System 5000 Press Control

TONNAGE MONITOR MODULE COLOR DISPLAY OPERATING MANUAL

OmniLink 5000

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Section 1 Introduction

The Tonnage Monitor module is an optional addition to the OmniLink 5000 Press Control intended to measure and display the force being applied to the frame of a mechanical power press. The force applied during the working portion of the stroke is compared with allowable limits based on the capacity of the machine and correct operation of the die and material being used. Tonnages beyond these limits cause various types of stop signals to be sent to the press control depending upon the importance of the overload. Present tonnage readings, status messages, present tonnage limits, and detailed tonnage versus angle graphs (signatures) can be examined or programmed through the same Operator Terminal as all other OmniLink 5000 settings.

Section 1.1 Features

- The 5000-8A Tonnage Monitor Module provides four strain connections for use on two or four channel machines.

- A crankshaft angle with a resolution of .021 degrees is supplied to the module by an internal communication with the Press Control Logic Board. Position dependent parameters such as the working portion of the stroke or data window settings are entered directly into the Tonnage Monitor Module requiring no external cam switches.

- The same internal communication allows the module to instruct the press control to Top Stop, Cycle Stop, or Cycle Stop and turn Off the hydraulic overload outputs depending on the present stroking mode and the type of tonnage alarm that has occurred.

- Within the working portion of the stroke tonnage, limits for each job can be set for the maximum allowable forward tonnage (High Limit), minimum required forward tonnage (Low Limit), and maximum allowable reverse tonnage (Reverse Limit).

- Inside the monitoring region additional data windows can be set to become active at specific crankshaft angles, creating additional Low and High limits that become active only for the region specified. Up to four data windows can be programmed for each job.

- A maximum allowable forward tonnage limit is established when the module is installed, based on the capacity of the machine (Machine Rating) and cannot be turned Off.

- If desired, additional limits can be placed on the total tonnage that reflect the maximum allowable tonnage at specific positions in the stroke.

- Limits can be programmed manually, automatically calculated by the Tonnage Monitor Module, or recalled along with all other OmniLink 5000 settings through the use of job setups.

- Tonnage alarm counters are maintained for low, high, machine, and reverse tonnage alarms.

- Status messages for each channel indicate the first alarm condition that occurred during the stroke.

- Each channel can be configured with a 15 character description indicating its physical location on the

press.

- A graph of tonnage versus crankshaft angle can be displayed for each channel or the total. This graph also shows the active areas of the data windows, when used.

- A reference waveform can be stored for each job.

Section 2 Parameter Entry and Access Control

Section 2.1 Parameter Entry

Throughout the OmniLink control, a fairly standard form of data entry is employed. When data entry is allowed, an "editing cursor" will appear on the screen. This cursor can typically be moved from parameter to parameter on the screen with the up, down, left, and right arrow keys. The topmost softkey is used to select the parameter for editing and can change description depending on the parameter selected.

Section 2.1.1 Numeric Entries

Assuming access has been achieved by one of the means listed in the following sections, to change a numeric value:

a) Place the editing cursor on the parameter to be changed by using the up, down, left, and right arrow keys as appropriate. Note that the editing cursor will only appear on the screen when editing is allowed. For instance, editing is usually not allowed when the press is running.

b) The topmost softkey will usually say something along the lines of "CHANGE XXXXXX" where XXXXXX is the name of the value to be changed. It may also simply say "CHANGE NUMBER." In any case, hit this softkey to enter numeric input mode. The editing cursor will change to a rectangle around the parameter to be edited.

c) Use the numeric keypad to input the new number desired for the parameter.

d) Press the ENT key to finish.

Note that moving off the parameter with the arrow keys or hitting the EXIT key will abort the edit and leave the parameter at the value it had before the editing process began.

Section 2.1.2 Text Entry

For text entry:

a) Place the editing cursor on the text to be changed by using the up, down, left, and right arrow keys as appropriate. Note that the editing cursor will only appear on the screen when editing is allowed. For instance, editing is usually not allowed when the press is running.

b) The topmost softkey will usually say something along the lines of "CHANGE XXXXXX" where XXXXXX is the name of the value to be changed. It may also simply say "CHANGE TEXT." In any case, hit this softkey to enter text entry mode. The right-hand softkeys will change, a letter selection box will appear, and the editing cursor will change to a rectangle around the text to be edited. Figure 2.1 shows the softkeys and an example text parameter.

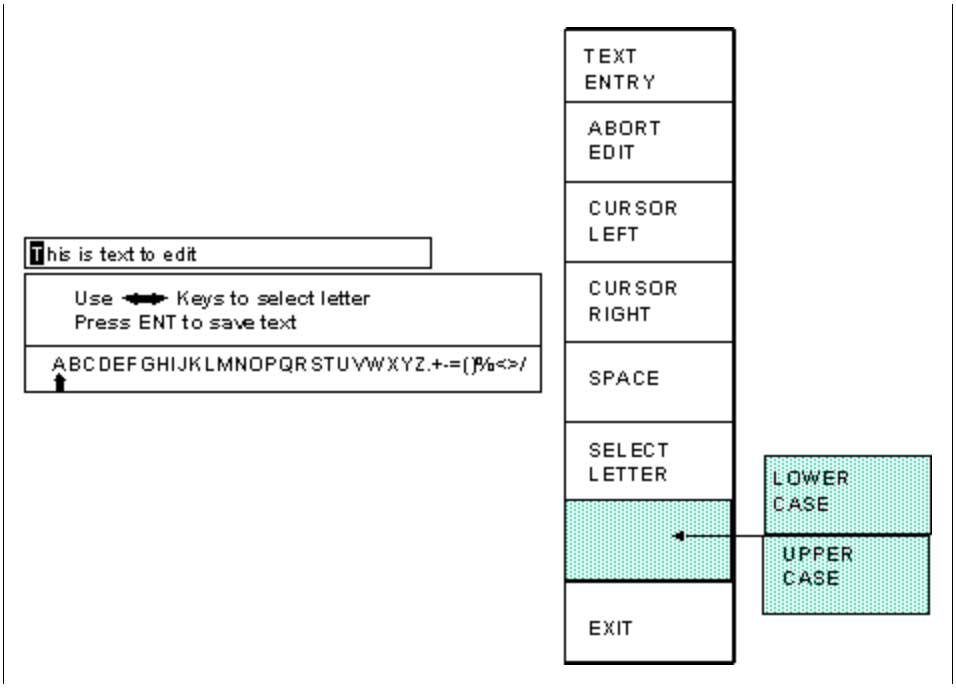

Figure 2.1: Example Text Entry

c) The fist character of the text is highlighted with the text cursor. The CURSOR LEFT and CURSOR RIGHT softkeys will move this cursor.

d) Use the left and right arrow keys to point to the letter desired in the letter box next to the text being edited. This box will just appear above or just below the text to be edited depending on where it is in the screen. Hit the SELECT LETTER softkey to place that letter at the text cursor. In the example above, the text cursor is on the "T" in "This" and would be replaced with an "A". The text cursor will automatically move to the right when a letter is selected. Note that numerals can be entered directly with the numeric keypad.

e) The SPACE softkey can be used to enter a space character in the text.

f) The softkey immediately above the EXIT softkey is used to select between uppercase and lowercase letters.

g) The EXIT or ABORT EDIT softkeys can be used to abort the editing operation. The text will revert to what it was before the editing operation started.

h) After the text has been changed as desired, press the ENT key to accept the changes.

Section 2.2 Access Control

The OmniLink control has several parameters or operations that have limited access. In regards to the tonnage monitor the ability to perform actions of turning bypass off and on, resetting faults, or changing limits must be restricted to certain personnel. The OmniLink control provides several means to limit access to these parameters or operations. These parameters and operations are called restricted items.

The OmniLink control employs combinations of two different means to limit access to restricted items. These means are the RUN/PROG key switch on the operator terminal and a user password system. The user password system assigns names and passwords to up to sixteen users. These two means can be used alone or in combination with each other. When a user employs the proper means to gain access, he will have the ability to perform the actions and change the parameters which have been designated to his control.

There are four possible modes of operation for the restricted access system. They are the "Key Only" mode, the "Key or Password" mode, the "Password Only" mode, and the "Key and Password" mode. The control can be configured to operate in any one of these four modes.

Section 2.2.1 Key Only Mode

The "Key Only" mode is the least complex of the four modes. This mode employs the RUN/PROG key as the only means to limit access to restricted items. Any user with the RUN/PROG key can access all of the restricted items. Without the RUN/PROG key, user access to all of the restricted items is prohibited.

Although the "Key Only" mode has the advantage of being easy to use, it does have a disadvantage. This mode cannot give a particular user access to only some of the restricted items. When operating in this mode, any user with the RUN/PROG key will have access to all of the restricted items.

Section 2.2.2 Key or Password Mode

The key or password mode allows for either of two means to gain access to the restricted items. A user with RUN/PROG key can access all of the restricted items. A user with the correct password can access the restricted items that have been designated for that particular user's access only. The system allows for passwords to be assigned to sixteen users. Each user can be assigned access to any or all of the restricted items.

The following is an example of a "Key or Password" mode operation. The RUN/PROG key is given to the die set-up personnel. A press operator is assigned a user name and password. With the password the operator can reset tonnage monitor faults. This is the only tonnage monitor related item to which the operator has access. In order to load a die, the set-up personnel uses the RUN/PROG key to recall a job from job storage. The set-up personnel will also be able to make changes to tonnage monitor limits. Once the set-up personnel sets the die and verifies its correct operation, the operator is left to run the die. If a tonnage monitor fault occurs, the operator can enter the correct password and then reset the fault. However, the operator cannot change tonnage monitor limits or bypass the tonnage monitor. This will allow the operator to keep running the job and reset faults that occur. However, if consistent stops occur because a tonnage monitor limit needs changing, the set-up personnel must be called to change the

tonnage monitor limit.

The example above can be taken one additional step, if two press operators are given different user names and different passwords. One operator can be assigned the ability to change tonnage monitor limits in addition to the ability to reset tonnage monitor faults, while the other operator is not assigned the ability to change the tonnage monitor limits.

Section 2.2.3 Password Only Mode

The "Password Only" mode allows for sixteen users. Each user can be assigned access to some or all of the restricted items. This mode does not use the RUN/PROG key.

The example listed above indicated that setup personnel required access to all restricted items. In the "Key or Password" mode, the setup personnel used the RUN/PROG key to gain access to all of the restricted items. In the "Password Only" mode, the setup personnel can still have access to all of the restricted items, but the system must be configured as such. The setup personnel must be assigned a user name and password. In addition, all restricted items would be assigned access to the setup personnel.

Section 2.2.4 Key and Password Mode

The "Key and Password" mode requires the user to have the RUN/PROG key, user name, and user password. Operation is basically the same as the Password only mode, except that in addition to entering the password the user must switch the RUN/PROG key to the PROG position.

Section 2.2.5 Tonnage Monitor Restricted Items

The following table lists the tonnage monitor restricted items name and function.

TONNAGE MONITOR RESTRICTED ITEMS

NAME	FUNCTION
TM Bypass	Bypass the Tonnage Monitor
TM Reset	Reset Tonnage Monitor Faults
TM Peak High Limits	Change the Tonnage Monitor Peak High Limits
TM Peak Low Limits	Change the Tonnage Monitor Peak Low Limits
TM Reverse Limits	Change the Tonnage Monitor Reverse Limits
TM Auto Setup	Perform a Tonnage Monitor Automatic Setup
TM Data Windows	Change the Tonnage Monitor Data Windows High Limits, Low Limits, Start Angle, and Stop Angle

Section 2.2.6 Access Control Operation

To gain access control the user must use one of two means or a combination of these two means. These means are the RUN/PROG key or the user password system.

Section 2.2.6.1 RUN/PROG Key Switch Operation

The RUN/PROG key switch is located on the lower right side of the operator terminal. This is a two position switch. The key is removable in the RUN position only. If the RUN/PROG key switch is being used as a means to access the restricted items, the switch must be turned to the PROG position. When the RUN/PROG key switch is switched to the PROG position, the press will Top Stop and stroking will be prohibited until the switch is returned to the RUN position.

When operating in the Key Only mode the key switch is the only means available to access the restricted items. All restricted items are accessible when the RUN/PROG key switch is switched to the PROG position.

When operating in the "Key or Password" mode, the key switch is one of the means available to access the restricted items. All restricted items are accessible when the RUN/PROG key switch is switched to the PROG position.

When operating in the "Key and Password" mode, the key switch and password must be used to access the restricted items. In this mode, the user will be granted access only to the restricted items that have been assigned to him.

Section 2.2.6.2 Password System Operation

Figure 2.2 displays a typical password entry sequence. This example shows the steps necessary to change a tonnage monitor limit setting. This is typical for password entry for all restricted items.

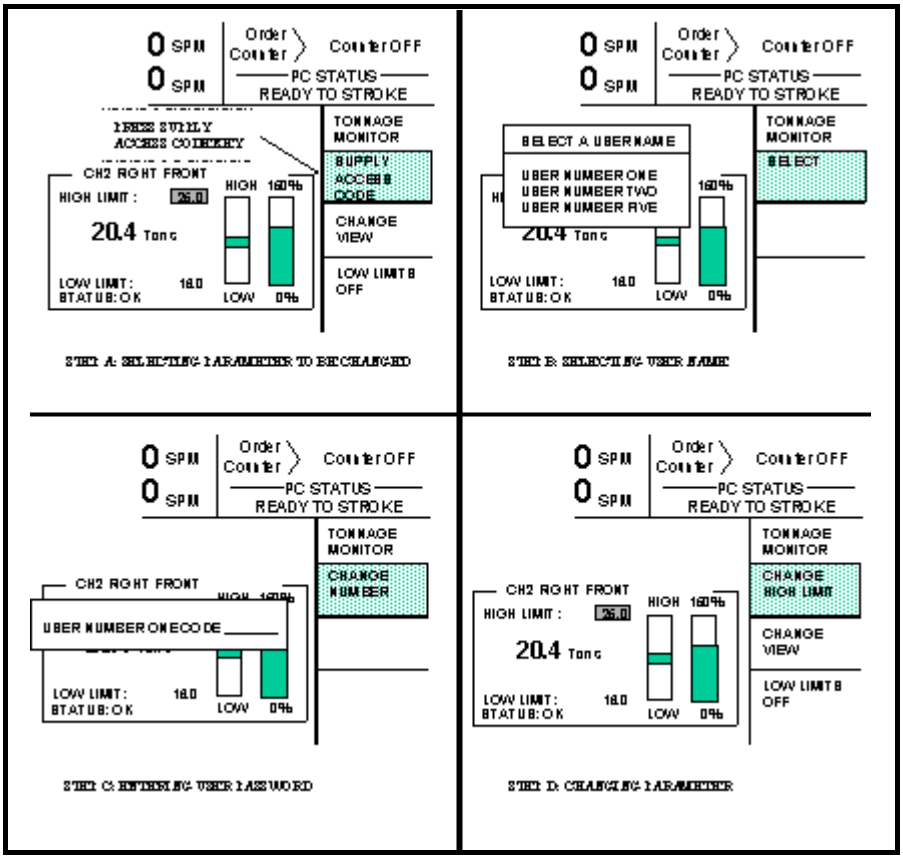

Figure 2.2: Password Entry Sequence

Step A: Select the restricted item. In the example shown in Figure 2.2 the restricted item is Channel 2 High Limit. Once the parameter is selected then Softkey # 1, the upper vertical softkey (Softkey # 1 is highlighted in Figure 2.2) , will display the legend “SELECT”.

Step B: A list of users that have access to this restricted item will appear. In the example shown in Figure 2.2 only User Number One, User Number Two, and User Number Five have access to this restricted parameter. The system may have several more users, but the three users listed on the screen are the only users that have access to change a High Peak Limit. The user must use the arrow keys to position the cursor on his user name. After placing the cursor on the correct name, the user must press the SELECT softkey. The SELECT softkey must be pressed even if there is only one user name displayed.

Step C: The display will show the selected user name and request the user password. The user must enter the correct password and then press the ENT key.

Step D: Upon entry of the correct password, the user will be allowed access to the restricted item. In the example shown in Figure 2.2, the user will have access to change the Channel 2 High Limit.

After performing the steps listed above, the user will be logged in to the password system. The user will

have access to all restricted items that have been designated for his access. This access will remain until the user performs a log out or until the user is automatically logged out.

The user can log out by using the ACC key. This key will directly switch the display to the Quick Access screen. The LOGOUT soft key legend will appear along the bottom of the screen. If the operator presses this key, he will log out. He will no longer have access to the restricted items, unless he repeats steps A through D.

In addition to the manual log out, the system contains an automatic logout. The intent of automatic log out is to reduce the possibility of users other than the intended user having access to restricted items. If there were no provisions for automatic log out and a user forgot to manually log out, all restricted items to which the user had been designated for access would be available from the log in time until power was removed from the OmniLink control. This presents the possibility of users other than the intended user having access to restricted items. Automatic log out is based upon both time and press strokes. During system configuration automatic Access Timeout parameters are entered. An automatic access timeout time and automatic access timeout strokes are entered. The time entered is the amount of time after the last key stroke that will be allowed before the system will automatically log out the user. For example, if the automatic access timeout is set to 60 seconds, the user will be logged out 60 seconds after the last key stroke. If the user presses a key before the 60 seconds have elapsed, a new 60 second cycle will be started. The number of strokes that are entered is the number of press strokes after the last key stroke that will be allowed before the system automatically logs out the user. For example, if the automatic timeout is set to 10 strokes, the user will be logged out when the press completes ten strokes after the last key stroke. If the user presses a key before 10 strokes have been completed, a new 10 stroke cycle will be started.

Section 3 Definitions and Terminology

This section will give some background and explain the meaning of various settings and readings in the tonnage monitor. It is strongly recommended that this section be read in order to use the tonnage monitor effectively!

Section 3.1 Tonnage

The tonnage monitor reads forming forces ("tonnage") from strain gauges mounted on the machine frame. Each strain gauge is a "channel". Tonnage monitors typically have two or four strain gauges depending on the type of machine. For example, OBI presses typically use two strain gauges (one on each side), while straight side presses typically use four strain gauges (one on each corner). Section 7 covers gauge mounting considerations and procedures.

Section 3.1.1 Channel Tonnage

A channel tonnage is the tonnage read from a single strain gauge. A numerical channel tonnage reading shown by the tonnage monitor is the highest tonnage exerted on that channel through the stroke or data window (data windows are discussed in section 3.2). In addition, the tonnage monitor can show the tonnage waveform for a channel. This waveform shows how the tonnage varies with press crankshaft angle.

Section 3.1.2 Total Tonnage

In addition to recording the maximum tonnage measured for each channel, the tonnage monitor module calculates and records the instantaneous summation of all channels. It performs the same peak measurement on this value as is performed on the individual channels. This value is displayed as the total tonnage exerted on the machine frame at any single position in the stroke.

When forces occur on all channels at the same time, the maximum total tonnage is the summation of the maximum channel tonnages. For example, the die shown in Figure 3.1 contains two equally sharp punches of equal cross-sectional area and equal length.

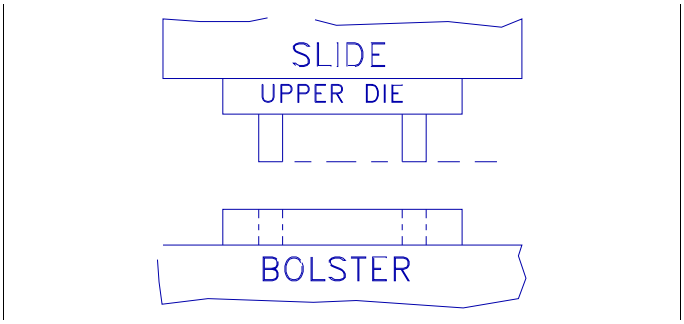

Figure 3.1: Example Die 1

This die is located in the center of an OBI press bed equipped with a two channel tonnage monitor with strain gauges mounted on both sides of the press frame. If the tonnage required for each punch is 100

tons and both punches impact the material at the same position in the stroke (at the same time) the graph in Figure 3.2 shows the forces applied to the left and right sides of the machine frame along with the resulting total force. This process would result in the tonnage monitor displaying 100 tons for the left channel, 100 tons for the right channel, and 200 tons for the total.

