained by ensuring that the scribed line identified HEIGHT SET MARK on the Tracing Head, is level and at the correct height with respect to the tracing table. See Figure 2-1, Tracing Head Mounting Details.

Four holes, slotted vertically, enable the unit to be bolted securely to its mount, while permitting some adjustment of the height and levelling.

Complete the following steps:

STEP 1 Insert the mounting hardware through the four holes and tighten them finger-tight.

STEP 2 Adjust the height of the Tracer Unit so that the set mark on the head is located 38 mm (1.5 inches) above the pattern table.

STEP 3 Tighten all mounting screws securely.

STEP 4 Check the height at several places on the tracing table to ensure that height variations do not exceed 3 mm from minimum to maximum. Variations in excess of 3 mm will result in an out-of-focus condition which can cause unreliable operation.

Control/Amplifier Unit

Using the three mounting holes in the bottom plate, mount the unit in a position where it is readily accessible to the operator. Refer to Figure 2-2, Control/Amplifier Unit Installation, for mounting details.

Allow sufficient clearance, front and rear, for easy access to the interior for servicing, and for wiring.

The unit is usually mounted on the main carriage and can be located either to the right or to the left of the Tracing Head, as best suits space and cabling requirements.

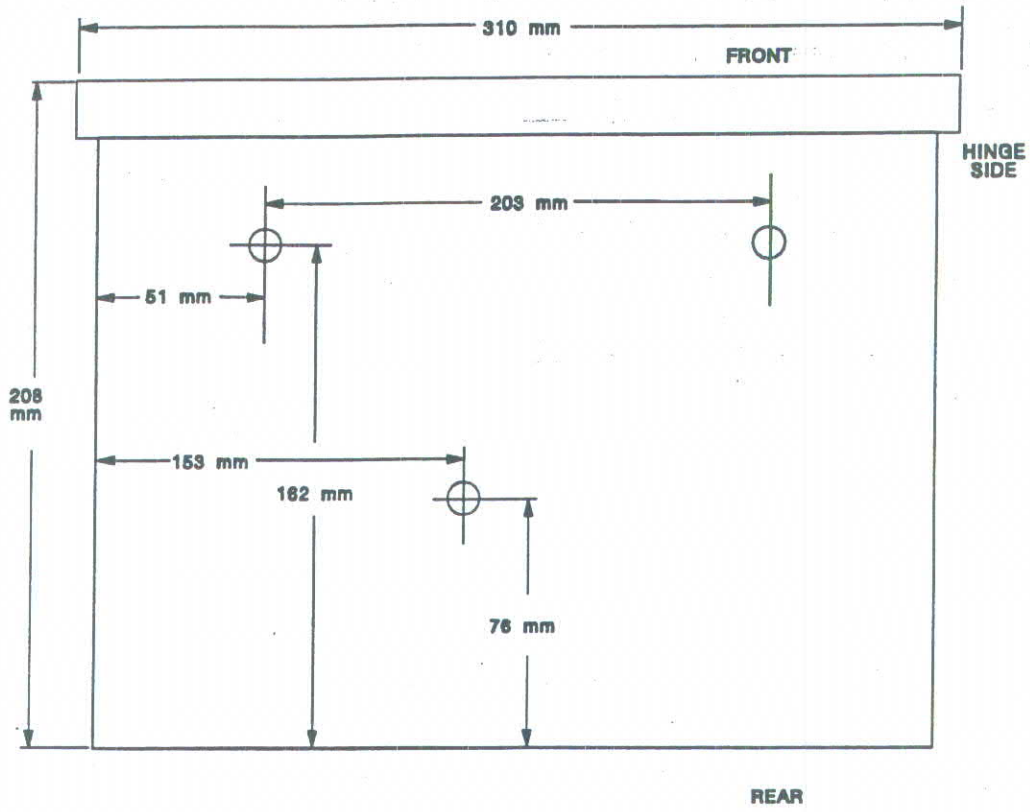


Figure 2-2 Control/Amplifier Unit Installation, Bottom View.

Drive Units

The Drive Sub-system consists of two drive units with integral cables. See Figure 2-3 for details of the Drive Assembly.

> NOTE
>
> The two drive units can (if cable length permits) be interchanged without causing damage. Once a unit is selected though, it must be identified, as either X or Y, for future reference.

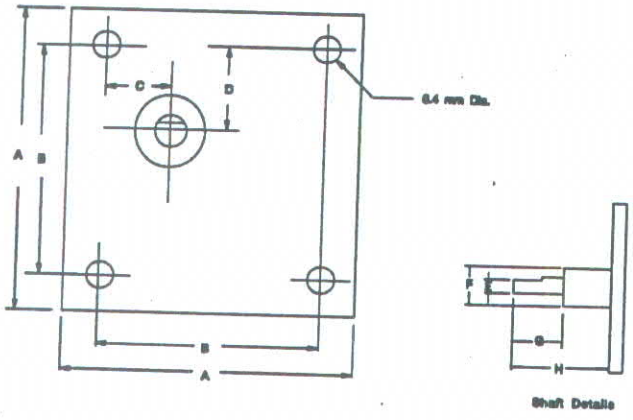


Figure 2-3 Drive Assembly Detail.

A	86 mm (3.40 inches)	E	8 mm dia (.315 inches)
B	70 mm (2.75 inches)	F	18 mm dia (.71 inches)
C	35.6 mm (1.40 inches)	G	20 mm (0.8 inches)
D	20 mm (0.8 inches)	H	6.4 mm Hole dia.

Before installing drives, make sure the machine moves freely and that the machine rails, in both axes, are clean and free of obstructions.

Standard drive units are configured so that clockwise rotation of the drive unit output pinion results in motion along the +X axis and +Y axis respectively.

ELECTRICAL CONNECTIONS

All electrical connections are made at the rear of the Control/Amplifier Unit, refer to Figure 2-4.

Power Requirements

The operating voltage for the HL-93 system is marked on the rear of the Control/Amplifier Unit, and may be either:

- 100/115 vac +10% -15%, 50/60 Hz, single phase, 4 Amp nominal or,
- 220 vac +10% -15%, 50/60 Hz, single phase, 4 Amp nominal.

Ensure that the power supply matches the rating marked on the Control/Amplifier, before making the connection.

> **WARNING**
>
> This system is designed to operate from a three-wire grounded power source.
>
> Failure to observe this requirement can be hazardous to the operator or service personnel.

