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PORTA-PEAK[®] PLM-4 OPERATING INSTRUCTIONS

OPERATING INSTRUCTIONS

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Getting Started

- 1. Carefully remove the PLM-4 load monitor from the shipping container and rest the unit on a table or desktop. Use the bottom of the unit as the contact surface. Note: Never rest unit on the back panel as damage to controls may result.
- 2. Rotate the PLM-4 handle from the carrying position down to the rest position while elevating the front of the unit. Press button on each side of handle to allow movement. The handle adjusts to several convenient positions.
- 3. With the PLM-4 unit in the front inclined position, lift the translucent plastic panel to access front panel controls.
- 4. Refer to page 4 through 8 of this manual to identify each component on the front and rear panel.
- 5. Refer to the appropriate sections of this manual for system set-up and unit operations.

Porta-Peak System Overview

- Performs accurate press calibrations using the PLM-4 unit and Helm calibration load cells
- Performs fast die set-ups using the PLM-4 unit and Helm calibrated force transducers mounted to the machine or tooling
- Performs continuous press load monitoring using the PLM-4 unit and Helm calibrated force transducers
- Verifies die cast and injection molding machine clamp force tonnage, platen squareness and parallelism using the PLM-4 unit and Helm model SB squaring block
- Monitors tie bar strain of die cast and injection molding machines using the PLM-4 unit and Helm tie bar sensors
- Load monitoring and process analysis capabilities for a wide variety of machines used in the metalforming industry

PLM-4 Porta-Peak Unit

- Four channel strain gage input
- Digital tonnage readout
- Displays Peak (dynamic) or Track (static) loads
- Reverse load capabilities
- Memory circuit stores and recalls optimum (good part load values of up to 100 jobs for faster die set-ups
- Rugged enclosure with carrying handle
- Die Cast industry version includes special rear panel for force transducer cable connections
- Optional computer interface capabilities
- Standard one-second time window for capturing peak load values
- Selectable time window for peak load and signatures using computer interface functions





When used as an analytical tool, the PORTA-PEAK will dynamically identify improper press conditions such as loose tie rods, gib misalignment, worn bearings or excessive snap-thru forces.



Detailed forming signatures can be obtained from the PORTA-PEAK by using a chart recorder or optional Helm FirstMate signature analysis software. These recordings provide a benchmark to help understand and optimize many forming processes.

Calibration Load Cells

- Standard load cells are available in 50, 100, 250, 500 and 1000 ton capacities for most press applications
- 1000 ton load cells are adaptable to upsetter machines
- Includes inter-connect cable for fast connection to PLM-4 unit
- Factory calibration is traceable to the National Institute of Standards and Technology (N.I.S.T.)



Bolt-On Strain Gain Transducers

- Standard model HT-400 sensor is widely used on stamping presses for continuous load monitoring and die set-up
- Typical sensor locations include: press frame, press columns, pitman and pull arms
- High output version for rigid machine cross-sections
- High temperature version for forging applications
- Reduced size versions for limited space applications
- Drill and tap or weld mount installation kits
- Sensors are calibrated on site with Helm calibration load cells



Model SB Squaring Block

- Verifies machine clamp force tonnage, platten squareness and parallelism of die cast and injection molding machines
- Sizes and capacities vary depending on application requirements
- Fully protected internal force transducers
- Rugged interconnect system
- Squaring block calibration traceable to N.I.S.T.



Model T-2640 Tie Bar Sensor

- Provides continuous tie bar strain output while installed in the central (neutral axis) of one to four machine tie bars
- Easy remote sensor installation using Helm installation tools, made in nominal one foot increments from two to six feet in length.
- Rugged interconnect system
- Installation holes can be drilled by the machine manufacturer or end-user to Helm specifications. The installation holes can also be drilled by Helm field service personnel using a specialized portable gun-drilling apparatus.
- Sensor is calibrated using a Helm model SB Squaring Block or by a special field calculation based on machine parameters and a factory benchmark calibration of the sensor which is traceable to N.I.S.T.







Front Panel Component Identification and Description

- 1 <u>Digital Meter Display</u> for Ch. 1 output, "cal" number and zero balance.
- Digital Meter Display for Ch. 2 output, "cal" number and zero balance.
- ③ <u>Digital Meter Display</u> for Ch. 3 output, "cal" number and zero balance.
- (a) <u>Digital Meter Display</u> for Ch. 4 output, "cal" number and zero balance.
- (5) <u>Digital Meter Display</u> for Total Load (sum of all force transducer inputs).

Note: With a mechanical load applied to the calibrated force transducer(s), the digital meters display force output (directly in tons) for each channel when the TRACK/PEAK switch is in the TRACK or PEAK position. The total load meter displays the sum tonnage of all connected force transducers when the TRACK/PEAK switch is in the PEAK position only. The channel meters will display actual output when the calibrated force transducer signal generates a tonnage readout from 10 percent (min.) to 195 percent (max.) of the meter scale. The meter scale is input by the PLM-4 operator.

- 6 <u>Manual Zero Balance</u> Adjustable potentiometer used to adjust the transducer bridge for zero balance under a no load condition.
- Channel Gain Adjustable potentiometer used to adjust transducer signal gain (amplification) under a no load condition. The target gain value is equivalent to the "CAL" number for each force transducer.
- CAL Switch Momentary switch which displays channel gain setting ("CAL" number) when toggle is manually moved to the up position. Toggle is manually held in the up position while making channel gain adjustments.
- (9) <u>CAL Sensitivity Switch</u> Applies a simulated load (shunt calibration resistance) to the transducer bridge circuit using an internal resistor. This load is required to internally validate the gain amplification ("CAL" Number) in order to obtain a true calibrated output display from the force transducer signal. Each position of the CAL sensitivity switch corresponds to one specific value of four internal shunt resistors. This switch must be positioned to the corresponding shunt resistor value of the force transducer which is being set up through the PLM-4 unit. The internal shunt resistor values are: Position 1 140K ohms, Position 2 56.2K ohms, Position 3 499K ohms, Position 4 1 Meg ohms.
- Track/Peak Switch Used to select track mode for force transducer set-up and static load operations, or peak mode for dynamic load operations.
- (1) <u>Recorder Output Receptacle</u> BNC type connector used to access analog track-out voltage, voltage 'CAL' numbers, and voltage zero bridge balance of force transducer for each channel.