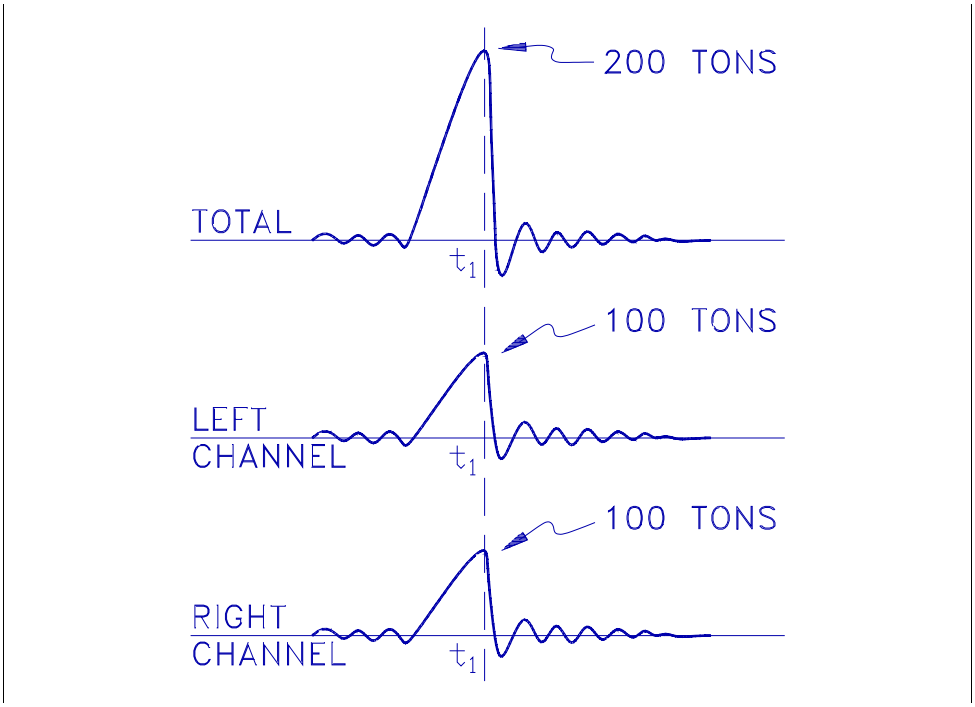

Figure 3.2: Tonnages From Example Die 1

When forces occur on the individual channels at different positions in the stroke (at different times), the total force depends on the amount of force exerted at any specific position. If the die described in the previous example had punches of different lengths as shown in Figure 3.3, the punches would not impact the material at the same position in the stroke.

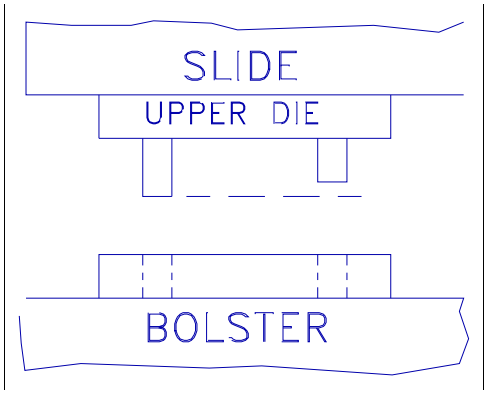

Figure 3.3: Example Die 2

The graph in Figure 3.4 shows that the punch on the left contacts the material first and exerts a total force of 100 tons at time t1, with 60 tons distributed to left side of the machine frame and 40 tons distributed to the right. After the left punch breaks through the material, and at a different position in the

stroke, the punch on the right contacts the material and exerts a total force of 100 tons at time t2, with 60 tons distributed to the right side of the machine frame and 40 tons distributed to the left. This process would result in the tonnage monitor displaying that the maximum tonnage measured on the left side of the machine frame was 60 tons, that the maximum tonnage measured on the right side of the machine frame was 60 tons, and that the maximum total tonnage exerted on the machine frame was 100 tons.

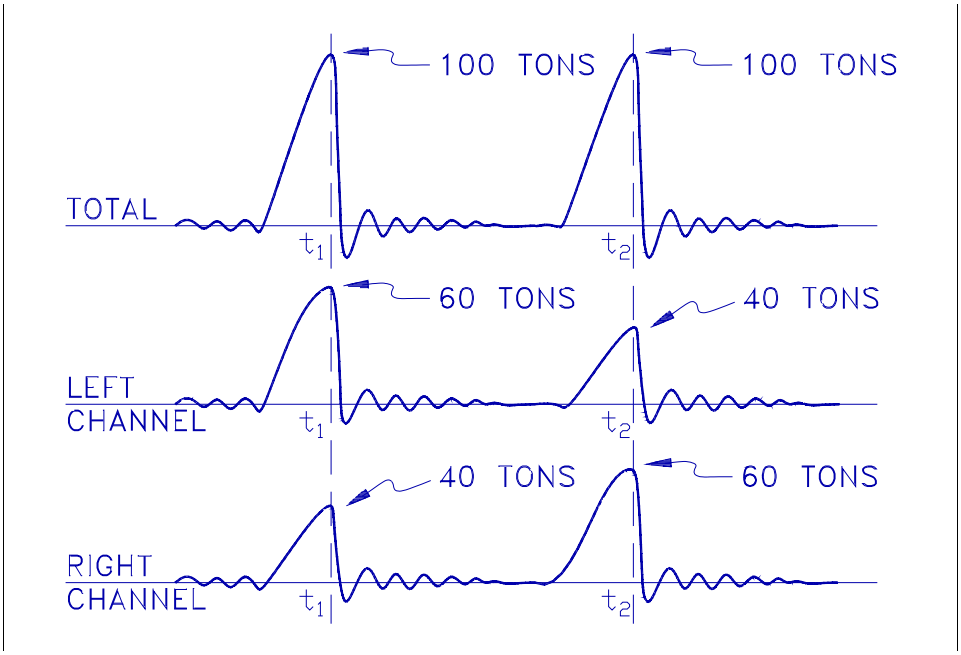

Figure 3.4: Tonnages from Example Die 2

Section 3.1.3 Reverse Tonnage

In addition to monitoring the "forward" tonnages for a press, the tonnage monitor also measures and monitors the "reverse" tonnage. A press frame acts as a kind of stiff spring. When exerting tonnage in the down part of the cycle, portions of the press frame stretch proportionally to the tonnage exerted. In the case of a punch, for example, the tooling comes down and contacts the material. The press frame starts stretching, and this generates tonnage exerted on the material. Finally the tonnage exerted is sufficient for the punch to "break through" the material, and when it does the press frame tries to "spring back" to its original shape. Just like a regular spring, the press will overshoot its original resting position due to inertia and will actually compress instead of stretch. The tonnage registered on the frame during this "rebound" is the reverse tonnage. Reverse tonnages are typically much harder on the press than forward tonnages. As a result, press manufactures typically allow much less reverse tonnage on a machine than forward tonnage. For instance, a 500 ton machine may only be rated for 50 tons of reverse load.

Section 3.2 Data Windows

Peak tonnage monitors capture the maximum tonnage seen by each strain gauge over the stroke. 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 highest peak being checked against setpoints. Where closer monitoring is desired in these applications, the tonnage monitor module provides up to four "Data Windows" to monitor additional peaks other than the absolute maximum peak tonnage. These additional peaks are referred to as "local" peaks. Each data window consists of a separate high and low limit that are used from a given start angle to a given end angle.

The tonnage graph in Figure 3.5A is for a two station die. The first station cuts out the part (local peak), and the second station stamps a logo onto the part (absolute peak).

Since the tonnage required to coin the logo is greater than the tonnage required to cut the part, the local peak is not checked using a normal peak tonnage monitor. The local peak could completely disappear and a normal peak tonnage monitor would not detect any anomaly in the process since the absolute peak limits are still being satisfied by the coining part of the die. This is exactly what would happen if the material did not feed between strokes as shown in Figure 3.5B. Using a single data window, however, places a separate high and low limit on the local peak.

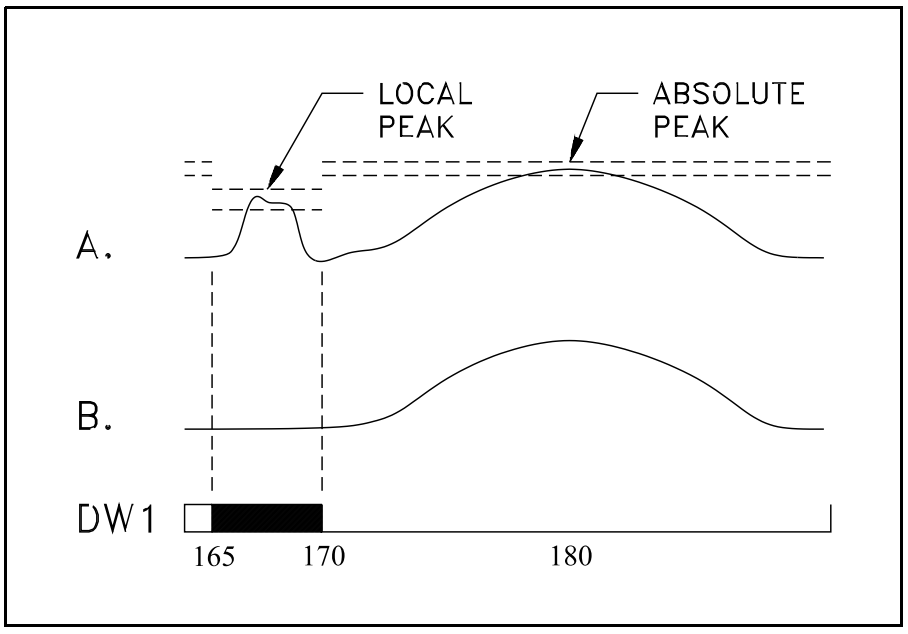

Figure 3.5: Example Data Window.

Section 3.2.1 Data Window On Angle

The On Angle for a data window is the angle at which the setpoints for that data window start to be enforced. For example, in Figure 3.5, data window 1 has an on angle of 165 degrees.

Section 3.2.2 Data Window Off Angle

The Off Angle for a data window is the angle at which the setpoints for that data window stop being enforced. For example, in Figure 3.5, data window 1 has an off angle of 170 degrees.

Section 3.3 Limits

The tonnage monitor can compare the tonnages it reads to limits set for each job. The following sections detail these limits.

Section 3.3.1 Machine Rating Limit

The machine rating limit, unlike low and high limits, is intended to protect the machine rather than the tooling. This limit is 125% of the tonnage rating for each channel. For instance, on a 400 ton machine with a four channel tonnage monitor module, each channel is rated at 100 tons (400 ton machine divided by four channels). The machine rating limit for each channel in this case is 125% of 100 tons which is 125 tons. Note that it is possible to get a machine rating alarm even though the total tonnage does not exceed the machine rating. Suppose the tonnages for the above machine read 80 for channel 1, 90 for channel 2, 130 for channel 3, 80 for channel 4, and 380 for the total. A machine rating alarm would be indicated on channel 3 even though the total tonnage was less than 400 tons. A machine rating alarm results in a Cycle Stop to the press. Unlike high, low, and reverse limits, this limit can NOT be bypassed.

Section 3.3.2 Low Limits

A Low Limit is the minimum tonnage required to properly produce a particular part. There are separate low limits for each channel of the tonnage monitor for both the peak tonnages and data window tonnages. If something in the process changes during normal operation that causes any channel to not reach its' minimum limits, a Top Stop is provided to the press control in order to stop the process. In stroking modes Inch and Timed Inch it is common the operate the press without material in the die during the setup operation. In order to prevent unintended Top Stops, the tonnage monitor module will automatically turn OFF the Low Limits during these modes. The Low Limit for a particular channel can NOT be set greater than or equal to that channels' High Limit.

Section 3.3.3 High Limits

High Limits should be set above the maximum tonnage required to properly produce a particular part and is set for each channel of the tonnage monitor for both peak and data window tonnages. If something in the process changes during normal operation that causes the tonnage developed to exceed this maximum limit, a Stop Signal is provided to the press control in order to stop the process. The tonnage monitor module can be configured to generate either a Top Stop or a Cycle Stop when a high tonnage alarm occurs. It can also be configured to generate a Cycle Stop AND Turn Off Hydraulic Overload Outputs when a high tonnage alarm occurs.

Section 3.3.4 Reverse Limits

A Reverse Limit should be set more negative than the maximum reverse tonnage developed when properly producing a particular part and is set for each channel of the tonnage monitor for the peak tonnage only. Data windows do NOT have reverse limits associated with them. If something in the process changes during normal operation that causes the tonnage developed to exceed this maximum reverse limit, a Top Stop Signal is provided to the press control in order to stop the process. Excessive reverse tonnages are damaging to the machine frame and reverse tonnage limits are active during the entire working portion of the stroke.

Section 3.3.5 Total Tonnage Limit

There is only one limit that can be applied to the total tonnage. If so configured (see section 5.2 for details), the machine rating derate table will apply a limit to the total tonnage that varies with the crank angle (related to height off the bottom of the stroke). The machine rating is specified by the press manufacturer at a specific height off the bottom of the stroke (typically .25 inches). Above this height the total tonnage available is limited by the torque of the crankshaft and clutch and will decrease as the height off the bottom at which the tonnage occurs increases. The machine rating derate table tells the tonnage monitor how to limit the total tonnage. A Cycle Stop will be generated if this limit is exceeded.

Section 4 Operation

Section 4.1 Main Operator Terminal Screen

The Operator Terminal Main Menu shown in Figure 4.1 provides the current status of the tonnage monitor module directly beside the TONNAGE MONITOR softkey.

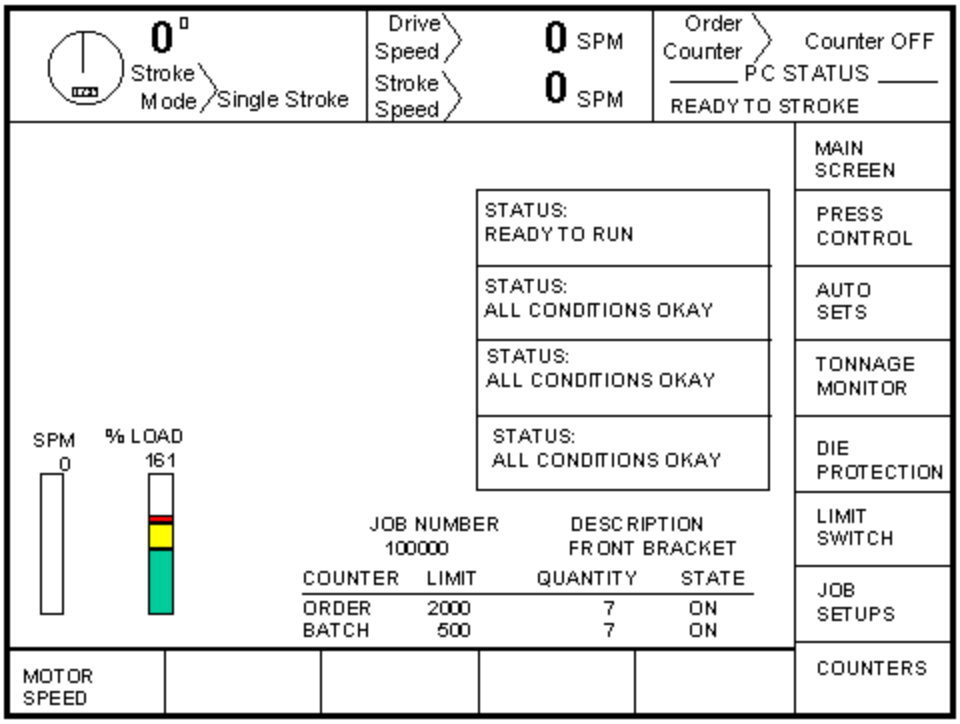

Figure 4.1: OmniLink Main Screen

The status of the tonnage monitor module could indicate any of the following conditions:

"OK"	No tonnage alarms exist and no stop signals are being given by the module.
"Error Condition Exists"	A tonnage alarm or an error has been detected and must be reset before press control will allow stroking. This will be displayed in red.
"BYPASSED"	Tonnage module is bypassed and will not supply a stop signal to the press control if an overload occurs. This will be displayed in yellow.
"Option is NOT Installed"	Press control has not been configured to recognize the tonnage monitor module.
"Communication Failure"	A problem exists in the serial communication link between the operator terminal and the tonnage monitor module (see section 9 for details). This will be displayed in red.

Section 4.2 Main Tonnage Monitor Screen

The TONNAGE MONITOR softkey in the Main Menu provides access to the tonnage monitor module installed to operate with either two or four channels. This screen shows the maximum forward tonnages recorded during the last stroke, the description and status of each channel, the overall status of the tonnage monitor module, and limits that apply to the current view. Peak forward tonnage, peak reverse tonnage, and data window forward tonnages can be selected for viewing. Figure 4.2 is an example of a peak forward tonnage view, Figure 4.3 shows a data window forward tonnage view, and Figure 4.4 shows a peak reverse tonnage view. Two channel screens look much the same but have no channel three or channel four information. There are several softkeys on the main tonnage monitor screen that come into play at various times. The softkeys and other functions of this screen are discussed in the following sections. In the following screens, softkeys that are shaded may not always be present and may say different things depending on the circumstances.

