SYSTEM 1100 ACCESS CODES

NORMAL ACCESS CODE: 3721

STROKE COUNTER
ACCESS CODE: 0072

SYSTEM 1100 TONNAGE MONITOR

OPERATING MANUAL

Manual LS-004
Revision 01

CONTENTS

SPECIFICATIONS

SIZE:	14½" wide, 7¼" high, 6" deep
INPUT POWER:	Standard Unit 115VAC ± 15VAC, 1 ampere Remote Display Version Base Unit 115VAC ± 15VAC, 1 ampere Display 115VAC ± 15VAC, 1 ampere
OUTPUT RELAY CONTACTS:	5 AMPS @ 120VAC normally open energized closed.
DISPLAYS:	One four-digit LED display for the total peak tonnage and one four-digit LED display for each channel peak tonnage. One ten-segment multi-color bar graph LED display for each channel and one 2 line by 20 character alpha-numeric LCD display.
INSTRUMENT ACCURACY:	± 0.1% of full scale.
ALARM REPEATABILITY:	0.1% of full scale.
GAIN RANGE:	500 to 10,000
RECORDER OUTPUT:	10 volts, full scale
SPEED:	0-2000 SPM
RESPONSE TIME:	less than 15 milliseconds
OPERATING TEMPERATURE:	45°C (113°F) Maximum Ambient

Section 1. Introduction

Link's System 1100 Tonnage Monitors are a family of microprocessor-based instruments that can determine, display, and compare developed forces with preset limits for a variety of machines - mechanical power presses, press brakes, powdered metal presses, forging presses, die cast machines, injection molding machines, cold headers, and similar machines - that use large forces in production processes. System 1100 Tonnage Monitors are simple, for ease of use in everyday production, yet sophisticated enough to be used as analytical instruments by press and tooling engineers. These instruments can help:

- PROTECT MACHINES from excessive bearing wear and broken frames and load transmission components. Properly applied and used System 1100 Tonnage Monitors provide setup personnel with information about total and distributed machine loads (both forward and reverse loads can be displayed). By operating machines within capacity with a properly distributed load, short term catastrophic machine damage due to overload or maldistributed load, and long term fatigue of machine parts, and wear of bearing surfaces can be reduced. The monitoring capability of the System 1100 will help prevent continuing overloads by stopping the machine if tonnage exceeds preset limits during a machine cycle.

- PROTECT DIES or other tooling from production process malfunctions that don't damage the tooling due to one out of tolerance stroke (several bad strokes may occur on high speed machines that can't stop in one stroke).

- ASSESS TOOLING WEAR of shear surfaces on blanking, piercing, and trimming operations. Early indication of tooling wear can help schedule tool repair and extend tooling life by reducing the severity of wear before sharpening is indicated.

- CONTROL PART QUALITY by providing the load information necessary for consistent tooling and machine setup. Out of limit hits will stop the production process, allowing corrections before large numbers of scrap parts are generated.

- CONSERVE ENERGY by using <u>only</u> the tonnage necessary to make a part. A few thousandths of shut-height misadjustment can mean tens of tons of unnecessary force in coining and forming operations on larger presses. Every excess ton of force takes energy out of the drive system with resultant increased electric bills. The System 1100 Tonnage Monitors can also help match tooling and machines so that larger than necessary machines aren't used in low tonnage applications, again saving energy.

- MEET OSHA REQUIREMENTS to operate within machine capacity. OSHA's General Industry Standards 29CFR1910.217 (f) (4) require mechanical power presses to be operated within tonnage rating. System 1100 Tonnage Monitors provide this information simply and directly.

System 1100 Tonnage Monitors offer a wide range of practical features and design parameters that make them extremely versatile in application and use. Some of these features are:

- Layered accessibility to controls allows easy display of load, setpoint information and alarms, but all operating mode and setpoint selection controls require the use of a keyed selector switch for supervisory control. Selectable keyed reset after an alarm is standard on all units.

- Two and four channel units are available to provide versatile and correct monitoring of a variety of machines.

- Large 4-digit LED displays continuously display forward or reverse loads in tons for all channels and the total.

- Multi-colored LED displays graphically show the peak tonnage relative to the high and low setpoints for each channel.

- A 2 line by 20 character LCD display and 25 key keyboard provide easy access to all tonnage monitor functions.

- Settable tonnage limits provided are: Maximum allowable forward tonnage (HIGH SETPOINT), minimum required forward tonnage (LOW SETPOINT), and maximum allowable reverse tonnage (REV SETPOINT).

- One hundred twenty-three setups containing as many as 60 setpoints can be stored in non-volatile memory and recalled by job number or name.

- Data windows allow for close monitoring of even complex dies by not only checking absolute peak tonnages, but also checking up to four additional 'local peaks' created by staggered tooling. This feature requires a rotary cam switch or limit switch for each data window used.

- Automatic Setup allows all setpoints (peak setpoints and all data window setpoints) to be calculated and set automatically by the System 1100.

- The number and types of alarms are automatically recorded by the System 1100 through the alarm counters (machine rating, high setpoint, low setpoint, and reverse setpoint alarms).

- A stroke counter, presettable batch counter, parts counter, and quality check counter are standard.

- An RS-232 port is provided as standard equipment for interfacing to personal computers. With optional software package tonnage signatures captured by the System 1100 can be displayed and stored on a personal computer.

- Signal output terminals are provided for each channel and the total to drive a recorder or oscilloscope.

- May be calibrated either statically or dynamically.

- Operates up to 2,000 strokes per minute.

1.1 System Overview

Figures 1 and 2 show the components that are contained in the System 1100 for the self-contained and the panel-mount versions respectively.

The self-contained unit (Figure 1) houses all the electronics of the System 1100 Tonnage Monitor. External connections are required only for strain links, press control stop circuit, and optional rotary cam switches.

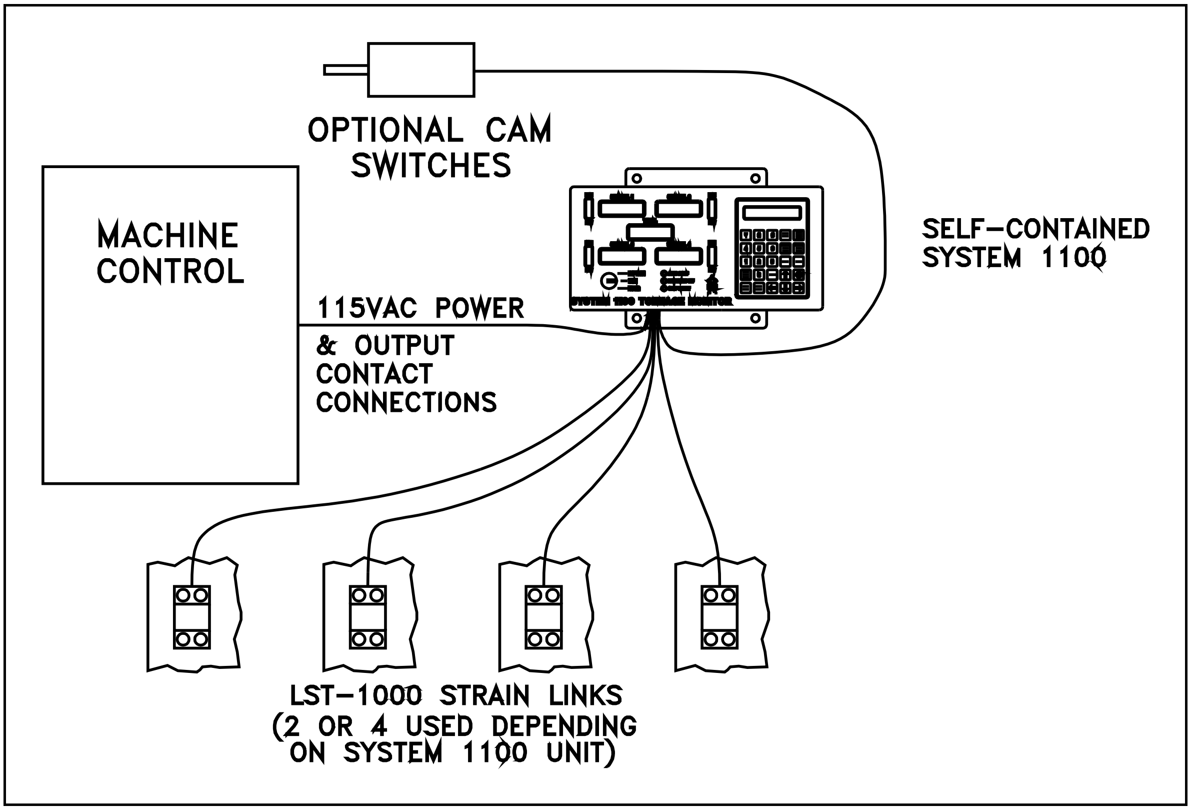


Figure 1. System Components of Self-contained System 1100.

The panel-mount unit (Figure 2) separates the Operator Interface Terminal electronics from the Logic Unit electronics. This configuration is useful when the tonnage monitor display is to be mounted in a panel where depth is limited, or when the display is to be mounted a long distance from the strain gauges.

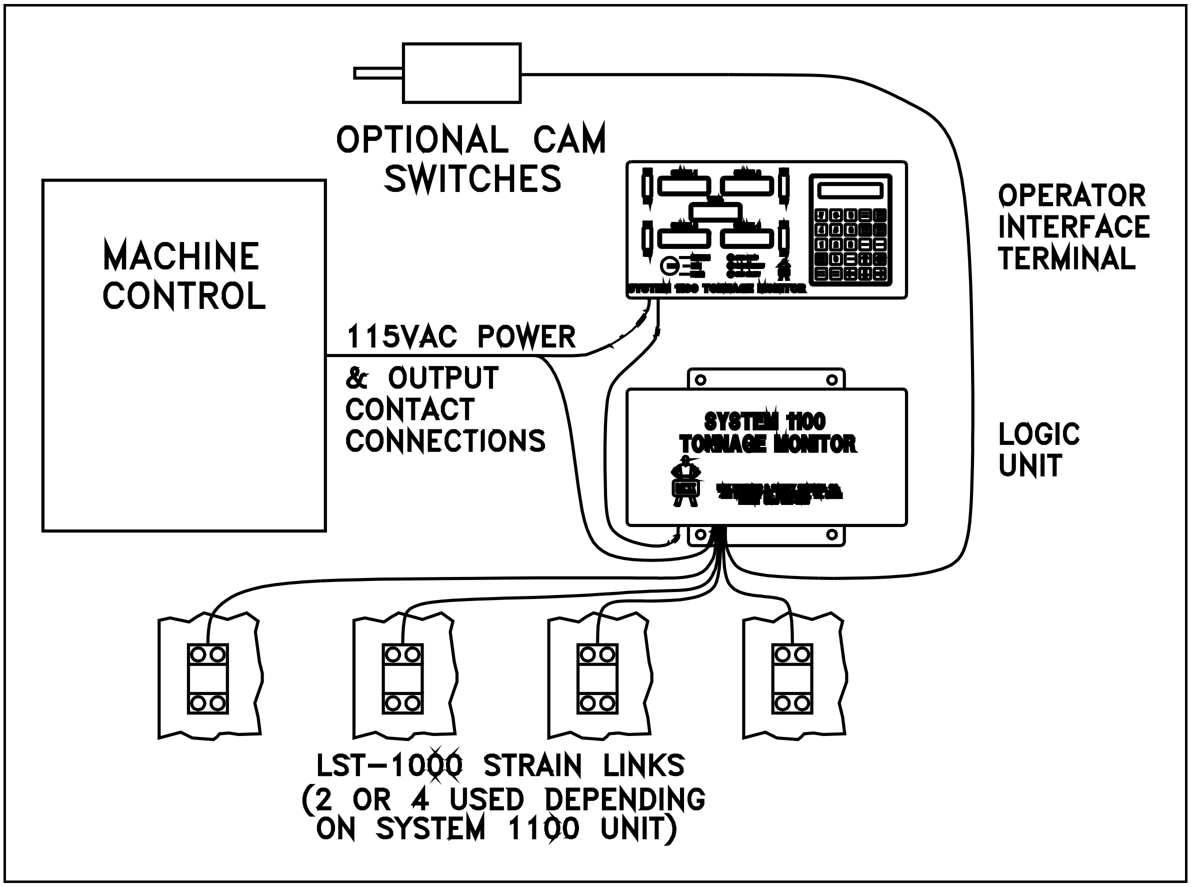


Figure 2. System Components for Panel-mount System 1100.

Section 2. Operation

2.1 The Operator Interface

The operator interface is the means by which the operator can control the operation of the System 1100. The following features of the Operator Interface will be referred to extensively in this manual and so the operator should be familiar with them. A picture of the Operator Interface is located on the last page of this manual and can be folded out for viewing.

1) Tonnage Displays. The tonnage displays are large 4-digit red LED displays used to display peak tonnage.

2) Tonnage Bar-graphs. The tonnage bar graphs are ten segment multi-colored LED displays used to show peak tonnage relative to the HIGH and LOW setpoints and to indicate high and low alarms.

3) Mode Selector Keyswitch. The mode selector keyswitch is used to control the operating mode of the System 1100 and to gain access to tonnage setpoint limits and configuration data.

4) Indicator LEDs. The three indicator LEDs are used to indicate Auto Setup mode, Low Limits Off, and an active Stop Circuit.

5) LCD Display. The 2 line by 20 character LCD display is used to display messages and access the menus of the System 1100.

6) Keyboard consisting of 25 keys. The keyboard is used to enter setpoints, configuration data, clear alarms, and for all other operator input that is required.

2.1.1 Tonnage Displays and Bar Graphs

The tonnage displays are used to display the peak forward and reverse tonnage measured by the System 1100. Selection of forward or reverse peak tonnage for display is discussed in the next section.

The bar graphs are used to graphically display the measured forward tonnage relative to the high and low setpoints. The top segment on the bar graph represents the high setpoint, and the bottom segment the low setpoint. The segment representing the measured tonnage relative to the high and low setpoints is lighted each time a new tonnage is displayed.

2.1.1.1 Display of Alarms

Alarms are generated when the System 1100 detects that the measured tonnage has exceeded a preset value (high setpoint, reverse setpoint, or machine rating) or in the case of low setpoints, has not exceeded a minimum value. Alarms are indicated on the System 1100 using the tonnage displays and the bar graphs.

Machine rating alarms are generated when the measured tonnage exceeds 125% of the channel rating, where the channel rating is the machine rating divided by the number of channels. Machine rating alarms are indicated by a flashing tonnage display on the channel on which the alarm occurred.

High setpoint alarms are generated when the measured tonnage for a channel meets or exceeds the high setpoint for that channel. High setpoint alarms are indicated by the top red segment on the channel bar graph flashing.

Low setpoint alarms are generated when the measured tonnage for a channel during the stroke does not meet or exceed the low setpoint. Low setpoint alarms are indicated by the bottom red segment on the channel bar graph flashing.

Reverse setpoint alarms are generated when the reverse tonnage for a channel meets or exceeds the reverse setpoint for that channel. Reverse setpoints alarms are indicated by a flashing reverse tonnage (reverse tonnages are indicated by a minus sign in the tonnage display).

2.1.2 Keyboard Use

The upper left portion of the System 1100 keyboard is the numeric keypad. The numeric keypad is used for entering setpoints, configuration data, and other numeric data. The remaining keys have special functions that are explained in the remainder of this section.

2.1.2.1 AUTO SETUP key

The AUTO SETUP key is used to access the Automatic Setup function of the System 1100. The operator must be in the Main menu and have the keyswitch in the PROG position to access this function.

Automatic setup stores the highest and lowest peak tonnage from sixteen successive strokes. High setpoints are calculated as the highest peak tonnage plus a user selected percentage of channel rating (the auto setup tolerance), low setpoints are the lowest peak tonnage minus the auto setup tolerance, and reverse setpoints are the highest reverse reading plus the auto setup tolerance. Automatic setup sets all setpoints, high, low, and reverse, for the peak and for all data windows (if used).

When Automatic Setup is begun by the operator, the AUTO SETUP indicator will turn on and the automatic setup screen will appear as shown below.

```
AUTO SETUP TOL:  5%
STROKES NEEDED: 16
```

While the keyswitch is in the PROG position, the automatic setup tolerance will flash, indicating that it can be changed. The tolerance can be adjusted up to 30% or down to 1% using the up and down arrow keys respectively.

The number of STROKES NEEDED will count down as the operator cycles the machine. When all sixteen strokes have been made the System 1100 will calculate and store all setpoints. The AUTO SETUP light will then go out, and the Main menu will again appear. The setpoints are stored in the current setup just as if they had been entered manually.

The automatic setup procedure can be aborted at any time before the sixteenth stroke by pressing the CLEAR key or the EXIT key. The previously entered setpoints will then remain in effect.

<u>WARNING!</u> While in Automatic Setup Mode (when AUTO SETUP light is on) the System 1100 is effectively <u>BYPASSED</u>. All high, low, and reverse alarms are turned OFF. Only machine rating alarms are active.

2.1.2.2 LOW LIMIT ON/OFF key

The LOW LIMIT ON/OFF key is used to switch the low setpoint limits on or off. This functions is accessible only while the keyswitch is in the PROG position.

2.1.2.3 DOWN TIME CODE key

The DOWN TIME CODE key is for use with the Link System Tonnage Monitor local area network system and is not used at this time.

2.1.2.4 TONNAGE FORWARD/REVERSE key

The TONNAGE FORWARD/REVERSE key is used to switch the tonnage displays between forward and reverse tonnage. When reverse tonnage is selected a minus sign will appear at the left of each tonnage display, when forward tonnage is selected the minus sign will go out.

2.1.2.5 HELP key

The operator may request a Help screen from the System 1100 by pressing the HELP key. The Help screens are intended to aid the operator by giving additional information and explanation of the current stage of the program sequence. Some Help screens may be more than two lines long. If the last character on the screen is a down arrow, more help information is available. The operator can press the down arrow key to view the additional lines. The operator can terminate a help screen and return to the program at any time by pressing the EXIT key . If no help screen is available for the present program sequence, a message will inform the operator that a help screen is not available.

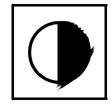
2.1.2.6 CLEAR key

The CLEAR key is used for two main functions. The first function is to remove any data input in progress. If the operator keys in the wrong data but has not yet pressed the ENTER key, he may press the CLEAR key to remove the entire data input. The correct data may then be keyed in. The CLEAR key cannot remove any data once it has been entered with the ENTER key.

The second function of the CLEAR key is to clear stops, alarms and errors. If a counter reaches its programmed limit and stops the machine, the CLEAR key can be pressed to reset the counter and allow the machine to be restarted. If an alarm is present, such as channel 3 high setpoint alarm, or and error is present, such as

ERROR 40 - End Of Cycle cam failure, the CLEAR key can be pressed to clear the alarm or error.

2.1.2.7 CONTRAST key



The CONTRAST key is used to adjust the contrast of the LCD display. The display can be adjusted brighter or dimmer by holding down the CONTRAST key then pressing the up or down arrow keys respectively. If the keys are held down this function will automatically repeat to avoid having to repeatedly press the keys for large adjustments.

2.1.2.8 HIGH SET and LOW SET keys

The HIGH SET and LOW SET keys are used to display the high and low setpoints on the tonnage displays. The setpoints will be displayed as long as the key remains depressed.

2.1.3 Mode Selector Keyswitch

The Mode Selector Keyswitch is a three position keyswitch. The key can only be removed in the RUN position.

RUN - This is the normal operating mode of the System 1100. When the key is in this position, the operator can only view setpoint limits, and counter information. Tonnage setpoint limits and counter limits and count values cannot be altered or cleared.

PROG - This is the program mode of the System 1100. When the key is in this position, tonnage setpoint limits can be changed or turned off, setups can be stored, recalled or removed, and counter limits can be changed, turned off, and count values cleared.

BYPASS - This mode is intended for use while die setting. While in Bypass mode all high, low, and reverse setpoint alarms are turned OFF. Only machine rating alarms are active while in bypass mode.

2.2 Menu Selection

The LCD (Liquid crystal display, at the right-top of the operator interface) provides the operator with information needed to program the System 1100. This is done by displaying a menu (list of choices) and allowing the operator to select one of the menu items. The blinking pointer is called the cursor and is used to identify which item on the list is currently selected. The cursor can be moved to a different choice on the menu using the up and down arrow keys (see the figure on the foldout in the back of the manual). Once the cursor is on the item desired, the operator can press the ENTER key to get further information about that item. The operator is not required to memorize any function names or keyboard entry sequences.

2.2.1 Main Menu

The Main menu is the first list of options offered to the operator during programming of the System 1100. The Main menu contains six functions from which to choose. The Main menu is shown below.

```
MAIN █DISPLAY     █
MENU █SETPOINTS   █↓
-------------------
      STO/RCL
      COUNTERS
      ERRORS
      CONFIG
```

Only two menu options can be shown at one time on the LCD display; the remaining options are accessible by using the up and down arrow keys. If options are available either above or below the currently displayed menu options, then up or down arrows will appear on the right side of the menu indicating so.

To select an option from the menu list, move the cursor to the desired option using the up and down arrow keys then press the ENTER key.

Note that if data windows are disabled in the Config menu the DISPLAY option will not appear in the Main menu.

2.3 Tonnage DISPLAY Selection

If the System 1100 has been configured for use with data windows (section 2.8.6), the DISPLAY option will appear as the first selection in the Main menu. The Tonnage Display menu, simply called 'DISPLAY' in the Main menu, is used to select which tonnage reading will appear on the tonnage displays. The Tonnage Display menu is shown below.

TONNAGE DISPLAY ▌ PEAK TONNAGE ▌↓
DATA WINDOW 1
DATA WINDOW 2
DATA WINDOW 3
DATA WINDOW 4

The up and down arrow keys are used to select the desired tonnage for display. When the desired tonnage is shown on the menu the corresponding tonnage readings will be displayed on the tonnage displays.

Exiting the Tonnage Display menu automatically switches the tonnage displays back to the peak tonnage. The Tonnage Display menu can be exited by pressing the EXIT key or the CLEAR key.

2.4 SETPOINTS

If the System 1100 has been configured for use with data windows (section 2.8.6), the Setpoints menu will appear when the SETPOINTS option is selected from the Main menu, if the System 1100 has not been configured for use with data windows, the screen shown in section 2.4.1 will appear.

The Setpoints menu (shown below) allows the user to select a group of setpoints for viewing or editing and to turn on or off the use of individual data windows.

```
SETPTS  PEAK
 MENU   DW1  (ON)      ↓

        DW2  (ON)
        DW3  (OFF)
        DW4  (OFF)
```

To view or edit a group of setpoints, select the desired group using the up and down arrow keys, then press the ENTER key. Setpoints for data windows that are turned OFF cannot be viewed or edited until they are turned ON.

To turn on or off the use of a data window, first move the keyswitch to the PROG position. Next, select the desired data window using the up and down arrow keys, then press either the ON or OFF key.

2.4.1 Editing Setpoints

The Setpoints Editing screen allow the operator to view and edit a group of setpoints. A group of setpoints consists of a high, low, and reverse setpoint for each channel. A typical setpoints editing screen for a four channel System 1100 is shown below.

```
HI-SET LO-SET          REV-SET (ON)
CH1   22.0   18.2 ↓→      2.0

CH2   21.7   17.9         2.1
CH3   21.9   18.1         2.0
CH4   21.1   17.3         2.2
```

Because of the limited size of the LCD display, not all setpoints can be shown at one time. When additional setpoints are located either above, below, right, or left of the displayed setpoints, arrows indicating so will appear on the right side of the screen.

While the keyswitch is in the BYPASS or RUN positions the operator can only view the tonnage setpoint limits. When the keyswitch is in the PROG position the currently selected setpoint limit will flash indicating that it can be changed. To change a setpoint, first select it using the up, down, left, and right arrow keys, then enter the new setpoint over the old using the numeric keypad. When finished entering the setpoint, press the ENTER key.

The group of setpoints shown above is for the absolute peak tonnage. Data window setpoint groups are indicated as shown below with the data window number appearing in the upper left corner of the setpoints editing screen.

DW2	HI-SET	LO-SET		REV-SET (ON)
CH1	11.3	9.3	↓→	.4
CH2	11.3	9.2		.4
CH3	10.9	9.1		.4
CH4	11.2	9.2		.4

The following rules apply to setpoint limits:

1) High setpoints cannot exceed 125% of channel rating. (channel rating = machine rating/number of channels)

2) A Low setpoint must be lower than the channel's high setpoint.

3) Reverse setpoints cannot exceed 125% of channel rating.