Front Panel Component Identification and Description (continued)

- Reset Button Clears all meter displays of previous output data when monitoring peak (dynamic) loads. Although the PLM-4 unit will automatically update and show the most current peak signal (if greater than previous hit), the reset button can be depressed between machine cycles (single stroke for presses) to verify electrical zero balance of the transducer bridge(s). Manual adjustment is always required to compensate for transducer zero offset to ensure that the true peak tonnage is captured. The reset button is not active when the PLM-4 unit is set up for track (static loads).
- Target Load Button Momentary pushbutton switch which temporarily displays the previously stored target load (good part) peak tonnage values for a selected job number, when the Manual/Target loads switch is in the "Target Loads" (up) position.
- Job Number Selector Thumbwheel dial which is used to select a previously stored job number. Once selected, the meters will display reference (good part) peak tonnage data from a previous job when the manual/target loads switch is toggled to the "target loads" position, and the target load button is depressed. This data is manually stored at the time the good parts are made. Up to 100 different jobs can be stored for subsequent recall. This function is part of the JDC Job Data Control system.
- (5) <u>Store Button</u> Momentary pushbutton switch, which stores reference (good part) peak tonnage data to a specific job number for subsequent recall. This function is part of the JDC Job Data Control system.
- (b) Manual/Target Loads Switch Two position toggle switch which allows the PLM-4 unit to operate in manual mode; all load data current, or to operate in manual mode with access to the JDC Job Data Control functions.
- Manual LED Indicates the PLM-4 unit is operating in manual mode all manual functions active.
- (B) <u>JDC LED</u> Indicates the PLM-4 unit is operating in JDC Job Data Control mode all manual functions are active, plus access to stored Job Data Reference (good part) PEAK tonnage values.
- (9) <u>Computer LED</u> Indicates the PLM-4 unit is operating in computer interface mode, where all functions are controlled by a remote computer. Note: An optional computer interface card must be installed into the PLM-4 unit for computer interface capabilities.



Rear Panel Component Identification and Description

- (A) <u>Line Voltage Input Connector</u> 3 pin male power receptacle accesses internal switching power supply for 120-240 VAC line voltage. Nominal 7 ft. power cord provided with mating female connector and 120 VAC style male plug.
- (B) <u>Line Fuse</u> Buss GDC time-lag fuse rated at 500mA/250V capacity. Dimensions are 5mm dia. x 20mm LG.
- © Power Switch Rocker style switch with ON/OFF indicators in English and Binary code.
- D Primary Sensor Input Connector 7 pin female Amphenol connector mates directly with a Helm Porta-Peak cable for connection to a Helm calibration load cell. Also allows for connection of any Helm Strain Gage force transducer outfitted with mating 7 pin male connector. One connector per channel, one sensor input per channel.
- (E) <u>First Auxiliary Sensor Input Connector</u> 5 pin male Turck Eurofast style connector mates directly to Helm molded cordsets or Turck field-wirable connectors which are wired to Helm specifications. Accepts input from any Helm strain gage force transducer. One connector per channel, one sensor input per channel.
- (F) Second Auxiliary Sensor Input Connector 5 pin male Weidmuller connector mates with Helm sensor cable wired to female mating connector. The main purpose for this connector is to temporarily bypass a Helm TLG type unit for troubleshooting or field analysis purposes. Bypass connection can be made from the end of the Strain Gage force transducer cable at (but not connected to) the TLG unit, or by accessing the Weidmuller type junction box located within the sensor interconnect system (where applicable). Extra mating connectors are provided on the PLM-4 unit for convenience. One connector per channel. One sensor input per channel.
- (G) <u>Meter Scale Selector</u> Thumbwheel dial (labeled "SCALE SET") used to set meter scale (for all channels) based on rated calibration load cell capacity or rated machine capacity. See "System Setup" section for more details.
- (H) <u>High/Low Meter Range Switch</u> Locking toggle switch (labeled "HIGH, LOW") which sets the meter range (for all channels) to high or low depending on rated load cell capacity or machine capacity. See "System Setup" section for more details.
- <u>Normal/Reverse Switch</u> Rotary switch which puts PLM-4 unit in normal load (positive force transducer output displayed) or reverse load (negative force transducer output displayed as positive output). Refer to page 27 for detailed instructions relating to "Reverse Load" operation.
- ① Channel On/Off Switch Locking toggle switch for channel 2, 3 and 4. The toggle arm must be pulled outward to unlock the switch before it is moved to the desired position. In the ON position, the PLM-4 unit is ready to accept live force transducer input at the primary or auxiliary connectors for channel 2, 3 or 4. Any of these channels which are not needed for live sensor input must be shut off. When the switch is in the OFF position, an internal resistor is introduced into the load circuit (per channel) applying a simulated load in order to maintain proper instrument functions. NOTE: Channel 1 cannot be switched off and always requires live sensor input.
- Computer Interface Input Jack RS-232 serial communications port for computer interface functions. This interface allows the PLM-4 unit to be controlled by a remote computer. NOTE: An optional computer interface card must be installed into the PLM-4 unit for computer interface capabilities.