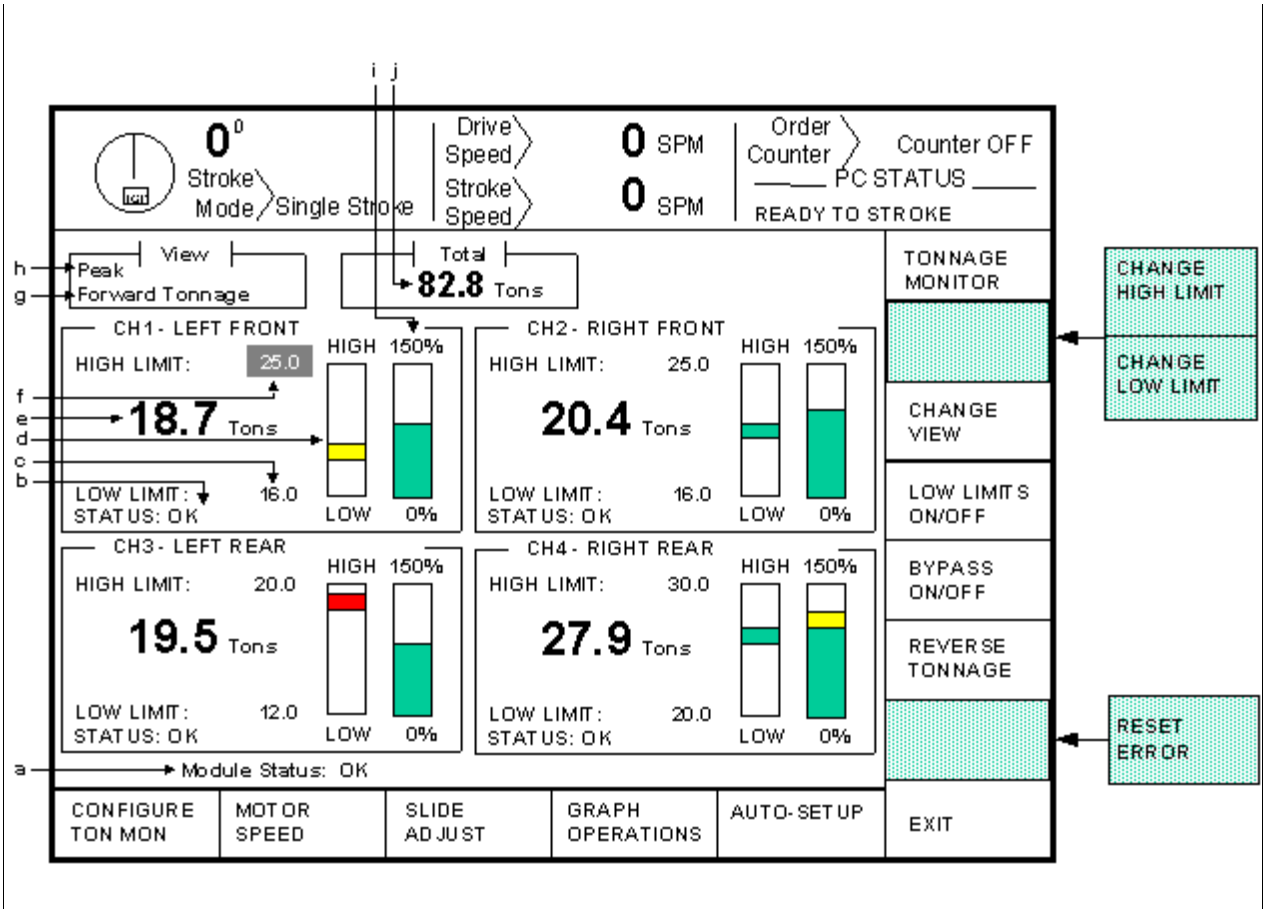

Figure 4.2: Example Peak Forward Tonnage View

Referring to Figure 4.2, the various parts of this screen are:

a) Module Status - The overall status of the tonnage monitor.

b) Channel Status - Each channel also has a status that indicates any alarms conditions

or other problems related to just that channel.

c) Low Limit Value - The low tonnage limit setting for this channel and view (peak, data window 1, data window 2, etc).

d) Graphical Limit Bar - This is a floating bar graph that graphically indicates where the tonnage for a channel is relative to the low and high setpoints for that channel. The bottom of the graph is the low limit and the top of the graph is the high limit. A tonnage that is halfway between the low and high limits will show a green bar in the middle of the graph. If the tonnage were to start going up towards the high limit (perhaps due to material thickness variation), the bar would also go up and would first turn yellow, and then red as it approached the high limit. Likewise, if the tonnage started to go down towards the low limit, the bar would go down and first turn yellow, and then red as it approached the low limit.

e) Tonnage Reading - The numeric tonnage reading for this channel and view. In the example screen of Figure 4.2, this is the peak forward tonnage for channel 1.

f) High Limit Value - The high tonnage limit setting for this channel and view (peak, data window 1, data window 2, etc).

g) Tonnage Direction - This indicates whether forward or reverse tonnage is being viewed (Note that data windows do not have reverse tonnage associated with them).

h) View - This line indicates which tonnages and settings are being viewed - Peak, Data Window 1, Data Window 2, Data Window 3, or Data Window 4.

i) Channel Rating Graph - This bar graph shows the percent of channel rating that the tonnage represents. It will be green to 100% channel rating, yellow from 100% to 125% channel rating, and red from 125% to 150% channel rating. For example, a 400 ton 4 channel machine would have a 100 ton channel rating. For this case, If a channel read 100 tons then the graph would be all green up to about 2/3 of the graph. If the channel read 110 tons, then a little yellow would show above the green. If the channel read 130 tons, There would be red above the yellow. In general, this graph should always be kept in the green.

j) Total Tonnage Reading - This is numeric value for the total tonnage.

Figure 4.3 shows a four channel screen when viewing data window tonnages. Notice that the major difference between this screen and that of Figure 4.2 is the addition of three new parameters and the lack of a REVERSE TONNAGE softkey.

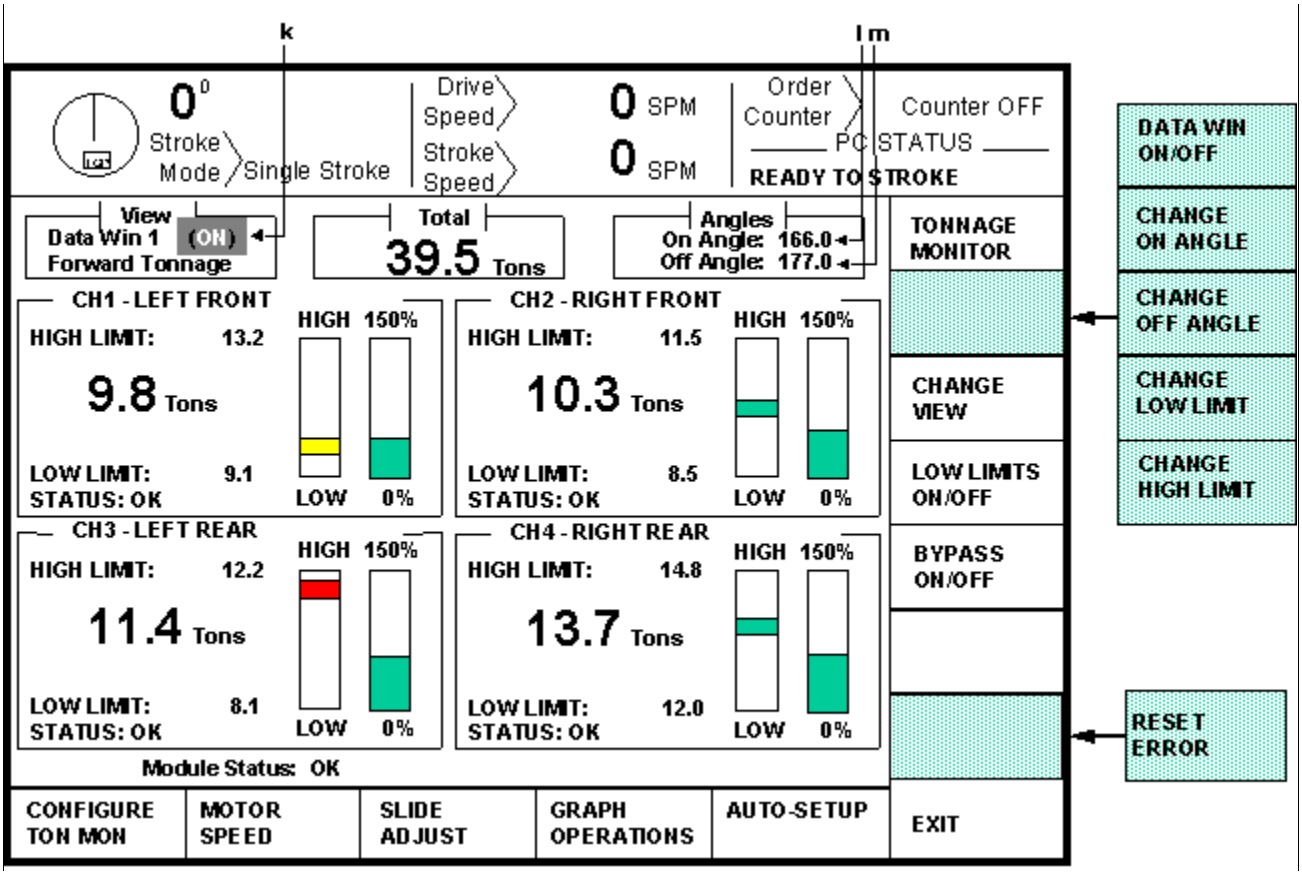

Figure 4.3: Example Data Window Tonnage View

Referring to Figure 4.3, some additional settings in a data window view are:

k) Data Window On/Off Setting - This determines whether the data window is active. When "On", the data window setpoints are enforced from the "On Angle" to the "Off Angle". When "Off", these settings are not used at all and will NOT stop the press.

l) Data Window On Angle - This is the angle at which the data window setpoints will start to be enforced.

m) Data Window Off Angle - This is the angle at which data window setpoints stop being enforced.

Figure 4.4 shows a four channel screen when viewing reverse tonnages.

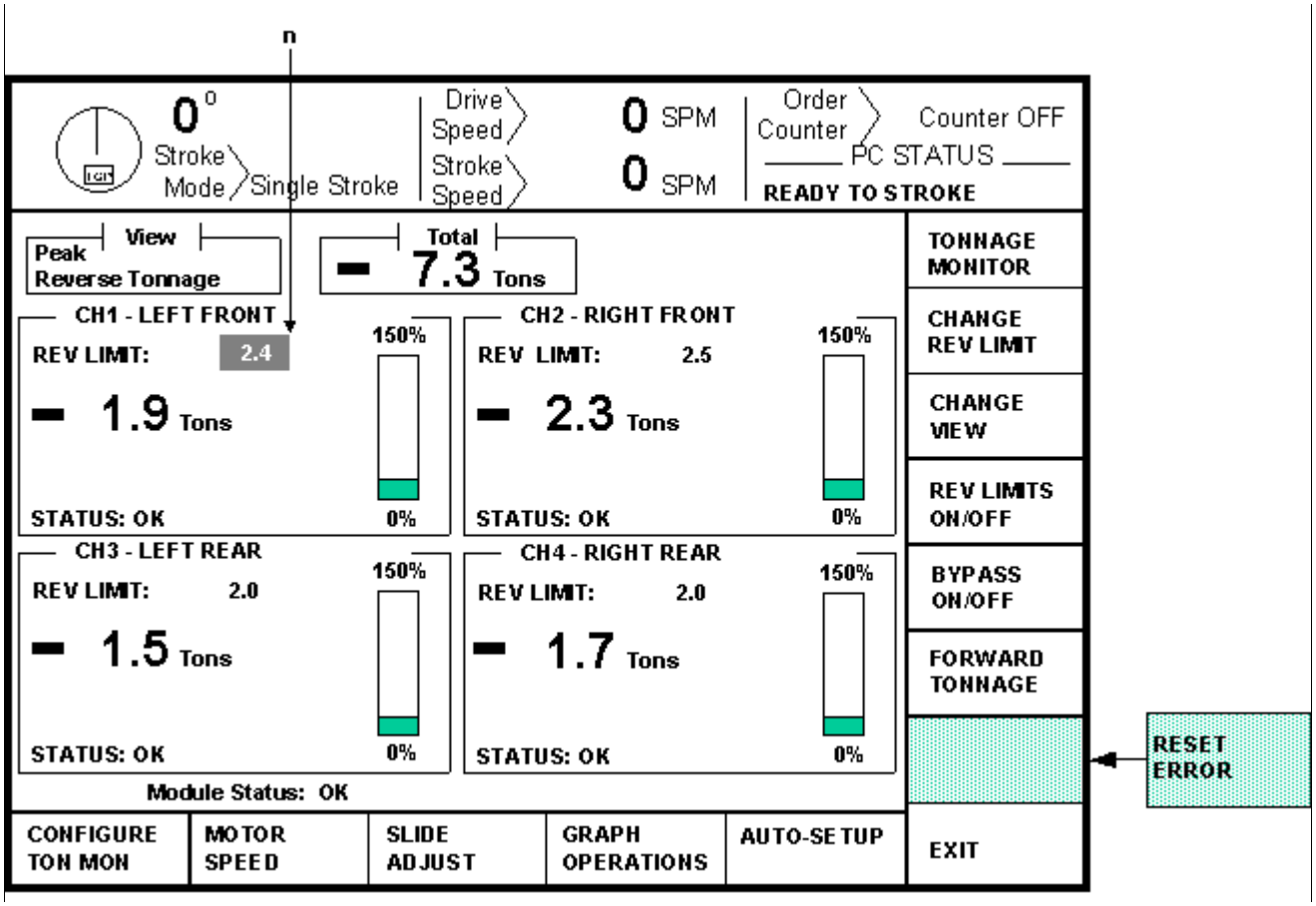

Figure 4.4: Example Peak Reverse Tonnage View

Notice that there are no limit bars when viewing reverse tonnage as there is only one reverse limit for each channel. Referring to Figure 4.3, an additional setting in the reverse tonnage view is:

n) Reverse Limit Value - The reverse tonnage limit setting for this channel. Note that only peak tonnage has a reverse limit.

Section 4.2.1 Selecting a View

As explained in section 3.2, data windows can monitor "local" peaks with a separate set of setpoints from the "absolute" peak. Each set of tonnages and limits comprise a "view" in this screen and is indicated by the box in the upper left of the screen as shown by "h" and "g" in Figure 4.2. The absolute peak tonnages and associated limits are called the "peak view". In all, there are six different "views" of tonnages and settings - peak forward, peak reverse, data window 1 forward, data window 2 forward, data window 3 forward, and data window 4 forward. The default view on entering the screen is peak forward tonnages and settings.

Section 4.2.1.1 Viewing the Peak and Data Window Tonnages and Settings

The CHANGE VIEW softkey allows the operator to select which set of tonnages and settings are shown on the tonnage monitor screen. The view can be the maximum forward tonnage that occurred anywhere during the last stroke (Peak) or the maximum tonnage that occurred during a particular data window (Data Window 1 through Data Window 4). Each time the CHANGE VIEW softkey is hit the view will change. The order is Peak, Data Window 1, Data Window 2, Data Window 3, Data Window 4, and then back to Peak.

Section 4.2.1.2 Showing Forward and Reverse Tonnage

When viewing peak forward tonnage, pressing the REVERSE TONNAGE softkey allows the operator to change the view to peak reverse tonnage and settings. This key is only available in the peak forward view (as seen in Figure 4.2) as data windows do not have reverse tonnage associated with them.

When viewing peak reverse tonnages and settings, the FORWARD TONNAGE softkey allows the operator to change the view to peak forward tonnage and settings. This key is only available in the peak reverse view as shown in Figure 4.4.

Section 4.2.2 Setting Limits

As can be seen in Figures 4.2 to 4.4, there are several limits that must be set in the tonnage monitor for it to perform its function. Each channel in the peak view has a low, high, and reverse limit. Each channel in a data window has a low and high limit as well as a data window start and end angle.

NOTE:	These limits are restricted items and access to them is controlled by the RUN/PROG key, access code, or both as described in Section 2. In addition, these items are only allowed to be changed when the editing cursor is present. For most items, the editing cursor will NOT be available when the press is running. Also, when the access mode is "Key Only" or "Key AND Code" (see Section 2 for details), the editing cursor will only appear when the RUN/PROG key switch is in the PROG position. The following subsections assume that access to the parameters has been obtained and that the editing cursor is present.

Section 4.2.2.1 Setting High Limits

To set a high limit, first choose the view and channel to change. Place the data entry cursor on a high limit setpoint (see "f" in Figure 4.2) using the up, down, left, and right arrow keys. Softkey 1 (The uppermost vertical softkey) should read "CHANGE HIGH LIMIT". Press this softkey to enter numeric entry mode. Enter the new limit with the numeric keypad and press the ENT key to set the limit. The high limit MUST be greater than the low limit for that channel and view but less than 125% of channel rating!

Section 4.2.2.2 Setting Low Limits

To set a low limit, first choose the view and channel to change. Place the data entry cursor on a low limit setpoint (see "c" in Figure 4.2) using the up, down, left, and right arrow keys. Softkey 1 (The uppermost vertical softkey) should read "CHANGE LOW LIMIT". Press this softkey to enter numeric entry mode. Enter the new limit with the numeric keypad and press the ENT key to set the limit. The low limit MUST be less than the high limit for that channel and view! Note that setting this value to zero effectively disables it.

Section 4.2.2.3 Setting Reverse Limits

To set a reverse limit, first set the view to "peak reverse" as shown in Figure 4.4. Place the data entry cursor on a reverse limit setpoint (see "n" in Figure 4.4) using the up, down, left, and right arrow keys. Softkey 1 (The uppermost vertical softkey) should read "CHANGE REV LIMIT". Press this softkey to enter numeric entry mode. Enter the new limit with the numeric keypad and press the ENT key to set the limit.

Section 4.2.2.4 Automatically Setting Limits

The AUTO-SETUP softkey initiates an automatic calculation of the present tonnage limits. Like manually setting limits, this is a restricted function. The operator must have access via RUN/PROG Key or access code depending on how the system has been configured (See Section 2 for access configuration details). When this key is pressed, a box will appear which allows the operator to enter a Percent Tolerance (percent of machine rating of each channel) which is applied to the peak tonnage recorded during the automatic setup process. A tolerance from 1 to 30 percent of the channel rating is added to the highest tonnage recorded in the sixteen (16) successive strokes made in the auto setup mode in order to calculate the High Limit. The tolerance is subtracted from the lowest peak tonnage recorded during the procedure in order to calculate the Low Limit. The tolerance is subtracted from the most negative peak tonnage recorded in order to calculate the Reverse Limit.

To begin the automatic setup procedure the operator must remain in the tonnage monitor screen, switch the RUN/PROG keyed selector switch to the RUN position, and make sixteen strokes in order to allow the tonnage monitor to measure the typical variation of the process. The actual tonnages and number of strokes remaining are automatically updated each stroke. A maximum of 60 seconds is allowed between strokes or the setup procedure will automatically abort and leave the present limits unchanged. After the last stroke, the tonnage monitor module will automatically exit the setup mode and calculate the tonnage limits. Normal operation will continue with the new limits. Low limits and reverse limits are updated even if turned OFF. Data window limits are not updated if the data window is turned OFF. The automatic setup procedure can be aborted at any time before the sixteenth stroke by pressing the EXIT softkey. The previously entered limits will then remain in effect.

Warning!	While in AUTO SETUP mode, the tonnage monitor module will ignore any high, low, or reverse alarm. Only machine rating alarms are active. For progressive dies, material must complete its progression through all stations before beginning Auto Setup.

Section 4.2.2.5 Turning Low Limits ON or OFF

Pressing the LOW LIMITS ON/OFF softkey will toggle all low limits (including those in all data windows) ON or OFF. This key is only available when viewing forward tonnage (as in Figure 4.2 and Figure 4.3). Like changing setpoints, this is a restricted operation. The operator must have access to this operation via RUN/PROG Key or access code depending on how the system has been configured (See Section 2 for access configuration details). When low limits are turned off, "Low Lims OFF" will be displayed with a yellow background just below the tonnage reading on each channel. Note that Individual low limits can be effectively turned OFF by setting the limit to zero.

Section 4.2.2.6 Turning Reverse Limits ON or OFF

Pressing the REV LIMITS ON/OFF softkey will toggle all reverse limits ON or OFF. This key is only available when viewing reverse tonnages (as in Figure 4.4). Like changing setpoints, this is a restricted operation. The operator must have access to this operation via RUN/PROG Key or access code depending on how the system has been configured (See Section 2 for access configuration details). When reverse limits are turned off, "Rev Lims OFF" will be displayed with a yellow background just below the tonnage reading on each channel. Note that individual reverse limits can be effectively turned OFF by setting the limit to a large negative number (up to 100% of channel rating).

Section 4.2.3 Setting Additional Data Window Parameters

In addition to high and low setpoints, data windows have three other parameters associated with them.

Section 4.2.3.1 Turning Data Windows ON or OFF

Each data window can individually be turned ON or OFF. When OFF, the limits associated with the data window are NOT enforced. To set the data window ON/OFF state, change the view to the data window desired. The screen should look something like Figure 4.3. Place the data entry cursor on the ON/OFF parameter in the View box as pointed to by "k" in Figure 4.3. Softkey 1 (The uppermost vertical softkey) should read "DATA WIN ON/OFF". This softkey toggle the data window setting between ON and OFF when pressed.

Section 4.2.3.2 Setting the Data Window "Start Angle"

The "Start Angle" for data window is the crankshaft angle at which the setpoints associated with the window start to be enforced. To change the start angle, change the view to the data window desired. The screen should look something like Figure 4.3. Place the data entry cursor on the "Start Ang" parameter ("l" in Figure 4.3). Softkey 1 (The uppermost vertical softkey) should read "CHANGE START ANGLE". Press this softkey to enter numeric entry mode. Enter the new value with the numeric keypad and press the ENT key to set the angle. The start angles can be entered with a resolution of .5 degrees and MUST be less than the end angle for that data window!