2.4.1.1 Turning Reverse Setpoints ON/OFF

Reverse setpoints can be enabled or disabled in the setpoints editing screen by selecting any reverse setpoint using the cursor keys, then pressing either the ON or OFF key. This will enable or disable ALL reverse setpoints (peak and all data windows). Enabling and disabling of reverse setpoints can only be done while the keyswitch is in the PROG position.

2.5 STO/RCL

In the System 1100, the information which includes all peak and data window tonnage setpoint limits is called the current setup. Since tonnage setpoints limits are set according to the tonnage required to make a good part for a particular die, and they must usually be changed each time the die is changed. Ordinarily this would require either manually entering new setpoints or executing the automatic setup function. Manually entering large numbers of setpoints can be tedious, and using automatic setup each time a die is changed gives no indication of what tonnage the die operated at the last time it was used. What is needed is a permanent record of the required tonnage for each die. The System 1100 provides for permanent storage of up to 123 different setups through the Sto/Rcl menu. The Sto/Rcl menu is shown below.

```
STORCL█STORE      █
 MENU █RECALL     █↓

       REMOVE
```

The Sto/Rcl menu provides the operator with the capability to store setups to backup memory, recall setups from backup memory, and erase setups from backup memory.

2.5.1 STORE

The Store menu allows the operator to assign a job number and description to the current setup, and to save the current setup to backup memory. The Store menu is shown below.

```
STORE █ENTER JOB# █
 MENU █ENTER DESC.█↓

       STORE JOB
```

2.5.1.1 ENTER JOB#

The ENTER JOB# screen allows the operator to assign a six digit job number to the current setup. When the ENTER JOB# screen is entered, the job number of the current setup is displayed as shown below.

```
ENTER JOB NUMBER:
      000025
```

While the keyswitch is in the PROG position, the job number will flash indicating that it can be changed. To change the job number enter the new number over the old using the numeric keypad, then press the ENTER key.

2.5.1.2 ENTER DESC

The ENTER DESC screen allows the operator to assign a 16 character description to the current setup. When the ENTER DESC screen is entered, the description of the current setup is displayed as shown below.

```
 ENTER JOB DESC:
(LATCH01         )
```

While the keyswitch is in the PROG position, the description will flash indicating that it can be changed. To change the description, enter the new description over the old using the numeric keypad for numbers and the up and down arrow keys for letters. When selecting letters with the up and down arrow keys, once the desired letter is selected use the right arrow key to move to the next letter in the description. When finished entering the description press the ENTER key.

2.5.1.3 STORE JOB

Once the job number and description have been set, the setup should be stored to backup memory. When the STORE JOB option is selected from the Store menu the screen below will be displayed.

```
STORE (YES/NO) ?
     000025
```

To store the job to backup memory press the YES key, to abort this operation press the NO key or the EXIT key. If a setup is already stored in backup memory with the same job number, the screen below will appear.

```
JOB FOUND IN MEMORY.
OVERWRITE (YES/NO) ?
```

To store the current setup over the setup already in backup memory press the YES key, otherwise press the NO key or the EXIT key.

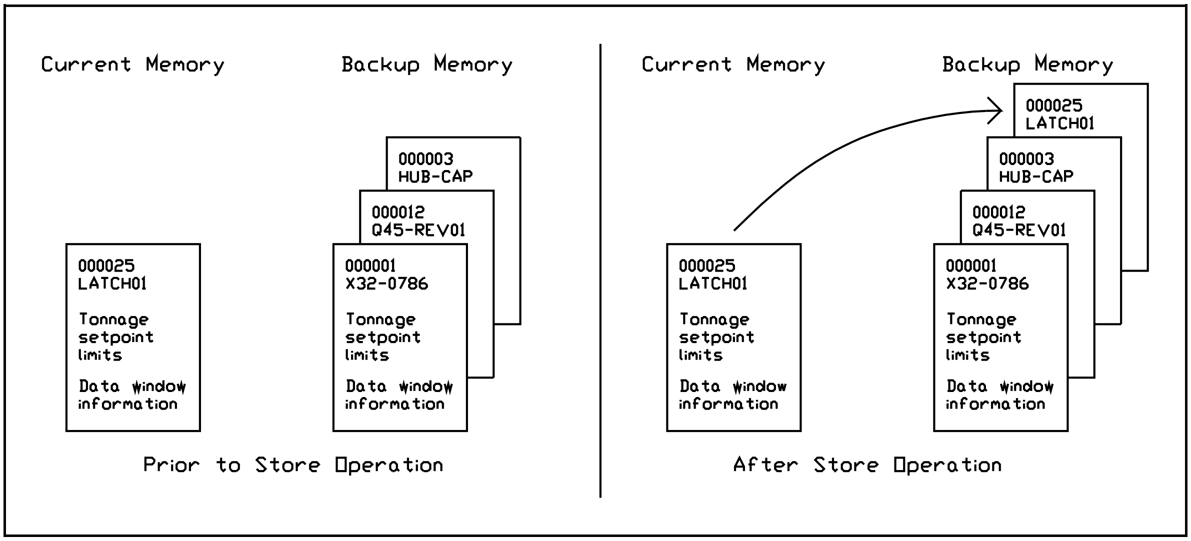


Figure 4. Storing a Setup.

At the conclusion of a successful job storage operation, the screen below will be displayed.

```
JOB STORAGE DONE.
PRESS EXIT.
```

> NOTE: Although setups are stored in the System 1100 the operator is encouraged to keep written records of stored setups. These records will be useful in recovering setups accidently lost by operator error or in the event of memory failure within the System 1100.

2.5.2 RECALL

The Recall menu allows the user to recall previously stored setups from backup memory into the current setup. The Recall menu is shown below.

```
RECALL█ENTER JOB# █
 MENU █SELECT JOB █↓
```

2.5.2.2 ENTER JOB#

The ENTER JOB# screen allows the operator to directly enter the number of job to recall. The ENTER JOB# screen is shown below.

```
ENTER JOB NUMBER TO
RECALL:  ______
```

The six digit job number is entered by the operator using the numeric keypad. When the operator presses the ENTER key after keying in the job number, the System 1100 searches the backup memory for the requested job and recalls it if it is found. If the requested job is not present in backup memory a message indicating so will be displayed.

2.5.2.1 SELECT JOB

The SELECT JOB screen allows the operator to search through a list of all jobs stored in backup memory and select from that list a job to recall. A typical SELECT JOB screen and list of jobs is shown below.

The operator can use the up and down arrow keys to move through the list of jobs. When the operator presses the ENTER key the System 1100 recalls the job currently shown on the LCD display.

```
JOB NUMBER: 000001
(X32-0786         ) ↓
```

```
JOB NUMBER: 000012
(Q45-REV01        )
```

```
JOB NUMBER: 000003
(HUB-CAP          )
```

```
JOB NUMBER: 000025
(LATCH01          )
```

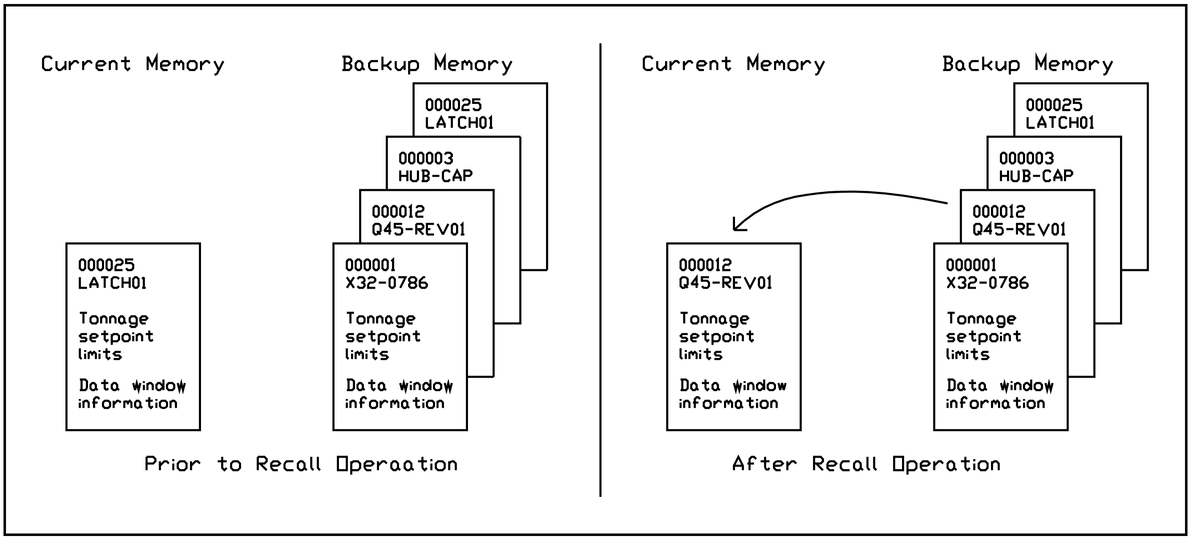


Figure 5. Recalling a Setup.

2.5.3 REMOVE

The Remove menu allows the user to erase stored job setups from backup memory. The Remove menu is shown below.

```
REMOVE█ENTER JOB# █
 MENU █SELECT JOB █↓
```

2.5.3.1 ENTER JOB#

The ENTER JOB# screen allows the operator to directly enter the number of the job to remove from backup memory. The ENTER JOB# screen is shown below.

```
ENTER JOB NUMBER TO
REMOVE:  ______
```

The six digit job number is entered by the operator using the numeric keypad. When the operator presses the ENTER key the System 1100 searches backup memory for the requested job and erases it if it is found. If the requested job is not found a message indicating so will be displayed.

2.5.3.2 SELECT JOB

The SELECT JOB screen allows the user to search through a list of all jobs stored in backup memory and select a job for removing. A typical SELECT JOB screen and list of jobs is shown below.

JOB NUMBER: 000001 (X32-0786) ↓
JOB NUMBER: 000012 (Q45-REV01)
JOB NUMBER: 000003 (HUB-CAP)
JOB NUMBER: 000025 (LATCH01)

The operator can use the up and down arrow keys to move through the list of jobs. When the operator presses the ENTER key the System 1100 erases from backup memory the job currently displayed on the LCD display.

2.6 COUNTERS

The Counters menu provides access to the eight counters of the System 1100. The counters can be divided into three types, counters with presettable limits, alarm counters, and the Stroke counter. Counters with presettable limits include the Part, Batch, and Quality counters. Alarm counters include Machine Rating Alarms, High Setpoints Alarms, Low Setpoint Alarms, and the Reverse Setpoint Alarms counters.

When the Rate of Change automatic zeroing method is used (section 3.5.1) spurious counts can be produced if clutch or brake engagement produces forces in the machine frame greater than the zeroing threshold. The most accurate counts can be obtained when the System 1100 is used with the optional zeroing cam (sections 2.8.5 and 3.5.2).

The Counters menu is shown below.

```
CNTRS █PART        █
 MENU █BATCH       █↓
-------------------------
       QUALITY
       M.R. ALARM
       HIGH ALARM
       LOW ALARM
       REV. ALARM
       STROKE
```

2.6.1 PART, BATCH, and QUALITY COUNTERS

The Part, Batch, and Quality counters have presettable limits. These counters can be programmed to stop the production process after a specified number of parts have been made. Only good parts are counted, that is, parts whose forward tonnage is between the high and low setpoints, and whose reverse tonnage is less than the reverse setpoint. These counters operate in this way regardless of BYPASS mode, or low or reverse limits being turned off.

For installations where the System 1100 stop circuit is connected to the emergency stop of the press control, the System 1100 provides a top-stop delay timer (section 2.8.9). This timer is capable of providing delays from 0 to 1 seconds to stop the machine with the ram at the top of the stroke when a counter limit is reached.

The Part counter is intended to count the total number of parts in a run. The Batch counter is intended to count the number of parts per batch. This counter is useful if part bins must be changed several times during a part run. The Quality counter is used to stop the production process at regular intervals for the operator to perform part quality inspections.

The Part, Batch, and Quality counters all operate similarly and so the examples discussed below apply to all of these counters. An example Batch counter screen is shown below.

```
 BATCH CNT: 0012934
(ON) LIMIT: 0123000
```

While the keyswitch is in the PROG position, the counter limit will flash, indicating that it can be changed. This is done by entering the new limit over the old using the numeric keypad, and then pressing the ENTER key. The counter can be turned on or off while in PROG mode by pressing the ON or OFF keys respectively. The count value can be reset to zero while in PROG mode by pressing the CLEAR key. The screen below will then appear.

```
CLEAR COUNTER?
   (YES/NO)
```

Pressing the NO key will leave the count value in tact, while pressing the YES key will reset the counter to zero. The example counter screen is shown below after the counter has been cleared.

```
 BATCH CNT: 0000000
(ON) LIMIT: 0123000
```

2.6.2 MACHINE RATING, HIGH, LOW and REVERSE ALARMS COUNTERS

The MACHINE RATING, HIGH, LOW, and REVERSE alarms counters count the number of occurrences of each type of alarm. These counters do not have limits, but should be checked regularly for excessive numbers of alarms. All alarm counters operate similarly and so the following discussion applies to all the alarm counters. An example HIGH alarms counter screen is shown below.

```
HIGH-SET ALARMS:
    0000027
```

While the keyswitch is in the PROG position alarm counters can be reset to zero by pressing the CLEAR key. The screen below will then prompt the operator for the access code.

```
ENTER ACCESS CODE:
     ____
```

The access code is entered by using the numeric keypad, then pressing the ENTER key. If the correct access code is entered, the screen below will then appear.

```
CLEAR COUNTER?
   (YES/NO)
```

Pressing the NO or EXIT keys will leave the alarm counter value in tact, while pressing the YES key will reset the alarm counter to zero. The alarm counter screen below is shown after the counter has been cleared.

```
HIGH-SET ALARMS:
    0000000
```

2.6.3 STROKE COUNTER

The stroke counter is used to record the total number of machine stokes since the System 1100 was installed on the machine. The stroke counter screen is shown below.

```
STROKE COUNT:
 0000145267
```

The stroke counter can be cleared by pressing the CLEAR key and then entering a special access code. The stroke counter can be cleared only while the keyswitch is in the PROG position. Since the stroke counter is meant to count the total number of strokes for the machine, it should never be cleared except in the case of moving the System 1100 to a different machine.

2.7 ERRORS

The Errors menu provides the operator with the capability to view a list of the currently active errors. Error codes are provided with a short plain English explanation of error.

An example list of errors is shown below.

```
ERROR 05 - Channel
1 above threshold.↓

ERROR 01 - Channel
 1 will not zero.

ERROR 40 - End Of
 Cycle cam failure.

ERROR 48 - Chan 1
high set too high.
```

Only one error is displayed at a time, with other errors available by pressing the up and down arrow keys as indicated by the arrows appearing at the right of the error screen. Errors can be cleared by pressing the CLEAR key.

2.8 CONFIG

The Config menu allows the operator to program important information about the machine on which the System 1100 is installed, and on how the System 1100 will operate.

When the CONFIG option is selected from the Main menu the operator will be prompted with the access code screen seen below.

```
ENTER ACCESS CODE:
        ____
```

The access code is entered by using the numeric keypad, then pressing the ENTER key. If the correct access code is entered, the Config menu will appear as shown below.

```
CONFIG CAL-CHECK
 MENU  MACH RATING ↓
-------------------------
       MACH NUMBER
       THRESHOLD
       CAM ZERO
       DATA WINDOW
       AUTO SETUP
       MACH SPEED
       TOPSTOP TMR
       DECIMAL PT.
       ALARM CLR
       MEMORY CLR
       STATIC-CAL
```

2.8.1 CAL-CHECK

The CAL-CHECK option is used to view the System 1100 calibration numbers. When the operator selects the CAL-CHECK option from the Config menu the screen below will appear and the calibration numbers for each channel will appear in the tonnage displays. If the number in the tonnage display varies, take the mean value of the numbers that appear as the calibration number.

```
** CAL-CHECK MODE **
 PRESS EXIT TO END
```

Always stop the machine from stroking before selecting the CAL-CHECK option. Calibration numbers are most accurately read when the main machine drive system, including flywheels, is at a standstill. Pressing the EXIT key will return the operator to the Config menu.

2.8.2 MACH RATING

The machine rating number is a scale factor that is programmed into the System 1100 during initial calibration. The machine rating should never be changed after calibration unless a memory failure causes the loss of the proper setting.

When the operator selects the MACH RATING option from the Config menu the machine rating screen will appear. An example machine rating screen for a 100 ton machine is shown below.

```
MACHINE RATING:
    100.0
```

A decimal point will automatically appear if the decimal point has been turned on (section 2.8.10). For machines with capacities of less than 500 tons, the decimal point should be turned on.

While the keyswitch is in the PROG position the machine rating will flash, indicating that it can be changed. The machine rating is entered directly by using the numeric keypad and then pressing the ENTER key. The machine rating should be set equal to the rated tonnage capacity of the machine on which the System 1100 is installed.

2.8.3 MACH NUMBER

The MACH NUMBER screen allows the operator to assign a four digit number to the machine. This number is used for machine identification by the Link Systems Tonnage Monitor local area network and Signature Analysis software.

When the MACH NUMBER option is selected from the Config menu, the MACH NUMBER screen will appear as shown below.

```
MACHINE NUMBER:
     1234
```

While the keyswitch is in the PROG position the machine number will flash, indicating that it can be changed. The machine number is entered by using the numeric keypad, and then pressing the ENTER key.

2.8.4 THRESHOLD

The zeroing THRESHOLD is the minimum tonnage on any channel that is required to produce a tonnage reading. Normally the zeroing threshold will be set at 5% of channel rating. However, on some machines clutch and brake engagement can cause forces in the machine frame greater than this threshold, resulting in nuisance tonnage readings. For this reason the threshold can be adjusted up to 10% in the THRESHOLD screen as shown below.

```
THRESHOLD:  5%
(USE ↑↓ TO CHANGE)
```

While the keyswitch is in the PROG position the threshold will flash, indicating that it can be changed. To increase or decrease the threshold press the up or down arrow keys respectively.

2.8.5 CAM ZERO

CAM ZERO (zeroing by position) enables an external rotary cam switch or limit switch to control the System 1100 zero circuits. When CAM ZERO is enabled, the zero circuits are no longer controlled by the zeroing threshold but instead by the closure of the external cam switch. The CAM ZERO screen is shown below.

```
CAM ZERO MODE: ON
(ON/OFF TO CHANGE)
```

While the keyswitch is in the PROG position the ON or OFF indicator will flash, indicating that it can be changed. To enable or disable the use of the external zeroing cam, press the ON or OFF keys respectively.

2.8.6 DATA WINDOW

The DATA WINDOW option in the Config menu allows the user to completely disable the use of data windows. If data windows will never be used, it is recommended that they be disabled in this way.

Disabling data windows simplifies some menu operations. In particular, disabling data windows eliminates the DISPLAY option in the Main menu. Also, when the SETPOINTS option is selected in the Main menu, the operator is immediately shown the peak setpoints instead of having to select from a list of the peak and data window 1, 2, 3, and 4 setpoints.

The DATA WINDOW screen is shown below.

```
DATA WINDOWS:  OFF
(ON/OFF TO CHANGE)
```

While the keyswitch is in the PROG position the ON or OFF indicator will flash, indicating that it can be changed. To enable or disable the use of the data windows, press the ON or OFF keys respectively.

2.8.7 AUTO SETUP

The AUTO SETUP option in the Config menu allows the operator to set the automatic setup tolerance. While the automatic setup tolerance can be adjusted during auto setup process, this screen is useful for initial machine configuration. The auto setup configuration screen is shown below.

```
AUTO SETUP TOL:  5%
(USE ↑↓ TO CHANGE)
```

While the keyswitch is in the PROG position the automatic setup tolerance will flash, indicating that it can be changed. The tolerance can be adjusted up to 30% and down to 1% using the up and down arrow keys respectively.

2.8.8 MACH SPEED

The MACH SPEED option in the Config menu allows the operator to configure the operating speed for the machine on which the System 1100 is installed. For variable speed machines, the speed range should be select for the maximum operating speed of the machine. The machine speed screen is shown below.

```
SPEED:  61-120 SPM
(USE ↑↓ TO CHANGE)
```

While the keyswitch is in the PROG position the speed range will flash, indicating that it can be changed. The operator can adjust the speed range from 'OVER 600 SPM' to '0-60 SPM' using the up and down arrow keys respectively. Correct setting the machine speed is necessary for the proper operation of the System 1100.

Note! For machines running over 500 strokes per minute a zeroing cam should be installed (section 3.5.2).

2.8.9 TOPSTOP TMR

For installations where the System 1100 stop circuit relay is connected to the press control emergency stop, the top-stop delay timer can be used to delay the activation of the stop circuit relay until the press ram is at the top of the stroke. The top-stop delay timer only affects stops caused by the PART, BATCH, and QUALITY counters. The top-stop delay timer screen is shown below.

```
TOP-STOP DELAY TIMER
       000 ms
```

While the keyswitch is in the PROG position the delay time will flash, indicating that it can be changed. The operator can program a new delay time by entering the new time over the old using the numeric keypad, and then pressing the ENTER key. The top-stop delay timer can be set from 0 to 1 second with one millisecond resolution.

For installations where the System 1100 stop circuit relay is connected to the press control top-stop circuit, the top-stop delay timer should be set to 000 milliseconds.

2.8.10 DECIMAL PT

The DECIMAL PT screen allows the operator to turn on or off the decimal point in the System 1100 tonnage displays. For machines with capacities of less than 500 tons, the decimal point should be turned on. The decimal point screen is shown below.

```
 DECIMAL POINT: ON
(ON/OFF TO CHANGE)
```

While the keyswitch is in the PROG position the on/off indicator will flash, indicating that it can be changed. The operator can turn the decimal point on or off by pressing the ON or OFF keys respectively.

When the decimal point has been turned on, a decimal point will automatically appear in all setpoint programming screens and the machine rating screen.

2.8.11 ALARM CLR

The ALARM CLR screen allows the operator to enable/disable restrictions on the use of the CLEAR key for clearing alarms and errors. The alarm clear configuration screen is shown below.

```
ALARM CLEAR ACCESS:
 BYPASS/RUN/PROG
```

The sample alarm clear screen shown above indicates that the CLEAR key can be used for clearing tonnage setpoint alarms and errors while the keyswitch is in any position (BYPASS, RUN, or PROG).

```
ALARM CLEAR ACCESS:
       PROG
```

The sample alarm clear screen shown here indicates that the use of the CLEAR key for clearing alarms and errors has been restricted to use only while the keyswitch is in the PROG position.

While the keyswitch is in the PROG position the alarm clear access will flash, indicating that it can be changed. The operator can toggle between the two alarm clear access settings by pressing the ENTER key.

2.8.12 MEMORY CLR

The MEMORY CLR function is used to erase the current job setup in the event of a failure of the non-volatile memory. If the System

1100 detects that the current setup has inadvertently been corrupted, ERROR 45 (Current job setup corrupt) will result.

Two options are available for correcting this situation, the operator can recall a previously stored setup, or can erase the current setup using the MEMORY CLR function. If the entire non-volatile memory has been corrupted, recalling a previously stored setup will not be possible, and so the MEMORY CLR function would be necessary.

When the MEMORY CLR option is selected from the Config menu, the operator is prompted with the screen below. Pressing the YES key will erase the current setup, while pressing the NO key will return the operator to the Config menu.

```
CLEAR CURRENT JOB
SETUP (YES/NO) ?
```

After the MEMORY CLR function has been executed all setpoints, peak and all data windows, will be set to zero tons. Stroking the machine with these setpoints will immediately cause setpoint alarms. The operator should either manually enter proper operating setpoints (section 2.4.1), or begin the automatic setup function (section 2.1.2.1) before stroking the machine.

2.8.13 STATIC-CAL

The STATIC-CAL screen is used for static calibration of the System 1100 using hydraulic jacks. When the STATIC-CAL option is selected from the config menu the screen below is displayed.

```
* STATIC-CAL MODE *
 PRESS EXIT TO END
```

While in the STATIC-CAL screen, the System 1100 keeps the zero circuits turned off, and continuously updates the tonnage displays with the current tonnage seen by the strain gages. This allows static loads, created using hydraulic jacks, to be used for calibration. For more information on static calibration see section 6.2.

Section 3. Theory of Operation

3.1 General

Load bearing structural members of machines are elastic bodies -- stretching, compressing, bending, and/or twisting depending on applied forces. Externally applied forces or moments (torsion) applied to a solid body cause internal stresses (forces per unit area) in that body, resulting in dimensional changes of the body. Such force induced dimensional changes are referred to as strain, and are expressed as changes in length per unit length.