System Set-up

- 1.) Force Transducer Installation All calibrated Helm force transducers and calibration load cells must be properly installed in their appropriate locations before proceeding with PLM-4 unit operations. Force sensor installation information contained in this manual is limited to Helm calibration load cells. Refer to the "Dynamic Press Calibrations using Helm Calibration Load Cells" section of this manual for important information including load cell placement, use of shims and spacers, and machine set-up before attempting a press calibration. For all other Helm force transducers, refer to the installation instructions provided with the sensors, or contact the Helm factory or representative for more information.
- 2.) Force Transducer Wiring Connections Beginning with channel one, connect a Helm force transducer or calibration load cell to one of the three types of sensor input connectors (Amphenol 7 pin, Turck 5 pin or Weidmuller 5 pin) located at the rear panel of the PLM-4 unit. Connect additional sensors to channel 2, 3 or 4. Sensor input connectors can be mixed or matched from channel to channel, but <u>not paralleled</u> on any one channel at the rear panel. Unused channels must be turned off at the rear panel (Ch. 2, 3 or 4 only). Refer to the "Standard Connector Wiring Codes" section of this manual when field wiring sensor connectors or extension cables. Channel/Sensor designation should correspond to a logical configuration according to the application. Note: Transducer signal cables should maintain a distance of two feet (minimum) from power or control lines.
- 3.) Power Connections Locate the line voltage input connector at the rear panel of the unit. Plug power cord (provided) into the line voltage input connector. Connect the opposite end of the power cord to a 110 VAC or 220 VAC line voltage supply. Energize the PLM-4 unit by switching the power switch to the ON position (at the rear panel). NOTE: For optimal performance, allow the PLM-4 unit to warm-up while energized for 15 minutes at an ambient temperature range of 68 to 77°F (20 to 25°C).
- 4.) **Normal/Reverse Load** Locate the NORMAL/REVERSE switch at the rear panel. Rotate the switch to the normal position.
- 5.) **Track/Peak Mode** Locate the TRACK/PEAK switch at the front panel. Rotate switch to the Track position.
- 6.) **Meter Scale and Range Settings** Locate the meter scale selector labeled "SCALE SET" and the meter range switch labeled "HIGH, LOW" at the rear panel. Set proper meter scale and range as follows:
 - a.) Helm Calibration Load Cells for one to four calibration load cells of the same size and load capacity, set the meter scale equal to the load cell capacity at the meter scale selector. For load ratings of 150 tons or less, enter the exact load value and put the meter range switch in the "LOW" position. For load ratings above 150 tons, drop the last digit and enter the remaining two numbers at the meter scale selector, then put the meter range switch to the "HIGH" position by pulling outward on the toggle arm to unlock the switch, then toggling upward.

Examples:	Load Cell	Meter	Meter
	Capacity	<u>Scale</u>	<u>Range</u>
	50 tons	050	LOW
	100 tons	100	LOW
	250 tons	025	HIGH
	1000 tons	100	HIGH

System Set-up (continued)

b.) Helm Bolt-on Strain Gage Sensors (calibrated) – Set the meter scale equal to the rated machine capacity divided by the number of sensor input signals at the rear panel. One sensor input at the rear panel is equal to a single sensor location (e.g., press column), or 2 sensors wired in parallel on the machine (e.g., pitman arm) where one cable run to the instrument contains the combined signal of two paralleled sensors (do not parallel sensor inputs at the rear panel). The meter range switch should be in the "LOW" position unless the machine capacity dividend is above 150 tons.

Examples:	Machine Capacity and Configuration	Meter <u>Scale</u>	Meter <u>Range</u>
	500 ton Straight Side Press (4 columns, 4 sensors, 4 inputs)	125	LOW
	600 ton Top Drive Press (2 pitmans, 4 sensors, 2 inputs)	030	HIGH

- c.) Helm Model SB Squaring Block Sensors refer to the "Die Cast and Injection Molding Applications" section for details.
- d.) Miscellaneous Helm Sensors For all other Helm force transducer applications, refer to the "Miscellaneous Helm Force Transducer Applications" section of this manual.
- 7.) **Sensor Bridge Balance** Locate the manual zero BALANCE potentiometer for channel one on the front panel. With the force transducer or load cell connected to the PLM-4 unit (under a no-load machine condition), manually adjust the potentiometer until the CHANNEL ONE meter displays zero. Repeat procedure for remaining sensors. If a channel is not used and is shut off, then the corresponding meter should also display zero.
- 8.) Setting Calibration Sensitivity Locate the CAL SENSITIVITY switch at the front panel. Select the switch position which matches the shunt resistor value of a particular sensor. This value can be referenced from the Calibration tag on the sensor or by its calibration record. The internal shunt resistor values of the PLM-4 unit correspond to the following switch positions: 1=140K, 2=56.2K, 3=499K, and 4=1Meg. If a shunt calibration resistor of particular Helm force sensor does not match any of the PLM-4 shunt resistor values, then a mathematical conversion can be used to establish a new "CAL" number which corresponds to one of the PLM-4 resistor values (see the "shunt calibration number conversions" section for details).

Note: Unlike the meter scale and range settings, which affect all channels, the calibration sensitivity only affects one channel at a time during "cal" number entry. The selected internal shunt resistor is only active when the CAL switch is in the ON position (per step #10) for a given channel.

9.) Sensor calibration number conversion from "Percent" to "Tons" – when using the PLM-4 unit, it is necessary to convert an established calibration number ("Cal" Number) expressed in percent to an equivalent "Cal" number expressed in tons. This is achieved by multiplying the load cell rated capacity by the "Cal" number in percent.

System Set-up (continued)

Example: The required "Cal" number in tons for a 250 ton calibration load cell with a 64% "Cal" number is (250T) x (64%) or (250) x (.64) = 160 tons. Therefore, 160 is the "Cal" number expressed in tons.