Section 4.2.3.3 Setting the Data Window "End Angle"

The "End Angle" for data window is the crankshaft angle at which the setpoints associated with the

window start to be enforced. To change the end angle, change the view to the data window desired. The screen should look something like Figure 4.3. Place the data entry cursor on the "End Ang" parameter ("m" in Figure 4.3). Softkey 1 (The uppermost vertical softkey) should read "CHANGE END ANGLE". Press this softkey to enter numeric entry mode. Enter the new value with the numeric keypad and press the ENT key to set the angle. The end angle can be entered with a resolution of .5 degrees and MUST be greater than the start angle for that data window!

Section 4.2.4 Bypassing the Tonnage Monitor

The BYPASS ON/OFF softkey toggles the tonnage monitor bypass state between ON and OFF. Like changing setpoints, this is a restricted operation. The operator must have access to this operation via RUN/PROG Key or access code depending on how the system has been configured (See Section 2 for access configuration details). When bypassed, all tonnage monitor limits are ignored with the exception of machine rating alarms. In addition, the tonnage monitor status will say "Bypassed" with a yellow background and "Bypassed" will be displayed with a yellow background just below the tonnage reading on each channel. The module will always power up with Bypass turned OFF.

Section 4.2.5 The GRAPH OPERATIONS Softkey

This softkey, which appears only when the tonnage monitor has a valid waveform to display, will display the tonnage monitor graph screen (See Section 4.5 for details on this screen).

Section 4.2.6 The SLIDE ADJUST Softkey

This softkey will display the slide adjust screen, if an Auto-Adjust module with slide adjust capability is installed.

Section 4.2.7 The MOTOR SPEED Softkey

This softkey will display the motor adjust screen.

Section 4.2.8 The CONFIGURE TON MON Softkey

This softkey will display the tonnage monitor configuration menu. Note that it is only present when the RUN/PROG key switch is in the PROG position. In addition, the system configuration code is required to gain access to these screens. See Section 5 for configuration details.

Section 4.3 Tonnage Alarms/Stop Conditions

The Main Tonnage Monitor screen provides a status indication for each channel. This message indicates any tonnage alarm or error condition that has occurred and under normal operating conditions should show "Status: OK". If a tonnage alarm occurs, the message will change to reflect the FIRST alarm detected on that channel during the stroke.

Section 4.3.1 Low Alarm

One of the messages listed below in the Channel Status indicates that the maximum tonnage recorded during the last stroke did not reach the Low Limit setting.

"Low Pk Alarm " Tonnage did not reach the Low Limit set in Peak Tonnage.
"Low Dw1 Alarm" Tonnage did not reach the Low Limit set in Data Window #1.
"Low Dw2 Alarm" Tonnage did not reach the Low Limit set in Data Window #2.
"Low Dw3 Alarm" Tonnage did not reach the Low Limit set in Data Window #3.
"Low Dw4 Alarm" Tonnage did not reach the Low Limit set in Data Window #4.

This limit is not checked and the message will not appear until the press reaches the end of the working portion of the stroke. When the condition is detected on any channel, a Top Stop is provided to the press control. This stop signal remains in effect and further stroking prevented until the alarm is reset by pressing the RESET ERROR softkey.

The Module Status in the bottom of the Main Tonnage Monitor screen will indicate "Tonnage Alarm".

The Present Running Status in the Press Control screen will indicate "Tonnage Top Stop".

Section 4.3.2 High Peak Alarm

A Channel Status message "High Pk Alarm" indicates that the maximum tonnage recorded during the last stroke exceeded the High Limit setting in Peak Tonnage.

If the tonnage monitor has been configured to generate Top Stops for High Peak alarms, this limit is not checked and the message will not appear until the press reaches the end of the working portion of the stroke. When the condition is detected on any channel, a Top Stop is provided to the press control. This stop signal remains in effect and further stroking prevented until the alarm is reset by pressing the RESET ERROR softkey.

If the tonnage monitor has been configured to generate Cycle Stops for High Peak alarms, this condition causes an immediate stop signal to be provided to the press control. This stop signal remains in effect and further stroking prevented until the alarm is reset by pressing the RESET ERROR softkey.

If the tonnage monitor has been configured to generate a Cycle Stop and Turn Off Hydraulic Overload outputs for a High Peak alarm, the press control will stop immediately and turn off its' hydraulic pump and cylinder outputs. Further stroking is prevented until the alarm is reset in the tonnage monitor and the press is Inched to the top of the stroke. Normal stroking is allowed only after the hydraulic overload is pumped back up.

The Module Status in the bottom of the Main Tonnage Monitor screen will indicate "Tonnage Alarm".

The Present Running Status in the Press Control screen will indicate "Tonnage Top Stop" or "Tonnage Cycle Stop".

Section 4.3.3 High Data Window Alarm

One of the messages listed below in the Channel Status indicates that the maximum tonnage recorded during the last stroke exceeded the High Limit setting in one of the data windows.

"High Dw1 Alarm" Tonnage exceeded the High Limit set in Data Window #1.
"High Dw2 Alarm" Tonnage exceeded the High Limit set in Data Window #2.
"High Dw3 Alarm" Tonnage exceeded the High Limit set in Data Window #3.
"High Dw4 Alarm" Tonnage exceeded the High Limit set in Data Window #4.

If the tonnage monitor has been configured to generate Top Stops for High Data Window alarms, this limit is not checked and the message will not appear until the press reaches the end of the working portion of the stroke. When the condition is detected on any channel, a Top Stop is provided to the press control. This stop signal remains in effect and further stroking prevented until the alarm is reset by pressing the RESET ERROR softkey.

If the tonnage monitor has been configured to generate Cycle Stops for High Data Window alarms, this condition causes an immediate stop signal to be provided to the press control. This stop signal remains in effect and further stroking prevented until the alarm is reset by pressing the RESET ERROR softkey.

The Module Status in the bottom of the Main Tonnage Monitor screen will indicate "Tonnage Alarm".

The Present Running Status in the Press Control screen will indicate "Tonnage Top Stop" or "Tonnage Cycle Stop".

Section 4.3.4 Reverse Alarm

A Channel Status message "Reverse Alarm" indicates that the maximum reverse tonnage recorded during the last stroke exceeded the Reverse Limit setting in Peak Tonnage. This limit is not checked and the message will not appear until the press reaches the end of the working portion of the stroke. When the condition is detected on any channel, a Top Stop is provided to the press control. This stop signal remains in effect and further stroking prevented until the alarm is reset by pressing the RESET ERROR softkey.

The Module Status in the bottom of the Main Tonnage Monitor screen will indicate "Tonnage Alarm".

The Present Running Status in the Press Control screen will indicate "Tonnage Top Stop".

Section 4.3.5 Machine Rating Alarm

A Channel Status message "Machine Rating" indicates that the maximum forward tonnage recorded during the last stroke exceeded 125 % of channel rating. When the condition is detected on any channel, a Cycle Stop is provided to the press control. This stop signal remains in effect and further stroking prevented until the alarm is RESET.

The Module Status in the bottom of the Main Tonnage Monitor screen will indicate "Tonnage Alarm".

The Present Running Status in the Press Control screen will indicate "Tonnage Cycle Stop".

Section 4.3.6 TOTAL Alarm/Stop Condition

This alarm condition indicates that the maximum TOTAL tonnage exceeded the capacity of the machine at the height in the stroke at which it occurred. It is the only limit applied to the total tonnage and may or may not coincide with any channel alarm. When the condition is detected on the total tonnage, a Cycle Stop is provided to the press control. This stop signal remains in effect and further stroking prevented until the alarm is reset by pressing the RESET ERROR softkey.

This alarm will only occur if the tonnage monitor is configured to derate the total tonnage capacity. The machine rating is specified by the press manufacturer at a specific height off the bottom of the stroke (for example .25 inches). Above this height the total tonnage available is limited by the torque of the crankshaft and will decrease as the height off the bottom at which the tonnage occurs increases (see section 5.2 for how this derate curve is programmed).

The Module Status in the bottom of the Main Tonnage Monitor screen will indicate "TOTAL Alarm".

The Present Running Status in the Press Control screen will indicate "Tonnage Cycle Stop".

Section 4.4 Error Conditions

Section 4.4.1 Setpoint Errors

When power is applied to the OmniLink 5000 or when a limit has changed and the RUN/PROG keyed selector switch is in the RUN position, the tonnage monitor module performs a series of calculations based on the present limit settings. If an invalid condition is found to exist either due to an incorrect setting or an internal fault, an error message is generated in the Module Status and a Top Stop provided to the press control. If the error is due to an incorrect setting, the condition can only be cleared correcting the improper limit and pressing the RESET ERROR softkey. The following is a list of setpoint errors and possible causes:

"Peak Set. Error" This indicates a limit in Peak Tonnage is invalid. It could occur if a low limit is greater than or equal to a high limit, a high limit is greater than 125% of channel rating, or a reverse limit is greater than or equal to -100% of channel rating. This typically would occur only if the tonnage monitor machine rating were changed to a lower value that made prior limits invalid. This could also indicate an internal fault in the nonvolatile memory on the tonnage monitor board.

"Peak Deg. Error" This indicates either the start sample window angle is not between 45 and 120 degrees or the end sample window angle is not between 220 and 250 degrees. This could indicate an internal fault in the nonvolatile memory on the tonnage monitor board.

"Mach.Rate Error" This indicates that the machine rating is not between 000.1 and 999.9 (0001-9999 without decimal point) and should only occur if there is an internal fault.

"Dw # Set. Error" This indicates an incorrect setting in the data window specified. It would occur if the data window On Angle is set greater than or equal to the Off Angle. It could also occur if the machine rating were changed to a lower value making low or high limits invalid. If all settings are correct this indicates an internal fault.

Section 4.4.2 Channel Errors

The following errors could indicate a field wiring problem, failure of a strain gauge, or an internal fault in the tonnage monitor module.

"Channel Error" Tonnage monitor can not zero the strain gauge on any channel with the status "Zero Error". Swap the strain gauge in question with a working channel and press the RESET ERROR softkey. If the "Zero Error" message moves to the other channel the problem is in the strain gauge or its external wiring. The tonnage monitor attempts to zero for 10 seconds before generating the error. If the error remains on the same channel the problem is on the tonnage monitor module.

"Vref Shorted" The 10.00v reference voltage for the strain gauges is below an acceptable threshold. When this occurs the tonnage monitor will "kill" the Vref in order to reduce power dissipation. Remove all strain gauge connections on the tonnage

monitor and press the RESET ERROR softkey. If the error message does not return, connect the strain gauges one at a time to determine which gauge causes the shorted condition or verify that the resistance of each gauge (Vref to Gnd) is approximately 350 ohms. If the problem remains, it indicates a failure on the tonnage monitor analog board.

Section 4.4.3 Resetting Errors

If an alarm or error condition is detected, a stop signal is provided to the press control and a RESET ERROR softkey provided in the Main Tonnage Monitor screen. If configured to lock out access to resetting errors, this softkey will appear only with the RUN/PROG keyed selector switch in the PROG position. In addition, if access codes have been enabled (see Section 2 for details), the operator will also require an access code to reset the tonnage monitor.

Section 4.5 The Tonnage Monitor Graph Screen

The GRAPH OPERATIONS softkey in the main tonnage monitor screen provides the operator or die setter more detailed analysis of machine forces by displaying tonnage versus crankshaft angle curves. The screen in Figure 4.5 shows an example screen when viewing peak tonnage information. Figure 4.6 shows the same example graph when viewing data window 2 information.

Notice that the shaded softkeys in these figures change depending on the circumstances. The top softkey, for instance, is the "editing softkey" and will change description based on what parameter the editing cursor is on. The INCREMENT and DECREMENT softkeys also change as the editing cursor moves.

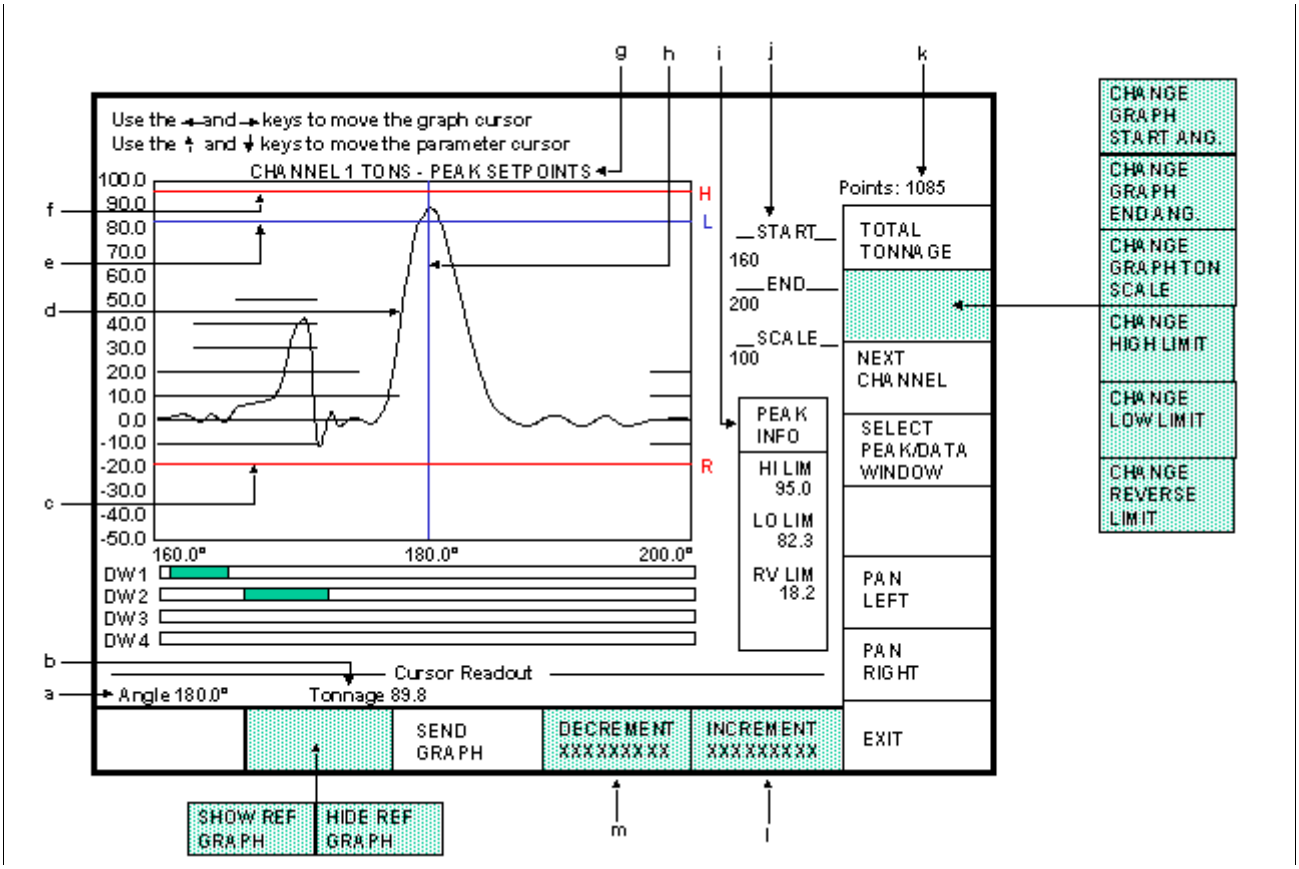

Figure 4.5: Example Tonnage Waveform With Peak Settings Selected for View

Referring to Figure 4.5, some of the items on this screen are:

a) Cursor Angle - The angle at which the vertical measuring cursor (at 180 degrees in Figure 4.5 and pointed to by "h") is sitting.

b) Cursor Tonnage - The numeric value of tonnage where the vertical measuring cursor (at 180 degrees in Figure 4.5 and pointed to by "h") crosses the tonnage waveform.

c) Reverse Limit Bar - This line (in red) graphically shows where the reverse limit is set with respect to the tonnage waveform. For a "good" hit, no part of the tonnage waveform should extend below this line. The "R" to the right of the line is for "Reverse".

d) Tonnage Waveform - This is the actual tonnage waveform collected by the tonnage monitor. The x-axis is crankshaft angle with 180 degrees being bottom dead center. The y-axis is in tons with the tonnage values given on the left side of the graph.

e) Low Limit Bar - This line (in blue) graphically shows where the low limit is set with respect to the tonnage waveform. For a "good" hit, some part of the tonnage waveform should extend above this line. The "L" to the right of the line is for "Low".

f) High Limit Bar - This line (in red) graphically shows where the high limit is set with respect to the tonnage waveform. For a "good" hit, no part of the tonnage waveform should extend above this line. The "H" to the right of the line is for "High".

g) Graph Title - The graph title indicates exactly what is being viewed. The first part of the title indicates the channel being viewed - Channel 1, Channel 2, Channel 3, Channel 4, or the Total. The second part of the title indicates which set of setpoints are being viewed - Peak, Data Window 1, Data Window 2, Data Window 3, or Data Window 4.

h) Measuring Cursor - The measuring cursor can be moved across the graph with the left and right arrow keys. The Cursor Angle (a) and Cursor Tonnage (b) are updated as the cursor moves. The cursor is extremely helpful for proper placement of data window start and end angles.

i) Information Box - The information box contains settings that apply to the current channel being viewed. Note that the information displayed also depends on whether peak or data window information is selected. The values in this box can be edited by using the up and down arrow keys to place the editing cursor (not the measuring cursor) on the parameter to change. Assuming the operator has access (via RUN/PROG key or access code), the numeric keypad can be used to key in a new value or the decrement (m) and increment (l) keys can be used to decrement or increment the value. The graph will immediately reflect the changes made. Note that by holding down the decrement and increment keys the operator can effectively "drag" the setpoint graphically to where it needs to be (especially nice for data window setup).

j) Graph Settings - These three values control the range of angles and range of tonnages that the graph displays. "START" is the graph start angle. *This*

should not be confused with the start angle of a data window. Likewise, "END" is the graph end angle. *This should not be confused with the end angle of a data window.* Note that the ending angle may not always be exactly the value entered for this parameter but is calculated by the tonnage monitor due to the way it handles the waveform. "SCALE" is the percent of channel rating (or machine rating when viewing the total) displayed on the y-axis. For instance, a 400 ton 4 channel machine will have a channel rating of 100 tons. If the graph scale is set to 100%, the maximum tonnage value shown on the graph will be 100 tons when viewing a channel, and 400 tons when viewing the total. The reverse tonnage range is always ½ of the forward range - so it would show -50 tons when viewing a channel and -200 tons when viewing the total.

k) Number of Points - The tonnage monitor module indicates the number of sample points taken during the last stroke in the upper right hand part of the screen. This number will depend upon the speed of the press, size of the working portion of the stroke, and the sample rate at which the module is configured. The graph can not be displayed if less than 240 points have been recorded. The maximum number of sample points is 4735 (4734 if sample rate is set at 200 microseconds). When the maximum number is reached (such as hitting an overload or stopping the press in the working portion of the stroke) no further samples are stored.

l) Increment Key - The text of this key changes depending on which parameter the editing cursor (not the measuring cursor) is currently on. In all cases, however, it will increment the value the editing cursor is on (assuming the operator has access via RUN/PROG key or access code). Note that an operator can effectively "drag" limits and data window angles on the graph by holding this key down.

m) Decrement Key - The text of this key changes depending on which parameter the editing cursor (not the measuring cursor) is currently on. In all cases, however, it will decrement the value the editing cursor is on (assuming the operator has access via RUN/PROG key or access code). Note that an operator can effectively "drag" limits and data window angles on the graph by holding this key down.

Figure 4.6 shows an example tonnage monitor graph screen when viewing a data window. For the most part, the screen is the same as when viewing peak tonnages.