> NOTE
>
> Any changes made to this equipment may void Canadian Standards Association (CSA) approval.

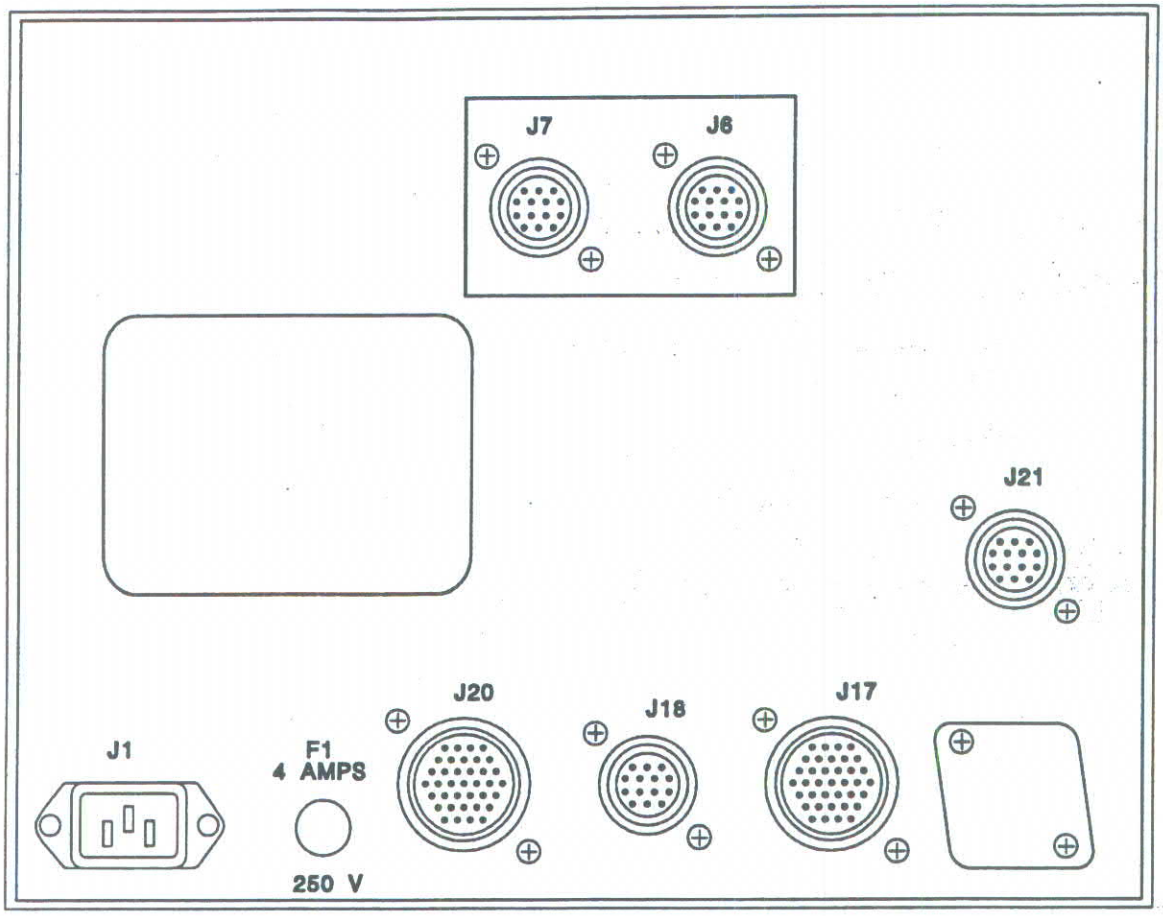


Figure 2-4 Control/Amplifier Unit, Connectors.

Connect the primary power to the standard 3-pin panel-mounted plug J1, as indicated in Figure 2-4.

J1 is a standard IEC320 Appliance Coupler Connector; cable colours are:

European

Line	Brown
Neutral	Blue
Ground	Green/Yellow

North American

Line	Black
Neutral	White
Ground	Green or Green/Yellow

Tracing Head

Connect the Tracing Head B-cable to J21 on the Control/Amplifier Unit.

Drive Units

Connect the X drive unit D-cable to J6 on the Control/Amplifier Unit.

Connect the Y drive unit E-cable to J7 on the Control/Amplifier Unit.

If, when the drives are turned ON, the machine travels in the correct axis, but in the wrong direction, the rotation of the motor(s) involved

must be reversed. This is done by reversing the motor leads (red and black) at the motor, and the tachometer leads (green and white) at the tachometer, for the drive(s) concerned. These leads are soldered to the motor terminals. DO NOT change the orientation of the DIRECTION switch knob.

Other Connections

Other connections which are made at the rear of the Control/Amplifier Unit are:

CONNECTOR		MATING CONNECTOR		
Connector	Function	Item	AMP	Westinghouse
J17	CNC	37-pin Shell	206305-1	73479C5A15
		Clamp	206512-1	73479C5A18
		Pin,#18-16	66099-2	73479C5A28
		Pin,#24-20	66103-2	73479C5A29
J18	Gas Control	14-pin Shell	606044-1	73479C5A22
		Clamp	206070-1	73497C5A24
		Pin,#18-16	66099-2	73479C5A28
		Pin,#24-20	66103-2	73479C5A29
J20	Torch Lifts	37-pin Shell	206305-1	73479C5A15
		Clamp	206512-1	73479C5A18
		Pin,#18-16	66099-2	73479C5A28
		Pin,#24-20	66103-2	73479C5A29

NOTE

If a system designed for use with a CNC is used without the CNC, a jumper must be installed at J17. A special plug, P17, is provided for this purpose.

This plug jumpers pins 4 to 6, 3 to 8, 12 to 13, and 14 to 15.

ALIGNMENT

A new system should not normally require alignment, except for checking Signal Level, Linear Speed, Low Speed Range Adjustment, and High Speed Stability Adjustment.

To aid in performing alignment, the procedure has been sub-divided into the following:

- Power Supply Checks.
- Signal Level Set-up.
- Zero-Signal Offset Adjustment.
- Line Frequency Change.
- Low Speed Range Adjustment.
- Accuracy Adjustment.
- High Speed Stability.
- Slowdown Circuit Calibration.

Where appropriate, references are made to procedures presented in Chapter 6, Maintenance And Troubleshooting Schematics.

Unless otherwise specified, all measurements are made at the Control/Amplifier Unit.

Power Supply Checks

The following power supply measurements must be made while the machine is moving.

STEP 1 Switch power ON.