The strain induced in a metal structural member depends on the externally applied force, the physical properties of the particular metal used, and the geometry of the structural member. As long as stresses within a structural member are less than a certain value, (dependent on type of material) called the limit of proportionality, strain is proportional to stress, and for a given geometric shape and material, to the size, direction, and point of application of externally applied force. Within this "elastic region" of the material, the structural member will return to its original dimensions when an externally applied force is removed.

External forces of such magnitude as to induce stresses in the material somewhat above the limit of proportionality will cause the material of the structural member to reach the yield point, causing permanent distortion of the structural body when the force is removed. Still greater applied forces will cause the material to reach the point of fracture, breaking the structural member.

Long term fatigue of structural members is also related to force induced stress levels and the number of stress cycles (applications and removals of force on the structural member). Lifetime of structural members operated well within the elastic region of the structural material (at low stress levels relative to the limit of proportionality) is extremely long in terms of stress cycles (and hence machine cycles). Lifetime is significantly reduced as structural member stresses near the limit of proportionality.

Structural members of machines that use force in production processes normally are designed so that induced stresses at rated load are well below the limit of proportionality, avoiding stretched, bent or "sprung" machine components and short machine cycle lifetimes. Thus, the machine operates in the elastic region of its structural members, with stresses and strains that are related to applied loads. The stretch or compression of certain machine structural members can indicate the force applied by the machine (machine load) as well as the load distribution to structural members in production processes.

3.2 Measurement of Load

System 1100 Tonnage Monitors use strain gauge transducers (strain links) mounted to appropriate load bearing structural members of power presses and other machines to measure load. These strain links, consisting of a Wheatstone bridge arrangement of strain gauges attached to an intermediate fixture, provide electrical signals proportional to the amount the intermediate fixture is stretched or compressed. When mounted to a machine structural member, the intermediate fixture follows dimensional changes of the machine structure, stretching and compressing with the section of machine structure between fixture mounting points.

A very stable voltage is used to excite the strain gauges on the intermediate fixture. When the fixture is stretched or compressed, the strain gauges change resistance with dimensional change, increasing or decreasing resistance due to tension or compression, respectively. A change in output voltage proportional to this resistance change and the excitation voltage is generated, providing a signal to the tonnage monitor that can be used to determine machine load.

The dimensional changes of machine structure between strain link mounting points are usually in the microinch range, with corresponding strain link signal outputs of millivolts. The strain links are connected to the tonnage monitor with shielded wire. The strain link signals are amplified by the System 1100 channel cards to larger voltage levels and the maximum (peak) signal is stored in a peak hold circuit each cycle until read by the microprocessor and displayed on the digital readouts as tonnage. Calibration of the tonnage monitor occurs when electrical signals from all strain links due to known load are amplified to a voltage level that causes the known load to be displayed on the digital readouts.

The selection of machine structural members whose strain is to be measured depends on machine structural configuration and load information desired. For example, on a single point gap or OBI power press, the total tonnage exerted by the press passes through the single connection from crankshaft to slide (ram). Therefore, a single strain link mounted on this connection can be used to monitor total machine tonnage.

This monitoring method, however, does not determine load distribution to the two sides of the machine frame due to off center die forces. Since press manufacturers rate machines with a uniformly distributed central load, the two "C" shaped side members of the machine are designed to carry one-half the total machine load rating (usually a generous overdesign allowance is provided for short-term overloads). Tooling forces that act to the left or right of the front vertical centerline of a gap or OBI press distribute a larger proportion of the load to the left or right side of the frame, respectively. Thus, it is possible to use dies that exert forces within the machine rating and still overstress one side of the machine frame due to off center loading.

Using two strain links, one on each sideframe member of a gap OBI press, and using a two channel tonnage monitor gives the distribution of tonnage to each side of the machine frame. Alarm limits may be set for both sides of the frame to prevent overloading due to off center loads. The total peak tonnage exerted by the press is obtained for display by continuously summing the two channel outputs and storing the maximum value of the sum each machine cycle.

Similarly, machines with straight side frame configurations (four corner post or modified four post construction) can be monitored as to load distribution and total load by using a four channel tonnage monitor with strain links on each upright between bed and crown. Such monitoring indicates both eccentric loading from front to back as well as left to right. A two channel tonnage monitor with strain links mounted on the two connections of a two point straight side press can measure left and right load distribution and total load, but not front to back off center loading.

3.3 Summing Multiple Channel Outputs to Obtain Total Load

When multiple strain links are used to measure load distribution to machine frame members, the outputs of tonnage monitor channels associated with each transducer must be added to obtain the total tonnage exerted by the machine in the production process. Strain links should be mounted on geometrically symmetrical frame members that share equal proportions of a centrally located machine load; i.e., the two side frames on "C" frame machines, uprights on straight side machines, or, in certain applications, on the multiple connections between crankshaft and slide on machines that develop slide motion mechanically. Under these conditions of geometric symmetry, a central machine load should be divided equally to each strain link. Each channel of a two channel tonnage monitor should read 1/2 and each channel of a four channel unit should read 1/4 of a central load.

To obtain the peak total tonnage exerted by complex tooling in a machine cycle with staggered forces that are not centrally located, System 1100 tonnage monitors do not add the peak tonnages on each channel. Rather, the instantaneous sum of all channel outputs is taken, and a separate peak hold circuit stores the peak total signal for display. On complex tooling, the total peak tonnage is not usually the sum of the displayed tonnages on each channel! To illustrate this principle, consider a die with two staggered punches of equal cross-sectional area and that are equally sharp. The longer punch is located on the left side of the die, and the shorter punch is on the right side of the die as shown in Figure 5.

Assume the die is located in the center of an OBI press bed and that two holes are to be pierced in a sheet metal blank. A two channel tonnage monitor is used with strain gauge transducers located on both sides of the press frame, and the load signal for both left and right channels is observed on an oscilloscope to be that shown in Figure 6.

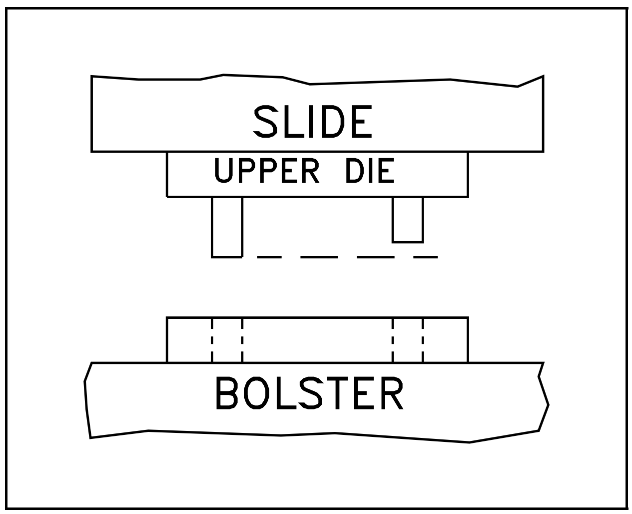


Figure 6.

The oscilloscope trace shows that the longer left punch contacts the blank first and exerts a peak total force of 100 tons at time t1, with 60 tons distributed to the left side of the frame (since the punch exerts its force to the left of the press centerline) and 40 tons distributed to the right side of the frame. A moment after the left punch breaks through the blank, the right punch contacts the blank and builds up to a total peak tonnage of 100 tons at time t2, with 60 tons distributed to the right side and 40 tons to the left side of the press frame.

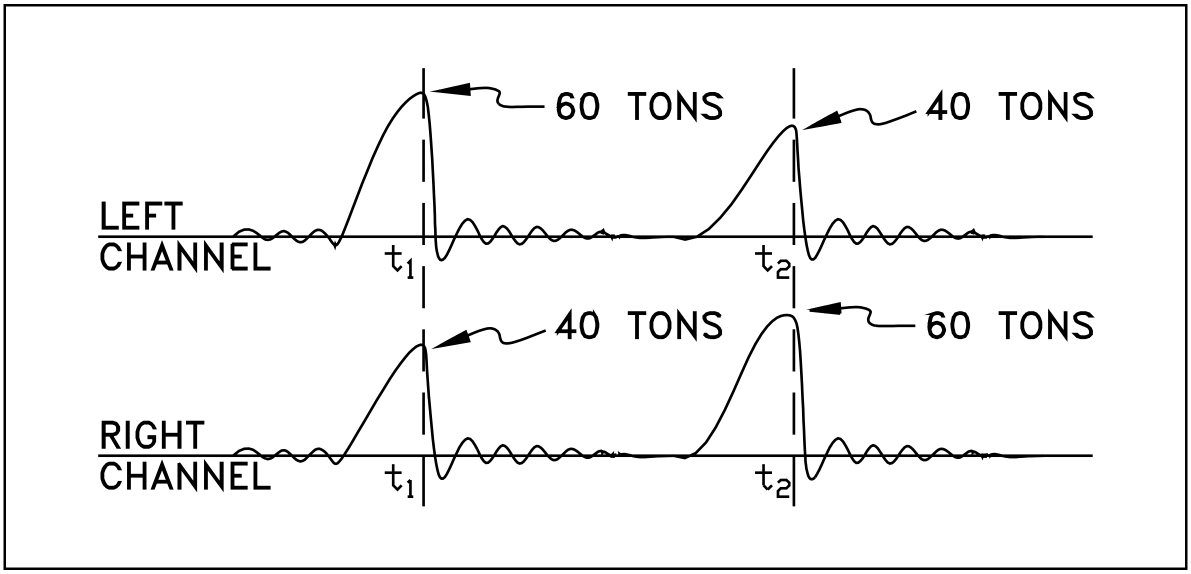


Figure 7.

The peak tonnage on the left side of the press was 60 tons at time t1. The peak tonnage on the right side of the press was 60 tons at time t2. But the peak total tonnage never exceeded 100 tons. Thus, the correct readings on the tonnage monitor display are 60 tons on the left channel, 60 tons on the right channel, and 100 tons for the total peak tonnage.

3.4 Limits of Measurement Accuracy

Several factors influence the absolute accuracy of tonnage measurements on machines that use forces in production processes. Although inherent instrument accuracy can be within 1% of total machine rating, there are machine and load dependent factors which can affect tonnage readings.

3.4.1 Machine Vibration

On mechanically driven machines with flywheels and crankshafts, harmonic vibratory forces induce low level tensile and compressive stresses and strains in the machine frame. The induced strain on large machines, and particularly large gear driven machines with clutch engaged, can be as large as a few percent of strains induced in the frame due to loading the machine to rated tonnage. This results in a "wiggly" baseline electrical signal from strain gauge transducers when no load forces are being developed in the machine, and may cause a small variation in displayed tonnage from stroke to stroke for each channel as harmonic strain is added to load strain. It should be noted, however, that the effects of harmonic vibration are generally reduced when the machine actually exerts force in the production process. Figure 7 illustrates harmonic "mechanical noise" in a strip chart recording of a tonnage monitor output signal.

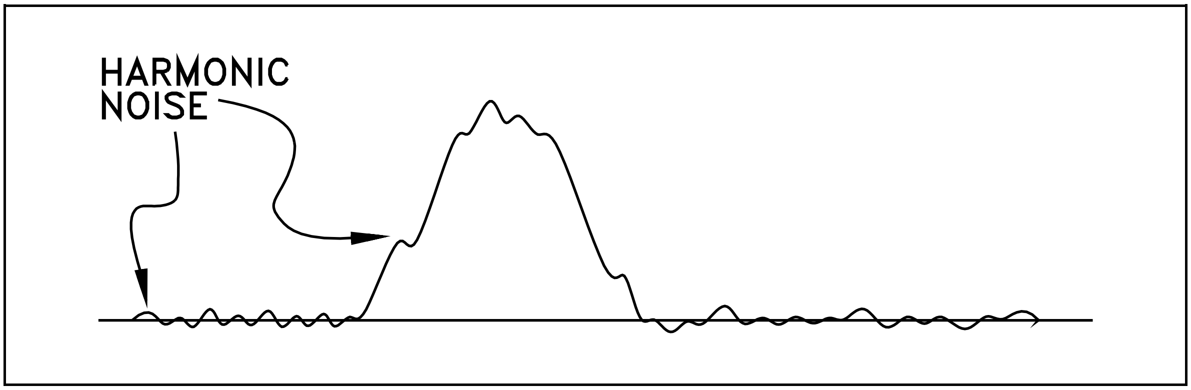


Figure 8. Harmonic Noise.

3.4.2 Structural "Ringing"

Any elastic body has a natural response which dies out with time if energy is suddenly applied to or removed from the body. Just as a diving board vibrates back and forth in dying oscillations until it is again stationary when suddenly relieved of a person's weight, a machine structure "rings" when load is suddenly released by material breakthrough in blanking and piercing operations. Figure 8 illustrates a typical ringing at the end of a blanking operation in a tonnage monitor signal.

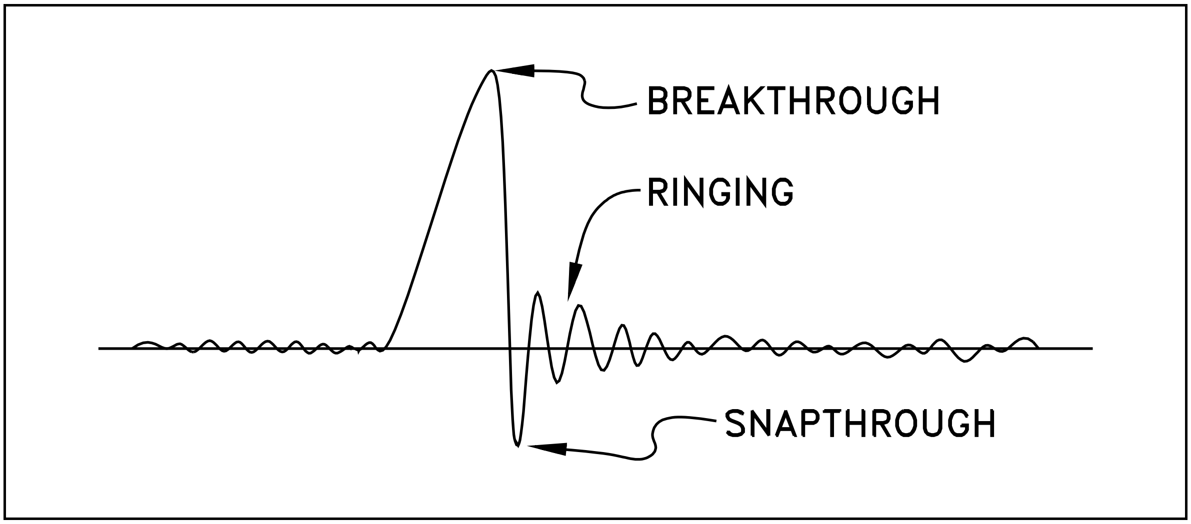


Figure 9. Structural Ringing.

The positive going signal is generated by machine frame stretch as the tooling builds up force on the material. The signal increases until the tooling breaks through the partly sheared material, suddenly releasing the machine load to zero. The sudden release of load causes the machine structure to rebound, creating the dying oscillations (ringing) in the machine structure after material breakthrough. The first negative peak of the oscillation is the largest strain caused in the machine frame due to ringing, and is often referred to as the "snapthrough" force. In effect, the energy stored in the machine's frame under load creates a reverse load on the machine when suddenly released.

Depending on structural mass and stiffness, ringing generally dies out in a few milliseconds to a few hundredths of a second. This short response normally has no effect on tonnage monitor accuracy as long as machine speeds are less than 600 strokes per minute. At speeds greater than 600 strokes per minute, the ringing may not die out between load signals, and can cause a small offset in tonnage monitor readings because the continuous ringing between load signals interferes slightly with automatic zeroing circuits.

Ringing normally doesn't occur in forming, coining, forging, or powdered metal compacting operations. The load on these operations is released slowly by the machine ram or slide in the upstroke.

3.4.3 Structural Nonlinearity and Eccentric Loading

Although stress and strain at a given location on a machine load bearing structural member is proportional to the load force transmitted to that location, certain conditions of eccentric loading can induce signals that are not equal to the actual force exerted by tooling.

Tonnage monitors on Gap, OBI, and other "C" frame power presses and other machines calibrated with a load centered under pitmans (or cylinder rod connections on hydraulic machines), will indicate a tonnage greater than that actually exerted by dies when tooling is moved forward of center under the ram or slide. When the same force is applied forward of slide center, it acts through a longer lever arm on the "C" frame, stretching (straining) the front of the frame and compressing the rear of the frame more than when centrally located. The larger strains act on the tonnage monitor strain links to indicate tonnages that are larger than actually exerted by tooling. It should be noted that the forward located tooling produces the same stress and fatigue of the frame as a centrally located tonnage seen by the frame. In addition, the forward load tries to cock the slide and introduces lateral forces in gibs in ways that accelerate wear.

On straight side presses and other machines of similar design, eccentric loading that is not supported by connections to the ram or slide can cock the slide or ram and introduce bending moments into uprights through gibbing that causes strain links to be stretched more than by vertical forces alone. Again, however, the effect on the machine is equivalent to a central load of the tonnage indicated by the tonnage monitor.

As long as bearing and gib clearances are within recommended tolerances, the tooling forces will be accurately indicated by a tonnage monitor on two point machines, if the load is applied beneath the connections or near the straight line between connections. On a four point machine, accurate tooling forces are indicated as long as loads are applied in the rectangular area within the four connections to the slide or ram.

3.5 Automatic Zeroing

Temperature changes cause expansion or contraction of machine structural members, introducing strains in typical steel or cast iron machine frames of 6 to 7 microinches/inch per degree Fahrenheit. The strains induced by temperature must be distinguished from the strains induced by machine loads and be compensated if tonnage monitors are to provide accurate reading. The temperature induced strains are sensed by tonnage monitor strain links and will shift the "zero" signal (baseline) level from which strains induced by loads are measured unless automatic zeroing of the baseline is provided.

3.5.1 Rate of Change Automatic Zeroing

Two alternative methods of automatic zeroing are provided with System 1100 Tonnage Monitors. The first method distinguishes between thermal and load induced signals by the rate of change of sensed strain. Temperature induced strains occur extremely slowly, while load induced strains occur extremely rapidly (in a few milliseconds). The slow changes are "zeroed out" of the system by a special circuit. Load signals reach a threshold level before the special zero circuit can react and turn off the zero circuit for the relatively brief time that the signal is above the threshold level.

After the primary load signal falls below the threshold level, an internal timer delays turn on of the automatic zero circuit for up to 200 milliseconds to allow peak circuits to capture reverse loads due to snapthrough or stripping forces and to avoid integrating snapthrough forces into the baseline.

The threshold level and internal delay timer associated with rate of change zeroing are also used to determine when a completed signal is displayed on the tonnage displays. A load signal is displayed only after the signal has decreased below the threshold level and remained below the threshold for the internal delay time. This allows the highest peak only of several that might result in a single stroke from progressive or staggered tooling to be displayed, instead of the last peak. This is illustrated in Figure 9. The amount of delay time is set according to the machine speed setting located in the Config menu (section 2.8.8). For proper operation of the System 1100 the machine speed must be set correctly.

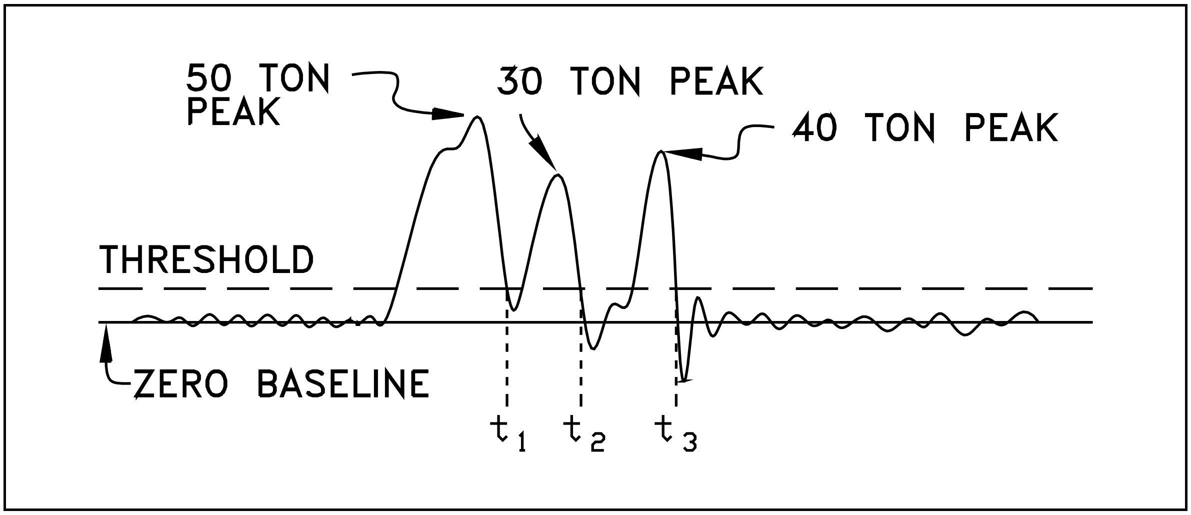


Figure 10.

Without the delay time, the tonnage display would be updated three times in a single stroke, retaining only the last (40 ton) peak for a time long enough to be read. Each time the signal goes above the threshold the timer is reset.

The threshold level to which a signal has to rise to turn off the automatic zero circuit is about 5% of rated channel tonnage. On some machines, particularly larger geared machines, clutch engagement or braking can introduce torques that strain the machine frame as much or more as load signals equal to 5% of rated channel tonnage. These extraneous signals will produce nuisance readings on the tonnage displays.

The threshold level can be changed to 10% of rated channel tonnage in the THRESHOLD screen located in the Config menu (section 2.8.4). This is only recommended for machines that don't perform draw operations or other operations using air cushions or nitrogen cylinders for material clamping. Air cushions or nitrogen cylinders may exert forces too low to reach the 10% threshold during the first part of tooling contact. The automatic zero circuit will then continue to operate until the tooling closes enough to exert forces that cross the 10% threshold, shifting the baseline by a few percent of rated tonnage and introducing errors of a few percent of rated tonnage into the peak tonnage indicated.

When clutch and brake engagement cause nuisance readings, the recommended procedure is to employ automatic zeroing by position, as discussed next in this manual.

3.5.2 Automatic Zeroing by Position

The second method of automatic zeroing provided on a System 1100 Tonnage Monitor is zeroing by position (cam zeroing). A cam switch or limit switch adjusted to be closed when the machine ram or slide is in a region where no force is generated by tooling "tells" the automatic zero circuit when no load is on the machine, allowing the circuit to be activated. The cam or limit switch opens before the tooling closes in the downstroke to turn off the zero circuit and capture the peak load signal. The cam or limit switches close again on the upstroke after tooling and stripper forces are over to resume zeroing.

3.6 Data Windows

Peak tonnage monitors capture the maximum tonnage seen by each strain gauge. This maximum tonnage is used for comparison to setpoints in determining if an alarm should be generated to stop the production process. While this is adequate for most applications, complex tooling can produce multiple peaks resulting in only the greatest peak being checked against setpoints. Where closer monitoring is desired in these applications, System 1100 Tonnage Monitors provide four Data Windows to monitor up to four additional peaks other than the absolute maximum peak tonnage. These additional peaks are referred to as 'local' peaks. The position of the local peaks is determined by external cam switches connected to the System 1100 data window inputs, labeled DW1, DW2, DW3, and DW4.