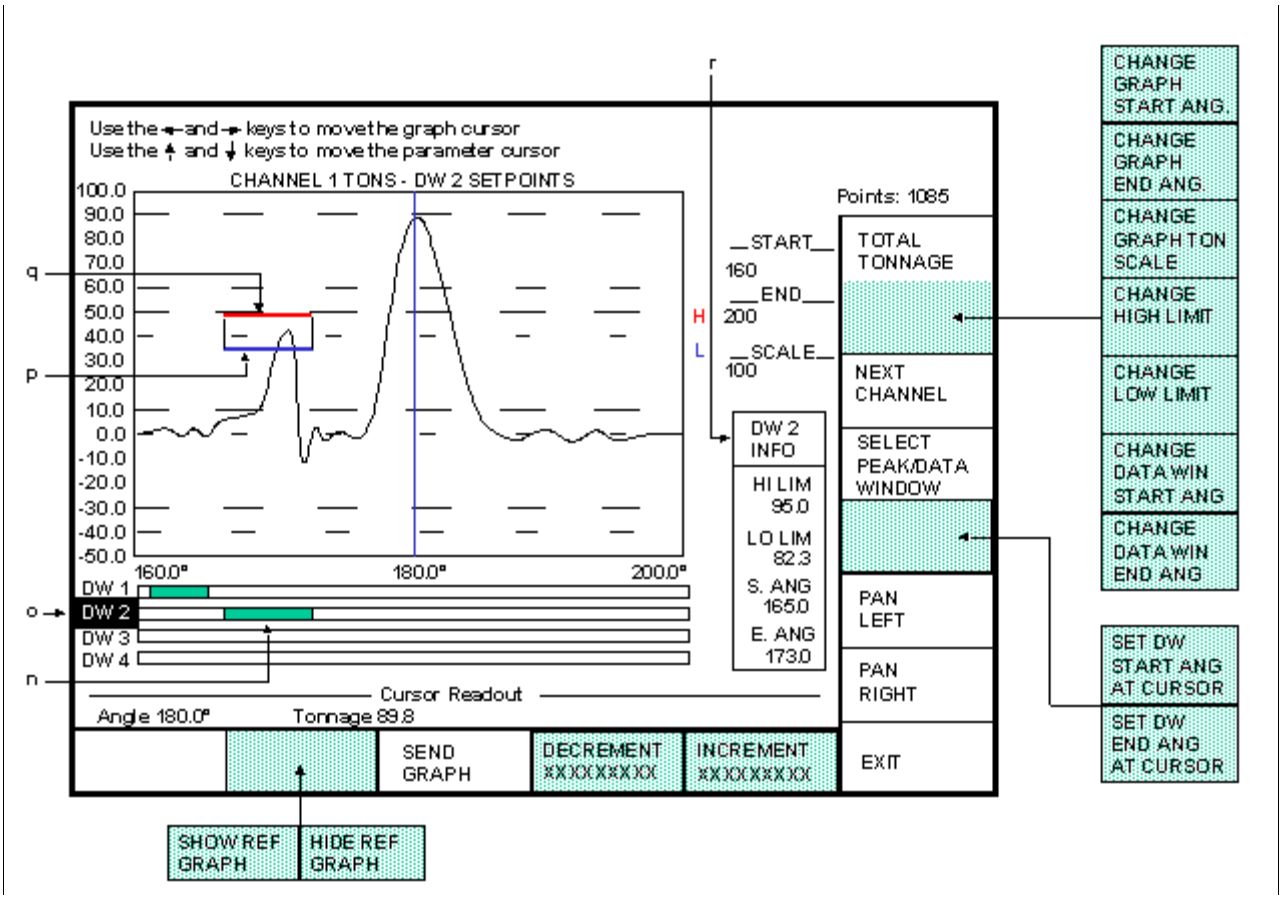

Figure 4.6: Example Tonnage Waveform With Data Window 2 Settings Selected for View

Referring to Figure 4.6, some additional or different items on data window views are:

n) Data Window Bars - The lower portion of the graph display is used to indicate the active area of the data windows. This graphically shows the position of the data window with respect to the tonnage waveform. No bar appears for Peak Tonnage since it is always active. The active area of a data window is shown as a green horizontal bar on the same line as the data window indicator ("D1", "D2", "D3", "D4" for data windows 1, 2, 3, and 4 respectively). The position of a data window appears even if the data window is turned OFF. This allows location of the window to be set before allowing the limits to cause stop signals.

o) Data Window Name - If a data windows' setpoints are selected to be shown on the graph, the name of the selected data window is highlighted in reverse video.

p) Low Limit Bar - This line (in blue) graphically shows where the low limit is set with respect to the tonnage waveform. Notice that the line only exists where the data window is active. For a "good" hit, some part of the tonnage waveform between the data window start angle and the data window end angle should extend above this line. The "L" to the right of the line is for "Low".

q) High Limit Bar - This line (in red) graphically shows where the high limit is set with respect to the tonnage waveform. Notice that the line only exists where the data window is active. For a "good" hit, no part of the tonnage waveform from the data window start angle to the data window end angle should extend above this line. The "H" to the right of the line is for "High".

r) Information Box - Notice that the reverse setpoint information is not present as it was when peak settings were viewed as data windows do not have reverse setpoints. Instead, the data window starting and ending angles are displayed.

Section 4.5.1 Viewing the Graph

The particular part of the tonnage graph to be shown is controlled through three parameters and a few softkeys.

Section 4.5.1.1 Graph Start Angle

The graph start angle (the number directly under "__START__" in Figure 4.5) specifies the crankshaft angle at which to begin displaying the tonnage waveform. *This should not be confused with the start angle of a data window.* The graph can not be set to start before the start of the working portion of the stroke (see start of the sample window in machine settings configuration screen). The graph in Figure 4.5 is set to start at 160 degrees. To change this value, place the editing cursor on the graph start angle parameter using the up and down arrow keys. Then, use the numeric keypad and press the ENT key.

Section 4.5.1.2 Graph End Angle

The graph end angle (the number directly under "__END__" in Figure 4.5) specifies the crankshaft angle at which to stop displaying the tonnage waveform. *This should not be confused with the end angle of a data window.* Note that the graph end angle may not always be exactly the value entered but is calculated by the tonnage monitor due to the way it handles the waveform. The minimum difference between the graph start and end angle is 5 degrees and the maximum is 220 degrees. The graph of Figure 4.5 has a graph end angle of 200 degrees. To change this value, place the editing cursor on the graph end angle parameter using the up and down arrow keys. Then, use the numeric keypad and press the ENT key.

Section 4.5.1.3 Graph Scale

The graph scale (the number directly under "__SCALE__" in Figure 4.5) is the percent of channel rating (or machine rating when viewing the total) displayed on the y-axis of the graph. For instance, a 400 ton 4 channel machine will have a channel rating of 100 tons. If the graph scale is set to 100%, the maximum tonnage value shown on the graph will be 100 tons when viewing a channel, and 400 tons when viewing the total. The reverse tonnage range is always ½ of the forward range so it would show -50 tons when viewing a channel and -200 tons when viewing the total. The graph scale can range from 10% to 150%. To change the graph scale, place the editing cursor on the end angle parameter using the up and down arrow keys. Then, use the numeric keypad and press the ENT key.

Section 4.5.1.4 Panning the Graph

Panning is the action of "sliding" the view window left or right on the graph. Pres the PAN LEFT softkey to move the view of the graph to the left. Likewise, press the PAN RIGHT softkey to move the view of the graph to the right. The graph will shift about 1/4 of the viewed width. This means, for example, that if 20 degrees of the waveform is being viewed, the pan keys will shift the graph about 5 degrees left or right.

Section 4.5.1.5 Selecting the Channel

The graph display will always begin with total tonnage and will alternate through the available channels with the NEXT CHANNEL softkey. The channel being displayed is indicated in the title above the graph as shown by "g" in Figure 4.5.

Section 4.5.2 Graphically Setting Values

One of the most useful features of the graph display, especially for data windows, is the ability to set limits, data window start angles, and data window end angles graphically right on the screen.

NOTE:	These parameters are restricted items and access to them is controlled by the RUN/PROG key, access code, or both as described in Section 2. In addition, these items are only allowed to be changed when the editing cursor is present. For most items, the editing cursor will NOT be available when the press is running. Also, when the access mode is "Key Only" or "Key AND Code" (see Section 2 for details), the editing cursor will only appear when the RUN/PROG key switch is in the PROG position. The following discussion assumes that access to the parameters has been obtained and that the editing cursor is present.

The information box ("i" in Figure 4.5 for peak settings and "r" in Figure 4.6 for data window settings) contains settings that apply to the current channel being viewed. Note that the information displayed also depends on whether peak or data window information is selected. Change the channel using the NEXT CHANNEL softkey and the set of parameters using the SELECT PEAK/DATA WINDOW softkey. Note that the graph title (shown as "g" in Figure 4.5 always indicates the channel and Peak/Data Window currently viewed. The values in the information box can be edited by using the up and down arrow keys to place the editing cursor (not the measuring cursor) on the parameter to change.

Assuming the operator has access (via RUN/PROG key or access code), the numeric keypad can be used to key in a new value or the decrement (m) and increment (l) keys can be used to decrement or increment the value. The graph will immediately reflect the changes made. Note that by holding down the decrement and increment keys the operator can effectively "drag" the setpoint graphically to where it needs to be. The key thing to remember is that the increment and decrement keys apply to the value the editing cursor is currently on.

An additional editing method is provided for setting the data window start and end angles. When a data window is selected and the editing cursor is on the start angle parameter in the information box, a softkey with the legend "SET DW START ANG AT CURSOR" will appear. Pressing this key will set the data window start angle where the measuring cursor ("h" in Figure 4.5), not the editing cursor, is positioned at. If the angle read out ("a" in Figure 4.5) indicates 167.0 degrees and the SET DW START ANG AT CURSOR softkey is pressed, the system will attempt to set the start angle for the currently selected data window (as shown by the highlighted data window name - see "o" in Figure 4.6) to 167.0 degrees. Note that this will fail if for some reason the angle would be invalid - such as a start angle larger than an end angle. The same procedure can be used for the data window end angle, with the softkey reading instead: "SET DW END ANG AT CURSOR". Note that data windows can overlap, but the settings for the first (lower numbered) data window will take precedence. For example, if data window 2 and data window 4 overlap, the settings for data window 2 will be used in the overlapped portion of the stroke.

Section 4.5.3 Sending the Graph

The SEND GRAPH softkey commands the tonnage monitor module to transmit all present tonnage data through the operator terminal to an internally stored reference graph for the current job, external laptop computer, or to the LinkNet networking host computer. When this softkey is pressed, a list will "pop-up" with the available sending options. Note that not all options may be available at any given time. The sections detailing each option will indicate when that particular option is available.

Section 4.5.3.1 Store As Reference

When equipped with a flash storage card, the OmniLink can store one "reference" tonnage waveform per job. This reference waveform can be overlaid with the current waveform to make a direct on-screen comparison of the two. The "Store As Reference" selection of the SEND GRAPH softkey will retrieve the tonnage waveform from the tonnage monitor, make a reference waveform from it, and store it under the current job number. The progress of these operations is shown at the top of the screen just above the tonnage graph in a special progress window. Note that this operation is a restricted operation and may require the RUN/PROG key and/or an access code depending on system configuration (see Section 2 for details). Depending on the number of channels, the number of samples taken, and the way in which that particular tonnage signature compresses the transmission time can vary from a few seconds to thirty or forty seconds. After success or failure is reported, press any key to resume normal operation of the screen.

Section 4.5.3.2 Send To Laptop

This option is only available if the laptop interface has been set up in auxiliary communications. In addition, a computer with the Link Graphical Tonnage Analyzer must be connected to the laptop port for

this operation to succeed. When the "Send To Laptop" option of the SEND GRAPH softkey is selected, the OmniLink will retrieve the tonnage waveform from the tonnage monitor and transfer it to the laptop. The progress of the operations is shown at the top of the screen just above the tonnage graph in a special progress window. Depending on the number of channels, the number of samples taken, and the way in which that particular tonnage signature compresses the transmission time can vary from a few seconds to thirty or forty seconds. After success or failure is reported, press any key to resume normal operation of the screen.

Section 4.5.3.3 Send To Network

This option is only available if the LinkNet interface has been set up in auxiliary communications and the network is "online". When the "Send To Network" option of the SEND GRAPH softkey is selected, the OmniLink will retrieve the tonnage waveform from the tonnage monitor and transfer it to the network host computer. This will result in the tonnage waveform being shown in a window on the LinkNet host computer. The waveform can then be printed, archived, or deleted as desired. The progress of the operations is shown at the top of the screen just above the tonnage graph in a special progress window. Depending on the number of channels, the number of samples taken, and the way in which that particular tonnage signature compresses the transmission time can vary from a few seconds to thirty or forty seconds. After success or failure is reported, press any key to resume normal operation of the screen.

Section 4.5.3.4 Archive To Network

This option is only available if the LinkNet interface has been set up in auxiliary communications and the network is "online". When the "Archive To Network" option of the SEND GRAPH softkey is selected, the OmniLink will retrieve the tonnage waveform from the tonnage monitor and transfer it to the network host computer. This will result in the tonnage waveform being automatically archived into the waveform database on the LinkNet host computer. The progress of the operations is shown at the top of the screen just above the tonnage graph in a special progress window. Depending on the number of channels, the number of samples taken, and the way in which that particular tonnage signature compresses the transmission time can vary from a few seconds to thirty or forty seconds. After success or failure is reported, press any key to resume normal operation of the screen. Note that this operation is a restricted operation and may require the RUN/PROG key and/or an access code depending on system configuration (see Section 2 for details).

Section 4.5.3.5 Print To Network

This option is only available if the LinkNet interface has been set up in auxiliary communications and the network is "online". When the "Print To Network" option of the SEND GRAPH softkey is selected, the OmniLink will retrieve the tonnage waveform from the tonnage monitor and transfer it to the network host computer. This will result in the tonnage waveform being automatically printed at the configured printer from the LinkNet host computer. The progress of the operations is shown at the top of the screen just above the tonnage graph in a special progress window. Depending on the number of channels, the number of samples taken, and the way in which that particular tonnage signature compresses the transmission time can vary from a few seconds to thirty or forty seconds. After success or failure is reported, press any key to resume normal operation of the screen. Note that this operation is

a restricted operation and may require the RUN/PROG key and/or an access code depending on system configuration (see Section 2 for details).

Section 4.5.4 Reference Waveforms

For each job, one reference waveform may be stored. This will typically be a "known good" waveform representative of a setup that is producing good parts. If a problem, or suspected problem, later comes up with the job, the reference waveform can be "overlaid" with the current waveform to check for important differences. See section 4.5.3.1 for how to store a reference waveform.

To display a reference waveform, press the "SHOW REF GRAPH" softkey (as seen in Figure 4.6). Note that this softkey will only be displayed if a reference waveform has been previously stored for the current job. The reference waveform will show in green, overlaid with the current waveform which will still be in black. Once the reference waveform is displayed, the "SHOW REF GRAPH" key changes to "HIDE REF GRAPH". Pressing this key will, of course, remove the reference waveform from the screen leaving only the current waveform.

Section 5 Configuration

The configuration menus of the tonnage monitor module are accessed by selecting the CONFIGURE TON MON softkey in the Main Tonnage Monitor Screen with the RUN/PROG keyed selector switch in the PROG position. The operator terminal will request entry of the configuration access code and upon correct entry will provide the configuration menu shown in Figure 5.1.

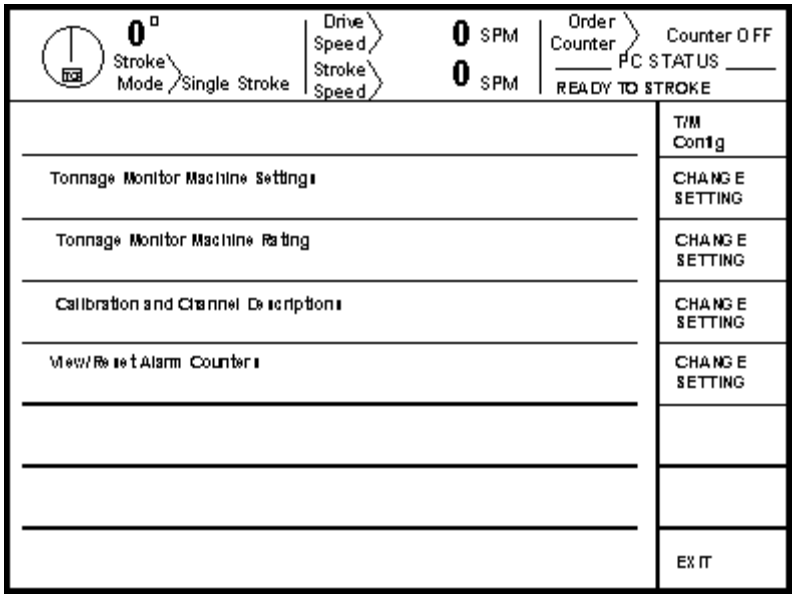

Figure 5.1: Tonnage Monitor Main Configuration Screen

Section 5.1 Tonnage Monitor Machine Settings

This selection displays the screen shown in Figure 5.2. Changes are made with the RUN/PROG keyed selector switch in the PROG position by positioning the cursor onto the desired parameter with the Up and Down arrow keys, using the numeric keypad to set a new value, and pressing the ENT key.

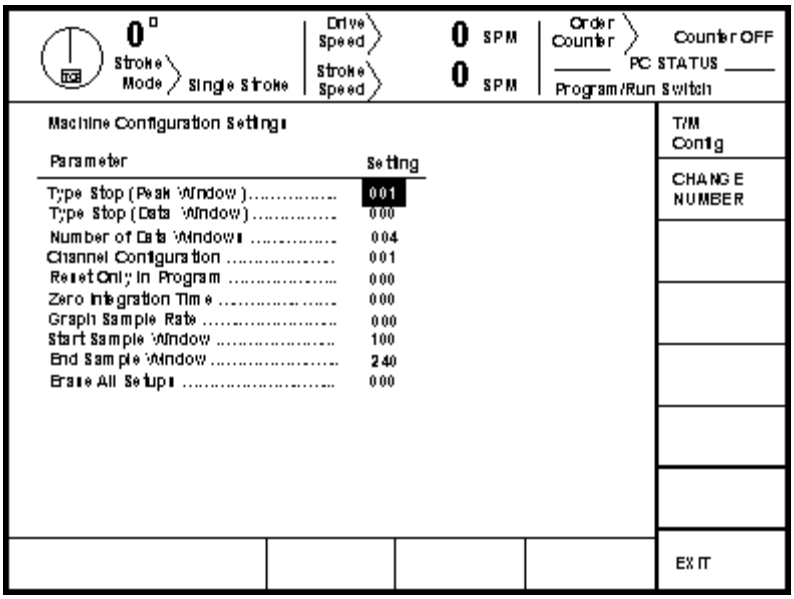

Figure 5.2: Machine Settings Configuration Screen

Section 5.1.1 High Peak Alarm Stop

This parameter defines the type of stop signal sent to the press control when a High Alarm occurs in the working portion of the stroke (View: Peak Tonnage). The following settings are allowed:

Setting=000 This programs the tonnage monitor module to send a Top Stop signal to the press control.

Setting=001 This programs the tonnage monitor module to send a Cycle (immediate) Stop signal to the press control.

Setting=002 This programs the tonnage monitor module to send an Hydraulic Overload signal to the press control. This will cause the press control to Cycle Stop and turn OFF both Output Relay 2 (OR 2) and Output Relay 3 (OR 3). This will take place only if the press control has been configured by the factory to allow a hydraulic overload system (see OmniLink 5000 press control manual). This feature provides benefit only if the outputs (OR 2/3) control a mechanism that releases the hydraulic fluid in the overload system quickly.

Section 5.1.2 High Data Window Alarm Stop

This parameter defines the type of stop signal sent to the press control when a High Alarm occurs in any data window (View: Data Window 1-4). The following settings are allowed:

Setting=000 This programs the tonnage monitor module to send a Top Stop signal to the press control.

Setting=001 This programs the tonnage monitor module to send a Cycle (immediate) Stop signal to the press control.