STEP 2 Set SPEED control to 5 (50%).

STEP 3 Set MODE switch to STRIP.

STEP 4 Set DRIVE switch to ON.

STEP 5 Verify the following voltages on the Chassis Board cca:

- +20V ±3 vdc at the +20V TP.
- -20V ±3 vdc at the -20V TP.
- +12V ±0.6 vdc at +12V TP.

STEP 6 Verify the following voltages on the Tracing Circuit cca:

- +12V ±0.6V at TP1.
- -12V ±0.6V at TP2.

Signal Level Set-up

STEP 1 Position a typical shop pattern under the Scanner Assembly.

STEP 2 Set the tracer controls to acquire the pattern and, once the pattern is acquired, set the DRIVE switch to OFF.

STEP 3 Observe the voltage at TP5, on the Tracing Circuit cca, and adjust R21 until the output shows no further increase; between 9.5 and 11.5 vdc.

If adjusting R21 does not result in signal increase, adjust R1 on the Tracing Circuit cca.

After the equipment has been in service for some time, typical symptoms of decreasing signal level may be erratic acquisition of a pattern, and tracer reversal on pattern.

Zero-Signal Offset Adjustment

STEP 1 Switch the power OFF.

STEP 2 Remove the Tracing Head cover.

STEP 3 Disconnect connector J3/P3, or stop the scanner from rotating.

STEP 4 Switch power ON and the drive switch OFF.

STEP 5 Measure the voltage at TP3 on the Tracing Circuit cca. Adjust R73 until the voltage level at TP3 is 0V ±5 mvdc.

STEP 6 Measure the voltage at TPXM on the circuit card and adjust R50 for 0V ±50 mvdc.

STEP 7 Measure the voltage at TPYM on the circuit card and adjust R52 for 0V ±50 mvdc.

STEP 8 Switch power OFF.

STEP 9 Re-connect J3/P3.

STEP 10 Reinstall the Tracing Head cover.

STEP 11 Switch power ON.

STEP 12 Measure the voltage at TP3 on the Tracing Circuit card. Adjust R41 for 5.3V ±0.1 vac measured with a digital voltmeter ($15V_{PP}$ ±0.3V).

Linear Speed Adjustment

The 0 to 10 calibration on the SPEED potentiometer represents speeds from zero to the maximum rated speed of the machine. A setting of 5 therefore represents 50% of maximum speed.

The following example is for a machine with a maximum speed of 3000 mm/min (120 IPM) with the drive switch on and the drive range set to Hi. The procedure is:

STEP 1 Remove the cap from the SPEED control knob (it can be lifted out with fingers).

STEP 2 Loosen the collet-locking nut and remove the knob from the control shaft.

STEP 3 Trace a test line, drawn in the X-axis direction, 1000 mm long.

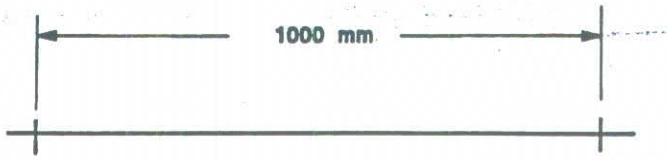


Figure 2-5 Speed Measurement Test Line.

STEP 4 Starting from the fully CCW position, slowly rotate the control until the X drive begins to turn, then back the control off until the drive just stops.

STEP 5 Replace the knob on the control shaft with the index mark over the scale 0, and tighten the collet-locking nut.

STEP 6 Repeat Step 4 and check that the drive stops at scale 0. Re-adjust if necessary, then re-insert the cap in the control knob.

STEP 7 Set the SPEED to 10, and record the time taken to traverse the 1000 mm test line.

At 3000 mm per minute, this should be 20 seconds.

STEP 8 While tracing the test line, measure and record the tachometer voltage at TPXT on the circuit card.

STEP 9 Calculate the calibrated speed voltage (V_{CAL}) as follows.

In this example it is assumed that the tachometer voltage measured at TPXT was 8 volts; and the time taken to travel the 1000 mm test line was 18 seconds.

$$V_{CAL} = \frac{18 \text{ sec}}{20 \text{ sec}} \times 8 \text{ volts}$$

$$= 7.2 \text{ volts}$$

STEP 10 Retrace the test line and adjust R65 for a tachometer output of 7.2 volts at TPXT. Verify that the tracer takes 20 seconds to travel 1000 mm.

STEP 11 Calibrate the Y-axis in a similar manner, with the 1000 mm test line orientated in the Y-axis.

The Y-drive tachometer output voltage is measured at TPYT, and is adjusted by R66.

The example given is based on a machine rated at 3000 mm per minute. For a different speed rating, adjust the test-line travel time accordingly.

Low Speed Range Adjustment

STEP 1 Set the SPEED control to 10.

STEP 2 Select the LO DRIVE RANGE.

STEP 3 Adjust R122 to obtain a linear speed of 600 mm/min (24 IPM).

$$V_{TACHO} = \frac{600 \text{ mm/min}}{3000 \text{ mm}} \times 7.2 \text{ volts}$$

$$= 1.44 \text{ volts}$$

Corner Enhancement Compensation Points

STEP 1 Adjust R86 for 5.0V ±0.1 vdc at TP13. Wait several seconds for the voltage at TP13 to stabilize after adjusting R86.

STEP 2 Operation at high speeds, on the low-speed range, may result in excessive overshoot on sharp corners. If overshoot occurs repeat Step 1 above, setting the voltage at TP13 to 6.0V ±0.1 vdc.

Corner compensation can be increased by adjusting R86 until a 4.0V ±0.1 vdc level is measured at TP13.

Accuracy Adjustment

This procedure is for critical applications, or for correction of line width.

STEP 1 Check that the Tracing Head is mounted at the optimum height, and that Kerf is set to zero. See Mechanical Installation, Tracing Head, in this Chapter; and Kerf, Re-zeroing Kerf in Chapter 3.

STEP 2 Trace both sides of a 45° diagonal line of 0.02 inches width (Test Pattern 205P773 may be used). Use a tracing pen to record the path followed by the tracer.

STEP 3 Adjust R46 on the Tracing Circuit cca until the two lines coincide. Re-adjustment may be required if the mirror assembly is changed.

High Speed Stability

STEP 1 If the machine exhibits instability during high speed operation, check that shunts are installed to connect pins 1 & 2 and 3 & 4 of W1 and W2.

STEP 2 Ensure that the gearbox mounting and spring pressure, do not permit free-motion of the machine.