10.) Entering the calibration number ("Cal" Number) – Any "Cal" Number entered into the PLM-4 unit must be represented in tons (as covered in step #9). A "Cal" number may also require further manipulation, depending on application requirements. In addition, the percent "Cal" number must fall within the useable "Cal" number range based on the nominal bridge resistance of the Helm force transducer, before it is converted to a tonnage "CAL" number. Detailed procedures and sample calculations for typical "Cal" number conversions are covered in the "shunt calibration number conversions" section of this manual.

To enter a properly converted "Cal" number into the PLM-4 unit, position the CAL SENSITIVITY switch to the appropriate position (per step #8). Beginning with channel one, verify a sensor bridge balance of zero on the channel one meter display (adjust if necessary per step #7). Locate the channel one CAL ON/OFF switch at the front panel. Toggle the CAL switch to the ON position and hold. Locate and adjust the channel one GAIN (amplification) potentiometer (above the CAL switch) until the channel one meter displays the proper "Cal" number. Release the CAL switch and re-check meter for zero balance. Repeat procedure for additional channels (remember to set the "CAL SENSITIVITY" switch to the required position according to the shunt resistance of each sensor for each channel).

NOTE: When entering tonnage "CAL" numbers (in track mode) into the PLM-4 unit, the channel meter will automatically show whole "CAL" number values or mixed "CAL" number values, depending on the meter scale and range settings. For meter scale settings of 100 (tons) or greater, whole number values are displayed. For meter scale settings of 010 to 099 (tons), whole numbers and one number to the right of the decimal point are displayed. For meter scale settings of 001 to 009 (tons), whole numbers and one number to the right of the decimal point are displayed. For meter scale settings of 001 to 009 (tons), whole numbers and two numbers to the right of the decimal point are displayed. These changes only occur when the meter range is in the LOW position.

11.) The PLM-4 system is now ready for operation. Refer to the appropriate sections of this manual for manual mode operation, JDC-Job Data Control operation, computer interface operation, dynamic press calibrations using Helm calibration load cells, die cast and injection molding applications, and miscellaneous force transducer applications.

MANUAL MODE

All user functions (described in the system set-up section of this manual) are manually controlled by the PLM-4 operator. JDC-Job Data Control and computer interface functions are not active.

JDC – JOB DATA CONTROL MODE

In the JDC mode, the PLM-4 unit operates the same as in Manual mode, but with the added capability to store and recall target (good part) peak tonnage output readings. The recalled values are based on previous load data of specific jobs. This is primarily used for target load verification at job set-up due to a die change for repetitive jobs. The force transducer signal source is typically a Helm HT-400 bolt-on strain gain sensor which has been previously calibrated to the machine.

STORING AND RECALLING JOB OUTPUT DATA

Storing:

- Set the PLM-4 unit to MANUAL, NORMAL, PEAK mode. The green LED on the front panel will be lit but not flashing.
 - 2.) Cycle the machine (making good parts), then stop the machine. NOTE: Do not clear the "good part" peak tonnage data from the meter displays.
 - 3.) Select a job number from 00 to 99 at the front panel.
 - 4.) Push the "Target Load" button at the front panel to check for previously stored data. If peak tonnage values appear at the meter displays, then select a different job number to avoid over-writing this data with new values. If zero values appear at the meter displays, then the selected job number is open and ready for new value input.
 - 5.) While current "good part" peak tonnage values are displayed at the meters, press the "store" button at the front panel. The green LED will flash 5 times to indicate the selected job number has been internally accessed.
 - 6.) Toggle the MANUAL/TARGET LOADS switch up to the "Target Loads" position. If the yellow LED at the front panel is lit but not flashing, then the selected job number has been internally activated. If the yellow LED is flashing, then repeat steps #5 and #6.
 - 7.) Press the "Store" button at the front panel. The green LED will flash 5 times, indicating the target "good part" peak tonnage values have been successfully stored. Note: This step will over-write any previously stored values from the selected job number.
 - 8.) Record job number, peak tonnage values, and part identification data in the "Notes" section of this manual or in a separate location for future reference.
 - 9.) Press the "Reset" button at the front panel to continue JDC or MANUAL operations.
- **Recalling:** 1.) Set PLM-4 unit to JDC, NORMAL, PEAK mode.
 - 2.) Refer to written record of previously stored job numbers if necessary.
 - 3.) Select job number at the front panel.
 - 4.) Toggle the MANUAL/TARGET LOADS switch up to the "Target Loads" position.
 - 5.) Press the "Target Load" button to display the previously stored peak tonnage values for the selected job number.
 - 6.) Release the "Target Load" button and continue with JDC or Manual operations.

COMPUTER INTERFACE FUNCTIONS

Computer interface functions are used to control the PLM-4 unit by a remote computer to perform data acquisition and load signature analysis, using Helm Mariner software. If the PLM-4 unit was originally purchased with computer interface hardware and software, then go directly to the "Signature Mode Operations" section of this manual (pg.15). If the PLM-4 unit was originally purchased without computer capabilities, then refer to the "Computer Interface Upgrade" section of this manual (pg. 13).

This section covers field-upgrade procedures for PLM-4 computer interface capabilities. This upgrade requires the purchase of a special EIC (Enhanced Interface Communications) card, communications cable and Helm Mariner software. Contact the Helm sales department to obtain the necessary upgrade items.