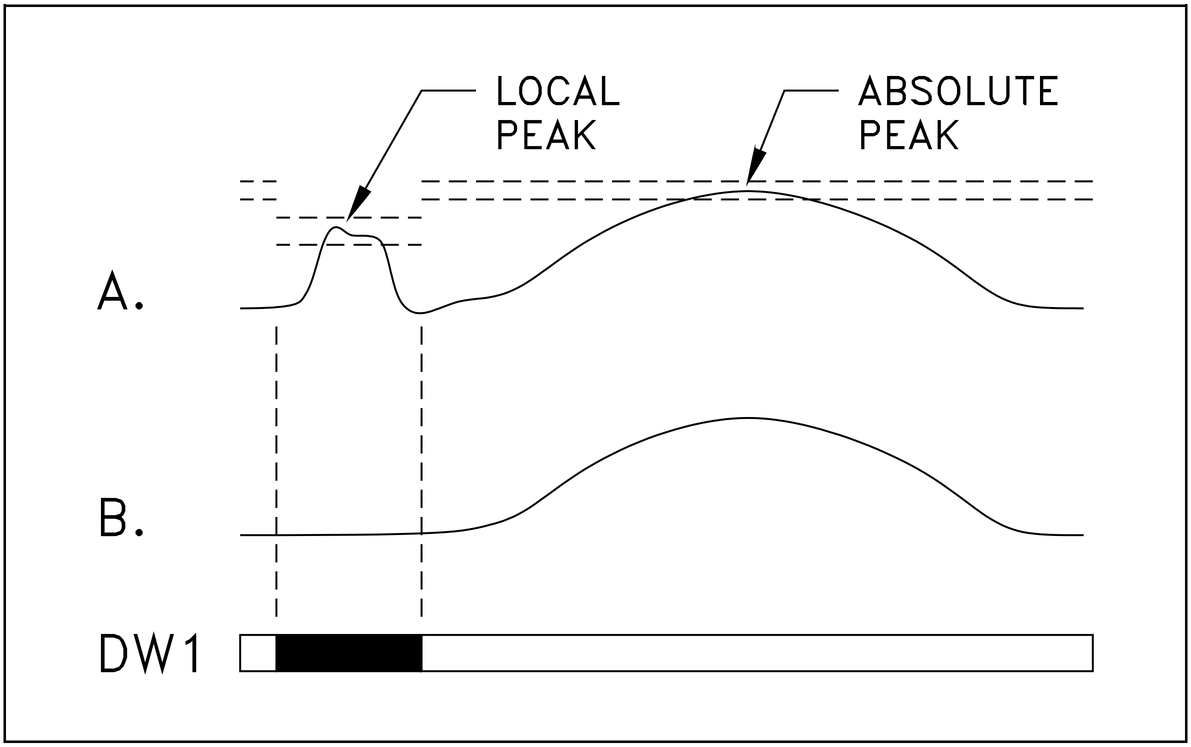


Figure 11. Use of a Data Window.

The tonnage verses time graph in Figure 10A is for a two station die. The first station stamps a logo onto the part (absolute peak) and the second station cuts out the part (local peak).

Since the absolute peak tonnage is created by the coining of the logo, the local peak is not checked using a normal peak tonnage monitor. The local peak could completely disappear as shown in Figure 10B and a normal peak tonnage monitor would not detect any anomaly in the process. This is exactly what would happen if the material did not feed between strokes. Using a single data window, however, places a high, low, and reverse tonnage setpoint on the local peak.

Data window cams should be set to turn on before the local peak and turn off after the local peak. When a data window input is active (cam closed), the corresponding data window setpoints become active. When no data window inputs are active (all open) the absolute peak setpoints are active. This is illustrated in Figure 10 with the active setpoints shown as horizontal dashed lines.

In the maximum configuration the System 1100 can use five groups of setpoints (peak & 4 data windows). On a four channel unit using

all three types of setpoints (high, low, and reverse) this yields a total of 60 setpoints (5 x 4 x 3 = 60), which is a lot of setpoints to key in by hand! The System 1100 Auto Setup function makes entering these setpoints unnecessary, by automatically calculating and storing all of these setpoints.

Section 4. Applications Information

4.1 Selection of Automatic Zeroing Method

As explained in the Section 3 of this manual, two methods of automatic zeroing are possible with a System 1100 Tonnage Monitor. The rate of change method of automatic zeroing requires less hardware (no cam switch or limit switch) and less installation wiring and is excellent for most non-geared mechanical power presses, hydraulic presses, and similar machines. Each System 1100 shipped from the factory is set up for standard rate of change zeroing.

Although rate of change zeroing often works well on some large gear driven machines, a significant number of such machines experience strains in the machine frame large enough to induce small load readings on the System 1100 tonnage display due to forces introduced by gear slap, clutch engagement, and/or brake engagement acceleration characteristics. It is recommended that zeroing by position (cam zeroing) be used on large gear driven machines. Some smaller non-geared machines with high clutch or brake torque may also significantly strain the machine frame and produce unwanted tonnage readings due to clutch or brake engagement.

If rate-of-change zeroing is used, follow the checkout procedures outlined in Section 7 to confirm that no nuisance readings due to mechanical "noise" interfere with desired tonnage readings.

4.2 Strain Link Mounting Locations

4.2.1 "C" Frame Machines

Machines with "C" frame configurations, such as OBI and GAP frame presses, OBS hydraulic presses, etc., are best monitored with two strain links input to a two channel System 1100 Tonnage Monitor. One strain link should be mounted on each sideframe member.

This monitoring method indicates total tonnage as well as load distribution to both sides of the machine frame. It also indicates when excessive stress is placed on the machine by tooling that is located forward of the pitman(s) or other connection(s) to the machine slide. Choices of strain link mounting locations are illustrated in Figure 11.

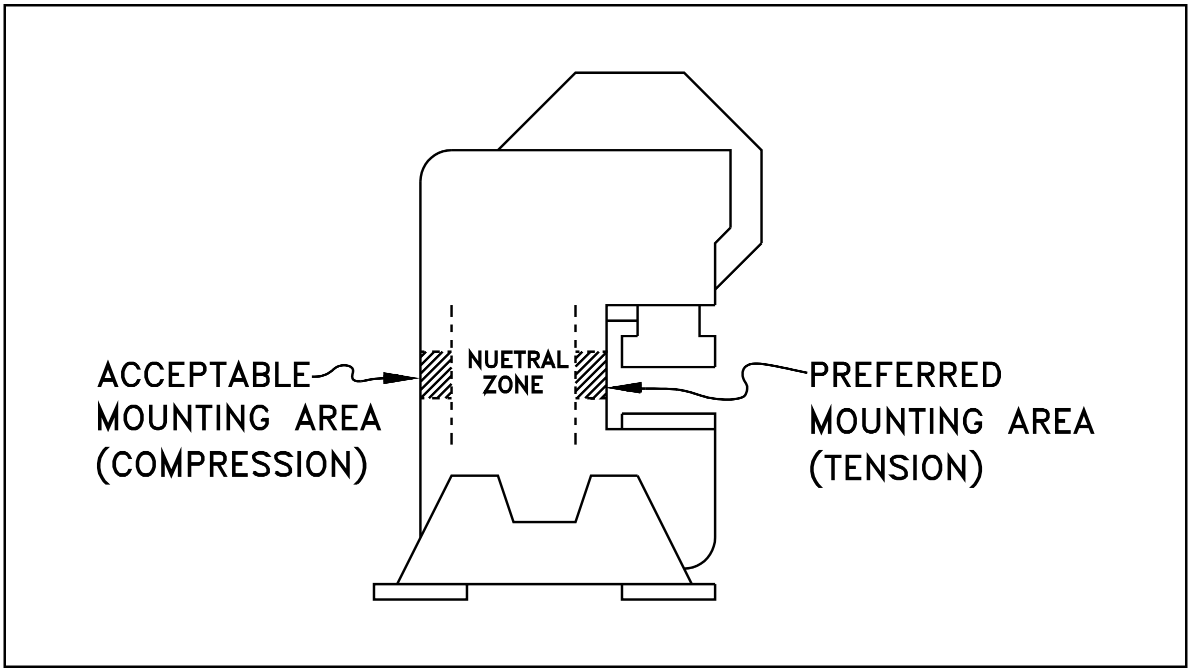


Figure 12. "C" Frame Machine.

The preferred mounting locations are near the middle of the front of the "C" frame. The forces that occur at the front of the machine frame are tensile forces. The compression forces that occur at the "acceptable" locations at the rear of the "C" frame can be accompanied by nonlinear buckling (bending) on thin web sideframes of some machines.

Do not mount strain links near the curves at the front of the "C" frame. The curvature of the frame produces nonlinear strain signals. Also, on presses with increased cross sections near the front of the frame, avoid mounting sensors next to the change of cross section to avoid nonlinear strain signals. The center portion of the front face of the "C" frame is an excellent sensing location, but sensors are highly susceptible to damage from die setting operations.

4.2.2 Straight Side Machines

Straight side presses and other machines of four "corner post" or modified four "corner post" construction are best monitored by four strain links that input to a four channel System 1100 Tonnage Monitor. On machines with tie rod through hollow upright (column) construction, strain links may be mounted on either the tie rods or the uprights, although ease of installation usually dictates mounting the strain links on uprights. On solid frame straight side machines, the uprights are also the best strain link locations.

Mounting strain links on each upright gives load distribution to each upright as well as total load. This method helps indicate optimum tooling location to minimize load and machine deflection.

The best strain link locations are below gibs and at least 12 inches above where the upright joins the machine bed. Locating the strain links in the gib region can cause excessive bending moments to be translated through the gibs into the upright as the slide tries to "cock" for some conditions of eccentric loading. Locations too near the bottom of the upright may produce a nonuniform strain field. Do not mount strain links on any side of an upright that has a tie rod access opening. When holes are present in the desired upright mounting location, avoid mounting strain links any closer than three diameters of the hole directly above or below the hole or any closer than one diameter of the hole to the side of the hole. Don't mount strain links in recessed panel areas in uprights.

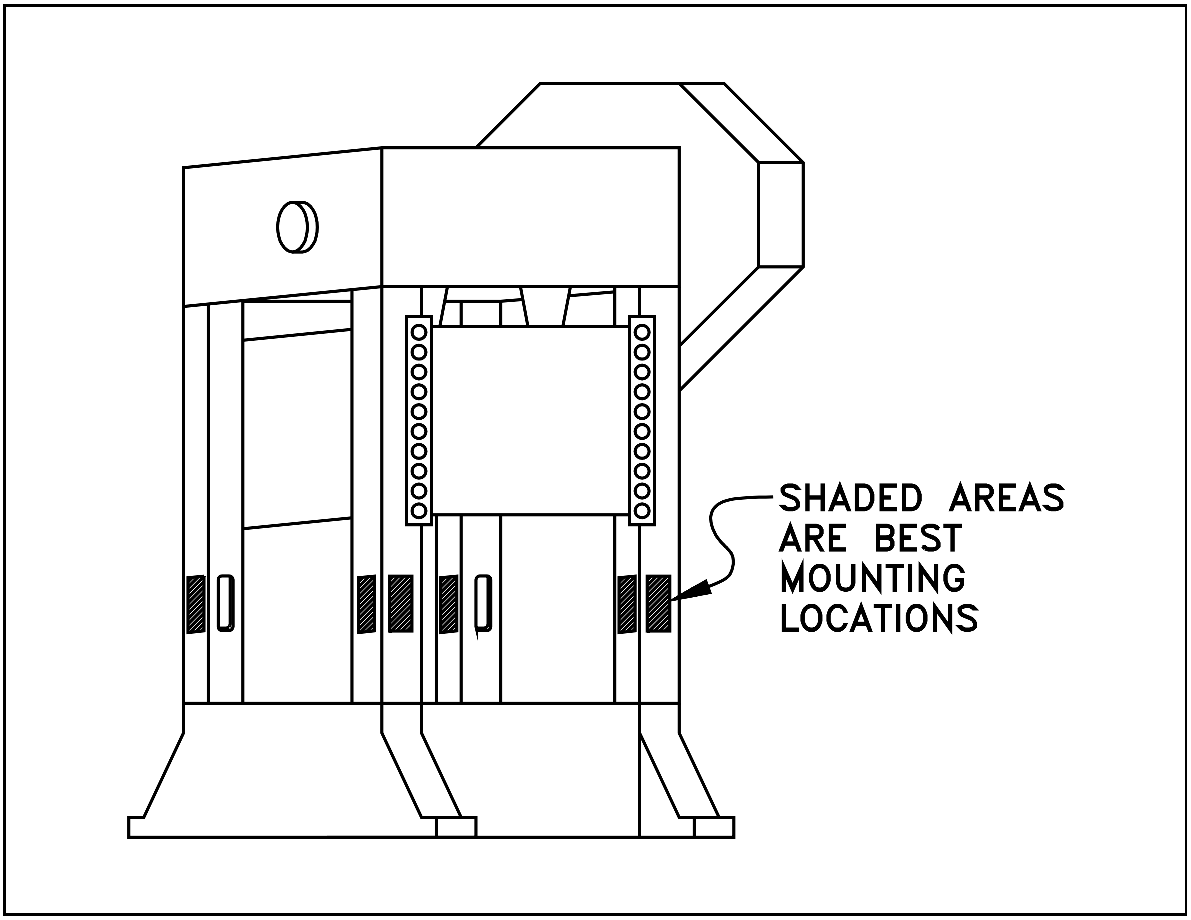


Figure 13. Straight Side Machine.

Stay away from corners of uprights as strain link mounting locations. The best locations on the upright for strain links on machines of tie rod construction are generally on the centerline of the tie rod. Avoid any mounting locations where uprights have internal reinforcements or other change of section. Insofar as possible, strain links should be mounted in conditions of geometric symmetry on uprights and at the same vertical height on each upright. Figure 12 illustrates mounting locations for straight side machines of tie rod construction.

Figure 13 shows areas to avoid on uprights of straight side machines of tie rod construction. The cross-hatched areas should be avoided.

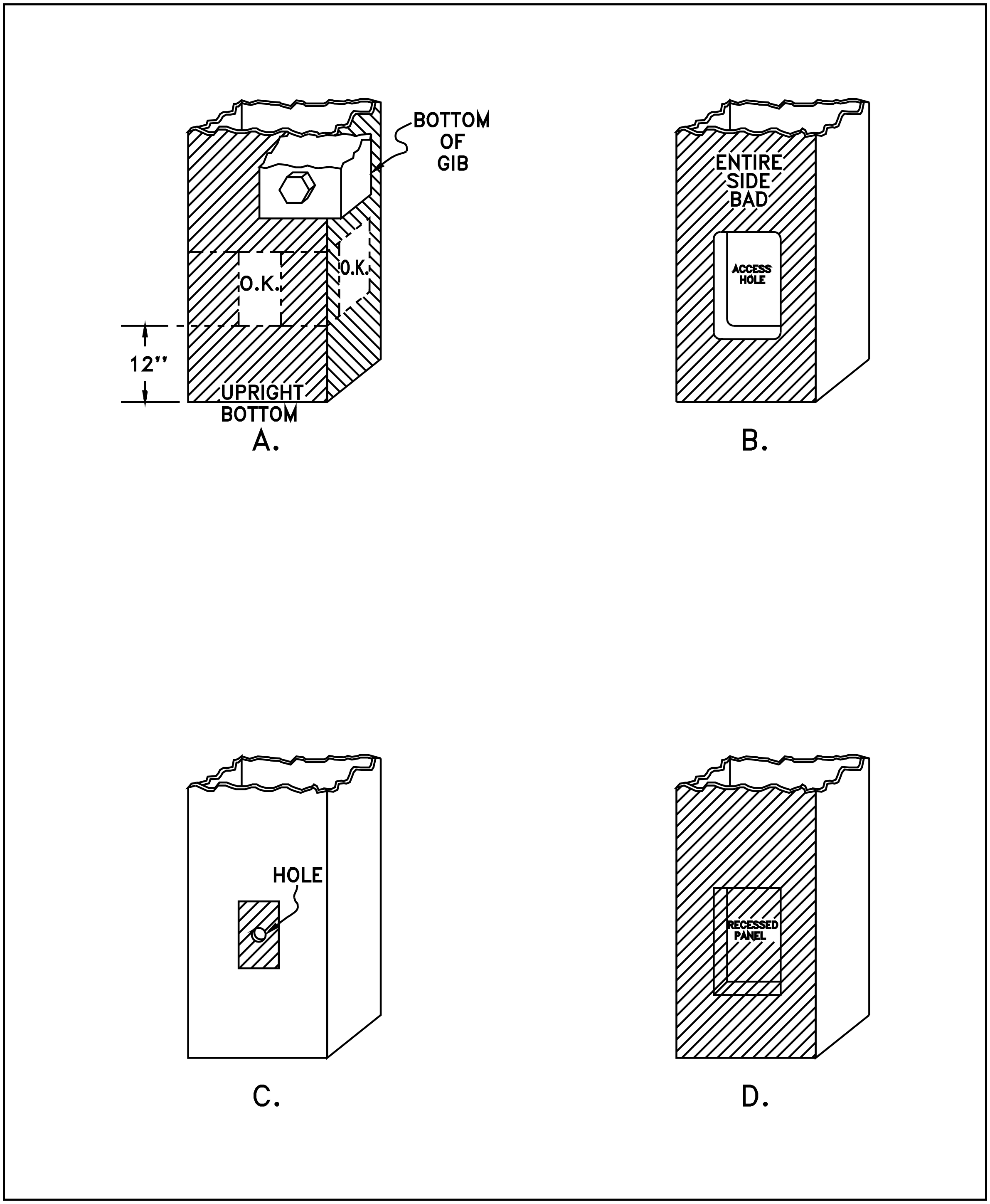

BOTTOM
OF
GIB
O.K.
O.K.
12"
UPRIGHT
BOTTOM
A.
ENTIRE
SIDE
BAD
ACCESS
HOLE
B.
HOLE
C.
RECESSED
PANEL
D.

Figure 14.

On solid frame straight side machines, the preferred strain link mounting location is inside the "windows" under the ends of the crankshaft. A strain link should be mounted on the inside face of each column forming the "windows" as shown in Figure 14.

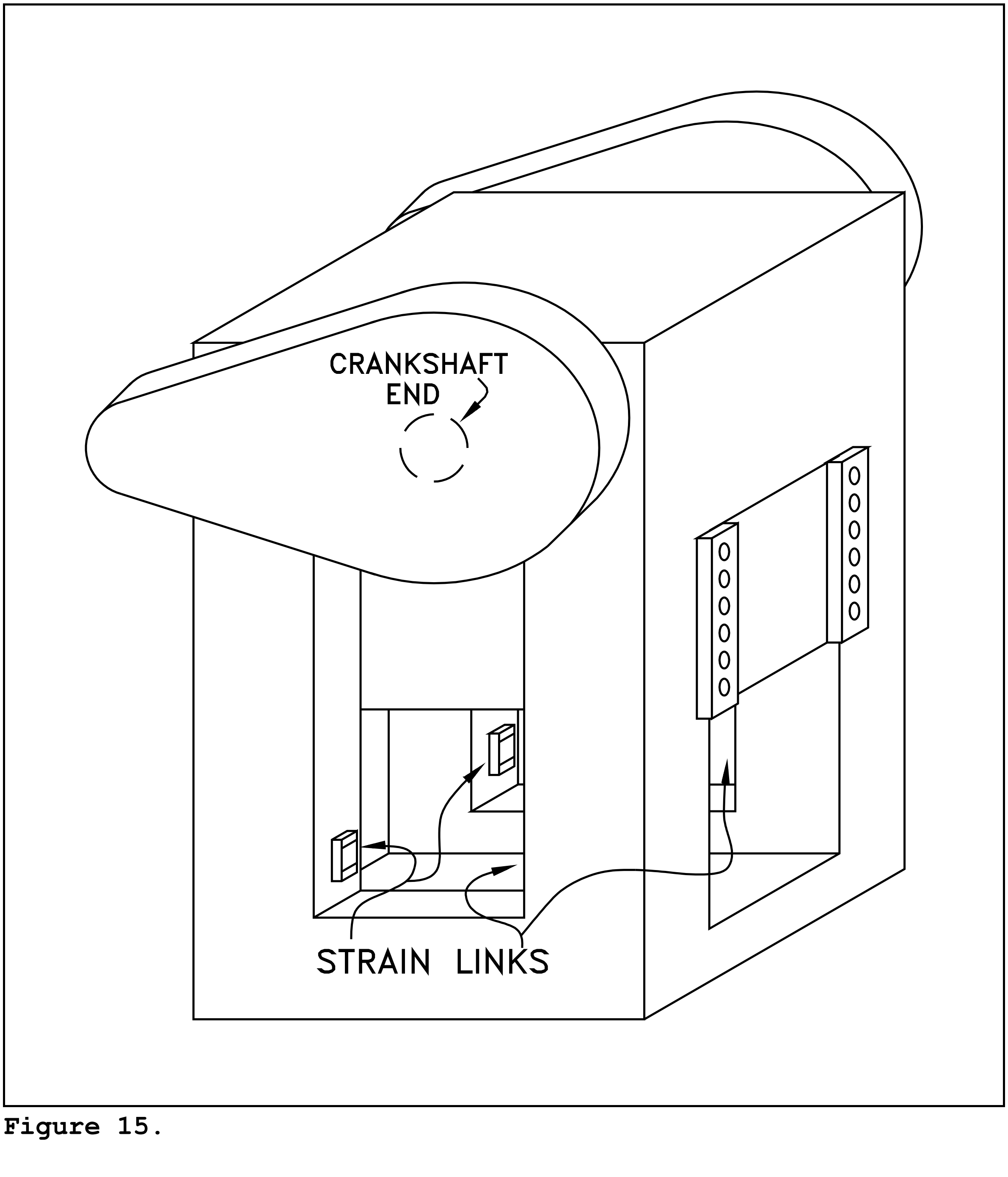


Figure 15.

4.2.3 Overdrive Double Action Presses

Overdrive double action presses have an inner and an outer slide that are driven by connections from crankshafts located in the crown (top) of the press structure.

If the strain links are installed on the uprights of the press (double action presses are usually straight side structures) the peak tonnage displayed will be the sum of the outer slide and the inner slide tonnages. Additionally, One data window can be used to measure the tonnage of the outer slide alone. The data window cam should be set to close before the outer slide reaches the bottom of the stroke then open before the inner slide contacts the material to be formed.

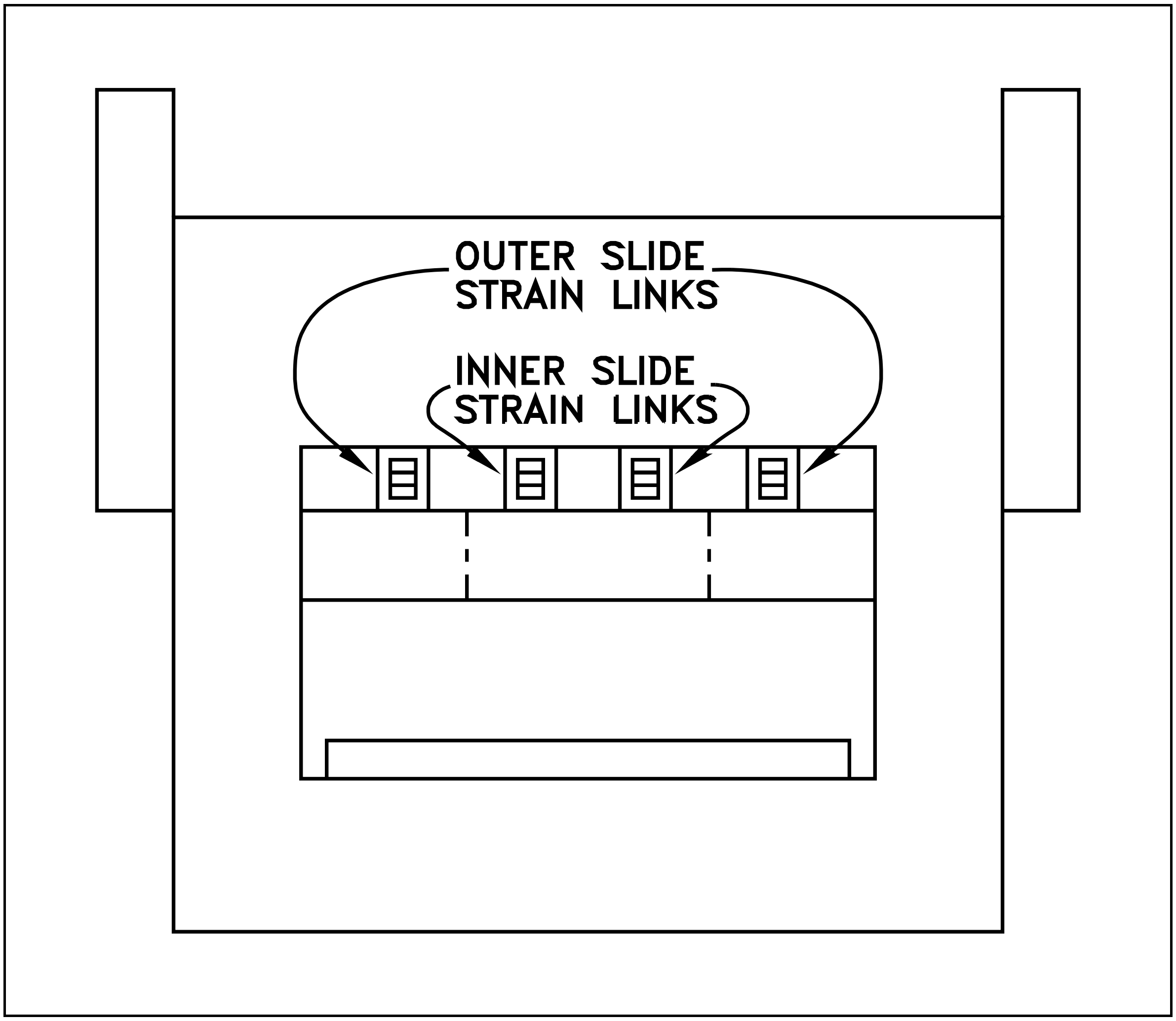


Figure 16. Overdriven Double Action Press.