If instability persists, the machine is not suitable for high speed operation.

STEP 3 If the machine exhibits excessive overshoot during high speed operation, remove the shunt connecting pins 1 & 2 of W1 and of W2.

If the machine becomes unstable, replace the shunt; otherwise proceed to the next step.

STEP 4 If the machine is stable and further reduction in overshoot is required; remove the shunt at pins 3 & 4 of W1 and W2; install a shunt to connect pins 1 & 2 of W1 and of W2.

If the machine becomes unstable, move the shunt back to the pins 3 & 4 position of W1 and of W2; otherwise proceed to the next step.

STEP 5 If the machine is stable and still further reduction in overshoot is required, remove the shunt connecting pins 1 & 2 of W1 and of W2.

If this results in instability, replace the shunt connecting pins 1 & 2 of W1 and of W2.

Slowdown Circuit Calibration

STEP 1 To enable the command circuit, install a shunt across the left/centre pins of Jumper S6 (below U36 on Tracing Circuit cca); install the shunt across the centre/right pins, to disable the circuit.

STEP 2 Using Pattern 206P969, operate the Tracer over a Command Mark and stop the Tracer.

STEP 3 Observe the signal at TP15 with a digital voltmeter, and adjust R95 CCW until the point at which an increase in R95 does not result in a change in the voltage at TP15. Or,

Using an oscilloscope, observe the signal at TP14 and adjust R95 to obtain a saturated signal for the duration of time that the Command Mark is scanned. Do not increase the gain settings past the point where the signal is clipped. Noise from dirt on patterns may cause improper operation of the circuit.

STEP 4 Verify correct operation of this circuit by tracing Pattern 206P969.

STEP 5 Adjust R120 to obtain a speed, during slowdown operation, which results in optimum corner tracing at the maximum operating speed using a typical pattern. Maximum counter-clockwise (CCW) adjustment results in a slowdown speed which is approximately 1/3 of the dial speed.

Line Frequency Change From 60 Hz To 50 Hz

The Linatrol HL-93 can operate on either 50 or 60 Hz line frequencies.

STEP 1 Using a digital voltmeter, measure the voltage at TP3 on the circuit card. Adjust R41 for 5.3V ±0.1 vac ($15V_{PP}$ ±0.3V).

STEP 2 Set the Tracer to trace left on Test Pattern 205P773.

STEP 3 Set the drive switch to OFF.

STEP 4 Adjust R30 for a positive-going pulse of 34 msec ±1 msec at TP6.

STEP 5 Adjust R35 for a negative-going pulse of 10.0 msec ±0.15 msec at TP7.

STEP 6 Set the Tracer to trace right.

STEP 7 Adjust R54 for a positive-going pulse of 10.0 msec ±0.15 msec at TP7.

> **NOTE**
>
> Resistors R30, R35, and R54 are sealed with Glyptol cement. Break the seal to adjust and reseal when complete. Mark the cca to read 50 Hz.

STEP 8 Perform steps 2 through 9 of the zero-signal offset adjustment procedure.

Line Frequency Change From 50 Hz To 60 Hz

STEP 1 Using a digital voltmeter, measure the voltage at TP3 on the circuit card.

Adjust R41 for 5.3V ±0.1 vac ($15V_{PP}$ ±0.3V).

STEP 2 Set the Tracer to trace left on Test Pattern 205P773.

STEP 3 Set the drive switch to OFF.

STEP 4 Adjust R30 for a positive-going pulse of 28 msec ±1 msec at TP6.

STEP 5 Adjust R35 for a negative-going pulse of 8.33 msec ±0.15 msec at TP7.

STEP 6 Set the Tracer to trace right.

STEP 7 Adjust R54 for a positive-going pulse of 8.33 msec ±0.15 msec at TP7.

> **NOTE**
>
> Resistors R30, R35, and R54 are sealed with Glyptol cement. Break the seal to adjust and reseal when complete. Mark the cca to read 60 Hz.

STEP 8 Perform steps 2 through 9 of the zero-signal offset adjustment procedure.

Chapter 3: Tracing Unit

Chapter 3

TRACING SYSTEM

TRACING HEAD ASSEMBLY

The Tracing Head is an opto-electronic device which uses a circular scan system to trace either line or silhouette patterns. The scanner generates signals which, when processed and applied to a drive system, enable a machine to follow the pattern accurately. A circular scan device is used to detect the pattern, and to generate a sine-wave reference signal. Figure 3-1 is a simplified diagram illustrating the scanner operation.

The scanner motor is a synchronous ac motor which rotates at 1800 rpm on a 60 Hz supply (or 1500 rpm on a 50 Hz supply). A magnet, mounted within the scanner, rotates between an ac generator coil to produce a sine-wave reference signal. A scanning mirror mounted on the lower end of the scanner shaft, reflects an image of the pattern, projected by the lens, onto the photo-transistor Q1. The mirror is inclined at a shallow angle, relative to the optical axis, so that a circular path is scanned.

When the scan intercepts the black pattern line, the output of Q1, appearing across R1 and R5, becomes less positive. Load resistor R1 provides adjustment to compensate for the differing sensitivities between photo-transistors, so that a standard output level can be set for all tracing heads. The sensor output is therefore a series of pulses.

When tracing a line pattern, there are two pulses produced per revolution; one corresponds to the leading edge of the scan, the other to the trailing or 'back' edge of the scan. With a silhouette pattern, a single pulse is produced for each scan revolution. The pulse duration is approximately half of the scan time.

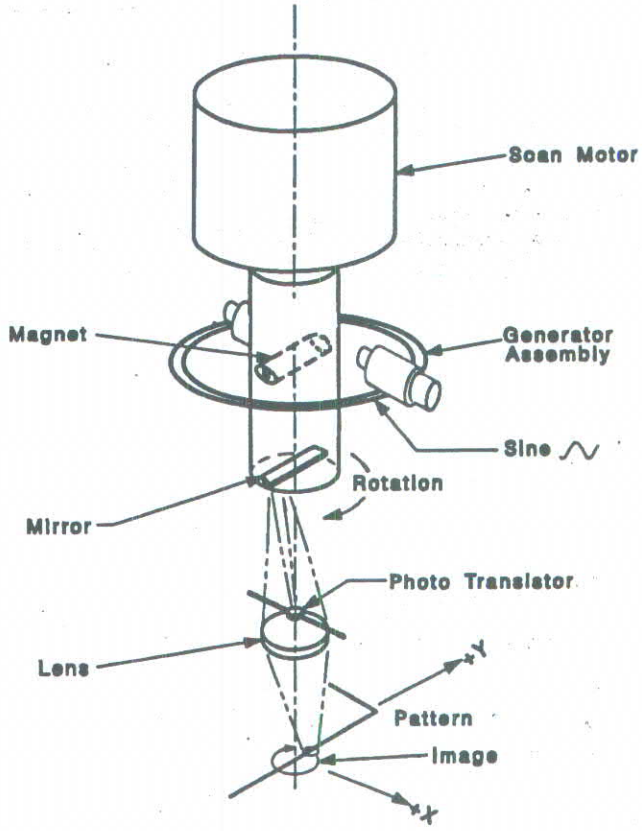


Figure 3-1 Scanner Operation.