COMPUTER INTERFACE UPGRADE PROCEDURE

- NOTE: Persons performing this upgrade should be experienced in working with sensitive electronic equipment.
- 1.) Set PLM-4 unit on a clean, flat work surface.
- 2.) Turn power switch to OFF position at the back panel and disconnect the power cord from the back of the unit.
- 3.) Rotate the carrying handle until it extends out across the front panel, allowing the unit to rest on the bottom feet.
- 4.) On each side of the unit, remove the 2 Phillips head screws toward the top.
- 5.) Remove top cover panel.
- 6.) Orient the unit to match illustration on pg. 14
- 7.) Locate slot rack as shown.
- 8.) Remove lock bar.
- 9.) Locate slot #1 as shown.
- 10.) Slide the EIC card into slot #1, keeping the "component side" of the board consistent with the other boards in the rack, as shown. The EIC card should be seated in the card connector when installed properly.
- 11.) Connect EIC card cable connectors to the 422/232 communications converter board as shown. Secure cable with tie-wrap at or near location shown.
- 12.) Re-install lock bar across the slot cards, making sure the lock bar tabs are inserted into the slotted metal plates at both ends of rack.
- 13.) Re-install top cover and screws. Note: The PLM-4 computer interface hardware upgrade is now complete. The communications cable will be needed later.
- 14.) Install Mariner software on a stationary P.C. or lap top computer. Note: Proceed to the "Signature Mode Operations" section of this manual to use the computer interface functions of the PLM-4 unit.

OPERATING INSTRUCTIONS



Install EIC card in slot #1

Tie wrap EIC cable to other $_{\rm 14}\,$ cables at this location

SIGNATURE MODE OPERATIONS

SET-UP

The purpose of the Signature mode of the PLM-4 unit is to enable the user to capture peak load values and analyze the signature (waveform) of dynamic processes such as metal stamping. Prior to activating Signature mode, the following conditions must be met:

- 1,) PLM-4 unit must contain the necessary components for signature mode (EIC card, communications cable).
- 2.) Helm Mariner software must be installed on a stationary P.C. or laptop computer.
- 3.) PLM-4 unit must be operational in manual or JDC mode and connected to the P.C. using the provided communications cable with RS-232 connectors.
- 4.) Proper CAL numbers and CAL sensitivity must be set manually at the unit and peak "Good Part" values captured from actual machine cycles should be stored in JDC mode, if desired.

Activating Signature mode switches the PLM-4 unit from Porta-Peak mode (true peak of hit) to Signature mode where PLM-4 functions as a Helm Loadgard unit. The user should be advised that when the PLM-4 is in Signature mode, a 25% threshold exists for Auto Peak reset. This means that the displayed tonnage will update only if the next hit is at least 25% in magnitude of the last hit of the press. This applies to continuous press cycles only. For single stroke press operation, the reset function must be activated between each load cycle.

The user should also be aware that the PLM-4 unit has a default time window for capturing load data. The default duration is one-second. This window can be expanded in Signature mode only. When switching from Signature mode to Manual, the time window reverts back to the default.

ACTIVATING SIGNATURE MODE

- 1.) Launch the installed Mariner 2000 program at the computer desktop screen.
- 2.) Refer to the Mariner software operating manual for complete instructions.
 - NOTE: Once the Signature mode is activated from the software, the red (computer) LED will be lit at the PLM-4 front panel. The green (manual) and yellow (JDC) LED's will not be lit.

DISABLING SIGNATURE MODE

1.) Turn Track/Peak to Track position, then back to Peak if desired. The PLM-4 is now back in Porta-Peak mode as signified by the illuminated green or yellow LED's at the front panel.

DYNAMIC PRESS CALIBRATIONS USING HELM CALIBRATION LOAD CELLS

This section covers general guidelines and procedures for performing dynamic press calibrations using the Helm PLM-4 four channel Porta-Peak instrument and Helm model LC calibration load cells. To ensure operator and machine safety, the reader is advised to study this section carefully. For questions regarding a specific machine application which may not be covered in sufficient detail within this manual, the reader is advised to discuss the application with a Helm field service technician before proceeding with the calibration.

DEFINING THE PRESS CALIBRATION

In general terms, electronic calibration of a press involves the use of remote instrumentation and load cells on the press bed to verify actual press tonnage at a specific shut height. The shut height is then adjusted in small increments until the instrument indicates the press is developing a load equal to its rated capacity. When the benchmark tonnage has been established, output from previously installed permanent force transducers are then electronically adjusted to match the benchmark load in tons or percent of capacity, depending on the signal conditioner in which the sensors are connected. Therefore, deflections from other parts of the press are assimilated to the actual tonnage being produced in the work area of the press. The permanently mounted sensors and permanent or portable instrumentation are then used to verify the working tonnage on an intermittent or continuous basis. The accuracy of the permanent load monitoring or calibration system at any load point, based on a change in the loading condition, depends primarily on the linearity of the system and overall press condition.

The primary function of the Helm PLM-4 unit and Helm calibration load cells is to verify press tonnage in order to accurately set-up a permanent Helm load monitor system such as HT-400 bolt-on strain gain sensors and a TLG series Loadgard signal conditioner (see illustration, pg. 20). If target load verification and job set-up (die change) is of more importance than continuous load monitoring, then the HT-400 or other Helm force transducers can be set-up through a separate PLM-4 unit, eliminating the need for a permanently mounted signal conditioner. Therefore, several calibrated machines which have Helm force transducers can be set-up as needed using one on-site PLM-4 unit (refer to page 40 for bolt-on strain gain sensor cable termination information). In some cases where all four channels of the PLM-4 unit are not required for Helm calibration load cell input, the remaining channels can be used for permanent sensors) based on the meter scale for the calibration load cells would be required to obtain true tonnage display for the permanent sensors (see the "Shunt Calibration Number Conversions" section of this manual for more details).

LOAD CELL SELECTION

Proper selection of Helm load cells depends largely on the rated press capacity and the size of the press bed. The type of press (e.g.; OBI, Straight side) is also a factor. Standard Helm load cells are produced in 50, 100, 250, 500 and 1000 ton capacities. The PLM-4 unit accepts up to four load cell inputs. Typically, many types of presses can be calibrated using one PLM-4 unit and one to four calibration load cells. On extremely large presses with a capacity in excess of 4000 tons, a second PLM-4 unit and/or multiple calibration load cells connected in series and/or parallel to the PLM-4 unit(s) may be necessary. These special applications are not covered in this manual and must be discussed in detail with a Helm field service technician.