If both inner and outer slide tonnage readings are desired, the most accurate measurement is obtained by using strain links on each connection to the outer slide as inputs to one System 1100 Tonnage Monitor, and strain links on each connection to the inner slide as inputs to a second System 1100 Tonnage Monitor. This is illustrated in Figure 15.

4.2.4 Underdrive Machines

Machines that have underdrive action with connecting rods that pull the slide(s) down from a drive system located in the bed of the machine must be monitored by strain links mounted on each connecting rod to the slide(s). On underdriven double action presses, two separate tonnage monitors should be used to monitor tonnage of the inner and outer slide.

4.2.5 High Speed Machines

The fast response of the System 1100 peak hold circuits and the total logic cycle time make it possible to monitor tonnage on machines that run continuously at speeds in excess of 2000 strokes per minute (spm). When such machines are operated at speeds in excess of 1000 spm at loads only a fraction of rated machine capacity, the mechanical "noise" introduced by harmonic motion and "ringing" of the frame may produce strains in the machine frame that are significant relative to the load signal. If so, the load indications of any tonnage monitor will exhibit significant variations from stroke to stroke.

Depending on machine construction and application, however, many high speed operations can be successfully monitored for load. The System 1100 has superior design characteristics for these applications. Strain Link mounting locations for "C" frame and straight side high speed machines are the same as for slower machines of similar frame construction.

4.2.6 Other Applications

System 1100 Tonnage Monitors can also be used on other machines that use force in production processes. These include upsetters, injection molding machines, cold headers, etc. Information concerning strain link mounting locations can be supplied by your Link representative.

Section 5. Installation

5.1 Mounting the Enclosure

System 1100 Tonnage Monitors are available in two mounting configurations, the self-contained unit, and the panel mount unit.

The self-contained unit (Figure 1, page 1-3) houses all System 1100 electronics in one enclosure. Mounting dimensions for the self-contained unit enclosure are shown in Figure 16.

The panel-mount unit (Figure 2, page 1-4) separates the Operator Interface Terminal (OIT) electronics from the Logic Unit electronics. This configuration is useful when the tonnage monitor display is to be mounted in a panel where depth is limited, or when the display is to be mounted a long distance from the strain gauges. Mounting dimensions for the OIT and the Logic unit enclosure are shown in Figures 17 and 16 respectively.

For either configuration the Operator Interface Terminal (OIT) or self-contained unit enclosure should be mounted in a position that permits operator observation of the tonnage displays and accessibility to persons designated to adjust setpoints. When the unit is mounted on the machine, always mount the enclosure on the shock mounts provided.

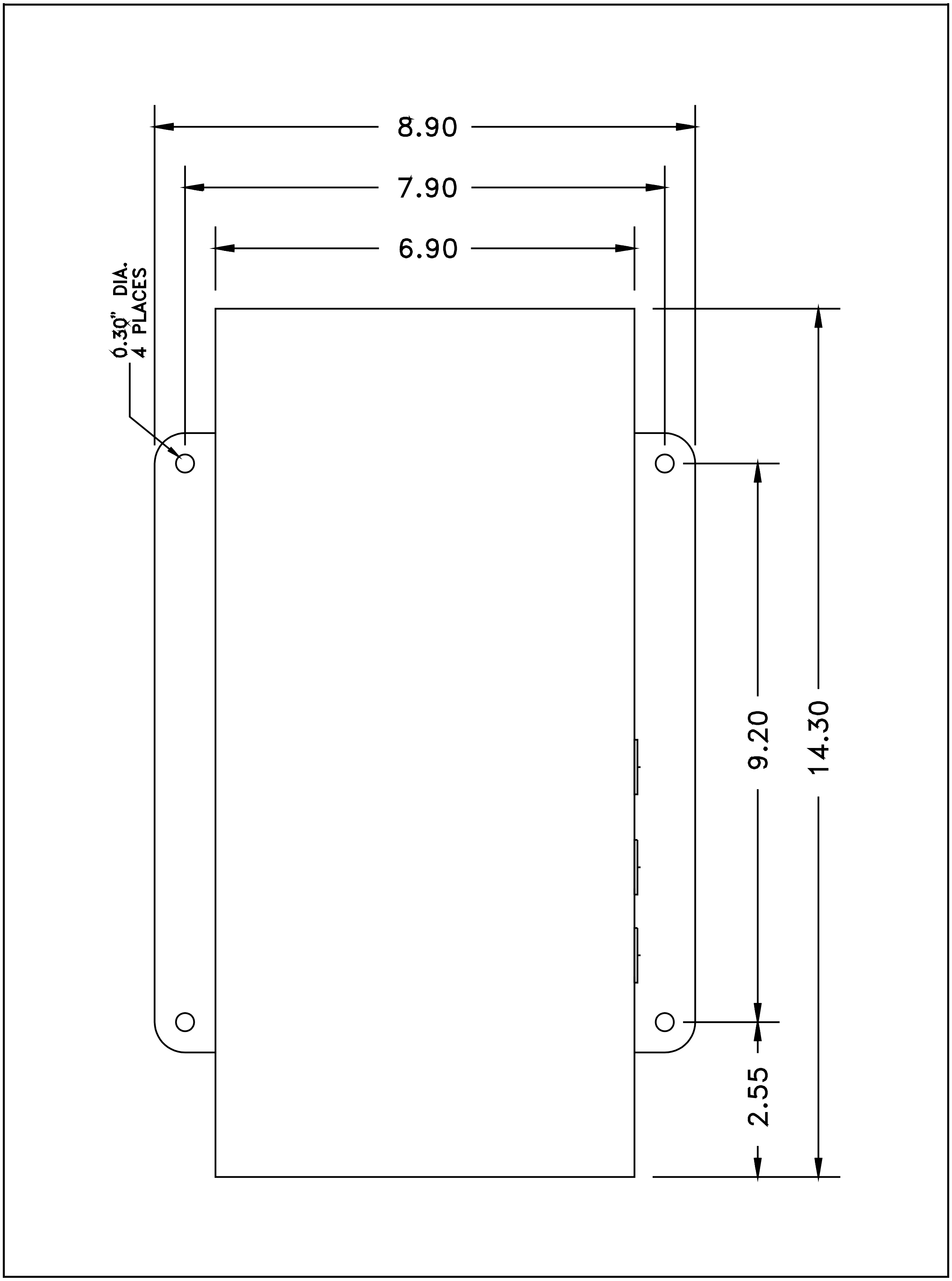


Figure 17. System 1100 Mounting Dimensions.

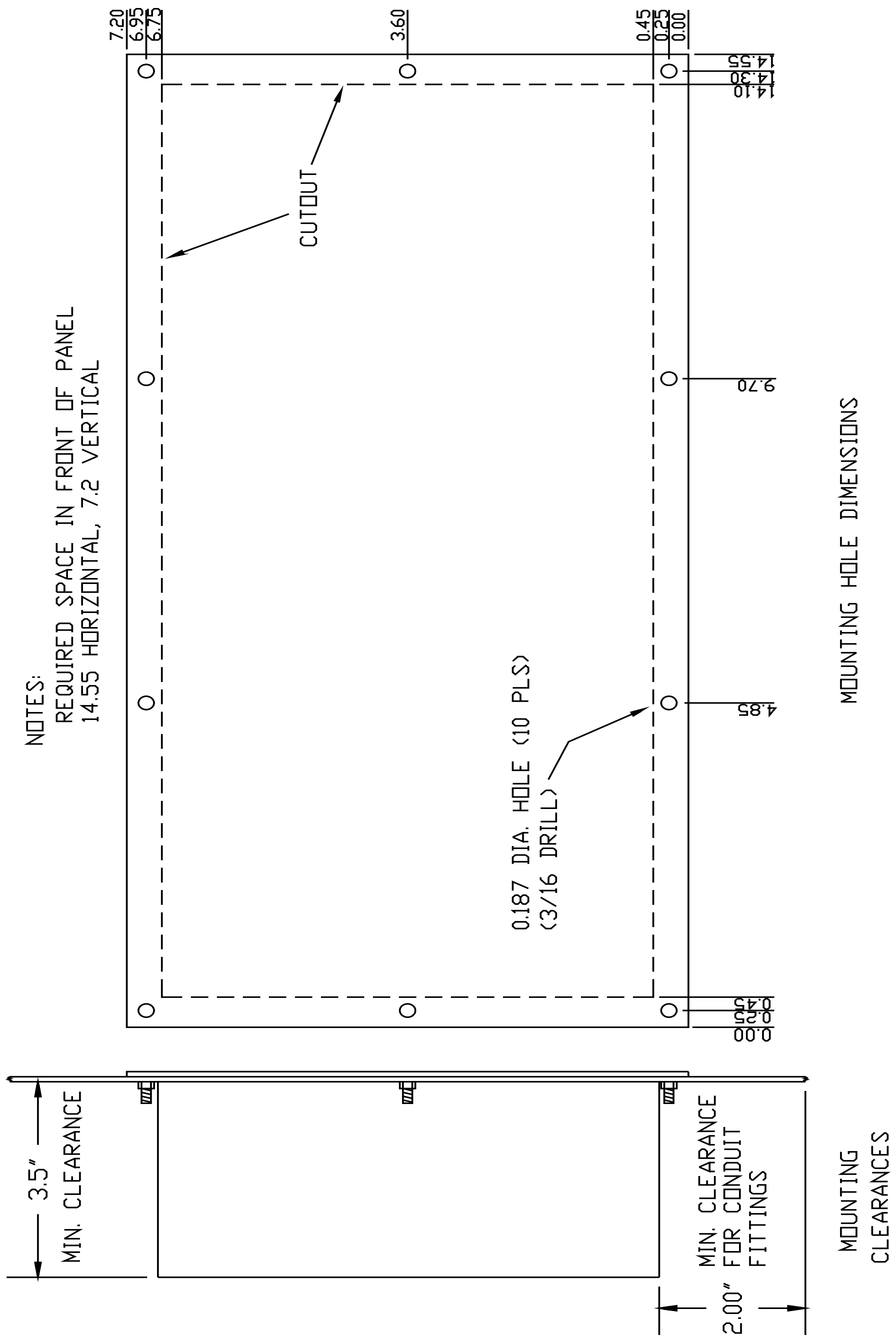


Figure 18. System 1100 Remote OIT Mounting Dimensions.

5.2 Mounting the Strain Links

Strain links may be bolted directly to the machine or bolted to intermediate pads welded or adhered to the machine.

5.2.1 Direct Machine Mounting

1) Select the desired mounting locations for the strain links (section 4.2).

2) Remove paint, oil, grease, etc., to obtain a bare metal surface slightly larger than the LST-1000 strain link. The metal surface must be flat and smooth so that the strain link is not warped and contacts the surface area evenly when mounted. A mounting surface that is flat within .0025 inches and with a 250 microinch or less finish will give best results. Grind the surface if necessary.

3) Scribe a line on the metal surface on which the strain link is to be mounted in the direction of tension or compression of the structural member. This will be a vertical line on columns or ties rods of straight side presses and OBI and other "C" frame machines that are <u>not</u> inclined. On inclined OBI presses and other machines, the scribe marks should follow the inclined angle.

4) Place the hardened drill fixture provided with the direct mounting strain link kit in position adjacent to the scribed line and use a no. 3 drill to drill a 5/8" deep hole through the center hole position of the drill fixture. Tap the hole for a 1/4 x 28 thread. Bolt the drill fixture securely to the mounting area, as shown in Figure 18.

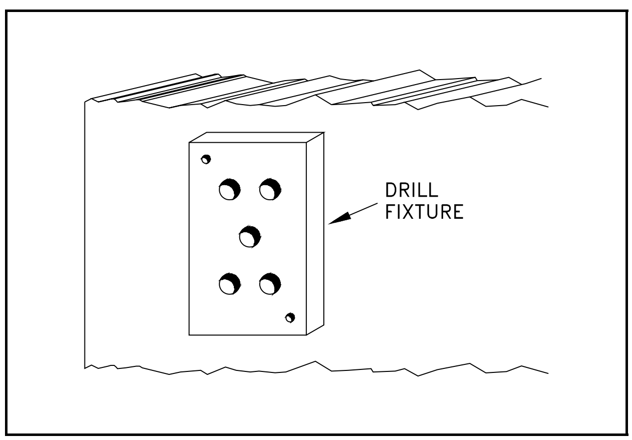


Figure 19. Drill Fixture.

5) Use a no. 3 drill to drill 5/8" deep holes in the mounting surface through the remaining four holes in the drill fixture. Tap the holes for a 1/4 x 28 thread after removing the drill

fixture.

Note! Do not attempt to locate and drill mounting holes without using the drill fixture. The hole pattern must be precise.

6) Deburr the mounting holes and wipe the mounting area with a clean rag.

7) Mount the strain link as shown in Figure 19. Make certain that the washers provided with the strain link kit are placed over the strain links. Torque the 1/4 x 28 bolts to 150 in-lbs. A calibrated torque wrench is the preferred tool to torque the bolts.

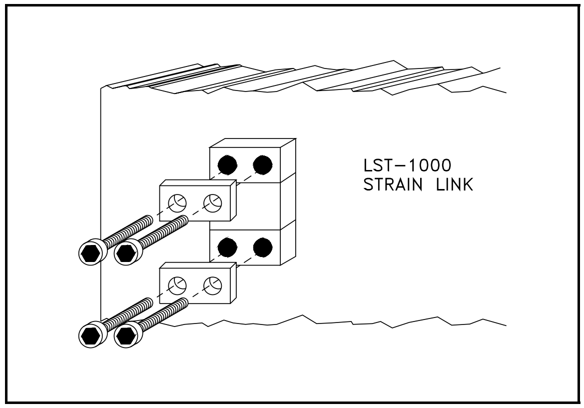


Figure 20. LST-1000 Strain Link.

8) Mount the protective cover box provided in the strain link kit, if used, centrally over the strain link. It is important to mount the cover box before calibration begins. The cover box mounting holes may slightly change the strain sensed by the strain links.

5.2.2 Intermediate Weld Pad Mounting

1) Select the desired machine mounting locations for the strain links (section 4.2).

2) Remove paint, oil, grease, etc., to obtain a bare metal surface slightly larger than the LST-1000 strain link.

3) Clean the mounting surface with a solvent, removing all grease, oil, and other contaminants.

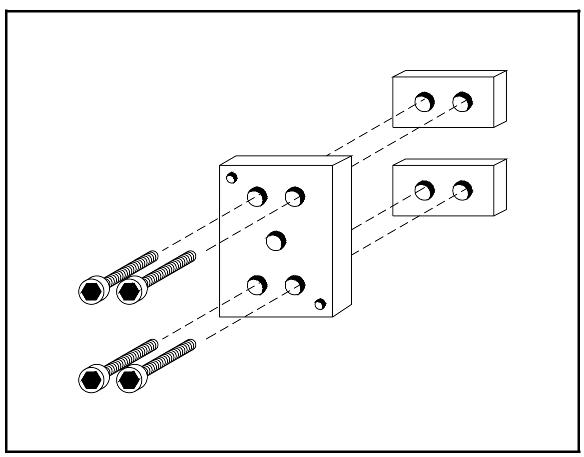


Figure 21. Alignment Fixture.

4) Assemble the intermediate pads to the alignment/clamping fixture using the 1/4 x 28 bolts provided, as shown in Figure 20.

5) Hold the alignment/clamping fixture firmly on the mounting area in the direction of tension or compression of the structural member or, alternatively, drill a 5/8 inch deep hole through the center hole of the alignment/clamping fixture, tap for 1/4 x 28 threads, and bolt the alignment/clamping fixture to the mounting area through the center hole. Tack weld both sides of each intermediate pad to the mounting surface first, then continuously weld the out ends and sides of the intermediate pads to the mounting surface as shown in Figure 21.

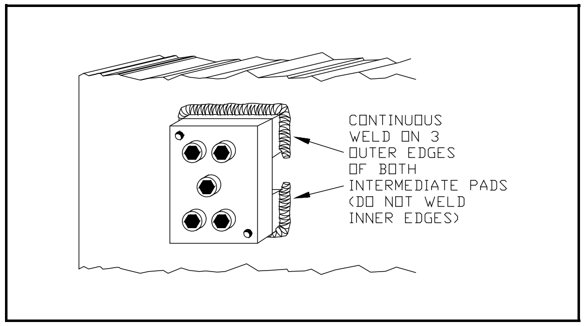


Figure 22. LST-1000 Weld Pads.

6) Remove the alignment/clamping fixture and bolt the LST-1000 strain link to the pre-tapped holes in the intermediate pads. Make <u>certain</u> that the washers provided with the strain link kit are placed <u>over</u> the strain links. Torque the 1/4 x 28 bolts to 150 in-lbs. A calibrated torque wrench is the preferred tool to torque the bolts.

7) Mount the protective cover box provided in the strain link kit, if used, centrally over the strain link. It is <u>important</u> to mount the cover box before calibration begins. The cover box mounting holes may slightly change the strain sensed by the strain links.

5.2.3 Intermediate Adhesive Pad Mounting

1) Repeat steps 1-4 of the procedure for Intermediate Weld Pad Mounting.

2) Thoroughly clean the mounting surface and intermediate pads with a solvent such a perchloroethylene or triclorethylene, etc.. It is important to remove <u>all</u> grease or oil from the surfaces to be bonded.

3) Mix the epoxy cement provided with the intermediate adhesive

pad strain link kit thoroughly.

4) Apply an even coat 1/16" deep on the bottom of the intermediate pads.

5) Clamp the alignment/intermediate pad assembly firmly to the mounting area for at least 24 hours. The press must not be operated during the curing of the epoxy.

6) After the epoxy has cured for 24 hours, remove the alignment/clamping fixture from the intermediate pads and bolt the LST-1000 strain link to the pre-tapped 1/4 x 28 holes in the intermediate pads. Make certain that the washers provided with the strain links are placed over the strain links. Torque the 1/4 x 28 bolts to 150 in-lbs. A calibrated torque wrench is the preferred tool to torque the bolts.

7) Mount the protective cover box provided in the strain link kit, if used, centrally over the strain link. It is important to mount the cover box before calibration begins. The cover box mounting holes may slightly change the strain sensed by the strain links.

   Four channel System 1100 units are shipped with stick-on labels designated CH1, CH2, CH3, and CH4. the labels should be applied to each strain link cover box so that the channel that the strain link is attached to is clearly identified.

5.3 Conduit

1) Run flexible or rigid conduit from the strain link protective boxes to the knockout holes in the bottom of the System 1100 enclosure. Open the door of the enclosure and place the retaining nut(s) on the conduit connector(s).

2) If optional cams or other limit switches are used for automatic zeroing and/or data windows, run conduit from one of the knockout holes to the rotary cam switch or other switch.

3) Run conduit from a knockout hole in the bottom of the System 1100 enclosure to the main machine control enclosure. Open the front door of the enclosure and place a retaining nut on the conduit connector.

5.4 Electrical Connections

5.4.1 Connecting the Strain Links

1) Pull the strain link cables through the conduit from strain link locations to the System 1100 enclosure (to the Logic Unit for panel-mount versions of the System 1100).

2) Cut excess cable lengths off, leaving about 12 inches of length between the entrance of the cable into the enclosure and the end of the cable. Strip about 2 1/2 inches of the cable insulation off of the braided wire shield. Remove the four conductor wires from the shield, taking care to leave the shield wire length connected to the cable.

3) The terminals for the strain links are shown in Figure 25. The conductor of the strain link cables are to be connected to the channel terminals. The connections of the strain link cables to the channel terminals should be:

Strain Link in Tension When Machine is Loaded

```
Green Wire ------------- REF
White Wire ------------- SIG+
Red Wire --------------- SIG-
Black Wire & Shield ---- GND
```

Strain Link in Compression When Machine is Loaded

```
Green Wire ------------- REF
Red Wire --------------- SIG+
White Wire ------------- SIG-
Black Wire & Shield ---- GND
```

For a two channel System 1100, connect the strain link mounted on the LEFT side of the machine to the Channel 1 terminals, and the strain link mounted on the RIGHT side of the machine to the Channel 2 terminals.

For a four channel System 1100, connect the strain link designated to be CHANNEL 1 to the Channel 1 terminals, and the strain links designated to be connected to channels 2, 3, and 4, respectively to the Channel 2, 3, and 4 terminals.

5.4.2 Connecting the OIT to the Logic Unit (panel-mount units)

For the panel-mount System 1100 (units in which the operator interface electronics is housed in a separate enclosure from the logic electronics) the Operator Interface Terminal (OIT) must be wired to the Logic Unit. This connection is made through a four conductor (2 twisted pairs) shielded cable. Connections should be made as shown in Figure 22.

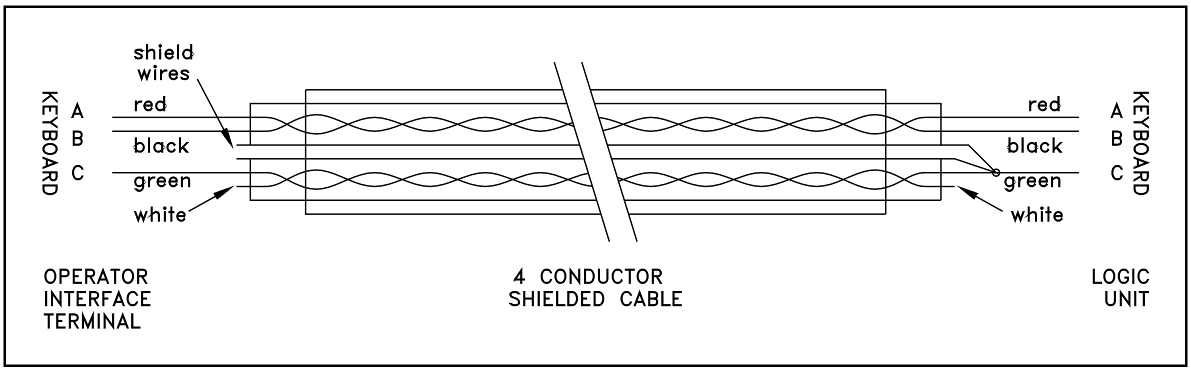


Figure 23. Connection of the OIT to the Logic Unit.

Connect the red wire to the KEYBOARD A terminal, the black wire to the KEYBOARD B terminal, and the green wire to the KEYBOARD C terminal at both the OIT and the Logic Unit. The white wire is not used and should be cut off at both ends of the cable. The two shield wires (each twisted pair is shielded) should be connected with the green wire to the KEYBOARD C terminal at the Logic Unit. The shield wires are not connected at the OIT end of the cable and should be cut off.

5.4.3 Connecting the Optional Cam Switch for Zeroing

1) The terminal for the End Of Cycle cam switch is shown in Figure 25. To install the zeroing cam switch, connect a wire from the EOC terminal (End Of Cycle) on the Logic board to one side of the cam switch contact. If the System 1100 is grounded to the machine ground, the second side of the cam

switch contact can be connected to the machine for grounding.

2) If an ungrounded machine control system is present, run a wire from the second side of the cam switch back to the GND terminal adjacent to the EOC terminal on the Logic board.

3) Adjust the zeroing cam switch as shown in Figure 23. The cam switch must be set to open before the machine tooling exerts force on the downstroke, and close after all tooling and stripper forces are relieved on the upstroke.

4) On machines that are not crankshaft driven, such as hydraulic power presses, a limit switch that is held closed when the slide is in the upper section of the stroke can be used instead of a cam switch. Always run cam switch or limit switch wires in separate conduit from 115VAC or higher voltage conductors.

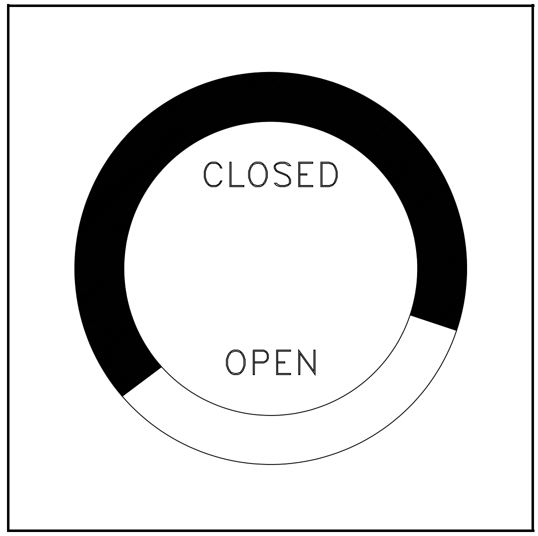


Figure 24. Setting of Optional Zeroing Cam Switch.