Field effect transistor Q2, in a source-follower configuration, converts the scanner signal to a low impedance output to minimize the pickup of electrical noise in the B-cable.

The axis of the sine reference signal generator coils is arranged so that it is oriented along the

cross axis of machine motion. The output signal therefore provides a direction reference for the tracing system.

The scanner signal and the sine reference signal are processed in the Control/Amplifier Unit to produce two vector signals that describe the angle of the pattern line.

Two flood lamps (DS1-DS2) mounted on the lower surface of the Tracing Head, illuminate the scanned area while operating in the tracing mode. A position indicator lamp (DS5) is provided so that, while in the Manual mode, the tracing head can be readily positioned.

LEAD

The mirror in the tracing head is tilted and mounted off centre to enable it to scan a circular path. It therefore scans the pattern ahead of its position by a distance, or 'look-ahead', known as the lead which, for the HL-93, is 3 mm (0.120 inches). Mirrors providing optional Leads of 1 and 1.5 mm are available upon request.

The maximum tracing speed for each mirror is, nominally:

1 metre/minute x the lead (in mm)

however, other factors such as gear-backlash and machine resonance characteristics may limit the maximum speed.

Changing The Lead (Mirror Assembly)

The Lead may be changed by the following procedure. Refer to Figure 3-2 for parts locations.

STEP 1 Switch the mains power OFF.

STEP 2 Remove the two cover securing screws (located on either side of the head, midway between the head mounting screws).

STEP 3 Loosen, but do not remove, the two top-plate securing nuts at the top rear flange.

STEP 4 Raise the top plate and remove the wrap-around cover by lifting it out of the groove in the bottom of the mounting frame, and sliding it out to the front of the head.

STEP 5 Remove the Motor Assembly by undoing the four mounting screws; the mirror and magnet assembly will come out with the motor.

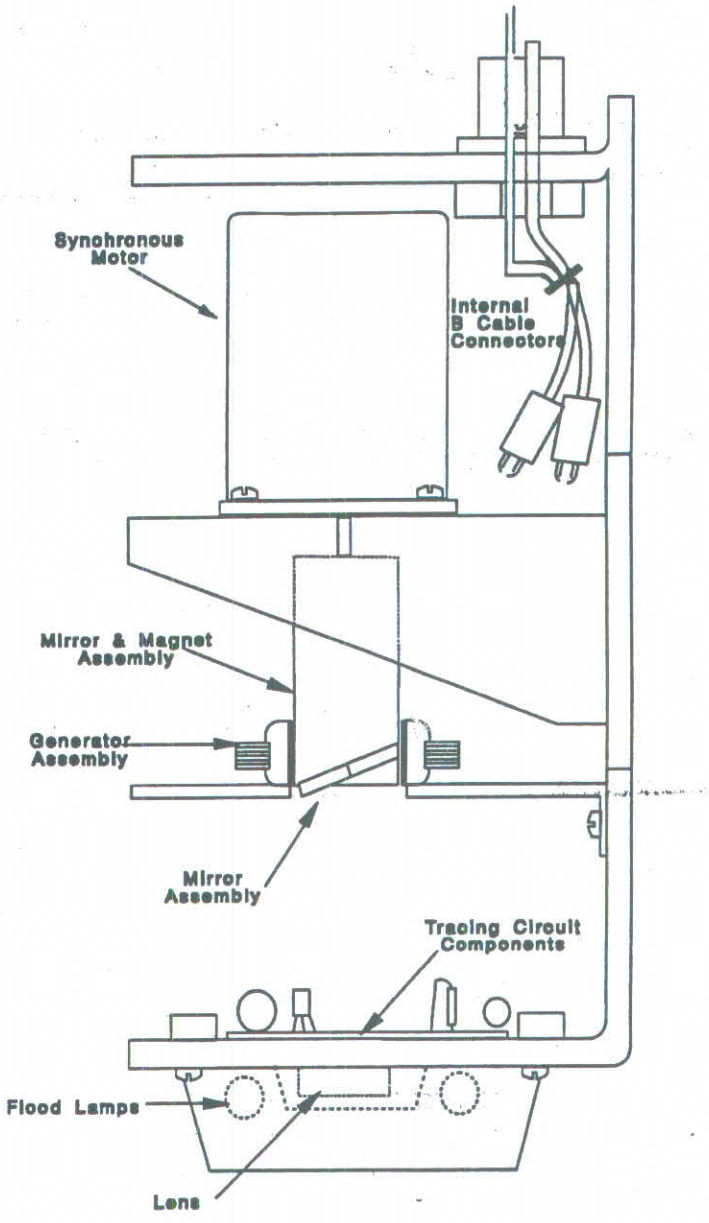


Figure 3-2 Tracing Head Components.

STEP 6 Remove the mirror and magnet assembly by undoing the two set screws which secure it to the motor shaft.

STEP 7 Install the new mirror and magnet assembly, positioning it on the shaft so that its end is located approximately 12 mm from the face of the boss on the motor end plate. See Figure 3-3.

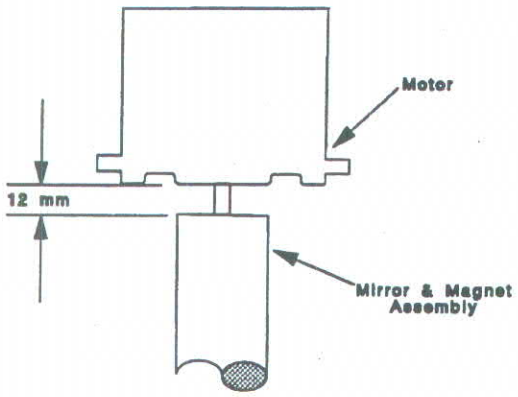


Figure 3-3 Mirror And Magnet Assembly.