Section 5.1.3 Number of Data Windows

This parameter defines the maximum number of data windows that the tonnage monitor module will allow. In situations where less than four data windows will ever be used on a machine, this setting will keep the CHANGE VIEW softkey from alternating through un-used windows. This does not affect the number of data windows that can be turned OFF individually for a specific job.

The entry can be:

Setting=000 No Data Windows Allowed
Setting=001 1 Data Window
Setting=002 2 Data Windows
Setting=003 3 Data Windows
Setting=004 4 Data Windows

Section 5.1.4 Channel Configuration

The OmniLink 5000 tonnage monitor module contains strain gauge connections for four (4) channels. This parameter defines the number of channels that will be monitored by the module and should be set only when the module is first installed in the control. If this setting is changed from the way it was shipped from the factory, the OmniLink 5000 power must be turned OFF and back ON. The channel configuration is examined only at power up.

The entry can be:

Setting=000 2 channel
Setting=001 4 channel

Section 5.1.4 Reset Only in Program

This parameter allows the RESET ERROR softkey to become active only with the RUN/PROG keyed selector switch in the PROG position and can be used to restrict access to resetting tonnage alarms.

The entry can be:

Setting=000 Reset allowed without RUN/PROG key
Setting=001 Reset Only with RUN/PROG key

Section 5.1.5 Zero Integration Time

Temperature changes cause expansion or contraction of machine structural members and induce strains which can be detected by the tonnage monitor strain gauges mounted to the machine frame. In addition, strain gauges are manufactured with an inherent zero imbalance which can change if the gauge experiences any long term creep. Slowly varying signals such as these are compensated by measuring the strain gauge signals while the machine frame is not exposed to any force and integrating the offset to zero. This is performed by the tonnage monitor module automatically when the press is at the top of the stroke. The "zero" portion of the stroke begins at 270 degrees in the up portion of the stroke and ends when the start of the sample window begins (see section 5.1.7). This parameter defines the rate at which the offset is integrated to zero and is typically set at 000 (.4 second integration time).

The entry can be:

Setting=000 0.4 second integration time
Setting=001 0.8 second integration time
Setting=002 1.2 second integration time
Setting=003 1.6 second integration time

Section 5.1.6 Graph Sample Rate

The tonnage monitor module acquires samples on a timed basis and "tags" each sample with the crankshaft angle at which it occurred in order to display the tonnage vs. crankshaft angle curve. This parameter defines the rate at which tonnage samples are stored for use in displaying this tonnage curve.

It has no effect on the determination of peak tonnage (sampled at 200 microseconds). Machines with speeds greater than about 20 strokes per minutes should be set to store at 200 microseconds. However, slower presses that begin the working portion of the stroke (Start of Sample Window) high in the downstroke may reach the maximum number of samples that can be stored (4735) before the end of the stroke is reached (End of Sample Window). This would result in not being able to examine the tonnage curve beyond the point where the storage area filled up. In this situation the storage rate should be set to 400 microseconds.

The entry can be:

Setting=000 Store sample point every 200 microseconds
Setting=001 Store sample point every 400 microseconds

Section 5.1.7 Start Sample Window Angle

This angle defines the point in the downstroke where the tonnage monitor module stops integrating machine offsets and starts taking samples. After it is reached each sample is examined in order to capture the peak tonnage for comparison with the limits in effect. The determination of peak tonnage continues until the end of the working portion of the stroke (End Sample Window). Since this angle defines the start of the working portion of the stroke, it must be set prior to the angle that tooling forces begin. The angle can be set from 45 degrees to 120 degrees.

Section 5.1.8 End Sample Window Angle

This angle defines the point in the up portion of the stroke where the tonnage monitor stops sampling the peak tonnage. At this point all limits that create top stops are examined and a stop signal sent to the press control if any alarm detected. Alarm counters are also updated at this time, along with saving the last machine offset. Since this angle defines the end of the working portion of the stroke it must be set beyond the angle where tooling forces end. The angle can be set from 220 degrees to 250 degrees.

Section 5.1.9 Erase All Setups

The tonnage monitor module stores limits for job setups in a nonvolatile memory. If a module is ever moved to another machine, the limits that exist are no longer applicable. This function will erase all job setups. It requires an additional access code to initiate (see section 10).

Section 5.2 Machine Rating

This selection displays the screen shown in Figure 5.3. Changes are made with the RUN/PROG keyed selector switch in the PROG position by positioning the cursor onto the desired parameter with the arrow keys, using the numeric keypad to set a new value, and pressing the ENT key or through the softkeys provided.

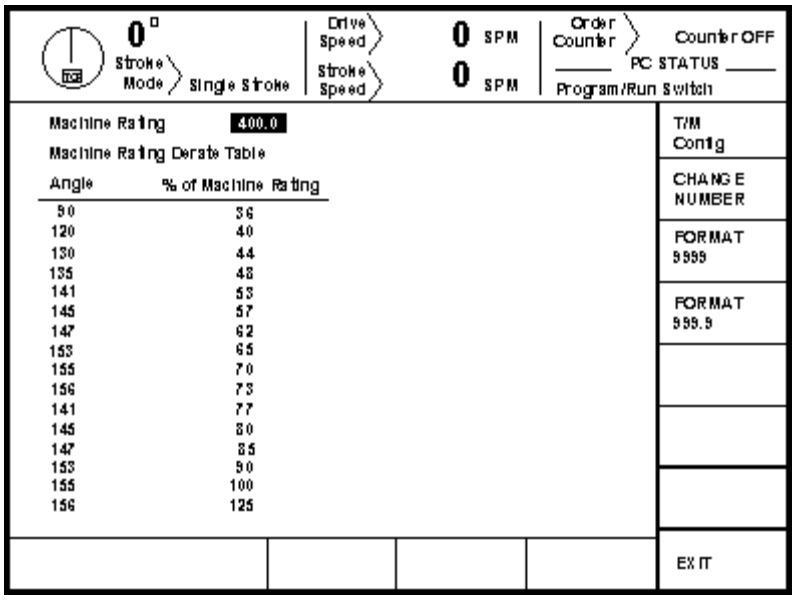

Figure 5.3: Machine Rating Configuration Screen

The Machine Rating is the total capacity of the machine frame as defined by the press manufacturer and is typically specified at some position off the bottom of the stroke. The tonnage monitor will use this parameter along with the number of channels to determine the rating of each channel. The scale factors calculated are used to translate strain gauge outputs into tonnage values. This value should be set at the time that the tonnage monitor module is installed and not changed afterward.

Section 5.2.1 Decimal Point

The tonnage monitor module can measure and display tonnages 150% greater than the machine rating. A machine rating greater than about 660 tons could not show the entire measurable range with a display format of 999.9. For machine capacities greater than this, the tonnage monitor module should be formatted to display without the decimal point (9999). The format (decimal point position) is selected by pressing the desired softkey.

Section 5.2.2 Derate Total Tonnage

A mechanical power press is typically specified by its manufacturer with a tonnage capacity rating and a height off of the bottom of the stroke at which this rating applies. One reason for this is that an mechanical advantage is created in the translation of rotary motion of the crankshaft to linear motion of the slide that changes depending upon crankshaft angle. The constant torque of the clutch develops more downward force as the crankshaft angle travels from 90 degrees (mid stroke) to 180 degrees (bottom).

If torque were the only limiting factor, the press could deliver infinite tonnage at the bottom of the stroke. However, the elastic limits of the press frame place an additional limitation near the bottom. Below the point where the machine is rated, an absolute maximum limit of 125% of rated capacity is placed on each strain gauge mounted to the machine frame in order to stop the machine before permanent damage is done to the structural members. This limit is automatically set based on the machine rating and the number of channels.

Above the point where the press is rated, an additional limit can be set so that the torque available from the clutch is not exceeded. This torque is delivered to the entire machine frame and is measured by examining only the total tonnage (combined tonnage on all frame members). Since the limit is placed on the tonnage (and not directly measuring torque), it must decrease as crankshaft angle moves from 180 to 90 degrees (derates the machine rating). Tonnage curves are available from the press manufacturer that describe the amount of total tonnage that can be developed at different points in the stroke.

If desired, the total tonnage can be derated by examining the press manufacturers' tonnage rating curve for a particular type machine and entering this information into the tonnage monitor. The entry process requires that the machine curve be divided into 16 discrete regions with a single tonnage limit that applies for each region. Height off the bottom of the stroke must be converted to crankshaft angle in order to position each region. Figure 5.4 shows the tonnage curve for a 12 inch stroke press with a 30 inch connecting rod. Rated tonnage is specified at .25 inch off bottom. In the example, the limits are placed approximately 10% beyond the rating.

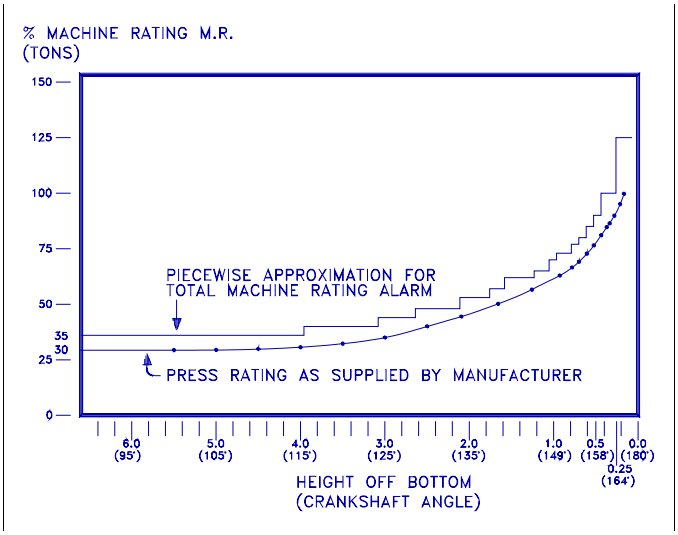

Figure 5.4: Capacity vs. Position

Figure 5.3 shows the table of 16 angle regions and % of machine rating for that angle region approximated from the curve. The screen shows that a Total Alarm will occur if tonnage exceeds 36% of machine rating from 90 degrees to 119 degrees, 40% from 120 to 129 degrees, etc.. This feature is not required and may be bypassed by entering 125% for all tonnage limits.

Section 5.3 Calibration Screens

Section 5.3.1 Dynamic Calibration

This selection displays the screen shown in Figure 5.5. Changes are made to the tonnage monitor calibration numbers (gain) with the RUN/PROG keyed selector switch in the PROG position by positioning the editing cursor onto the desired calibration number with the up, down, left, and right arrow keys as necessary. Softkey 1 (the uppermost vertical softkey) will change to read "CHANGE CAL NUM". Press this key and use the numeric keypad to enter a new value. Press the ENT key to accept and set the value. The press can be operated with the selector switch in the RUN position and will update the actual peak tonnage measured each stroke.

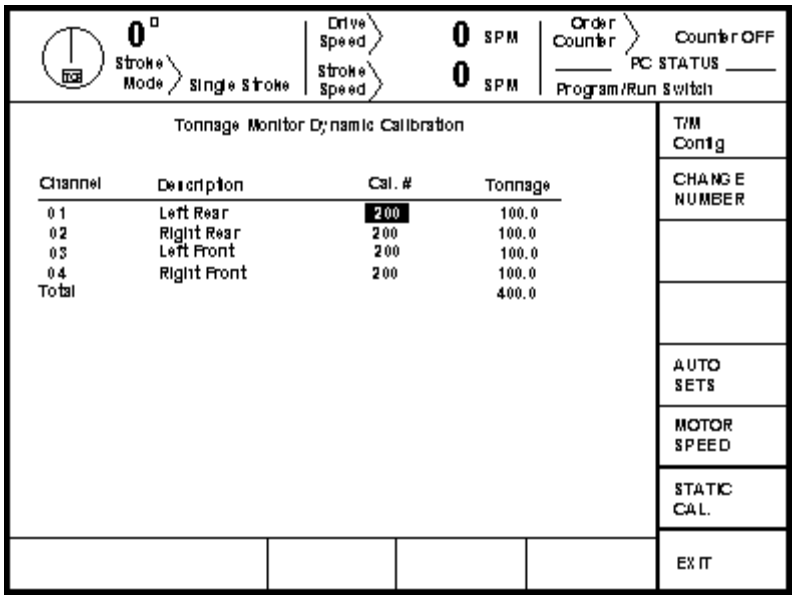

Figure 5.5: Calibration Screen

Section 5.3.2 Static Calibration

The STATIC CAL. softkey causes the tonnage monitor to enter Static Calibration mode. With the RUN/PROG keyed selector switch in the RUN position, it will initially zero any force present on the strain gauges. After any offset force has been integrated to zero, it will hold that offset value and begin displaying the present force (tonnage) applied to the strain gauges (this force can indicate either positive or negative). The channels can be re-zeroed by selecting DYNAMIC CAL. and the selecting STATIC CAL. to re-enter the mode. While in this configuration screen, a cycle stop is generated in order to keep the press from being operated. Calibration numbers (gain) are entered through the keyboard as described above.

Section 5.3.3 Channel Descriptions

The channel descriptions can be changed in the screen of Figure 5.5. Changes are made with the RUN/PROG keyed selector switch in the PROG position by positioning the cursor onto the desired channel description with the up, down, left, and right arrow keys as necessary. When the editing cursor is on a description, softkey 1 (the uppermost vertical softkey) will read "CHANGE DESC". Hit this

softkey and use the alphanumeric selection method described in section 2 to enter a new description.

Section 5.4 Reset Alarm Counters

This selection displays the screen shown in Figure 5.6. Counters are reset with the softkeys shown.

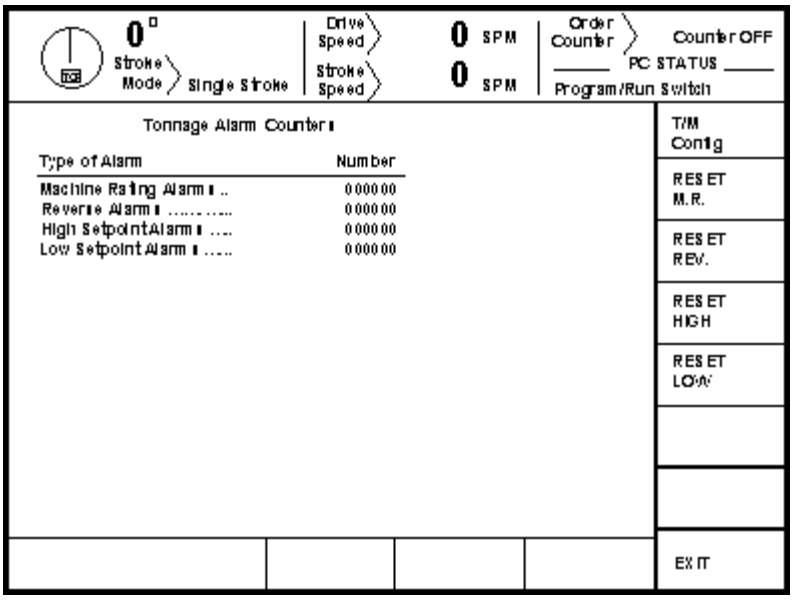

Figure 5.6: Alarm Counters Screen

Section 6 Job Setups

In the OmniLink 5000, all pertinent information for the current job such as programmable limit switch setpoints and automatic feed settings can be stored for later use as a block of information called a "job setup". Since this programmed data may change from job to job or as machine dies are changed, saving a job setup prevents the operator from having to manually change all this information when dies are changed. The operator can simply recall the appropriate job setup which he previously stored and the press is ready to run. The OmniLink 5000 has memory capability for storing 500 job setups. Information on storing, recalling, or erasing job setups is in the OmniLink 5000 manual.

The Tonnage Monitor Module will also store or recall all its pertinent data when the operator stores or recalls a job setup. This includes all programmed information such as, the low limits, high limits, reverse limits, data window states (ON/OFF), data window angles, and reference waveforms. The operator need not perform any additional or separate operations to store or recall tonnage monitor information; simply follow the standard procedure for job setups listed in the OmniLink 5000 manual and the setup change is done automatically in the Tonnage Monitor Module.

If a tonnage monitor module is installed after an OmniLink 5000 has been in operation and job setups have been stored in the press control, the jobs will not exist in the tonnage monitor module. If a job is recalled, the tonnage monitor will detect that the setup does not exist and the operator terminal will display the message "No Tonnage Monitor Settings". In this situation the operator should select to continue the recall operation, all other press control parameters will be recalled and the present settings in the tonnage monitor will not be changed. Once the tonnage monitor settings are set correctly for this job, the operator should store this job with the same job number and description. This will store the tonnage monitor settings under this job number for recall later.

Note: If the Tonnage Monitor Module is installed in the OmniLink 5000 as an option after the system has been in operation, there may be job setups stored in the press control that have not been stored in the Tonnage Monitor Module. This situation might also arise if a Tonnage Monitor Module is swapped from one OmniLink 5000 control to another. In this case, when one of those previously stored jobs is recalled from memory by the operator, the Tonnage Monitor Module will not be able to find any information stored. If this occurs a message will be displayed on the job setup screen which reads "No Tonnage Monitor Settings". In this situation the operator should select to continue the recall operation, all other press control parameters will be recalled. The tonnage monitor settings will remain unchanged from what they were prior to the recall. *The operator MUST program the correct tonnage monitor settings for the current job*. Once the tonnage monitor settings are set correctly for this job, the operator should store this job with the same job number and description. This will store the tonnage monitor settings under this job number for recall later.

Section 6.1 New Die Installation

In normal operating conditions, the job recall function is used to load the tonnage monitor module with the correct low, high, and reverse limits for the die being used. However, when a new die is installed in the machine, the tonnage requirements may not be defined. The limits presently in the tonnage monitor remain in effect and may cause tonnage alarms when the press is run. While the BYPASS feature can be

used to prevent tonnage alarms from occurring, it will bypass ALL alarms (except machine rating alarms). Instead, it is suggested that the High Limits and Reverse Limits active during the working portion of the stroke (View: Peak Tonnage) be set for the approximate tonnage rating of the die. The Low Limits will be automatically disabled in Inch or Timed Inch modes.

After the correct tonnage monitor settings are established for the die, along all other OmniLink 5000 settings, the present settings should be stored under a job number and description for recall later.

Section 7 Installation

Section 7.1 Module Location

Figure 7.1 shows the OmniLink 5000 with the optional expansion rack and Tonnage Monitor Module installed. The module must be securely screwed to the card rack with the knurled screws attached to the faceplate of the card.