As a general rule, the number of load cells to be used is determined by the number of "connection" points on the press. In this manual, a "connection" is defined as the linkage between the slide and the main drive mechanism, such as a crankshaft (see illustration, pg. 20). For example, a single point press; requires one load cell on the press bed directly under the

"connection", two point press; two load cells, four point press; four load cells. It is important to use load cells with a combined capacity equal to or greater than the rated capacity of the press. On a single point press, the rated capacity of the single load cell is used as the reference. On multiple point presses, the required capacity for each load cell is equal to the rated press capacity divided by the number of "connections". Examples: for a 35 ton OBI press with one "connection", one 50 ton standard load cell can be used. For a 600 ton straight side top drive press with four "connections", four 250 ton standard load cells can be used.

SPACER PLATES AND BLOCKS

Spacer plates or blocks are used as stack-up to compensate for large differences in load cell height and the minimum shut-height of the press (see illustration, pg. 20). They are also used to increase the load bearing surface of the load cell(s) to avoid marking or coining the slide or press bed. These spacers are usually made from wrought or cast steel. Cast iron spacers should never be used. The spacers should be solid and uniform (top to bottom), usually square or round. The hardness of the spacers should be approximately the same as the hardness of the slide or press bed, which ever is less. The loading surface of these spacers should be machined or ground as flat and parallel as possible. The actual size and thickness of the spacers will be determined by the load cell height, minimum shut-height, PSI rating of the press slide or bed material, rated press capacity, and rated capacity and loading surface area of the calibration load cell(s). Also, if a void (hole, pocket, etc.) exists in the slide or bed which is located at or near the ideal location of the stack-up, then the void must be compensated for when calculating spacer size requirements. When "bridging" voids becomes necessary, a safe guideline is to make the spacer as thick as the longest lateral dimension of the void. This is especially important when the spacer and the slide or bed are made from the same basic material or have the same PSI rating. Load cells are typically located on top of the spacers when no voids are present on the slide at the stack-up locations. A Helm field service technician can be contacted to help determine spacer requirements.

SHIMS

Soft shims are used in the calibration stack-up to compensate for minor flatness and parallel deviations of the press slide and bed to ensure even loading. They are also used to compensate for small differences in (load cell and spacer) stack-up height and the shut-height of the press. Common shim materials are: mild steel, aluminum, or 1/8" thick tempered masonite. Shims are usually located directly on the top and bottom of the load cell(s). A Helm field service technician can be contacted to help determine shim requirements.

LOAD CELL AND STACK-UP PLACEMENT

The number of load cell and stack-up columns should equal the number of "connections" on the press, as described in the previous "load cell selection" section of this manual. Each stack-up should be centered under each "connection" on the press bed (see illustration, pg. 20). When using multiple stack-ups, it is critical to verify that the total height of each stack up is the same. Using a ground matched set of load cells helps to simplify this process. Proper positioning of the calibration stack-up(s) is critical to the accuracy of the press calibration, in terms of even load distribution within the press. Since permanent sensors such as HT-400's are usually electronically adjusted for matching output from all sensors, proper stack-up location will ensure the load center of the press is always known. This will allow for proper positioning of the tooling as well as accurate analysis of forming processes and detection of adverse machine conditions such as gib misalignment, worn bearings or loose tie rods.

BASIC CALIBRATION PROCEDURE

Before proceeding with the press calibration, the following conditions should be verified:

- The press is in good mechanical condition
- Press safety and single stroke functions are working properly
- The press slide is parallel to the press bed
- Proper stack-up spacers and shims are available
- Permanent Helm signal conditioner is properly installed and energized (where applicable)
- Permanent Helm force transducers are properly installed and connected to a Helm signal conditioner
- Helm PLM-4 unit is set-up and energized
- Helm calibration load cells are thermally stabilized, connected to the PLM-4 unit, and are not in the press bed

SET-UP

- 1.) Measure the total height of the **load cell/spacer/shim** stack-up.
- 2.) Jog press to bottom dead center (BDC).
- 3.) Adjust shut height to allow clearance of total stack-up.
- 4.) Cycle press once and stop at bottom dead center (BDC) to verify shut-height clearance by assembling the calibration stack-up on the bed. A minimum clearance condition should exist between the top of the stack-up and the slide at bottom dead center. NOTE: The load cell cables can be disconnected while assembling stack-up.
- 5.) Raise the slide to top dead center (TDC) and disrupt power to the press.
- 6.) Locate the calibration stack-up(s) directly under each "connection" of the press. Check for proper stack-up alignment from side to side and front to back in relation to each "connection".
- 7.) Reconnect load cell cables if necessary.
- 8.) Set the PLM-4 unit to Manual Track model and adjust zero balance for all live channels (shut off unused channels).
- 9.) Set the proper "CAL" numbers, meter scale and meter range at the PLM-4 unit.
- 10.) Re-check for zero balance and switch the PLM-4 unit to Manual, Peak Mode, then reestablish power to the press.

PRESS CALIBRATION

- Note: Press should be cycled in single-stroke mode only and calibration load cell zero balance should be checked and adjusted between each cycle.
- 1.) Cycle the press and make slight adjustments in shut-height until a small amount of output from the calibration load cell(s) is indicated at the PLM-4 unit.
- 2.) Continue to cycle the press and make slight shut height adjustments until the total load meter of the PLM-4 unit displays approximately 5-10% of the total target load (rated press capacity).
- 3.) For multiple stack-ups, a slight difference in load from channel to channel may be indicated at the meters of the PLM-4 display. This could be an indication of variation in stack-up height, or non-parallelism of the slide and bed. To compensate for this, add thin steel shim stock to the stack-up with the least amount of output until all stack-up outputs are equal.