STEP 8 Replace the Motor Assembly, and secure it in place using the four mounting screws removed in Step 5.

STEP 9 Replace the wrap-around cover, locating it in the groove in the bottom of the mounting frame.

STEP 10 Reposition the top plate and tighten the two securing nuts.

STEP 11 Replace the cover securing screws.

> NOTE
>
> When the Lead is changed, it may be necessary to re-zero the Kerf.
>
> See 'Re-Zeroing Kerf' instructions.

KERF

Kerf compensation, continuously variable from zero to an amount equal to the lead being used, is provided so that exact size copies of the pattern can be cut. It is obtained by rotating the Kerf Adjustment control on the Control/Amplifier Unit.

In order to determine the amount of kerf adjustment required, the kerf of the cutting tool and the lead of the scanner must be known.

Direction of Kerf Adjustment

The direction that the Kerf Control is rotated, CW or CCW, depends on the desired compensation; either 'inside' pattern, or 'outside' pattern offset. This relationship is shown in Figure 3-4.

When the Kerf Control is set to the zero reference mark, there is no compensation.

Re-Zeroing Kerf

When the mirror assembly or scanner assembly is changed, the kerf may require re-zeroing.

The procedure for checking, and if necessary correcting, kerf calibration is:

STEP 1 Attach a ball point pen, or similar scribing device, to the tracing head to scribe a drawing alongside the test pattern being traced.

STEP 2 Set the Kerf Control to zero.

STEP 3 Trace the L-shaped Test Pattern, 206P969, first with the MODE switch in the Auto Trace Right position; then with the switch in the Auto Trace Left position.

If the straight sides of the two drawings produced are exactly superimposed, the Kerf is zeroed and will not require re-zeroing. If the two scribed patterns are displaced by even a small amount, the sine generator coil must be re-aligned.

STEP 4 Switch the mains power OFF.

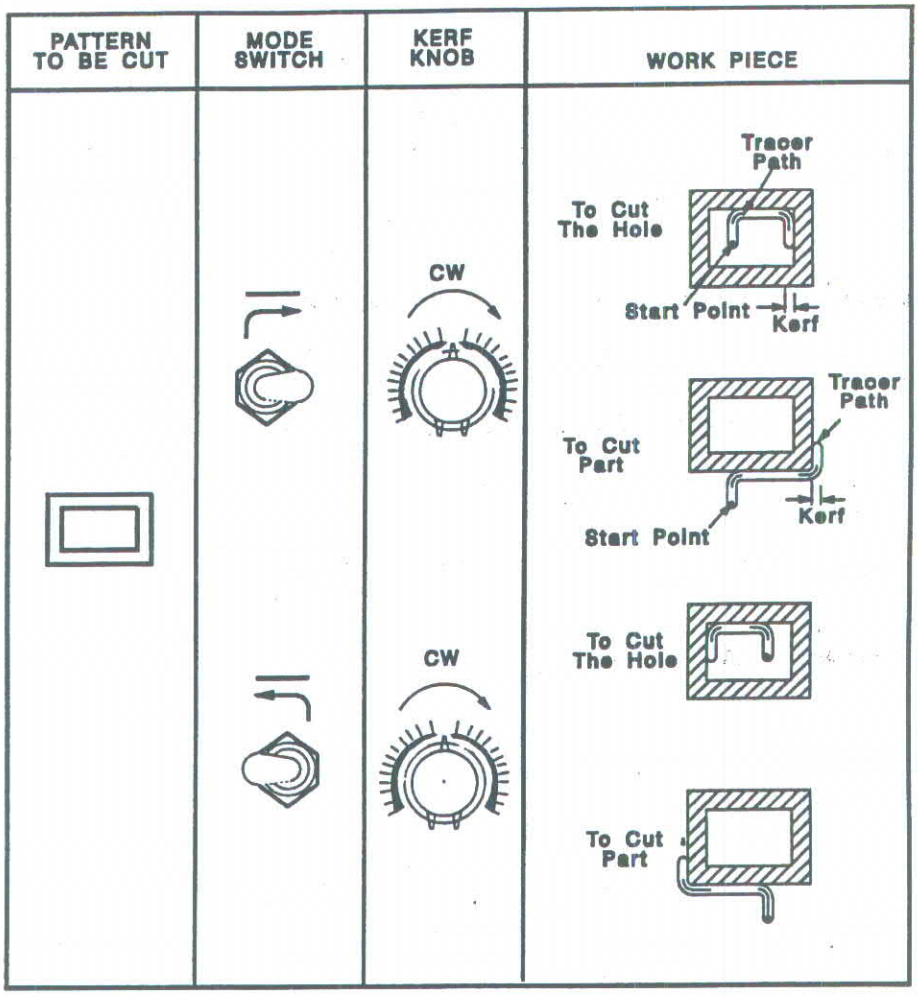


Figure 3-4 Direction of Kerf Control.

STEP 5 Remove the two cover securing screws (located on either side of the head, midway between the head mounting screws).

STEP 6 Loosen, but do not remove, the two top-plate securing nuts at the top rear flange.

STEP 7 Raise the top plate and remove the wrap-around cover by lifting it out of the groove in the bottom of the mounting frame, and sliding it out to the front of the head.

STEP 8 Loosen the two clamps which hold the generator assembly in place, by slackening, but not removing, the nuts on the top of the clamps.

STEP 9 The generator must be rotated, a small amount, and the test tracings repeated, until the position is found where the two scribed patterns are exactly superimposed.

During the tracing, the photocell must be shielded from outside light in order to ensure accuracy. This may be accomplished by putting the cover in place temporarily; alternatively a U-shaped shield may be made from opaque material such as light cardboard, and used to cover the

three sides of the tracer between the generator mounting plate and bottom horizontal surface of the mounting frame.

> **CAUTION**
>
> The adjustment of the generator may be made with the power ON and the scanner running, but care must be taken to ensure that fingers do not come into contact with the rotating mirror and magnet housing.

STEP 10 When the two traces are superimposed, turn OFF the power and wait until the scan motor has stopped rotating. Then tighten the generator clamps.

STEP 11 Replace the wrap-around cover, locating it in the groove in the bottom of the mounting frame.

STEP 12 Reposition the top plate and tighten the two securing nuts at the top rear flange.

STEP 13 Replace the two cover securing screws.