5.4.4 Connecting Optional Data Window Cam Switches

1) Data windows are used to display and place setpoints on tonnage other than the absolute peak tonnage. The data window cam switches should be setup as discussed in section 3.6. When data windows are to be used, connect a wire from one contact of each data window cam switch to the System 1100 data window terminals located on the Logic board is the Logic Unit. The four data window terminals are labeled DW1, DW2, DW3 and DW4. If the System 1100 is grounded to the machine ground the other contact of all the data window cam switches can be connected to the machine for ground.

2) If an ungrounded machine control system is present, wire the other data window cam contacts to the GND terminal adjacent to the data window terminals on the System 1100 Logic board.

3) Always run data window can switch wires in separate conduit

from 115VAC or higher voltage conductor.

5.4.5 Connecting an Optional Remote Reset

A remote reset pushbutton can be wired into the System 1100 allowing alarms and errors to be reset from a remote location. To install the remote reset button, connect one side of a normally open pushbutton to the RST terminal on the System 1100 Logic board. Connect the other side of the pushbutton to the GND terminal adjacent to the RST terminal.

Note that the remote reset button is pressed, the System 1100 drops out the stop circuit relay during the reset sequence. Care should be taken in placement of the remote reset pushbutton to avoid nuisance stops due to unintentional pressing during production.

5.4.6 Input Power and Machine Control Connections

The terminals for connecting 115VAC power to the System 1100 and connecting the System 1100 output relay contacts into the machine control system are located on the power supply module on the left side of the interior of the System 1100 enclosure (Logic Unit enclosure for panel-mount units).

The 115VAC power supply wires and output wires should be connected as shown in Figure 24, and run in a separate conduit from the low voltage d.c. wires connected to the Logic board and Channel cards.

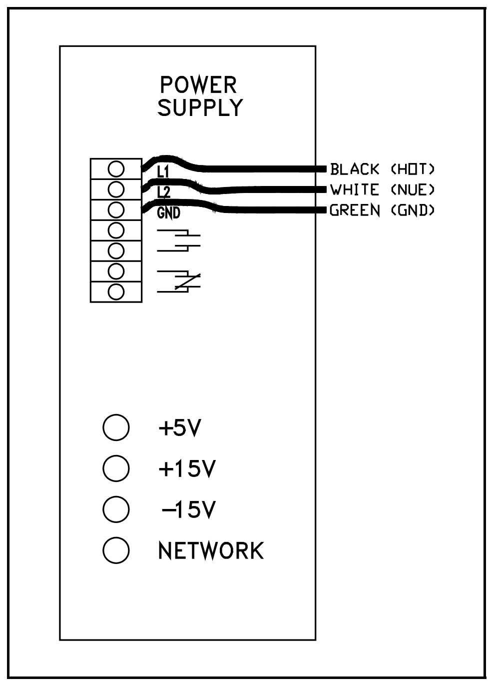


Figure 25. Power Supply Connections.

Connect the normally open contact (held closed during normal operation) on the power supply terminal strip into the machine top stop circuit. Alternatively, The System 1100 can be connected to machine emergency stop. Connecting the System 1100 output relay contact in the emergency stop circuit may or may not enhance die and machine overload protection by reducing the machine clutch torque before an overload reaches its maximum value. The pneumatic reaction time of the

clutch mechanism, the point in the stroke where the overload occurs, and the machine speed determine whether the machine can stop quickly enough after an overload is sensed to avoid the peak overload. One consequence of connecting the System 1100 into the emergency stop circuit can be sticking the machine on bottom when an overload occurs.

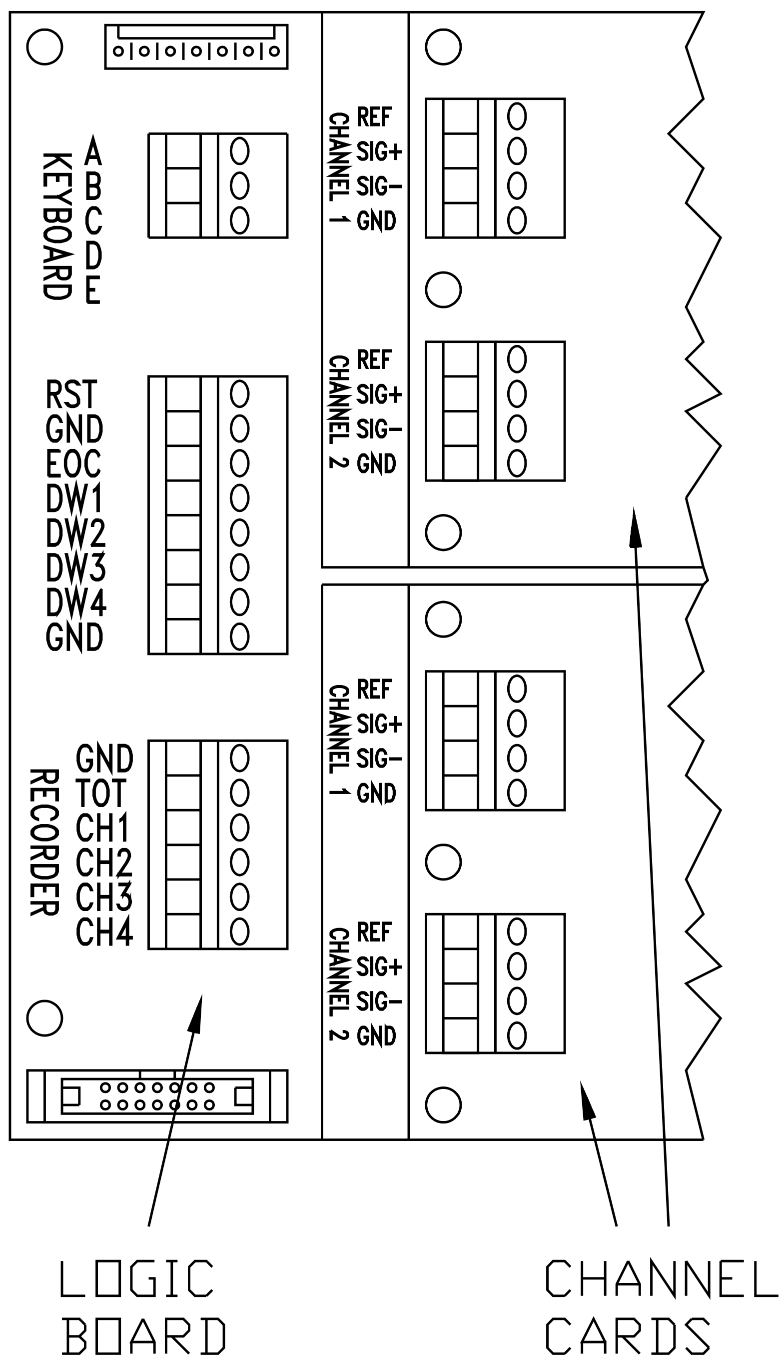


Figure 26. System 1100 Logic Unit Electrical Connections.

Section 6. Calibration

Calibration of a System 1100 Tonnage Monitor consists of achieving a known load on the machine and adjusting the installed monitor so that the known load is displayed by the monitor. The known load used during calibration should be at least 50% of rated machine load and preferably 100% of rated machine load. On straight side machine frame configurations of tie rod construction, it is always advisable to use loads of 100% of machine rating in calibration when strain links are mounted on uprights compressed by the tie rods. False load readings can be generated if a tie rod looses enough tension that the upright is released from compression before full load is reached. This condition can be detected during calibration if 100% of machine rating load is used.

Either static or dynamic calibration techniques can be used to calibrate System 1100 Tonnage Monitors. Load cell(s) are used to provide the known load in dynamic calibration. The load cell(s) are placed in the machine point of operation (normally with tooling absent) and a combination of shimming and machine shut height adjustment is used to generate the desired load to be used for calibration. The machine must be cycled, so that the slide strikes the load cells at the bottom of the stroke to generate the load. The load cells must be electrically connected to a tonnage monitor to indicate the maximum force (tonnage) exerted by the machine in a stroke. Each load cell has a pre-determined relationship between applied force and its electrical output signal to the tonnage monitor. This makes it possible to specify the calibration number to which a Link System 1100 Tonnage Monitor should be adjusted for use with that load cell to indicate the tonnage applied to the load cell.

Hydraulic jacks are used in static calibration of System 1100 Tonnage Monitors. The machine slide is placed in the bottom of stroke position, and, if necessary, the hydraulic jack(s) are placed upon plates or shims in the point of operation so that they can exert force between slide and bolster. A large pressure gauge is used to indicate the pressure of the hydraulic fluid as the jack is pumped up. The force exerted by the jack is equal to the fluid pressure times the area of the jack cylinder. Thus, the pressure required to exert a given force (tonnage) can be determined and adjusted to that value.

Single or multiple load cells or jacks can be used to load the machine to the value used for calibration. When a single load cell or jack is used for calibration, it should be centrally located under the machine slide. Where multiple load cells or jacks are employed for calibration, they should be located in a geometrically symmetrical pattern with respect to the center of the machine slide. The preferred procedure is to place a single load cell or jack directly under each connection to the slide from crankshaft, hydraulic cylinder, etc., on overdriven machines.

When multiple load cells are used, each load cell should be of the same physical dimensions and load rating. The load cells must be shimmed as necessary to provide equal loads on each cell. The combination of geometrically symmetrical location and equal loading for load cells will produce a total machine load equal to the sum of the loads on each individual load cell and will simulate a single central load.

Note! Incorrect gib adjustments, and/or severe bearing wear in the slide drive system can cause the slide to cock and generate significant forces against linear guides or gibs. These non-symmetrical forces can void the assumption of central loading and introduce some error in the calibration procedure.

CAUTION! Extreme care should be used in calibration procedures for tonnage monitors. Severe damage to the machine being calibrated or the calibration equipment can result from incorrect shut height adjustments, etc., on machines driven by rotary crankshafts, or from any action that causes a machine to develop excessive forces. Injury to personnel calibrating the machine or to others in the machine area can result from poorly implemented load cell or hydraulic jack stacks that fly out of the machine under load. NEVER place hands between load cell or hydraulic jack stacks and the machine slide! Link Systems provides calibration services at a reasonable charge. These services should be used if there is doubt that customer employees can correctly and safely calibrate a machine.

6.1 Dynamic Calibration with Load Cells

1) Check to see that the System 1100 Tonnage Monitor for permanent use on the machine is installed as per the installation instructions of this manual.

2) Turn on the power to the System 1100 Tonnage Monitor. Observe that the System 1100 tonnage displays zero. If the tonnage displays fail to zero within 40 seconds or an error occurs,

check that the strain links are wired correctly into the Channel cards and refer to error code charts in this manual.

3) Before calibration can proceed, the proper Machine Rating, Machine Speed, and Decimal Point settings must be programmed in the Configuration menu of the System 1100. If these parameters have already been programmed, verify their proper setting in Configuration menu (sections 2.8.2, 2.8.8 and 2.8.10).

   Other settings and options affecting the operation of the System 1100 are also programmed in the Configuration menu and should be properly programmed before proceeding.

   Note that setting the machine rating into the System 1100 is a calibration procedure only. Changing the machine rating number after calibration will result in erroneous tonnage readings.

   If error codes relating to setpoint limits occur, complete step 4 of these instructions and push the CLEAR key to clear the errors.

4) Follow the procedures in section 2.4.1 of this manual to set the high setpoint for each channel of the installed System 1100 Tonnage Monitor to about 10% greater than the tonnage expected on each channel when the machine is loaded at rated tonnage. The expected tonnage for a two channel System 1100 at full load is one-half (1/2) the rated tonnage of the machine. For a four channel System 1100, the expected tonnage for each channel is one-fourth (1/4) the rated tonnage of the machine.

   Example: A machine is rated at 200 tons. The high setpoint limits for each channel should be set to 110 tons (10% over 1/2 of 200 tons) if a two channel System 1100 is used; or to 55 tons (10% over 1/4 of 200 tons) if a four channel System 1100 is used to monitor tonnage.

5) Follow the procedures in section 2.4.1 of this manual to set the low setpoints for each channel of the installed System 1100 to Zero (0).

6) Bring the machine slide or ram to the bottom of stroke

position and turn off power to the machine. Place the load cell(s) to be used for calibration into position in the machine. Load cell(s) of similar capacity and dimension are preferably centered under each drive connection (pitman, cylinder rod, etc.) to the slide or ram of the machine. Also place any parallels or similar thickness plates on or under the load cells necessary to reduce the gap between slide and bolster (etc.) so that the "stack" of load cells and parallels can be contacted at the bottom of the machine stroke.

It is recommended that steel plates at least one inch thick and of at least 2 inches greater lateral dimension than load cell contact surfaces be placed both under and over the load cell to help distribute load and avoid load cell impressions in slide or bolster material. All plates or parallels should be symmetrically placed relative to the centerline of the load cells, and plates and parallels used for each load cell stack should be similar in dimension to those used in other stacks.

On mechanical power presses and other machines with shut height adjustments, the stack height should be greater than the minimum shut height, and the machine shut height must be adjusted so that clearance between the machine slide and the load cell stack(s) is provided.

Caution! If the load cell(s) stack height is greater than the machine shut height, as adjusted, cycling the machine may result in severe damage to the machine and to load cells!

7) Connect the load cell electrical cable(s) to the load cell(s). Plug connectors are provided for this purpose.

8) A second System 1100 Tonnage Monitor should be used as a "portable" unit in conjunction with the load cell(s) for the purpose of calibration. Connect the wire end of the load cell cable(s) to the channel terminals of the "portable" System 1100 unit. These terminals are accessible through the front door of the System 1100 enclosure.

   Only one load cell per System 1100 channel may be used. A two channel System 1100 used as a portable unit can provide for either single or double load cell calibration. A four channel System 1100 used as a portable unit can be used for calibrations that employ two, three, or four load cells.

The relationship of which load cell is connected to which channel is important. Load cells must be shimmed to carry equal loads in a subsequent step of this calibration procedure and the force generated by the machine on the load cell is indicated by the channel of the "portable" System 1100 to which the load cell is connected. A simple method of establishing the relationship between load cells and System 1100 channels is to label the load cell connected to Channel 1 as Load Cell 1, etc.

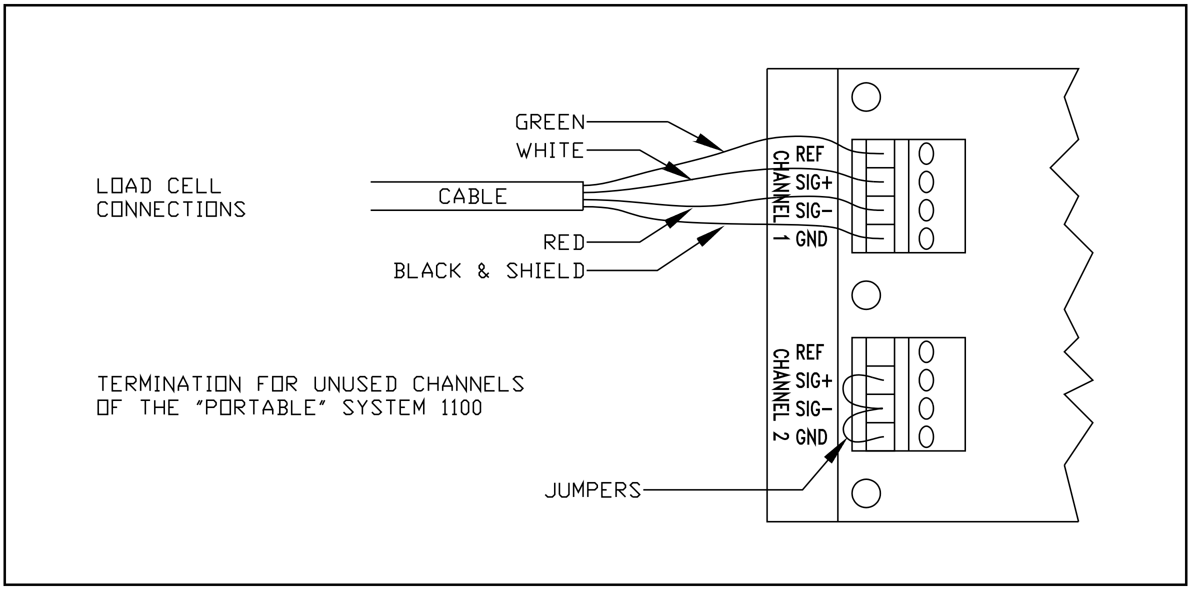


Figure 27. Portable Unit Load Cell & Unused Channel Connection.

The cable used to connect the load cell to a System 1100 channel termination has four conductors and a shield. The connections should be accomplished as shown in Figure 26. Power to the unit should be turned off before making these connections.

If the "portable" System 1100 unit has channels to which no load cells are to be connected, the terminals for these channels must be terminated by connecting the SIG+ and SIG- inputs to GND as shown in figure 26.

9) Supply power to the "portable" System 1100 tonnage monitor by connecting terminals L1, L2, an GND on the power supply module to a line cord an plugging into a 115VAC source. The power

supply module is located on the left side of the enclosure. (Note: The GND connection is important to avert possible electrical shock.)

10) Determine the machine rating number that must be programmed into the "portable" System 1100 connected to the load cells as follows:

    If a two channel System 1100 is used as the "portable" calibration unit, the machine rating number is twice (2X) the tonnage capacity of the load cell(s) used; i.e., if either one or two 100 ton load cells are used to load the machine, the correct machine rating number is 2 X 100 tons = 200.0 tons.

    If a four channel System 1100 is used as the "portable" calibration unit, the machine rating number is our times (4X) the tonnage capacity of the load cell(s) used; i.e., if one, two, three, or four 100 ton load cells are used to load the machine, the correct machine rating number is 4 X 100 tons = 400.0 tons.

11) Set the machine rating number into the "portable" System 1100 unit by using the MACH RATING option in the Config menu (section 2.8.2).

    Note that, when a System 1100 is used as a calibration unit in conjunction with load cells, the machine rating number is a scale factor dependent on the rated tonnage capacity of the load cell(s) used in calibration and is not determined by the tonnage capacity of the machine being calibrated.

    If error codes relating to setpoint limits occur, follow step 12 of this procedure then press the CLEAR key clear the errors.

12) Follow the procedures in the section 2.4.1 of this manual to set the high setpoint for each channel of the "portable" System 1100 unit used for calibration to about 10% greater than the rated tonnage of the load cell(s) used in calibration. For example, if one or more 100 ton load cells are used to calibrate a machine, each channel high setpoint limit should be set to 110.0 tons (10% more than 100 tons) regardless of whether a two channel, or four channel System

1100 is used as a "portable" calibration unit.

Follow the procedures in section 2.4.1 of this manual to set the low setpoints for each channel of the "portable" System 1100 to zero (0).

13) Set the calibration number for each channel of the "portable" System 1100 unit to the specified value labelled on the load cell connected as an input to the respective channel. To set the calibration number of a channel, select the CAL-CHECK option in the Config menu. Press the YES key when prompted with "ESTOP WILL ACTIVE! BEGIN CAL-CHECK (Y/N)?". The calibration number of each channel will then appear in each tonnage display.

    Adjust the GAIN ADJUST on the Channel card till the number on the channel's tonnage display is equal to the calibration number designated on the load cell.

    Clockwise rotation of the channel gain adjustment results in increasing numbers on the tonnage display.

    No calibration number can be displayed for unused channels on the "portable" System 1100 unit. However, GAIN ADJUST potentiometers for unused channels to which no load cell is connected should be turned fully counterclockwise.

14) Check to assure that load cell stacks are correctly located and that machine shut height of other bottom of stroke adjustment provides clearance between ram or slide and load cell stack(s) as per the instructions of step 4 of this calibration procedure.

    Turn on the power to the machine and the installed (permanent) System 1100 Tonnage Monitor and return the slide to the top of stroke position.

15) Make single strokes of the machine, adjusting the shut height or other bottom of stroke adjustments downward to lower the machine slide or ram from 0.002" to 0.004" between successive strokes until the "portable" System 1100 tonnage displays give a reading, indicating that contact is being made with one or more load cell stacks.

16) If a single load cell is used for calibration, continue to single stroke the machine and adjust shut height or other bottom of stroke adjustment until the rated capacity of the load cell or the machine, whichever is less, is reached on the CHANNEL of the "portable" unit to which the load cell is input.

The rated tonnage capacity of the load cell should be at least 50% of the rated tonnage capacity of the machine being calibrated. Adjustment distance should be restricted to less than 0.001" between strokes as rated machine tonnage is approached.

If two or more load cells are used for calibration, adjust the shut height or other bottom of stroke adjustment until about 20% of rated machine tonnage capacity is displayed on the "portable" unit TOTAL display. The tonnage exerted on each load cell is displayed on the channel tonnage displays to which each is input. If load cell tonnages are not equal, add shim stock to the stack of load cells with lower readings. Make a single stroke of the machine and observe the new tonnage readings of each load cell channel. Repeat this process until all load cell readings are equal to within 2%.

When load cell tonnages are equalized, again repeat the cycle of single stroking the machine with shut height or other bottom of stroke adjustment between strokes and continue to observe the tonnage on each load cell channel of the "portable" System 1100. It may be necessary to re-shim certain load cell stacks to equalize tonnage on all load cells as rated tonnage capacity of the machine is neared. Rated machine capacity of the machine is reached when individual tonnage on load cells equals the rated machine tonnage divided by the number of load cells used to calibrate the machine. For example, if four (4) load cells are used to calibrate a 200 ton mechanical power press, the press is loaded to capacity when each of the four load cells is loaded to 50 tons. When rated machine tonnage, or a lesser tonnage at which the machine is to be calibrated is reached, lock shut height adjustments, etc., and proceed to step 17.

Do not exceed rated tonnage capacity of the machine or load cells during the calibration process by more than five or ten percent. If the tonnage exerted on any channel of the "portable" System 1100 unit exceeds the High Setpoint limit, the CLEAR key must be pushed to obtain further readings.

Vibratory motion in the machine often introduces stroke to stroke variations of one or two percent in the load cell tonnage readings. When this happens it is impractical to try to refine the load on the machine any closer than within one or two percent of rated tonnage.

17) After loading the machine to the tonnage at which it is to be calibrated as per step 16 of this calibration procedure, check that the installed (permanent) System 1100 is set to display FORWARD tonnage (no minus sign in the tonnage displays). Also check that installed System 1100 is not in CAL-CHECK mode and press the EXIT key to end CAL-CHECK if it is.

    For a two channel installed System 1100 unit, make single strokes of the machine and perform gain adjustments for both channels between strokes until channel 1 and channel 2 tonnages of the installed System 1100 unit are within one or two percent of one-half (1/2) the sum of the load cell tonnages indicated by the channels of the "portable" System 1100 unit.

    For a four channel installed System 1100 unit, make single strokes of the machine and perform gain adjustments on the four channels between strokes until all four channel tonnages are within one or two percent of one-fourth (1/4) the sum of the load cell tonnages indicated by the channels of the "portable" System 1100 unit.

18) Turn the machine motor(s) off and wait for any flywheel motion, etc. to stop. Leave power on the installed System 1100 Tonnage Monitor. (On mechanical power presses it may be necessary to turn the press control system to the "Inch" mode to retain power to the System 1100 with the main drive motor off). Select the CAL-CHECK option in the Config menu to display calibration numbers. Press the YES key when prompted with "ESTOP WILL ACTIVE! BEGIN CAL-CHECK (Y/N)?". The calibration number of each channel will then appear in each tonnage display. These are the calibration numbers for the System 1100 as installed on the machine. It is IMPORTANT to retain these numbers so that periodic checks for calibration can be made. It is suggested that a copy of these numbers be retained inside the System 1100 cabinet and that a second copy

be kept in files.

If the calibration numbers displayed on the tonnage displays for a particular channel vary, take the median value of the numbers displayed as the calibration number.

19) Press the EXIT key to end CAL-CHECK mode.

20) Remove the load cells and associated "stack" elements from the machine and disconnect the cables from the load cells and the "portable" System 1100 unit.

Calibration is complete.

6.2 Static Calibration with Hydraulic Jacks

1) Follow procedures 1-5 under the Dynamic Calibration with Load Cells section of this manual.