- 4.) Continue to cycle the press and make slight shut-height adjustments until the total meter at the PLM-4 unit indicates a tonnage approximately equal to the rated capacity of the press within one or two tons. Achieve the exact value of rated capacity by making final shut-height adjustments or by adding thin steel shim stock to each stack-up.
- 5.) Once the target total tonnage has been achieved with equal output from all calibration load cell inputs, the permanent sensors can now be calibrated to the PLM-4 system benchmark.
- 6.) For permanent force sensors which are to be used with a permanently mounted Helm signal conditioner, follow the specific instructions for the signal conditioner to calibrate the sensors.
- 7.) For permanent force sensors to be calibrated with a separate PLM-4 unit, proceed as follows:
 - a.) Make sensor connections at the back of unit.
 - b.) Set the unit for Normal, Track mode.
 - c.) Check and adjust zero balance for each sensor.
 - d.) Refer to the "Shunt Calibration Number Conversions" section of this manual for instructions to set-up an arbitrary cal number and to determine the required "Cal" number for proper tonnage display for each permanent force sensor.
 - e.) With proper "Cal" numbers and tonnage output verified, the press and permanent sensors are now calibrated to the load cell benchmark at rated press capacity.
- 8.) For permanent sensors to be calibrated using the same PLM-4 unit as the calibration load cells (where open channels are available), proceed as follows:
 - a.) Make sensor connections at back of unit.
 - b.) Check and adjust sensor zero balance.
 - c.) Refer to the "Shunt Calibration Number Conversions" Section of this manual for instructions to set-up an arbitrary cal number (based on the meter scale of the load cells) and to determine the required "Cal" number for proper tonnage display for each permanent force sensor.
 - d.) With proper "Cal" numbers and tonnage output verified, the press and permanent sensors are now calibrated to the load cell benchmark at rated press capacity.
- 9.) For all permanent sensors, regardless of the type of signal conditioner in which they are connected, perform a linearity check as follows:
 - a.) Back-off the shut-height to achieve approximately 25, 50 and 75 percent tonnage of the rated press capacity using load cell output and PLM-4 unit as the control. Record output from permanent sensor(s) at each load point.
 - b.) Continue shut-height adjustment to achieve a 100% full scale capacity load point and record the output from the permanent sensor(s).
 - c.) Calculate full scale error at each load point. Note: If significant error from full scale is noted, then some possible causes could be, improperly tightened sensor installation hardware, poor sensor location, or improperly tightened tie rods. Verify the source of the problem and take corrective action. Then, re-check linearity.
- 10.) Record "Cal" numbers and shunt resistor values for all permanent force sensors.

TYPICAL PRESS CALIBRATION

USING HELM LOAD MONITORS, CALIBRATION LOAD CELLS & STRAIN GAIN SENSORS



SHUNT CALIBRATION NUMBER CONVERSIONS

It is possible to mathematically manipulate the calibration reference numbers such as the "Cal" number, calibration sensitivity ("Cal" resistor), and meter scaling while retaining the calibration validity of the system. Such conversions are typically done when calibrating permanently mounted force transducers to a known calibration condition. They can also be used to compensate for low signal output and to "equalize" the calibration values of different types of sensors connected to the same signal conditioner. The reader is advised to be aware of how the calibration reference numbers are represented within a given Helm signal conditioner. For model PLM-4 Porta-Peak units, the "cal" number is <u>always</u> represented in tons. The "CAL" number is typically represented in percent for other Helm signal conditioners such as the TLG series Trend Loadgard. This section covers basic terminology and sample calculations for typical shunt calibration number conversions. The reader is advised to study this section carefully and contact a Helm field service technician with questions.

SHUNT CALIBRATION TERMINOLOGY

Shunt Calibration – two types of shunt calibrations are typically used for Helm force transducers. These are **factory** and **field** shunt calibrations.

During a **factory** calibration, a production force transducer or calibration load cell is physically strained to a known load in a controlled test environment. The average output and linearity from repetitive cycles are recorded. Then, several values of shunt (calibration sensitivity) resistors are introduced into the transducer bridge circuit (one at a time) when no physical load is present. The resistor is "shunted" across two legs of the wheatstone bridge circuit to intentionally mis-balance the force transducer. This is done to electronically simulate a physical load on the transducer. An output ratio is then established by dividing the shunt output by the average physical output value. Multiplying this ratio by 100 yields the percent calibration number of the transducer for each shunt (calibration sensitivity) condition. This calibration number is required to obtain true calibrated output of the force transducer when connected to a Helm signal conditioner. The best calibration number is then selected based on a useable calibration number range for Helm signal conditioners, or by a shunt resistor condition which is pre-determined for a specific application.

Field calibrations are typically performed using calibration load cells and a PLM-4 Porta-Peak unit for independent load verification. Force transducers which are not factory calibrated (such as HT-400 sensors) are typically field calibrated by noting the output from the sensor at a known load and shunt resistor condition. Initially, this output is based on an arbitrary calibration number. The ratio of the target output over the actual output is then multiplied by the arbitrary calibration number to determine the proper calibration number to achieve target output at the known load and shunt resistor conditions.

Calibration or "CAL" Number – An amplification (or de-amplification) factor which allows for correct calibrated output of a given force transducer at a known physical load and shunt resistor (calibration sensitivity) condition.