CHANGING LIGHT & SENSING AND I/R ABSORBING LIGHT AND SENSING UNIT

> NOTE
>
> When the Infra-red Absorbing Light and Sensing Unit is installed, the recommendations given in this manual, that construction lines and notes be in red pen or pencil, is no longer valid. There should be no non-pattern lines of any colour in the pattern area.

It is not necessary to remove the Tracing Head from the machine to change the Light and Sensing Unit, if the Tracing Head can be moved clear of tracing table.

The Light and Sensing Unit can be installed using the following procedure.

Refer to Figure 3-2 for location of components.

STEP 1 Switch the mains power OFF.

STEP 2 Remove Tracing Head from machine, if necessary.

STEP 3 Remove the two cover securing screws (located on either side of the head, midway between the head mounting screws).

STEP 4 Loosen, but do not remove, the two top-plate securing nuts at the top rear flange.

STEP 5 Raise the top plate and remove the wrap-around cover by lifting it out of the groove in the bottom of the mounting frame, and sliding it out to the front of the head.

STEP 6 Disconnect the plug from the Light and Sensing Unit.

STEP 7 Undo the two mounting screws that secure the Light and Sensing Unit to the bottom of the Tracing Head. The screws are on the underside of the Light and Sensing unit and are located on the Fore-Aft centre line of the unit.

STEP 8 Remove the Light and Sensing Unit from the Tracing Head.

STEP 9 Fit the Light and Sensing Unit to the Tracing Head. Ensure that the connecting cable is passed through the hole in the generator mounting plate, and through the cutout at the back of the motor mounting plate.

STEP 10 Replace the two screws which secure the Light and Sensing Unit to the bottom of the Tracing Head.

STEP 11 Mate the connector to the Light and Sensing Unit.

STEP 12 Replace the wrap-around cover, locating it in the groove in the bottom of the mounting frame.

STEP 13 Reposition the top plate and tighten the two securing nuts at the top rear flange.

STEP 14 Replace the two cover securing screws.

STEP 15 Replace the Tracing Head if removed.

STEP 16 Adjust the Tracing Head height to bring the set mark on the Light and Sensing Unit to 38 mm above the tracing table.

STEP 17 Turn the mains power ON, and check performance on a typical pattern.

STEP 18 Make any necessary adjustments to set signals as described in this manual.

PATTERNS

The quality of the pattern has a considerable influence on the accuracy and reliability of the tracer. Patterns can be drawn so that material wastage is reduced and the efficiency of cutting operations improved. For accurate corner cuts, compensation for the lead/speed of the tracer may be made by adjusting the corners on the pattern.

Guidelines for Patterns

Factors associated with patterns which influence the tracing operation include:

- Contrast between line and background.
- Cleanliness of the pattern.
- Width of line (in line drawn patterns).
- Type of material patterns are drawn on.
- Type of material used to draw patterns.

To produce patterns which provide the best results, the following guidelines are recommended:

1. The edge of the line should be drawn accurately since it is the edge of the pattern that will be traced.

2. A red pen or pencil should be used for drawing construction lines or notes. The tracer will not detect red.

3. For optimum performance, lines should be drawn in black India ink, with a minimum width of 0.7 mm (1/32 inch), on a white or buff background. However, H or HB grade pencil drawn lines with a minimum width of 0.7 mm (1/32 inch) provide good results.

4. If pencils are used, the lines should be dense and free from breaks. Repeatedly going over a line tends to polish the surface, causing it to behave like a mirror. This should be avoided.

5. Some materials appear black to the human eye but are seen differently by the tracer and should be avoided. Refer to 'Infra-red Reflecting Patterns'.

Material	Remarks
Commercial Pattern Paper	Use India ink or firmly drawn pencil, H or HB grades. Ideal material for durability, dimensional stability and contrast.
Bristol Board (Buff or White)	Excellent contrast. Liable to absorb moisture.
Art Board (Buff or White)	Similar to Bristol board, more durable. Thickness may require re-focusing.
Heavyweight Bond Paper	Similar to Bristol board. Generally most popular for 'one-off' patterns.
'Mylar'	Excellent dimensional stability, durable, white backing sheet required. Tendency to curl requires material be held flat to maintain focus.
'Diazo' Transparencies	Reflect infra-red; requires special lens on tracer. Easily scratched. Good size stability.
Photographic Negatives	Not recommended.
Tracing Paper	White backing sheet required. Changes size with moisture. Not recommended.
Felt Pens	Some felt-tip pens reflect infra-red; may require special lens on tracer unit.
'Plexiglass'	If used as a protective cover, and to keep patterns flat, is susceptible to pitting from cutting splatter. Should be used with caution.

6. Paper or card stock used for patterns should be of a type which is not affected by moisture. Some types readily absorb moisture and may change size.

7. Patterns should be kept as clean as possible, especially near the tracer's path.

8. The minimum distance between adjacent lines on the pattern should not be less than the lead, i.e. 3 mm (0.125 inch) for the standard lead. See Figure 3-5.

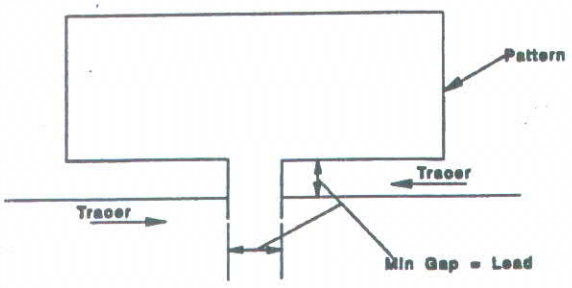


Figure 3-5 Minimum Line Spacing.

9. For comments on pattern materials refer to the information listed on the previous page.

Infra-red Reflecting Patterns

Patterns reproduced by the Diazo process, or with some felt or nylon tipped pens, reflect infra-red. While they appear black to the human eye, they give a weak response in the tracing system.

An Infra-red Absorbing Light & Sensing Unit must be installed to absorb infra-red light, if a pattern of this type must be traced.

Corner Compensation

Tracing head lead may be compensated for on the pattern, for accurate corner cuts at lower speeds.

Figure 3-6 illustrates the techniques. The lead-speed correction factor is obtained on a trial and error basis since it is affected by the physical characteristics of the cutting machine. The lower the cutting speed, the greater the correction factor.