6) Turn on power to the machine and place the machine ram or slide at the bottom of stroke position.

7) Turn off machine drive motors or hydraulic pumps, etc., and place the jack(s) to be used in calibration under the machine ram or slide.

If a single jack is used, directly center the jack under the ram or slide.

If multiple jacks are used, the jacks should be placed in a geometrically symmetrical pattern relative to the center of the ram or slide. On machines with multiple connections to the slide, it is preferable to use a jack directly under each connection.

Also place any plates or parallels under the jack necessary to reduce the gap between jack and slide at this time. Plates used to elevate the jack should have greater lateral dimensions than the jack and should extend beyond the jack on all sides.

8) Select the CAL-CHECK option in the Config menu to display calibration numbers. Press the YES key when prompted with "ESTOP WILL ACTIVE! BEGIN CAL-CHECK (Y/N)?". The calibration

number of each channel will then appear in each tonnage display.

For a two channel System 1100 unit, adjust the GAIN ADJUST potentiometer for CHANNEL 1 (left strain gauge) until the number 400 appears on the channel 1 tonnage display. Adjust the GAIN ADJUST potentiometer for CHANNEL 2 (right strain gauge) until the number 400 appears on the channel 2 tonnage display.

For a four channel System 1100 unit, adjust the GAIN ADJUST potentiometer for CHANNEL 1 until the number 400 appears on the channel 1 tonnage display. Repeat this procedure for CHANNEL 2, CHANNEL 3, and CHANNEL 4 until the number 400 appears in each channel tonnage display.

9) Press the EXIT key to end CAL-CHECK mode. Select the STATIC-CAL option in the Config menu. Press the YES key when prompted with "BEGIN STATIC-CAL (YES/NO)?".

For a four channel System 1100 unit, adjust ZERO ADJUST potentiometer until the number that appears in the channel 1 tonnage display reads between ±1% of rated tonnage of the machine to be calibrated. Repeat the zero adjustment procedure using the ZERO ADJUST for the respective channels until all channels are zeroed within ±1% of rated machine tonnage.

Do NOT exit the STATIC-CAL mode.

10) Use the hydraulic jack(s) equipped with suitable pressure gauge(s) to exert the tonnage at which the machine is to be calibrated, preferably rated tonnage of the machine but a tonnage of at least 50% of rated machine tonnage.

When more than one jack is used for calibration, each jack pressure should be adjusted to exert equal forces (±1%) on the ram or slide of the machine.

11) For a two channel System 1100 unit, rotate the GAIN ADJUST for CHANNEL 1 until the number appearing on the channel 1 tonnage display reads within ±1% of one-half (1/2) of the sum of the tonnages exerted by the jack(s).

For a four channel System 1100 unit, rotate the GAIN ADJUST for CHANNEL 1 until the number appearing on the channel 1 tonnage display reads within ±1% of one-fourth (1/4) of the sum of the tonnages exerted by the jack(s). Repeat this procedure for channels 2, 3, and 4.

12) Release the pressure of the jack(s) and remove the jack(s) and associated stack materials from the machine.

13) Press the EXIT key to end STATIC-CAL mode. Select the CAL-CHECK option in the Config menu to display calibration numbers. Press the YES key when prompted with "ESTOP WILL ACTIVE! BEGIN CAL-CHECK (Y/N)?". The calibration number of each channel will then appear in each tonnage display. These are the calibration numbers for the System 1100 as installed on the machine. It is IMPORTANT to retain these numbers so that periodic checks for calibration can be made. It is suggested that a copy of these numbers be kept inside the System 1100 cabinet and that a second copy be kept in files.

    If the calibration numbers displayed on the tonnage displays vary, take the median value of the numbers displayed as the calibration number.

14) Press the EXIT key to end CAL-CHECK mode.

    Calibration is complete.

Section 7. Zero Circuit Checkout After Calibration

If the "rate of change" automatic zeroing method (no cam switch used for zeroing) is used, it is necessary to verify that strains induced in the machine frame due to mechanical noise, such as engagement of clutches or brakes or gear "slap" do not exceed the factory set zeroing threshold of 5% of rated channel tonnage.

1) Select a die from the group of dies used in the machine with one of the heaviest upper die weights. Install the die in the machine and adjust the machine shut height so that the dies don't close at the bottom of the stroke. The purpose of installing this die is to make sure that acceleration and deceleration forces when a stroke begins and ends will produce the maximum strains in the machine frame that will be experienced in actual production operations. The heavier the upper die, or other tooling attached to the slide, the greater the acceleration and deceleration forces due to clutch or brake engagement or gear slap.

2) Set the low setpoint limits of the System 1100 to zero (0). The high setpoint limits should be set to at least 50% of rated machine tonnage capacity.

3) Make single strokes of the machine and observe the System 1100 tonnage displays. The tonnage displays will constantly read zero if acceleration and deceleration forces at the beginning and end of the stroke do not strain the machine frame enough to exceed the 5% zeroing threshold.

   If the tonnage displays remain zero throughout several single strokes, proceed to step 5 of this procedure.

   If the tonnage displays change from zero to indicate a number other than zero at the start of the stroke only, and retains this same number at the completion of the stroke, the acceleration forces at the beginning of the stroke are straining the frame enough that the 5% zeroing threshold is exceeded. In actual production operations the tooling force at the bottom of the stroke will replace the reading caused by acceleration forces and retain the actual tooling tonnage at the end of the stroke. Proceed to step 5 of these procedures.

   If the tonnage displays change to indicate a number at the end of the stroke, deceleration forces caused by braking are causing strains in the machine frame that exceed the 5%

zeroing threshold. Proceed to step 4 of this procedure.

4) Mechanical noise due to deceleration forces as the machine slide stops at the end of a stroke that exceed the 5% zeroing threshold will displace the tonnage display readings obtained due to tooling forces at the bottom of the stroke. To prevent this nuisance loss of actual tonnage readings, the zeroing threshold must be changed to a larger percentage of rated channel tonnage capacity, or the cam zero (zeroing by position) option must be used.

   The preferred method is to install a cam switch or other limit switch to determine when the System 1100 zeroes, following the procedures in section 5.4.3 of this manual.

   Alternatively, the zero threshold can be set to 10% of rated channel tonnage capacity and may eliminate the need for cam zeroing by elevating the threshold above the mechanical noise level. This is described in section 2.8.4 of this manual.

   After setting the zeroing threshold to 10%, repeat step 3 of this procedure. If the tonnage displays still change at the end of the stroke, the cam zeroing option is required. If the tonnage displays do not change at the end of the stroke, proceed to step 5 of this procedure.

5) When rate of change zeroing (non-cam zeroing) is used, the Machine Speed setting in the Config menu must be set accurately for proper operation of the System 1100 (see section 2.8.8).

Section 8. Unbalanced Loads and Scale Factor

Most machines that use force in production processes are designed for distributed central loads at rated tonnage and lesser non-central (eccentric) loads. However, some forging presses and other machines are designed to permit operation at full tonnage with either central loads or, within specified limits of offset from center, non-central loads.

The procedures in Section 6 "Calibration" of this manual are written for machines designed for rated tonnage only with distributed central loads. Since a central load will be distributed equally to each side of a "C" frame machine or to each column of a straight side machine, a two channel tonnage monitor expects 1/2 of rated machine tonnage to appear on each channel when the machine is operated at rated capacity. A four channel tonnage expects 1/4 of rated machine tonnage to appear on each channel when the machine is operated at rated capacity. The machine rating alarms for any channel are tripped any time, the tonnage of the channel exceeds 125% of the tonnage expected at full load, as explained in the following examples.

Example 1. A 100 ton OBI press is equipped with a two channel System 1100 Tonnage Monitor, with strain links mounted on each side frame member. A central load at rated tonnage will register 50 tons on channel 1 and 50 tons on channel 2 when a machine rating of 100 tons is programmed into the unit and the calibration instructions of this manual are followed. Programming the machine rating at 100 tons automatically sets the machine rating alarms at 62.5 tons (125% of 50 tons) on both channel 1 and 2. No tooling can be run in the machine that produces more than 62.5 tons on either side of the frame.

Example 2. A 100 ton straight side press is equipped with a four channel System 1100 Tonnage Monitor. A central load of 100 tons will register 25 tons on each of the four channels. When a machine rating of 100 tons is programmed into the unit, and the calibration instructions of this manual are followed, the System 1100 automatically sets the machine rating alarms at 31.25 tons (125% of 25 tons) for each channel. No tooling can be run in the machine that produces more than 31.25 tons on any column.

The machine rating number that must be programmed into the System 1100 is simply a scale factor. For machines that are designed to operate at full rated tonnage with an off center load, a machine rating alarm fixed at 125% of expected channel tonnage at full load

may prevent the machine from operating with acceptable non-central loads. This can be rectified by a simple procedure involving changing both the machine rating number (scale factor) and the channel calibration numbers.

After a System 1100 is calibrated using the standard procedures in the Section 6 of this manual, the allowable tonnage per channel, as set by machine rating alarms can be increased while maintaining calibrated tonnage readings by the following procedures.

For a two channel System 1100, the machine rating number which should be programmed to shift the machine rating alarms to a desired tonnage is determined by dividing the desired allowable tonnage per channel by 0.625. To keep the System 1100 correctly calibrated, it is then necessary to change each calibration number for both channels of the two channel unit to the new calibration numbers.

$$C'_{N1} = \frac{\text{ORIGINAL MACHINE RATING}}{\text{NEW MACHINE RATING}} * C_{N1}$$

and,

$$C'_{N2} = \frac{\text{ORIGINAL MACHINE RATING}}{\text{NEW MACHINE RATING}} * C_{N2}$$

where,

C'_{N1} = **New calibration number for channel 1**
C_{N1} = **Original calibration number for channel 1**

C'_{N2} = **New calibration number for channel 2**
C_{N2} = **Original calibration number for channel 2**

For a four channel System 1100, the machine rating number which should be programmed to shift the machine rating alarms to a desired tonnage is determined by dividing the desired allowable tonnage per channel by 0.3125. To keep the System 1100 correctly calibrated after changing the machine rating number, it is necessary to change each calibration number for each channel of the four channel unit to the new calibration numbers,

$$C'_{N1} = \frac{\text{ORIGINAL MACHINE RATING}}{\text{NEW MACHINE RATING}} * C_{N1}$$

$$C'_{N2} = \frac{\text{ORIGINAL MACHINE RATING}}{\text{NEW MACHINE RATING}} * C_{N2}$$

$$C'_{N3} = \frac{\text{ORIGINAL MACHINE RATING}}{\text{NEW MACHINE RATING}} * C_{N3}$$

and

$$C'_{N4} = \frac{\text{ORIGINAL MACHINE RATING}}{\text{NEW MACHINE RATING}} * C_{N4}$$

where C'_{N1}, C'_{N2}, C'_{N3}, C'_{N4}, are the new calibration numbers to which channels 1 through 4 should be adjusted, respectively. C_{N1}, C_{N2}, C_{N3}, C_{N4}, are the original calibration numbers for channels 1 through 4, which were determined by the procedures followed in the Section 6 of this manual.

The following examples illustrate how the System 1100 Tonnage Monitors on the machines of Examples 1 and 2 of this section can be set up to permit more tonnage on each channel while retaining calibration.

Example 3. Following the instructions in the Section 6 of this manual for the two channel System 1100 unit on the machine of Example 1 resulted in a machine rating number of 100.0 tons being programmed into the unit. The calibration numbers were found to be 144 for channel 1 and 148 for channel 2. It is desired to shift the machine rating alarms on each channel from 62.5 tons (125% of 50 tons for each side) to 70 tons for each channel. To do this, calculate the new machine rating number (scale factor). The required number is:

$$\text{MACHINE RATING NUMBER} = \frac{70 \text{ tons}}{} = 112 \text{ tons}$$

0.635

Reprogram the machine rating number from the original 100 ton value programmed during calibration to 112 tons.

Next calculate the new calibration numbers required to remain calibrated with the new machine rating number. These are:

$$C'_{N1} = \frac{100}{112} * 144 \approx 129$$

$$C'_{N2} = \frac{100}{112} * 148 \approx 132$$

Round off calibration numbers calculated as above to the nearest whole number. Adjust the calibration numbers to the new values calculated as above, i.e., 129 for channel 1 and 132 for channel 2 in this example.

Example 4. Following the instructions in Section 6 of this manual for the four channel System 1100 unit on the machine of Example 2 resulted in a machine rating number of 100.0 tons being programmed into the unit. The calibration numbers were found to be 526 for channel 1, 532 for channel 2, 535 for channel 3, and 524 for channel 4. It is desired to shift the machine rating alarms from 31.2 tons for each channel to 40 tons. To do this, calculate the new machine rating number (scale factor). The required number is:

$$\text{MACHINE RATING NUMBER} = \frac{40 \text{ tons}}{0.3125} = 128 \text{ tons}$$

Reprogram the machine rating number from the original 100 ton value to 128 tons.

Next, calculate the new calibration numbers for each channel. These are:

$$C'_{N1} = \frac{100}{128} * 526 \approx 411$$

100

$$C'_{N2} = \frac{\quad}{128} * 532 \approx 416$$

$$C'_{N3} = \frac{100}{128} * 535 \approx 418$$

$$C'_{N4} = \frac{100}{128} * 524 \approx 409$$

Adjust the calibration numbers to the new values, i.e., 411 for channel 1, 416 for channel 2, 418 for channel 3, and 409 for channel 4.

Section 9. Using System 1100 Tonnage Monitors

There are several possible levels of utilization of System 1100 Tonnage Monitors in everyday production operations. In addition, there are several special purpose and diagnostic uses that a System 1100 can perform. This section of the manual gives suggestions for using the System 1100. The information provided should be considered as guidance. As the operator gains familiarity with the System 1100, he should develop tonnage monitoring programs that best fit his needs.

9.1 Machine Overload Monitoring

The least complex use of a System 1100 Tonnage Monitor is as a monitor for machine overload. Many mechanical power presses and other machines are chronically operated in severely overloaded conditions because of improper matching of tooling to machine capacity, because tooling wear increases the tonnage required to produce a part, because of improper shut height adjustment, or because tooling is improperly positioned in the machine. Overloading drastically increases bearing wear, deflection, and breaking of load bearing structures on machine tools.

When used as a machine overload monitor, the high setpoint limits for each channel of the System 1100 are chosen and set so that any load which exceeds rated machine tonnage capacity, or, at the employer's discretion, up to 125% of rated capacity, will cause the System 1100 to generate a high setpoint alarm and prevent another stroke until the System 1100 alarm is cleared. This prevents operation of the machine when die setting procedures, tooling wear, improper location of dies etc., cause the machine to be overloaded.

Using the System 1100 only as a machine overload monitor requires the lowest level of operator and die setter involvement with the tonnage monitor. High setpoint limits, once chosen, are not reset and low setpoint limits can be turned off or set to zero.

During die setting, the die setter must interact with the tonnage monitor only if the dies, as set, produce an overload. During production operation, an overload alarm alerts the operator to determine and remove the cause of the overload.

9.1.1 Sample Die Setting Instructions

1) Follow normal die setting procedures, setting dies and making trial strokes with material in place while slowly decreasing shut height on mechanically driven (crankshaft) machines or

increasing pressure on hydraulic machines.

2) If no alarms are tripped on the System 1100 during trial strokes, including several trial strokes after the final adjustment that produces a satisfactory part, the machine may be turned over to production.

4) If a two channel System 1100 is used on the machine and a channel 1 high setpoint and/or machine rating alarm indicates an overload on the left side of the machine when making a trial stroke, shift the dies to the right in the machine bed till trial strokes indicate that the channel 1 and 2 tonnages are approximately the same to reduce the left overload. Similarly, tooling should be shifted left in the bed if a channel 2 high setpoint and/or machine rating alarm indicates an overload on the right side of the machine.

   If both channel 1 and channel 2 high setpoint and/or machine rating alarms are tripped on a trial stroke, check to see if a correct part can be made after reducing the tonnage by shut height adjustment, etc. Also, on "C" frame machines such as OBI, OBS, and gap presses, check to that dies are centered front to back under the connecting rods that drive the slide. Dies located too far forward under the slide of such machines cause greater strains on the machine frame.

   If a correct part cannot be made without tripping one or more high setpoint alarms and/or machine rating alarms, the die should be placed in a machine of larger capacity or reworked to require less tonnage to make the part.

5) If a four channel System 1100 is used on a straight side machine, and one of the four channel high setpoint and/or machine rating alarms is tripped during trial strokes, shift the tooling away from the corner of the machine monitored by the channel indicating the alarm. When possible, tooling should be located so that approximately equal tonnage readings are obtained on the tonnage displays for all four channels.

   If, under approximately balanced load conditions, high setpoint and/or machine rating alarms are tripped, reduce tonnage by shut height adjustment or other tonnage adjustment and see if a correct part can be made with less tonnage. The tooling should be placed in a machine of greater rated tonnage capacity or reworked to require less tonnage if a correct part cannot be produced without overloading the machine.

9.1.2 Sample Operator Instructions

1) Each time power is first turned on to the machine, observe that the System 1100 tonnage displays go to zero (0) before attempting to cycle the machine.

2) Observe that a reading appears on the tonnage displays after the first machine stroke that produced a part.

3) An overload on any channel will be indicated by a flashing light and/or flashing tonnage reading and will prevent another stroke. The supervisor should be called and the condition that caused the overload cleared before pushing the CLEAR key on the System 1100 and proceeding with production.

4) If the press will not stroke and an error occurs (indicated by a flashing STOP CIRCUIT indicator light) call the supervisor.

9.2 Comprehensive Load Monitoring

Although monitoring only for machine overload provides great benefits in machine maintenance and repair costs, using the System 1100 in a more comprehensive load monitoring scheme that establishes standards and monitors production tonnages more closely can greatly expand benefits to the user. Both machine and tooling life can be extended, energy can be conserved, fewer scrap parts generated, and part quality can be made more consistent by using the System 1100 to determine and optimize tooling location and required tonnage in die setting; and by selecting high, low, and reverse setpoint limits so that changes in tonnage greater than those due to normal variations in the production process will trip an alarm and stop the machine from cycling.

A comprehensive load monitoring program requires more knowledge and interaction with the System 1100 by die setters and operators than a simple machine overload monitoring program. The following procedures and information can be useful in establishing a comprehensive load monitoring program. Of course, the user may choose to modify or add to the described procedures to suit his particular needs.

1) Initially determine and record the optimum location and minimum required tonnage for each set of tools used in a machine. Any tooling that requires more tonnage to produce a correct part than the rated tonnage capacity of the machine, or, at management's discretion, some selected percentage over rated machine capacity should be moved to a machine with higher rated tonnage, or the tooling should be reworked to require tonnage below rated machine capacity.

2) Although not always practical because of other production considerations such as feeding, part transfer, part removal, or tooling design, the optimum die location on "C" frame machines such as OBI, OBS, and Gap presses is generally with tooling centered from front to back under the connection(s) that drive the slide (ram), and at a left to right location in the machine bed that produces approximately equal tonnage readings on the left and right channels of a System 1100 Tonnage Monitor. On a straight side frame machine, the optimum tooling location in the machine bed is generally that location that produces approximately equal tonnages on each channel of a four channel System 1100 Tonnage Monitor. Equalizing the load in the machine usually produces less deflection between lower and upper dies, reduces bearing and gib wear, and fatigues structural members of the machine less.

   Using the System 1100 to determine the minimum tonnage necessary for tooling to produce correct parts develops an initial die setting standard for more consistent setups that will conserve energy, extend machine and tooling life, and achieve more consistent parts from different production runs. The initial determination of minimum tonnage to make the part also provides a standard by which tooling wear may be judged and scheduled for rework when wear increases, or, in some instances, decrease the tonnage necessary to make a correct part.

   Note! Tool and die makers calculate the approximate tonnage required to produce a part. These calculations, in some instances, can be substantially overstated or understated. With the System 1100, the actual tonnage required to produce a part can be determined as well the normal variations in tonnage due to inconsistency of material thickness, material physical properties, parts lubrication, etc.

   During the initial use of the System 1100 to determine optimum die location and tonnage, the location and required tonnage is ideally recorded and attached to the die set as a reference for future setup and for determining die wear.

The high and low setpoint limits should then be determined for each channel. The high setpoints for each channel should be set far enough above each channel tonnage that normal variations in tonnage don't trip the high setpoint alarms. The low setpoint alarms should be set far enough below each channel tonnage that normal variations in production tonnage don't trip the low alarms. The combination of the high and low setpoint alarms provides a tonnage "tolerance", helping to assure parts quality. Out of tolerance hits warn of problems in the production process. A good starting point in the determination of high and low setpoint limits for a channel is about 10% above the average tonnage displayed by the System 1100 for that channel over several strokes for the high setpoint, and about 10% below the average tonnage for the low setpoint.

High and low setpoints should be set symmetrically above and below the operating tonnage respectively. The tonnage bar graphs should then light the middle GREEN bar graph segments on all channels. This symmetrical setting of setpoints can be performed automatically by the System 1100 through the use of the Auto Setup function. The Auto Setup function sets the high, low and reverse setpoint limits to a preset tolerance around the measured tonnage.

The Auto Setup tolerance can be increased and the Auto Setup function executed again if nuisance stops due to normal variations in production tonnage occur.

Once established, the initial setpoint tonnages for each channel of the System 1100 should be recorded on the label that contains initial optimum location and tonnage records for reference in future setups. The record should be kept on a separate label from the original die maker's specifications. The die maker's specifications should be left on the die! The tonnage setpoint limits should also be stored in the permanent memory of the System 1100 (section 2.5) for recall when the die is used in the future. The System 1100 provides storage for up to 123 setups.

2) Each time the tooling is used, the die setter should reference the initially determined optimum tooling location, minimum required tonnage, and should recall the tonnage setpoint limits for that die from permanent memory. Of course die wear and differences in material may require some changes in setup tonnages and setpoints from the initial reference values.

By comparing the progressive variation in minimum tonnage required to make a correct part with the initial values, die rework can be scheduled. After a die is reworked or repaired, reference location and minimum tonnage and setpoint limits for each System 1100 channel should again be determined and recorded.

3) During production, the System 1100 will generate an alarm, stop the machine, and prevent further strokes until the alarm is cleared if tonnage falls below a low setpoint or rises above a high setpoint. When this occurs the operator should clear the condition, or call the supervisor to clear the condition, before the alarm is reset and production resumed. High and low setpoint alarms may have to be changed where alarms are tripped due to greater than expected variation in material or tooling wear that occurs over longer runs.

On high speed machines, dies in rapid operation may heat enough that die expansion causes tonnage to progressively increase toward some equilibrium tonnage after stroking begins. Setpoint limit tolerances will have to be increased to allow this variation or, alternatively, the operator may reset setpoints during operation after equilibrium is reached as indicated by readings on the System 1100 tonnage displays.

9.2.1 Sample Die Setting Instructions

1) Locate dies in the previously determined optimum location that provides approximately equal tonnage readings on each System 1100 channel, or as near to equal readings as possible when feeding, part removal, part transfer, die design, or other considerations prevent the die from being located in the machine so that approximately equal tonnage readings are obtained on each channel.

Recall the setup from permanent memory then move the keyswitch to the BYPASS position to bypass all high, low and reverse setpoint alarms.

3) Follow normal die setting tryout procedures, making trial strokes with material in place and adjusting tonnage slowly upwards by shut height adjustment of mechanically driven machines or hydraulic pressure on hydraulic machines. When the TOTAL tonnage displayed on the System 1100 tonnage displays is approximately equal to the previously determined reference value recorded on the die, check to see if a correct part is being made. Compare the tonnage on each channel of the System 1100 with the previously determined reference tonnages for each channel to see if any significant changes in load distribution have occurred. Ideally the GREEN segments of each channel bar graph will light indicating that the measured tonnage falls directly between the high and low setpoint limits that were previously determined for the die.

If a correct part can be produced with the TOTAL TONNAGE set at a value near the reference tonnage, and if load distribution has not significantly changed, proceed to step 4 of this procedure. If load distribution is significantly changed, relocating the die from the reference location to a location that gives approximately equal tonnages on all System 1100 channels, if possible, is recommended only after checking to see that excessive die wear has not caused the change in tonnage distribution. Other causes of changing load distribution can be use of different shims or parallels on dies or different location of shims or parallels from setup to setup.

If, when the TOTAL tonnage is adjusted to the initial reference value recorded on the die, a correct part can't be made, adjust the tonnage slowly upward till a correct part is produced. Remember, differences in material thickness and hardness can cause more or less tonnage to be required. A TOTAL tonnage required to produce a correct part that is significantly greater than the reference tonnage recorded on the die may indicate die wear severe enough that die rework should be scheduled.