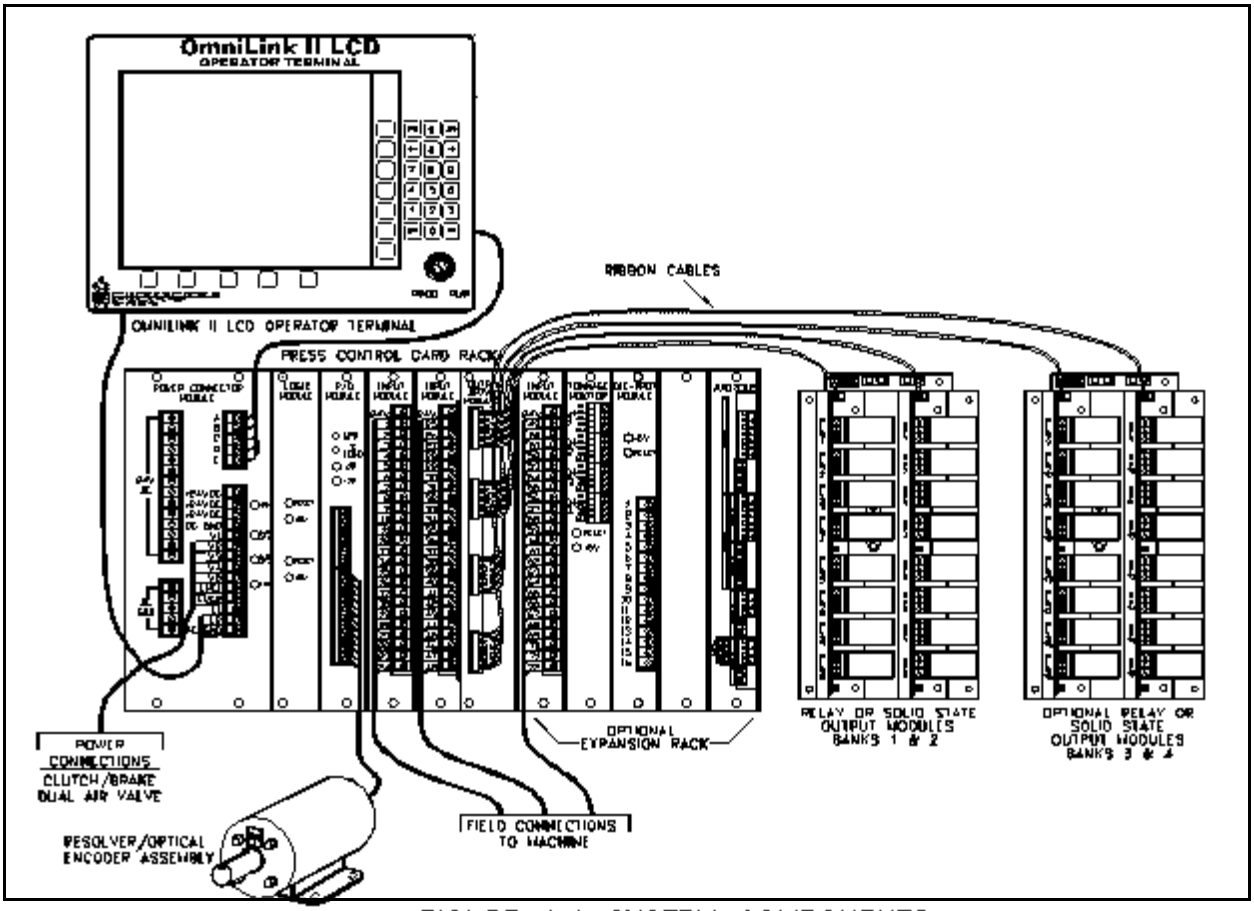

Figure 7.1: Tonnage Monitor Module Installed in Card Rack

Section 7.2 Strain Gauge Locations

Section 7.2.1 "C" Frame Machines

Machines with "C" frame configurations, such as OBI and GAP frame presses, should be installed with one strain gauge mounted to each side frame member and the tonnage monitor module configured for 2 channel operation.

Choices of strain gauge mounting locations are illustrated in Figure 7.2. 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 side frames of some machines.

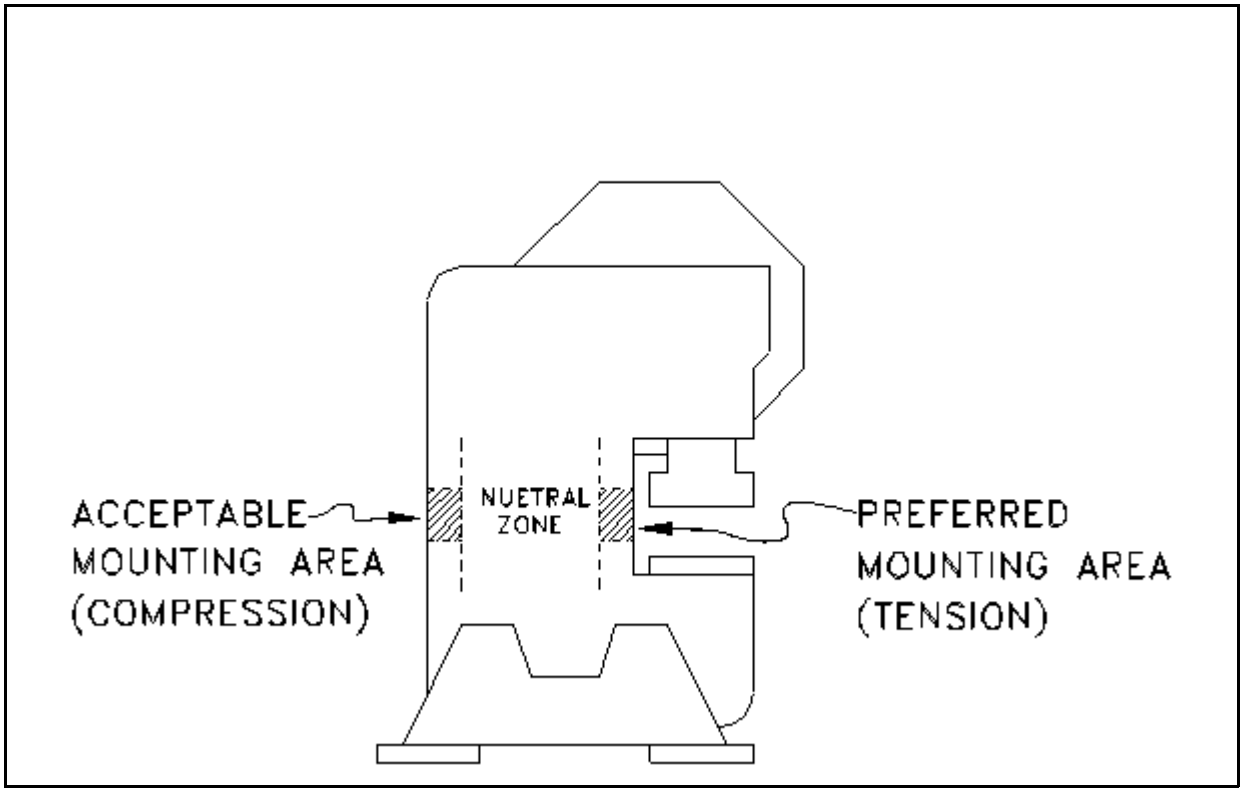

Figure 7.2: "C" Frame Machine

Do not mount strain gauges 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 susceptible to damage from die setting operations.

Section 7.2.2 Straight Side Machines

Straight side presses should be monitored with one strain gauge on each corner of the frame and the tonnage monitor module configured for 4 channel operation. On machines with tie rod through hollow upright (column) construction, strain gauges may be mounted on either the tie rods or the uprights,

although ease of installation usually dictates mounting the strain gauges on the uprights. On solid frame straight side machines, the uprights are also the best strain gauge locations.

The best strain gauge locations are below gibs and at least 12 inches above where the upright joins the machine bed. Locating the strain gauge 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 gauges 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 gauges 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 gauges in recessed panel areas in uprights.

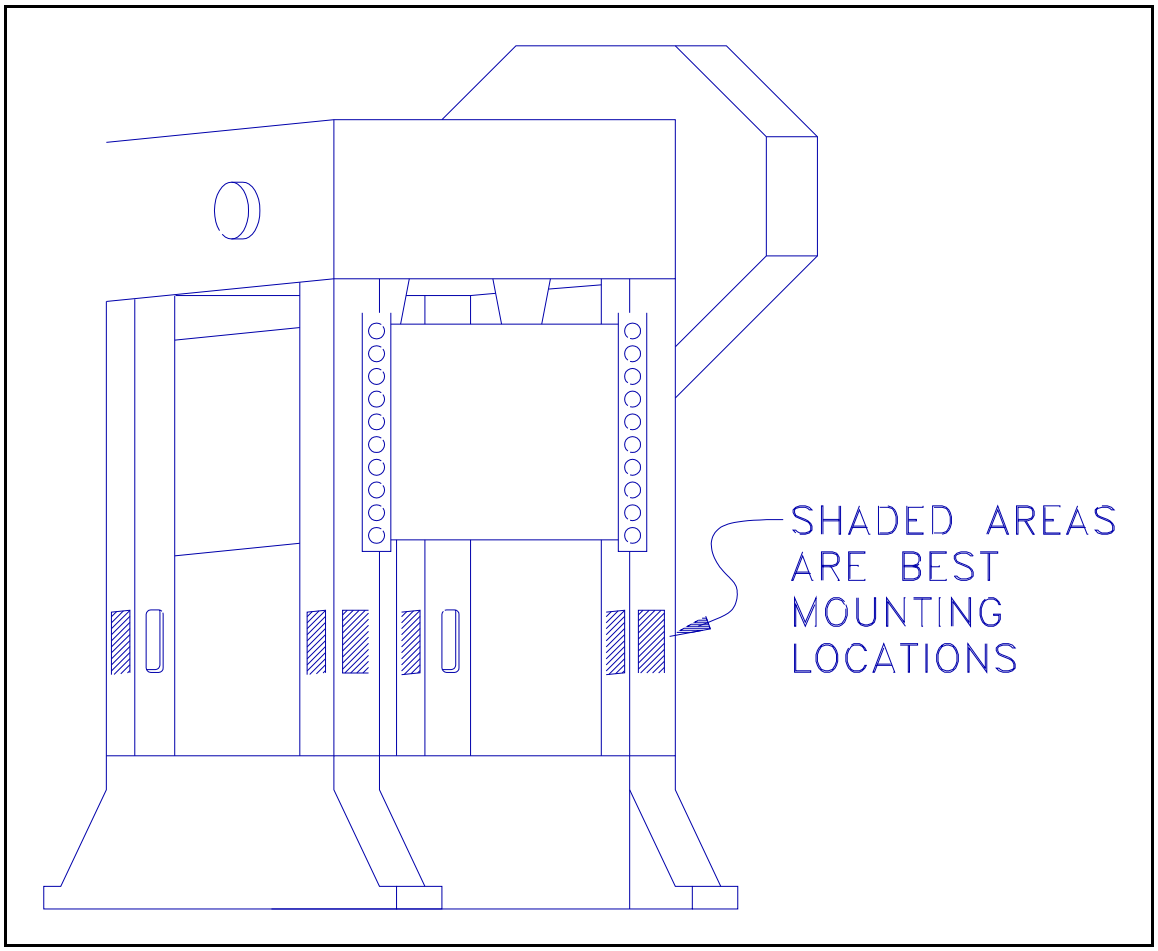

Figure 7.3: Straight Side Machine

Stay away from corners of uprights as strain gauge mounting locations. The best locations on the upright for strain gauges 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 gauges should be mounted in conditions of geometric symmetry on uprights and at the same vertical height on each upright. Figure 7.3 illustrates mounting locations for straight side machines of tie rod construction.

Figure 7.4 shows areas to avoid on uprights of straight side machines of tie rod construction. The cross-hatched areas should be avoided.

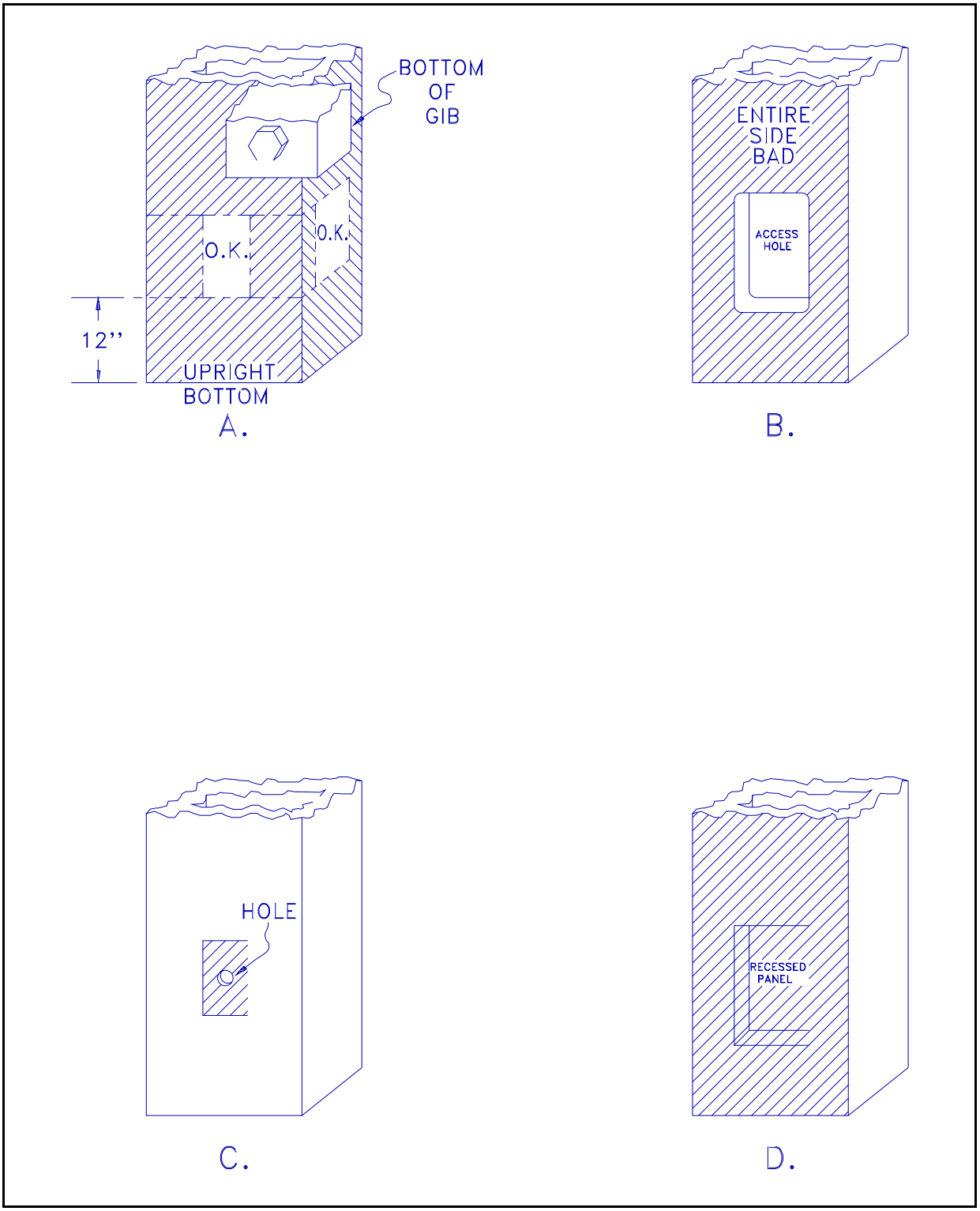

Figure 7.4: Areas to Avoid on Straight Side Machines (Do Not Mount in Cross- Hatched Areas)

On solid frame straight side machines, the preferred strain gauge mounting location is inside the "windows" under the ends of the crankshaft. A strain gauge should be mounted on the inside face of each column forming the "windows" as shown in Figure 7.5.

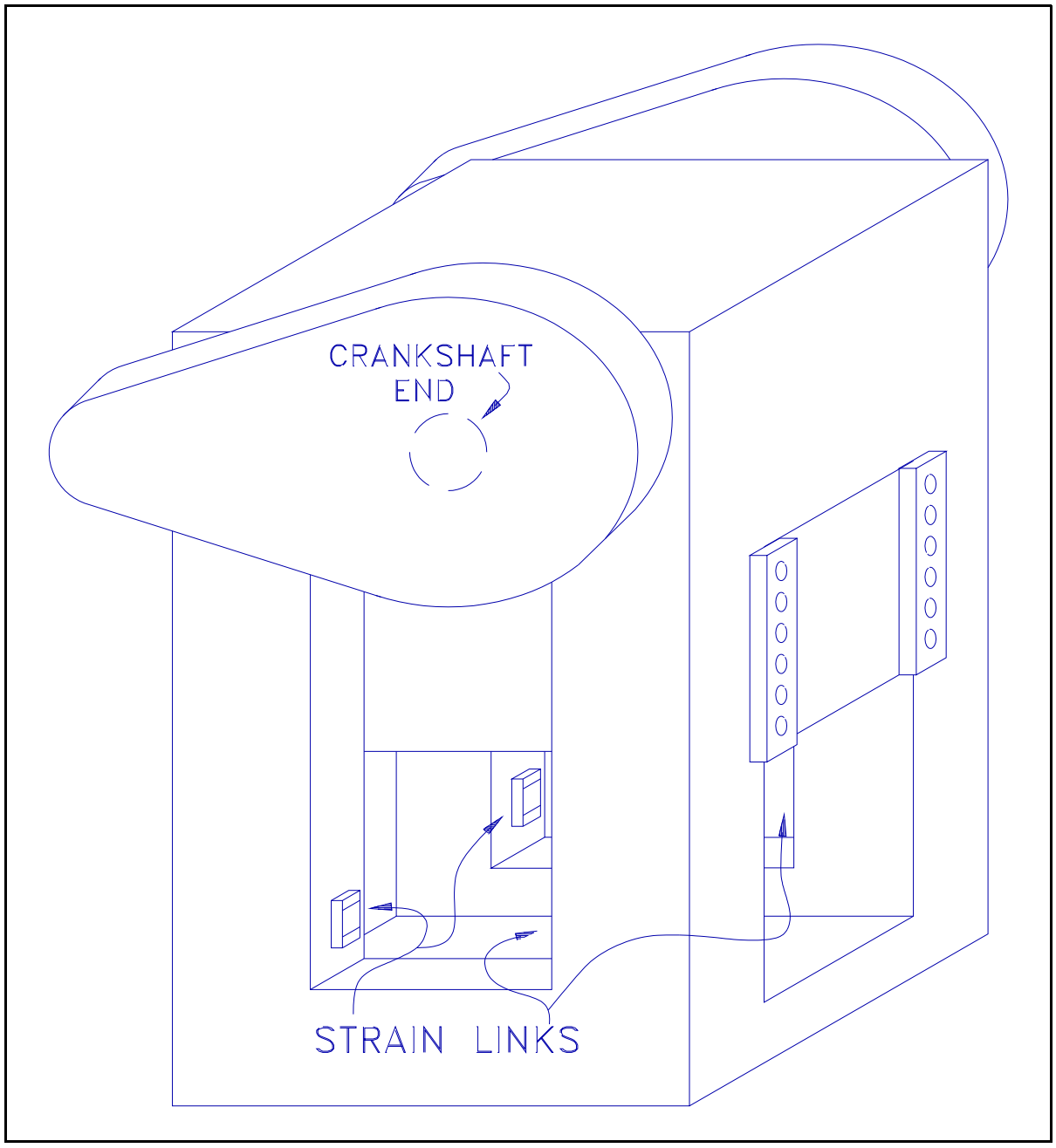

Figure 7.5: Strain Gage Mounting on Solid Frame Straight Side Machines

Section 7.3 Strain Gauge Mounting

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

Section 7.3.1 Direct Machine Mounting

1) Select the desired mounting locations for the strain gauges.

2) Remove paint, oil, grease, etc., to obtain a bare metal surface slightly larger than the LST-1000 strain gauge. The metal surface must be flat and smooth so that the strain gauge is not warped and contacts the surface area evenly when mounted. A mounting surface that is flat to 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 gauge is to be mounted in the direction of tension or compression of the structural member. This will be a vertical line on columns or tie rods of straight side presses and "C" frame machines that are not inclined. On inclined presses, the scribe marks should follow the inclined angle.

4) Place the hardened drill fixture provided with the direct mounting strain gauge kit in position adjacent to the scribed line and use a no. 3 drill to drill a 5/8" deep hold 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 7.6.

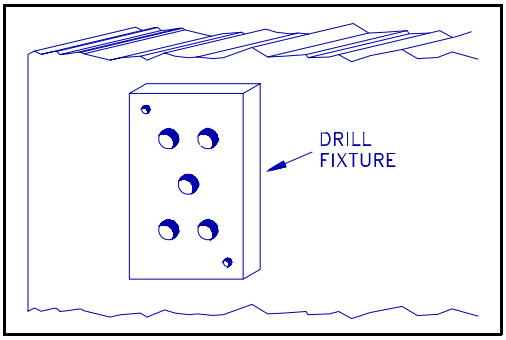

Figure 7.6: Drill Fixture

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.