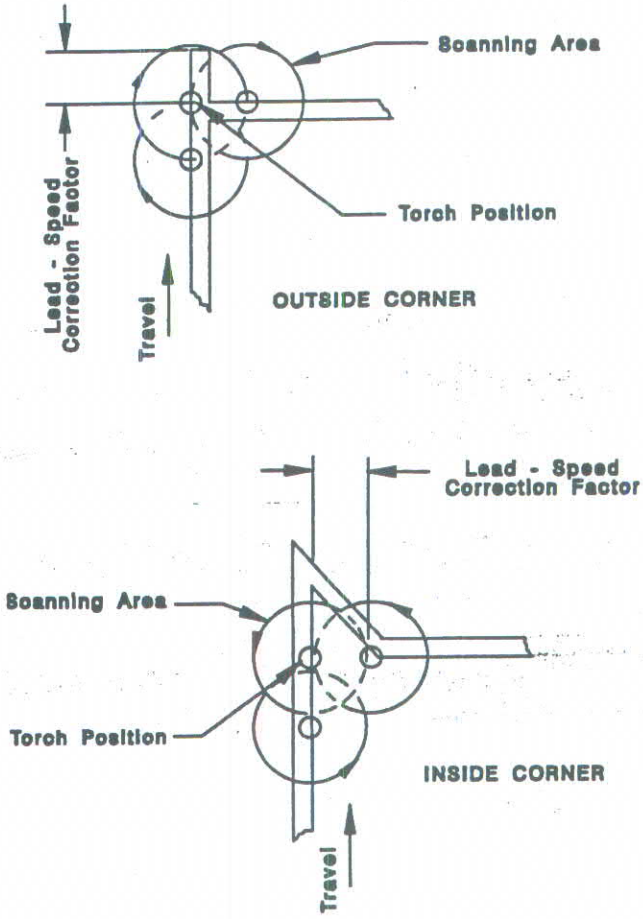


Figure 3-6 Corner Compensation.

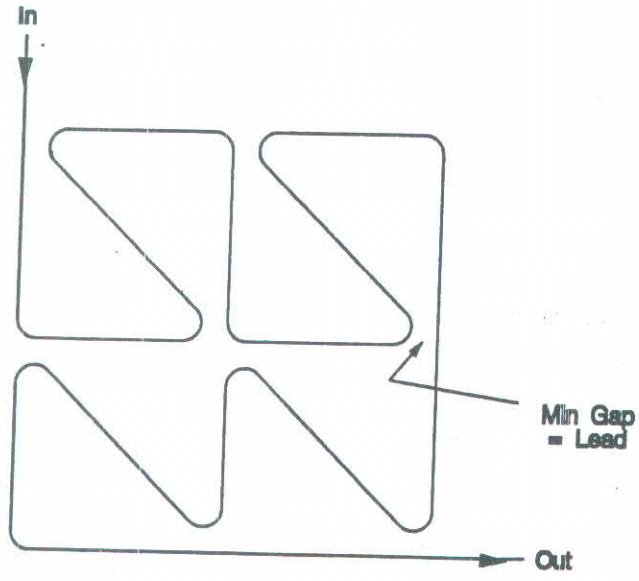
Low Contrast And Shopworn Patterns

Adjustments may be made if lighter pencil-drawn patterns need to be traced, i.e. patterns that provide a lower contrast than firmly drawn H or HB grade pencils.

Pattern Nesting

When cutting several parts from the same plate, it may be more economical and more efficient to group or nest them on one pattern.

Similar or dissimilar pieces may be nested together. See Figure 3-7 for one example.



1. When a Command mark is used, the leading edge of the mark should represent the desired point of slowdown and include allowances for 3 scan revolutions (120 msec for 50 Hz or 100 msec for 60 Hz operation) and machine-dependent deceleration time.
2. The width of the Command mark, dimension 'a' in Figure 3-8, should be at least 1-1/2 times the lead used, without any gap between it, and the pattern line.
3. There should be little or no difference in contrast between Command marks and pattern lines.
4. Kerf compensation cannot be adjusted when Command marks are used. Kerf allowances can be incorporated in the pattern.

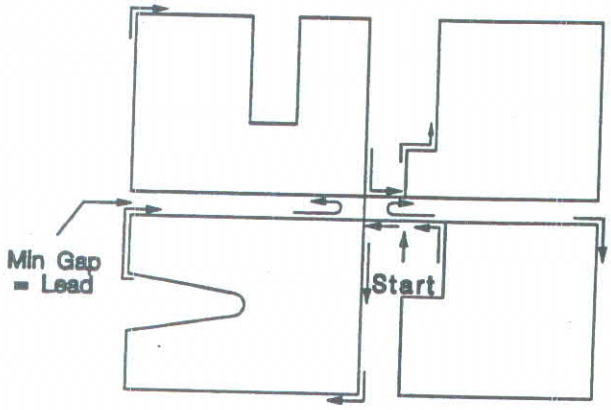


Figure 3-7 Pattern Nesting.

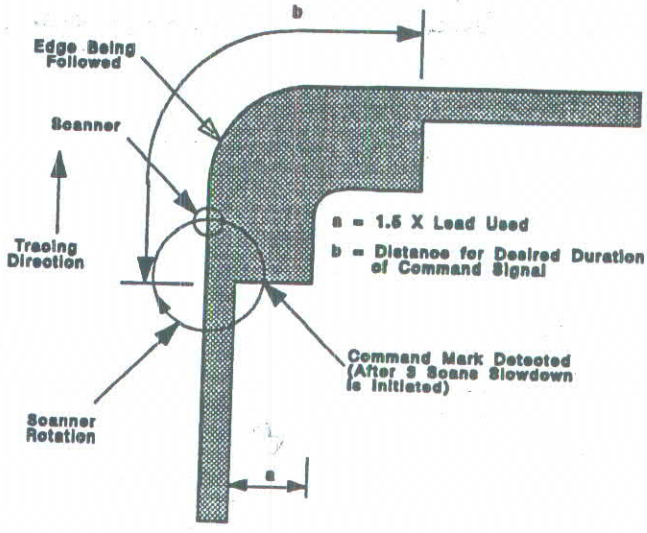


Figure 3-8 Command Marks For Corner Slowdown.

Command Marks

Command marks are placed on a pattern to initiate automatic corner slowdown operation. The use of command marks is only possible when the Corner Slowdown Option circuits are fitted in the system.

Command marks are detected at 90° after line interception. When drawing Command marks, the dimensional information given in Figure 3-8 should be closely followed, noting these points:

Chapter 4: Control/Amplifier Unit