Proceed to step four of this procedure after final die location and tonnage have been set.

4) Note the tonnage readings on each channel of the System 1100 Tonnage Monitor after making a trial stroke under final setup conditions. If the tonnages on each channel of the System 1100 fall approximately between the previously determined high and low setpoint limits, then move the keyswitch from the BYPASS position to the RUN position for production.

   If the tonnage on one or more channel(s) is different than the reference tonnage recorded on the die for that/those channel(s), set the high and low setpoints for each channel at about the same percentage above and below the actual tonnage readings of each channel as the previously stored setpoints. The System 1100 can do this automatically through the Auto Setup function. The keyswitch should be returned to the RUN position for production.

9.2.2 Sample Operator Instructions

1) Each time power is first turned on to the machine, observe that the System 1100 tonnage displays go to zero (0) before attempting to cycle the machine.

2) After the first machine stroke, observe that a reading appears on the tonnage displays.

3) In the event that a high or low alarm on one or more channels of the System 1100 stops the machine and prevents another stroke, the supervisor should be called and the condition that

caused the alarm cleared before pushing the CLEAR key on the System 1100 and proceeding with production.

4) If high or low alarms trip frequently in the production process and no apparent cause is found, nuisance alarms may be taking place because normal variations in the production process occasionally cause tonnage to fall somewhat below low setpoint limits or somewhat above high setpoints on any channel showing the high or low setpoint alarm with the actual tonnage reading for the channel and reset the low or high setpoint if necessary.

5) If the press will not stroke and an error occurs (indicated by a flashing STOP CIRCUIT indicator light) on the System 1100, call the supervisor.

9.3 Intermediate Load Monitoring

An intermediate load monitoring program that is somewhat more complex than simple overload monitoring but doesn't require the record keeping suggested in the comprehensive load monitoring program can provide many of the benefits of comprehensive load monitoring. The lack of recorded reference values to tonnage and die location primarily makes it more difficult to assess tooling wear, but in some instances the die setter's memory may compensate for lack of records.

9.3.1 Sample Die Setter Instructions

1) Move the keyswitch to the BYPASS position to turn off all high, low and reverse setpoint limits.

2) Follow normal die setting procedures, making trial strokes with material in place and adjusting tonnage slowly upwards by shut height adjustment of mechanically driven machines or hydraulic pressure on hydraulic machines. After each trial stroke, observe the tonnage on each channel of the System 1100 Tonnage Monitor. Shift the die location to obtain approximately equal tonnages on each channel, or as near to equal tonnages on each channel as possible when feeding, part removal, part transfer, or die design prevents the obtaining of approximately equal tonnage on each channel.

   Use the TOTAL tonnage reading on the System 1100 to set the tonnage near the least value that produces a correct part.

3) After correct setup is finished, use the Auto Setup function to calculate and set all high, low, reverse tonnage setpoint limits to a preset tolerance around the measured tonnage.

   The Auto Setup tolerance can be increased and the Auto Setup function executed again if nuisance stops due to normal variations in production tonnage occur.

9.3.2 Sample Operator Instructions

The recommended operator instructions for an intermediate load monitoring are the same as those for comprehensive load monitoring.

9.4 Diagnostic Uses

The System 1100 can help identify problems with machine or tooling and can help refine die design to reduce required tonnage or snapthrough tonnage, particularly when a recording instrument (strip chart recorder or oscilloscope) is connected to the "RECORDER" terminals, or a personal computer is connected to the RS-232 port, to show the complete signal waveforms produced by each strain link.

Pen and ink recorders such as the Gould 220 may be used for observation of forming and drawing operations on presses operating at lower speeds, however, the speed of response of such recorders is generally not sufficient to accurately show waveforms for blanking and piercing operations even on slower speed machines. Rates of change of actual tonnage signals will be slowed and peak values will be lessened. A storage oscilloscope connected to the recorder terminals, or a personal computer connected to the RS-232 port is necessary to accurately show the tonnage signal.

9.4.1 Incorrect Tie Rod Tension

A common problem that occurs on straight side presses of tie rod construction is improper tie rod tension. Such machines are designed for tie rods to be in tension such that the bed and crown of the machine are held to the uprights (columns) with a force of from 150% to 200% of rated machine tonnage. The tension forces in the tie rods produce equal compression forces in the uprights.

When strain links are mounted on uprights, the tonnage exerted by the machine tooling stretches (strains) the tie rod by an amount proportional to load and releases the compressive forces in the uprights proportionally to load. If the tension on a tie rod places a compressive force on the upright that is less than the force released by the load, all compressive force will be removed from the upright, and the signal from the strain link on the upright will no longer be proportional to load.

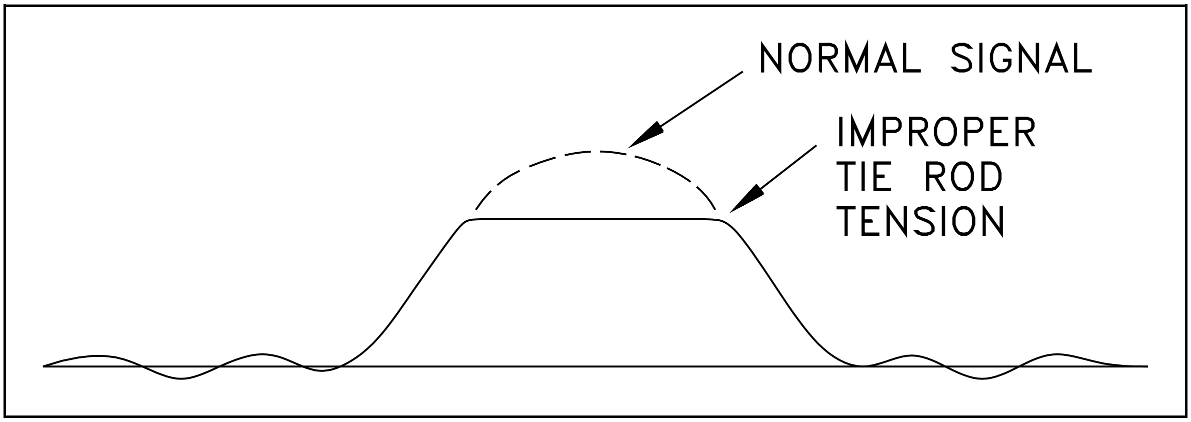


Figure 28. Clipping Due to Improper Tie Rod Tension.

This condition can be detected during calibration of a straight side machine when strain links are mounted on uprights. If, at rated tonnage, the calibration number associated with one or more channels with input strain links mounted in approximately the same place on each upright is required to be much higher to produce equal tonnage readings on each channel of the System 1100 Tonnage Monitor, improper tension of the tie rods is the most probable cause of the higher calibration numbers. To determine if the tie rod tension is the actual cause, reduce the load on the load cells during calibration till the sum of the load cell tonnages is equal to about 1/4 of rated machine tonnage, while making sure that approximately equal loads are on the load cells. If the channels with much higher calibration numbers now give tonnage readings on the System 1100 that are much larger than the channels with lower calibration numbers improper tie rod tension is indicated.

If a recorder, oscilloscope, or a personal computer with the Link Systems Signature Analysis software is available during calibration, incorrect tie rod tension can be seen on the waveform for a channel as a clipped signal, as illustrated in Figure 27.

9.4.2 Snapthrough Forces

Snapthrough forces associated with blanking or piercing action can be displayed on the System 1100 by pressing the TONNAGE FORWARD/REVERSE key to select reverse tonnage. Reverse tonnage is indicated by a minus sign on the tonnage displays.

Snapthrough tonnages greater than 20% of rated machine tonnage (10% for some machines) can cause more rapid machine structural fatigue than overloading the machine substantially in the forward direction. System 1100 Tonnage Monitors provide reverse tonnage setpoint limits to stop the production process in the event of an above limit reverse tonnage reading. If too much snapthrough is indicated by the System 1100, dies can often be reworked to reduce snapthrough. Placing shear on cutting edges or "catching" snapthrough on subsequent "bottoming" die action can significantly reduce snapthrough.

9.4.3 Stop Block Forces

Dies constructed with stop blocks to control depth of action can often present setup problems. If too much force is applied to stop blocks in faster operations, the stop blocks can heat and expand, changing penetration depth and tonnage required. Also, wear can change the die action relative to stop blocks, requiring more force on stop blocks to achieve the same depth of action.

The System 1100 can be used in setup to determine standards for stop block tonnage by cycling the machine when no material is in the die and observing the tonnage due to stop blocks alone. Also, when stop block tonnage must be increased to make a good part, as indicated by the System 1100, grinding the stop blocks can often reduce required tonnage.

9.4.4 Scrap Choppers

When separate crankshaft driven scrap choppers operate in the machine upstroke, scrap chopper tonnage may replace primary tooling tonnage readings on the System 1100 tonnage displays. This can be avoided by using the zeroing by position (cam zero) option with the System 1100. The cam should be set to open before die action occurs and to close again after the scrap chopper has operated.

Section 10. Error Codes

10.1 Error Listing

System 1100 errors are indicated by the STOP CIRCUIT indicator light flashing. The codes and descriptions for any active errors can be displayed using the ERRORS option in the main menu (section 2.7).

Errors are cleared by pressing the CLEAR key. Depending on the System 1100 configuration, the keyswitch may have to be in the PROG position to clear errors.

The following is a listing of error codes generated by the System 1100 Tonnage Monitor, software version 1.0, and suggested action for correction of the errors.

Error No.	Message / Action
001	Channel 1 will not zero.
002	Channel 2 will not zero.
003	Channel 3 will not zero.
004	Channel 4 will not zero.

Error codes 001, 002, 003, and 004 indicate that the output of the channel card identified by the error code fails to zero when no load is present. These error codes are caused by a fault in the strain link that is connected as an input to the channel card, or in the wiring from the strain link to the channel card input terminals.

1) Press the CLEAR key to see if the error code clears (depending on the System 1100 configuration, you may have to be in PROG mode to clear errors).

2) If the error code does not clear after pushing the CLEAR key, turn off the power to the System 1100 and open the front door of the enclosure. Check the connections to the strain link that is input to the channel indicated by the error code. If all connections are proper proceed to step 3.

3) Open the door of the System 1100 enclosure and unplug the strain link in error and the adjacent

Error No.	Message / Action

strain link on the same dual channel card. Now swap the strain link connections, plugging the strain link in error into the adjacent strain link's socket and vise versa. Turn on power to the System 1100. If the error code moves to the swapped channel, then the strain link or strain link wiring is causing the error and should be checked. If the error code stays on the same channel, then the Channel card is at fault and should be replaced.

005 Channel 1 threshold on too long.
006 Channel 2 threshold on too long.
007 Channel 3 threshold on too long.
008 Channel 4 threshold on too long.

Error codes 005, 006, 007, and 008 indicate that the output signal of the channel identified by the error code has stayed above the automatic zeroing threshold for too long. A fault in the particular channel card, the input strain link to the channel, or the strain link wiring will produce threshold errors. These error codes may also appear if the machine is stopped under load, or ,if configured for use with the optional zeroing cam, if the press is stopped 'off of the cam' (with the zeroing cam switch open) for extended lengths of time.

To correct these errors follow the same procedure outlined for error codes 001, 002, 003, and 004.

030 Speed setting error.

This error can be caused by a mal-adjusted speed setting in the System 1100 configuration menu, or by attempting to execute Auto Setup while running over 500 SPM using the rate of change zeroing method.

1) Check the MACH SPEED setting in the Config menu for correctness (see section 2.8.8).

Error No.	Message / Action

2) If running at speeds greater than 500 SPM a zeroing cam switch should be installed.

031 Supply Voltage too low.

When the operator attempts to change information stored in the non-volatile memory of the System 1100 the power supply voltage is first checked for the proper level. If the proper level does not exist, the System 1100 will not change data in the non-volatile memory and this error will result.

1) For self-contained System 1100 Tonnage Monitors open the front door of the enclosure and visually inspect the four power supply indicator lights for uniform and proper brightness.

   For remote display System 1100 Tonnage Monitors open the back of the Operator Interface Terminal and visually inspect the two power supply indicator lights for uniform and proper brightness.

2) Check the 110VAC power line to the System 1100 for proper level.

032 Internal Error. Call Factory.

1) Notify Link Systems of this error.

033 Internal Error. Call Factory.

1) Notify Link Systems of this error.

034 Internal Error. Call Factory.

1) Notify Link Systems of this error.

Error No.	Message / Action
035	Internal Error. Call Factory. 1) Notify Link Systems of this error.
036	Failure of Automatic Setup. This error results when the sixteen stroke automatic setup procedure is completed properly but a hardware failure prevents the new setpoints from being transferred into the non-volatile memory. 1) Press the CLEAR key to clear the error.
037	Auto Setup time-out. From the time automatic setup is begun, the operator has one minute to make the first press stroke in the sixteen stroke sequence. The operator also has only one minute allowed between each successive stroke in the sequence. If the operator fails to make a stroke during this minute, the automatic setup procedure is stopped, and this error results. 1) Press the CLEAR key to clear the error.
040	End of Cycle cam failure. This error indicates that the zeroing cam switch (when the cam zero option is used) connected to the EOC input terminal is faulty, or that the wire from the cam switch has come loose, been disconnected, or is shorted to ground. 1) Check the wiring from the cam switch to the EOC input terminal, making sure that all connections are in tact and no short circuits exist. 2) Check the cam switch. A faulty contact is indicated if all wiring is correct.

Error No.	Message / Action
041	Failure of Communications.

041 Failure of Communications.

This error indicates that the Operator Interface Terminal cannot communicate with the Logic Unit.

1) Check the communication cable connecting terminals A, B, and C of the Operator Interface terminal to the Logic Unit.

2) Check that the power supply connectors on the Operator Interface Terminal and the Logic Unit are properly connected.

042 Internal Error. Call Factory.

1) Notify Link Systems of this error.

043 Internal Error. Call Factory.

1) Notify Link Systems of this error.

044 Invalid job data detected.

This error occurs when the System 1100 Tonnage Monitor encounters an error when using the machine rating in tonnage setpoint scaling calculations. This error is usually caused by inadvertently changing the machine rating setting in the config menu. This error can also result from a memory failure causing a setpoint to assume an improper value.

1) Check the MACH RATING setting in the config menu for proper setting.

2) Check all setpoints (high, low, and reverse for the peak and all data windows) for correctness.

045 Current job setup corrupt.

Error No.	Message / Action
	This error results from a failure of the non-volatile memory. 1) If the setup has been previously stored in backup memory, go to the Sto/Rcl menu and recall the setup. If the setup is not present in backup memory, use the CLR MEMORY option in the Config menu to erase the current job setup. Follow the steps outlined in section 2.8.12.
046	Config data is corrupt. This error results from a failure of the non-volatile memory. 1) Go to the Config menu and re-enter all of the configuration parameters (MACH RATING, MACH NUMBER, THRESHOLD, CAM ZERO, DATA WINDOW, AUTO SETUP, MACH SPEED, TOPSTOP TMR, DECIMAL PT, and ALARM). Refer to sections 2.8.2 through 2.8.12 for instructions on setting each parameter. Note that certain parameters are considered essential for proper operation of the System 1100 and will be marked with an asterisk (*) in the lower left corner of their configuration screens until reset by the operator.
047	Failure of A/D converter. This error indicates a fault in the analog to digital converter in the System 1100 Logic Unit. 1) The Logic Unit Logic board must be replaced to correct this error.

Error No.	Message / Action
048	Channel 1 high setpoint too high.
049	Channel 2 high setpoint too high.
050	Channel 3 high setpoint too high.
051	Channel 4 high setpoint too high.

The Peak tonnage high setpoint of the channel indicated by the error code is set to a value greater than 125% of the channel rating.

1) Check the MACH RATING setting in the Config menu for correctness.

2) Adjust the indicated setpoint to a setting less than 125% of the channel rating.

052	Channel 1 low setpoint too high.
053	Channel 2 low setpoint too high.
054	Channel 3 low setpoint too high.
055	Channel 4 low setpoint too high.

The Peak tonnage low setpoint of the channel indicated by the error code is set to a value greater than 125% of the channel rating.

1) Check the MACH RATING setting in the Config menu for correctness.

2) Adjust the indicated setpoint to a setting less than 125% of the channel rating.

056	Channel 1 reverse setpoint too high.
057	Channel 2 reverse setpoint too high.
058	Channel 3 reverse setpoint too high.
059	Channel 4 reverse setpoint too high.

The Peak tonnage reverse setpoint of the channel indicated by the error code is set to a value greater than 125% of the channel rating.

1) Check the MACH RATING setting in the Config menu for correctness.

2) Adjust the indicated setpoint to a setting less

Error No.	Message / Action
	than 125% of the channel rating.
060	Channel 1 high setpoint < low setpoint.
061	Channel 2 high setpoint < low setpoint.
062	Channel 3 high setpoint < low setpoint.
063	Channel 4 high setpoint < low setpoint.
	The Peak tonnage high setpoint of the channel indicated by the error code is set to a value less than the low setpoint.
	1) Adjust the high or low setpoint so that the high setpoint is greater than the low setpoint.
064	Data window 1, channel 1 high setpoint too high.
065	Data window 1, channel 2 high setpoint too high.
066	Data window 1, channel 3 high setpoint too high.
067	Data window 1, channel 4 high setpoint too high.
	The Data window 1 high setpoint of the channel indicated by the error code is set to a value greater than 125% of the channel rating.
	1) Check the MACH RATING setting in the Config menu for correctness.
	2) Adjust the indicated setpoint to a setting less than 125% of the channel rating.
068	Data window 1, channel 1 low setpoint too high.
069	Data window 1, channel 2 low setpoint too high.
070	Data window 1, channel 3 low setpoint too high.
071	Data window 1, channel 4 low setpoint too high.
	The Data window 1 low setpoint of the channel indicated by the error code is set to a value greater than 125% of the channel rating.
	1) Check the MACH RATING setting in the Config menu for correctness.

Error No.	Message / Action

2) Adjust the indicated setpoint to a setting less than 125% of the channel rating.

072 Data window 1, channel 1 reverse setpoint too high.
073 Data window 1, channel 2 reverse setpoint too high.
074 Data window 1, channel 3 reverse setpoint too high.
075 Data window 1, channel 4 reverse setpoint too high.

The Data window 1 reverse setpoint of the channel indicated by the error code is set to a value greater than 125% of the channel rating.

1) Check the MACH RATING setting in the Config menu for correctness.

2) Adjust the indicated setpoint to a setting less than 125% of the channel rating.

076 Data window 1, chan 1 high setpoint < low setpoint.
077 Data window 1, chan 2 high setpoint < low setpoint.
078 Data window 1, chan 3 high setpoint < low setpoint.
079 Data window 1, chan 4 high setpoint < low setpoint.

The Data window 1 high setpoint of the channel indicated by the error code is set to a value less than the low setpoint.

1) Adjust the high or low setpoint so that the high setpoint is greater than the low setpoint.

080 Data window 2, channel 1 high setpoint too high.
081 Data window 2, channel 2 high setpoint too high.
082 Data window 2, channel 3 high setpoint too high.
083 Data window 2, channel 4 high setpoint too high.

The Data window 2 high setpoint of the channel indicated by the error code is set to a value greater than 125% of the channel rating.

Error No. — **Message / Action**

1) Check the MACH RATING setting in the Config menu for correctness.

2) Adjust the indicated setpoint to a setting less than 125% of the channel rating.

084 Data window 2, channel 1 low setpoint too high.
085 Data window 2, channel 2 low setpoint too high.
086 Data window 2, channel 3 low setpoint too high.
087 Data window 2, channel 4 low setpoint too high.

The Data window 2 low setpoint of the channel indicated by the error code is set to a value greater than 125% of the channel rating.

1) Check the MACH RATING setting in the Config menu for correctness.

2) Adjust the indicated setpoint to a setting less than 125% of the channel rating.

088 Data window 2, channel 1 reverse setpoint too high.
089 Data window 2, channel 2 reverse setpoint too high.
090 Data window 2, channel 3 reverse setpoint too high.
091 Data window 2, channel 4 reverse setpoint too high.

The Data window 2 reverse setpoint of the channel indicated by the error code is set to a value greater than 125% of the channel rating.

1) Check the MACH RATING setting in the Config menu for correctness.

2) Adjust the indicated setpoint to a setting less than 125% of the channel rating.

092 Data window 2, chan 1 high setpoint < low setpoint.
093 Data window 2, chan 2 high setpoint < low setpoint.
094 Data window 2, chan 3 high setpoint < low setpoint.
095 Data window 2, chan 4 high setpoint < low setpoint.

Error No.	Message / Action
	The <u>Data window 2</u> high setpoint of the channel indicated by the error code is set to a value less than the low setpoint.
	1) Adjust the high or low setpoint so that the high setpoint is greater than the low setpoint.
096	Data window 3, channel 1 high setpoint too high.
097	Data window 3, channel 2 high setpoint too high.
098	Data window 3, channel 3 high setpoint too high.
099	Data window 3, channel 4 high setpoint too high.
	The <u>Data window 3</u> high setpoint of the channel indicated by the error code is set to a value greater than 125% of the channel rating.
	1) Check the MACH RATING setting in the Config menu for correctness.
	2) Adjust the indicated setpoint to a setting less than 125% of the channel rating.
100	Data window 3, channel 1 low setpoint too high.
101	Data window 3, channel 2 low setpoint too high.
102	Data window 3, channel 3 low setpoint too high.
103	Data window 3, channel 4 low setpoint too high.
	The <u>Data window 3</u> low setpoint of the channel indicated by the error code is set to a value greater than 125% of the channel rating.
	1) Check the MACH RATING setting in the Config menu for correctness.
	2) Adjust the indicated setpoint to a setting less than 125% of the channel rating.
104	Data window 3, channel 1 reverse setpoint too high.
105	Data window 3, channel 2 reverse setpoint too high.
106	Data window 3, channel 3 reverse setpoint too high.

Error No.	Message / Action
107	Data window 3, channel 4 reverse setpoint too high.

The Data window 3 reverse setpoint of the channel indicated by the error code is set to a value greater than 125% of the channel rating.

1) Check the MACH RATING setting in the Config menu for correctness.

2) Adjust the indicated setpoint to a setting less than 125% of the channel rating.

108	Data window 3, chan 1 high setpoint < low setpoint.
109	Data window 3, chan 2 high setpoint < low setpoint.
110	Data window 3, chan 3 high setpoint < low setpoint.
111	Data window 3, chan 4 high setpoint < low setpoint.

The Data window 3 high setpoint of the channel indicated by the error code is set to a value less than the low setpoint.

1) Adjust the high or low setpoint so that the high setpoint is greater than the low setpoint.

112	Data window 4, channel 1 high setpoint too high.
113	Data window 4, channel 2 high setpoint too high.
114	Data window 4, channel 3 high setpoint too high.
115	Data window 4, channel 4 high setpoint too high.

The Data window 4 high setpoint of the channel indicated by the error code is set to a value greater than 125% of the channel rating.

1) Check the MACH RATING setting in the Config menu for correctness.

2) Adjust the indicated setpoint to a setting less than 125% of the channel rating.

116	Data window 4, channel 1 low setpoint too high.

Error No.	Message / Action
117	Data window 4, channel 2 low setpoint too high.
118	Data window 4, channel 3 low setpoint too high.
119	Data window 4, channel 4 low setpoint too high.

The Data window 4 low setpoint of the channel indicated by the error code is set to a value greater than 125% of the channel rating.

1) Check the MACH RATING setting in the Config menu for correctness.

2) Adjust the indicated setpoint to a setting less than 125% of the channel rating.

Error No.	Message / Action
120	Data window 4, channel 1 reverse setpoint too high.
121	Data window 4, channel 2 reverse setpoint too high.
122	Data window 4, channel 3 reverse setpoint too high.
123	Data window 4, channel 4 reverse setpoint too high.

The Data window 4 reverse setpoint of the channel indicated by the error code is set to a value greater than 125% of the channel rating.

1) Check the MACH RATING setting in the Config menu for correctness.

2) Adjust the indicated setpoint to a setting less than 125% of the channel rating.

Error No.	Message / Action
124	Data window 4, chan 1 high setpoint < low setpoint.
125	Data window 4, chan 2 high setpoint < low setpoint.
126	Data window 4, chan 3 high setpoint < low setpoint.
127	Data window 4, chan 4 high setpoint < low setpoint.

The Data window 4 high setpoint of the channel indicated by the error code is set to a value less than the low setpoint.

1) Adjust the high or low setpoint so that the high

Error No.	Message / Action
	setpoint is greater than the low setpoint.