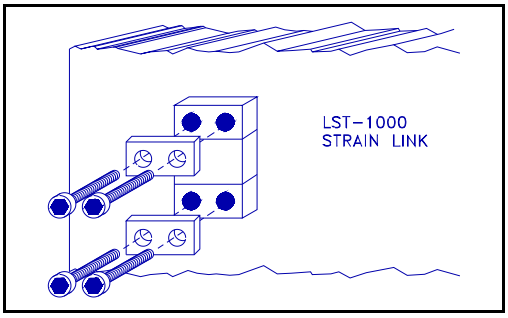

Figure 7.7: LST-1000 Strain Link

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

7) Mount the strain gauge as shown in Figure 7.7. Make certain that the washers provided with the strain gauge kit are placed over the strain gauges. Torque the 1/4 x 28 bolts to 150 in-lbs. A calibrated torque wrench is the preferred tool to torque the bolts.

8) Mount the protective cover box provided in the strain gauge kit, if used, centrally over the strain gauge. 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 gauge.

Section 7.3.2 Intermediate Weld Pad Mounting

1) Select the desired mounting locations for the strain gauges.

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

3) Clean the mounting surface with a solvent, removing all contaminants.

4) Assemble the intermediate pads to the alignment/clamping fixture using the 1/4 x 28 bolts provided, as shown in Figure 7.8.

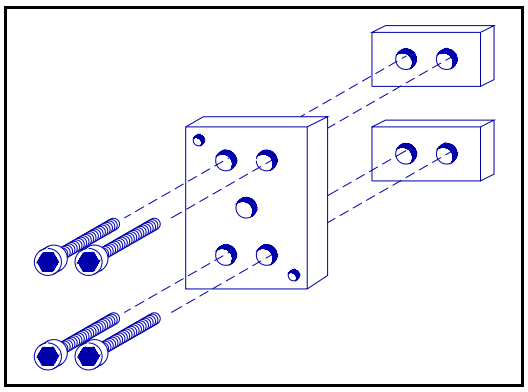

Figure 7.8: Alignment/Fixture

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" 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 outer ends and sides of the intermediate pads to the mounting surface, as shown in Figure 7.9.

6) Remove the alignment/clamping fixture. **Do not weld with the fixture removed.**

7) Bolt the LST-1000 strain gauge to the pre-tapped holes in the intermediate pads. Make certain that the washers provided with the strain gauge kit are placed over the strain gauges. Torque the 1/4 x 28 bolts to 150 in-lbs. A calibrated torque wrench is the preferred tool to torque the bolts.

8) Mount the protective cover box provided in the strain gauge kit, if used, centrally over the strain gauge. 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 gauge.

Section 7.4 Strain Gauge Wiring

1) Run flexible or rigid conduit from the strain gauge protective boxes to the control enclosure that contains the OmniLink 5000 card rack. Entry into the control enclosure should be as close as possible to the tonnage monitor module.

2) Pull the strain gauge cables through the conduit from the strain gauge locations to the control enclosure. Once inside the enclosure route the strain gauge cables away from all other voltage sources, as much as possible. Run cables to the channel connectors on the front of the tonnage monitor module and cut the excess cable lengths off.

3) Strip about 2 ½ inches of 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.

4) Wire the channel connectors as shown in Figure 7.10. Cover or tape the shield, to avoid accidental shorting to any other point.

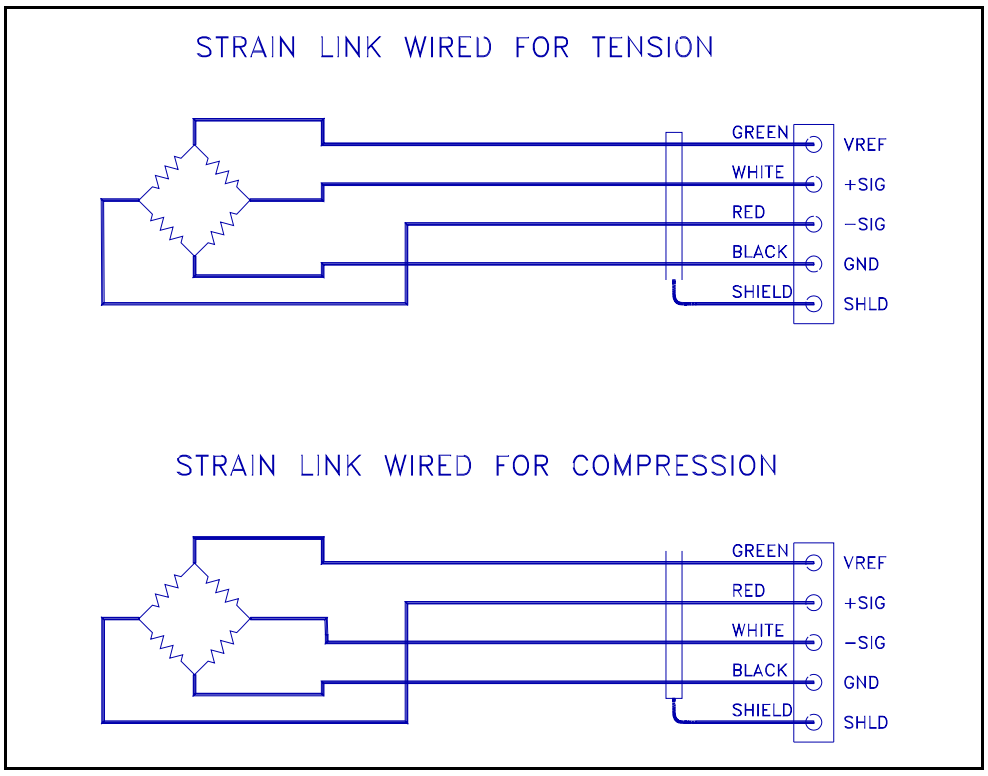

Figure 7.10: Strain Link Wiring

Section 7.5 Installation Procedure

1) Position the press at the top of the stroke, turn power to the machine off, and install tonnage monitor card in the OmniLink 5000 card rack. Make certain both knurled screws that hold the module in place are tight (see Section 7.1).

   If this installation is replacing a System 1000/1100 tonnage monitor already installed on the machine, before turning power OFF, write down the present machine rating and cal #'s. In addition to moving the strain gauge wires to the OmniLink 5000, the stop signal from the tonnage monitor must be removed and jumped out at the control.

2) Locate and mount the strain gauges, if not already installed on the machine (see Sections 7.2 and 7.3).

3) Route conduit from the strain gauges into the control enclosure the contains the OmniLink 5000 card rack. The conduit for the strain gauges should be dedicated for strain gauge wiring only. Do not run wiring other than strain gauge wiring in this conduit without consulting the factory.

4) Wire strain gauges to the connectors on the front of the tonnage monitor module (see Section 7.4).

5) Power up the press control and use the press control configuration menus to turn the tonnage monitor option ON (see Section 7.6).

6) Exit to the Main Menu and select the TONNAGE MONITOR softkey. Verify that the channel status indicates no errors for all channels.

7) With the RUN/PROG switch in the PROG position, select the CONFIGURE TON MON softkey and the Configuration Code.

8) The selections displayed in the configuration menu are arranged from top to bottom in level of importance. Select Tonnage Monitor Machine Settings (refer back to Section 5.1 and follow from start to finish) and set each parameter for this specific installation.

   <u>If the tonnage monitor Channel Configuration must be changed, make this entry first, power the control down and back up.</u>

9) Select Tonnage Monitor Machine Rating. Enter the machine rating and correct decimal point position (see Section 5.2). Disable the total derate table by setting all tonnage percentages to 125% until installation is complete.

10) Select Calibration and Channel Description. See Section 6 for the desired type of calibration procedure.

11) Select Channel Descriptions and enter the descriptions for the channels (see section 5.4).

12) Select View/Reset Alarm Counters and reset all counts (see section 5.5).

13) Exit back to the Tonnage Monitor Screen and enter high limits and low limits (for Peak Tonnage and all Data Windows). Enter reverse limits. The tonnage monitor is shipped from the factory with low, high, and reverse limits programmed. If the installation procedure required the machine rating to be changed, these limits may no longer be acceptable and could generate an error condition.

Section 7.6 Configuring Control

The OmniLink 5000 press control must be configured to allow the tonnage monitor module option. The installation procedure is as follows:

1) From the Main Menu screen, select the PRESS CONTROL softkey.

2) Switch the RUN/PROG keyed selector switch to the PROG position.

3) Select the CONFIGURE softkey and enter the Configuration Code.

4) Select MACHINE PARAMETERS. The Machine Parameters menu will appear.

5) Select the FACTORY CONFIG softkey. The Factory Parameters menu will appear.

6) Position the cursor onto the parameter Tonnage Monitor, use the numeric keypad to change the entry from 000 (OFF) to 001 (ON) and press ENT.

   The Configuration Code gives limited access to change parameters in this screen. Only three parameters that can be changed with the Configuration Code are Tonnage Monitor, Die Protection, and Automatic Setup. The system will not allow the other parameters to be changed with the Configuration Code.

7) Exit back to the Main Operator Terminal screen.

Section 8 Calibration

Calibration of an OmniLink 5000 Tonnage Monitor Module consists of achieving a known load on the machine and adjusting the installed monitor so that the known load is displayed correctly. 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 loses 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 Tonnage Monitor Module. 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.

Hydraulic jacks are used in static calibration of the Tonnage Monitor Module. 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 the crankshaft. Do not exceed the point loading of the ram specified by the press manufacturer.

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. 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.

Section 8.1 Dynamic Calibration with Load Cells

a) Check to see that the OmniLink 5000 Tonnage Monitor Module is installed as per the installation instructions of this manual.

b) Turn on the power to the OmniLink 5000. Observe that the OmniLink 5000 tonnage monitor module displays zero. If the tonnage displays fail to zero within 40 seconds or an error occurs, check that the strain gauges are wired correctly into the channel connectors and refer to error conditions listed in this manual.

c) Before calibration can proceed, verify that all configuration parameters are properly set.

> Note that the machine rating must be set correctly before calibration and not changed afterward. Changing the machine rating number after calibration will result in erroneous tonnage readings.

If error conditions relating to setpoint limits occur, correct the invalid conditions and press the RESET ERROR softkey.

d) Set the high setpoint for each channel of the installed OmniLink 5000 Tonnage Monitor Module 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 tonnage monitor at full load is one-half (½) the rated tonnage of the machine. For a four channel module, 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 ½ of 200 tons) for a two channel tonnage monitor module, or 55 tons (10% over 1/4 of 200 tons) if a four channel module is installed.

e) Set the low limits for each channel to Zero (0).

f) Set the reverse limits for each channel to -10% of channel rating.

g) 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 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 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!

h) 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 "g" of this calibration procedure.

i) Turn on the power to the machine and bypass (see Section 4.2.4) the OmniLink 5000 Tonnage Monitor Module. Return the slide to the top of stroke position.

j) 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 any of the load cell(s) give a reading, indicating that contact is being made with one or more load cell stacks.

k) 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.

   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 total of the load cell readings. 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 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 "l".

   Do not exceed rated tonnage capacity of the machine or load cells during the calibration process by more than five or ten percent.

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.

l) After loading the machine to the tonnage at which it is to be calibrated as per step "k" of this calibration procedure, access the T/M Configuration menu of the OmniLink 5000 Tonnage Monitor Module and select Calibration and Channel Description (refer to Section 5.3) to enter the Dynamic Calibration mode.

   For a two channel OmniLink 5000 tonnage monitor module:

   Turn the RUN/PROG keyed selector switch to the RUN position and make single strokes of the machine. The display will update the channel and total tonnage display each stroke. Between strokes, switch the RUN/PROG keyed selector switch to the PROG position and enter cal. #s for both channels until channel 1 and channel 2 tonnages of the OmniLink 5000 tonnage monitor module are within one or two percent of one-half (1/2) the sum of the load cell readings.

   For a four channel OmniLink 5000 tonnage monitor module:

   Turn the RUN/PROG keyed selector switch to the RUN position and make single strokes of the machine. The display will update the channel and total tonnage display each stroke. Between strokes, switch the RUN/PROG keyed selector switch to the PROG position and enter cal. #s for all channels until all four channel tonnages of the OmniLink 5000 tonnage monitor module are within one or two percent of one-fourth (1/4) the sum of the load cell readings

m) Retain the calibration numbers so that periodic checks for calibration can be made. It is suggested that a copy of these numbers be retained inside the control enclosure and that a second copy be kept in files.

n) Reduce the load gradually, and verify that the tonnages displayed by the OmniLink 5000 tonnage monitor module "track" within one or two percent of those of displayed on the load cells. Failure of this indicates a non-linearity which could be due to incorrect strain gauge location, improper strain gauge mounting, or incorrect tie rod tension (in frames of this construction).

o) Press the EXIT softkey and return to the Tonnage Monitor menu.

p) Remove the load cells and associated "stack" elements from the machine.

   Calibration is complete.

Section 8.2 Static Calibration with Hydraulic Jacks

a) Check to see that the OmniLink 5000 Tonnage Monitor Module is installed as per the installation instructions of this manual.

b) Turn on the power to the OmniLink 5000. Observe that the OmniLink 5000 tonnage monitor module displays zero. If the tonnage displays fail to zero within 40 seconds or an error occurs, check that the strain gauges are wired correctly into the channel connectors and refer to error conditions listed in this manual.

c) Before calibration can proceed, verify that all configuration parameters are properly set.

   Note that the machine rating must be set correctly before calibration and not changed afterward. Changing the machine rating number after calibration will result in erroneous tonnage readings.

   If error conditions relating to setpoint limits occur, correct the invalid conditions and press the RESET ERROR softkey.

d) Set the high setpoint for each channel of the installed OmniLink 5000 Tonnage Monitor Module 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 tonnage monitor at full load is one-half (1/2) the rated tonnage of the machine. For a four channel module, 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) for a two channel tonnage monitor module, or 55 tons (10% over 1/4 of 200 tons) if a four channel module is installed.

e) Set the low limits for each channel to Zero (0).

f) Set the reverse limits for each channel to -10% of channel rating.

g) Turn on the power to the machine and bypass (see Section 4.2.4) the OmniLink 5000 Tonnage Monitor Module. Return the slide to the top of stroke position.

h) Turn off machine drive motor, wait for the flywheel to come to a complete stop, 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.

i) Access the T/M Configuration menu of the OmniLink 5000 Tonnage Monitor Module, select Calibration and Channel Description (refer to Section 5.3). The T/M Calibrate menu will appear. Press the STATIC CAL softkey to enter the Static Calibration mode. The top of the screen will read "Tonnage Monitor Static Calibration Mode." With the RUN/PROG keyed selector switch in the PROG position enter a calibration number of 400 into each channel.

j) Verify that the channel and total tonnage displays read between ±1% of rated tonnage of the machine. If not press the DYNAMIC CAL. softkey and then the STATIC CAL. softkey to command a re-zero.

Do NOT exit the STATIC-CAL mode.

k) 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.

l) For a two channel OmniLink 5000 Tonnage Monitor Module:

Turn the RUN/PROG keyed selector switch to the PROG position and adjust the Cal.#s. Turn the RUN/PROG keyed selector to RUN. The channel tonnage for each channel should read within ±1% of one-half (1/2) of the sum of the tonnages exerted by the jack(s). If the calibrations numbers require re-adjustment, return the RUN/PROG keyed selector to the PROG position, and adjust the Cal. #'s. The RUN/PROG keyed selector must switch to the RUN mode between each entry, in order for a new tonnage reading to be calculated. Repeat this procedure until both channels read within ±1% of one-half (1/2) of the sum of the tonnages exerted by the jack(s).

For a four channel OmniLink 5000 Tonnage Monitor Module:

Turn the RUN/PROG keyed selector switch to the PROG position and adjust the Cal.#s. Turn the RUN/PROG keyed selector to RUN. The channel tonnage for each channel should read within ±1% of one-fourth (1/4) of the sum of the tonnages exerted by the jack(s). If the calibrations numbers require re-adjustment, return the RUN/PROG keyed selector to the PROG position, and adjust the Cal. #'s. The RUN/PROG keyed selector must switch to the RUN mode between each entry, in order for a new tonnage reading to be calculated. Repeat this procedure until all four channels read within ±1% of one-fourth (1/4) of the sum of the tonnages exerted by the jack(s).

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

n) Retain the calibration numbers so that periodic checks for calibration can be made. It is suggested that a copy of these numbers be kept inside the control enclosure and that a second copy be kept in

files.

o) Press the EXIT softkey and return to the Tonnage Monitor menu.

Calibration is complete.

Section 8.3 Replacing System 1000/1100

If the OmniLink 5000 Tonnage Monitor Module is replacing a System 1000 or System 1100 Tonnage Monitor that is already installed on the machine and calibrated, the calibration numbers from the System 1000/1100 can be transferred to the OmniLink 5000. This is done by accessing the configuration menus of the OmniLink 5000 Tonnage Monitor Module and selecting Calibration and Channel Descriptions. With the RUN/PROG keyed selector switch in the PROG position multiply the calibration number from the System 1000/1100 for channel 1 by 1.11 and enter this value into the Cal.# for channel 1 of the OmniLink 5000. Repeat this procedure for each channel.

Section 8.4 Calibration Numbers

The channel calibration number of the OmniLink 5000 Tonnage Monitor Module is a direct reflection of the analog gain on that channel.

A Cal.# of 200 = Gain of 20.0

The calibration number for a System 1000 or System 1100 Tonnage Monitor is proportional to gain but not equal to it. This means that transferring the cal. number from a System 1000/1100 to a OmniLink 5000 requires that the number be multiplied by a constant (constant=1.11).
Cal.#(OmniLink 5000) = Cal.#(System 1000/1100) * 1.11

Section 8.5 Incorrect Tie Rod Tension

Straight side machines of tie rod construction are designed for tie rods to be in tension such that the bed and crown or 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 gauges 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 proportional 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 gauge on the upright will no longer be proportional to load.

This condition can be detected during calibration of a straight side machine when strain gauges are mounted at approximately the same location on the uprights. If, at rated tonnage, the calibration number associated with one or more channels must be much higher than the other channels in order to produce equal tonnage readings, improper tension in the tie rod may exist. To determine if tie rod tension is the actual cause, reduce the load on the load cells during calibration until 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 much larger than the channels with lower calibration numbers improper tie rod tension is indicated.

Section 9 Troubleshooting

Section 9.1 Communication Failure

The message "Communication Failure" in the tonnage monitor status line of the Main Operator Terminal screen indicates that the operator terminal can not establish serial communication with the module. Since this serial interface is used to communicate will all boards in the OmniLink 5000 card rack, the problem may be that the display can not communicate with any of the boards. From the Main Menu select the PRESS CONTROL softkey and check if the Present Running Status of the press control indicates "Communication Fault". If so, verify that power is applied to the OmniLink 5000 card rack (check the power supply LEDs). If power appears correct, check the wiring of the five wire cable from the operator terminal to the power connector module on the card rack.

If loss of communication exists only between the display and the tonnage monitor module, the operator should turn power to the OmniLink 5000 off, remove the tonnage monitor module, and verify that there are no bent pins in either connector that plugs into the motherboard of the card rack. Reinstall the card, making certain that it is securely seated and screwed in, and turn power back on. If the problem remains, there may be an internal fault on the tonnage monitor module.

Section 9.2 Diagnostic LEDs

The 5000-8A Tonnage Monitor Module has two LED indicators which provide status the following information:

+5 V — This green LED indicates the status of the internal +5 volt power supply used by the "Ch B" side of the press control. It should be ON when power is applied to the card rack.

RESET — This red LED turns ON for approximately 1/2 second when power is applied to the card rack. It should never turn ON during normal operation, and indicates a fault on the tonnage monitor module if it does.

Section 10

Section 10.1 Software Version

The information in this manual is based on tonnage monitor software version 1.08

Section 10.2 Configuration Code and Clear Stroke Counter/Memory Code

The Configuration Code used to gain access to the tonnage monitor configuration menus is the same Configuration Code as used by the OmniLink 5000 press control.

The Clear Stroke Counter/Memory Code used to clear memory in the tonnage monitor is the same Clear Stroke Counter/Memory Code as used by the OmniLink 5000 press control.

These codes are described in the OmniLink 5000 Press Control manual, provided to customer supervisory personnel, and are not defined in this manual.