Percent "CAL" Number – The amplification factor of a given force transducer represented as the percentage of amplification required to obtain true calibrated output at a known physical load and shunt resistor (calibration sensitivity) condition. Example: a "cal" number of 40% @ 56.2K ohms @ 100 tons means an offset signal (due to the shunt resistor) is equal to 40% of the physical full scale output of the transducer. Inputting the percent "cal" number of 40% (or 40) will allow for correct output display during physical loading, when the transducer is connected to a Helm signal conditioner (except for model PLM-4 Porta-Peak units).

Tonnage "Cal" Number – Percentage "Cal" number of a given force transducer converted to an equivalent tonnage value for input to a Helm PLM-4 Porta-Peak unit.

Arbitrary "Cal" Number – An initial "Cal" number which is selected for field calibration of a Helm force transducer when an independent means of machine load verification is present. The arbitrary "Cal" number is used as a starting point for determining the proper field "Cal" number for an un-calibrated sensor. This arbitrary number usually represents a "Cal" number in percent when an un-calibrated sensor is connected to a Helm signal conditioner <u>other than</u> a PLM-4 Porta-Peak unit.

Shunt Resistor – One of several specific resistors which is used to electronically control the sensitivity of a force transducer, by affecting the "Cal" number value. From an end-user standpoint, different shunt resistor values can be used at the Helm signal conditioner to electronically change the sensitivity of the transducer, depending on the application requirements.

"CAL" NUMBER CONVERSIONS

CONVERTING A PERCENT "CAL" NUMBER TO AN EQUIVALENT TONNAGE "CAL" NUMBER

Percent "Cal" numbers for all Helm calibration load cells and force transducers <u>must</u> be converted to an equivalent tonnage "Cal" number when used with the Helm model PLM-4 Porta-Peak load monitor. This tonnage conversion should take place <u>after</u> all other percent "Cal" number manipulations (if any) have been calculated. Also, the percent "CAL" number must fall within the useable "CAL" number range based on nominal sensor bridge resistance, before it is converted to an equivalent tonnage "CAL" number (see pg. 29).

Basic conversion:

Helm LC-250T calibration load cell with a 64% "Cal" number at 140K ohm shunt value

$$(250 \text{ tons}) \times (64\%) = 160 \text{ tons}$$

or
 $(250) \times (.64) = 160$

Therefore, 160 is the "Cal" number expressed in tons because 160 tons is 64% of 250 tons. This means an offset signal (due to the shunt resistor) is equal to 64% of the physical full scale output of the load cell. Inputting the tonnage "CAL" number of 160 will allow for correct tonnage display during physical loading, when the load cell is connected to the PLM-4 unit.

ARBITRARY "CAL" NUMBER METHOD FOR FIELD CALIBRATION OF HELM FORCE TRANSDUCERS

Arbitrary "Cal" numbers are routinely used to field calibrate Helm HT-400 bolt on strain gain sensors which are installed in various locations, depending on the type of press. For example: a 400 ton straight side top drive press would typically have one HT-400 sensor located on each of the four press columns.

With the press developing a load at its rated capacity, which is verified through Helm calibration load cells and a PLM-4 Porta-Peak unit, the HT-400 sensors are generating an un-calibrated signal to a permanently mounted signal conditioner (such as a Helm TLG-4500 Trend Loadgard). Since the total output meter display of the Loadgard represents 100% of the press load, each channel must show 25% of the total load which is equal to 100 tons. In effect, each of the columns is considered to be a 100 ton load cell.

Assuming the shunt resistor value is 499K ohms for all four channels of the Loadgard, an initial arbitrary "Cal" number of 50% can be entered into the Loadgard for each sensor (refer to the appropriate operating manual for this procedure and proper instrument settings). Assuming an output display of 43% for channel one, the sensor is clearly producing more output than is required. The sensor signal requires de-amplification to produce a 25% meter display and to be in calibration with the load cells. The required "Cal" number can be calculated as follows:

Ch. 1:	Ch. 1: <u>Target Meter Display (25%)</u> Actual meter display using arbitrary "Cal" number	х	Arbitrary "Cal" Number (50%)	=	Required "Cal" Number	
	arbitrary our number		- OR -			
		<u>25%</u> 43%	x 50% = 29%			
		- OR -				
		<u>25</u> x 43	50 = 29			

Therefore, the required "Cal" number for channel one is 29% at a shunt resistor value of 499K ohms with an actual column load of 100 tons. This process is then repeated for the remaining channels. With required "Cal" numbers entered for all channels, the press is then cycled (single stroke) to verify individual channel and total meter output values.

Note: Target output values can usually be achieved on the first try of this procedure. However, if the press is not new or in like-new condition, then the output values may only be close to the target values. In this case the above procedure can be repeated using the new output values, or minor gain ("Cal" number) adjustments can be made at the channel gain potentiometer on a trial and error basis until the target values are obtained for each channel. In any case, the resulting percentage "CAL" number must fall within the useable "CAL" number range based on nominal sensor bridge resistance (see pg. 29).

"CAL" NUMBER CONVERSION BASED ON SHUNT RESISTOR VALUE

It is sometimes necessary to convert an established percent "Cal" number to a different value based on the shunt resistor (calibration sensitivity) condition. This is usually done to establish or improve a "Cal" number based on the useable "Cal" number range for Helm signal conditioners (see pg. 29). Typically, factory calibrated Helm force transducers do not require this procedure. However, converting a "Cal" number based on the shunt resistor may be required when field calibrating HT-400 bolt-on sensors which are otherwise mounted correctly at a feasible location of the machine.

For example: a field calibration for an HT-400 sensor with a nominal bridge resistance of 350 ohms yields a "Cal" number of 215% @ 499K ohms. According to the reference table (see pg. 29), the useable "Cal" number range is from 12% to 195%. A useable "Cal" number can be established by multiplying the original "Cal" number by the ratio of the original shunt resistor value over the new shunt resistor value:

Original "Cal" Number x <u>original shunt resistor</u> = New "Cal" Number new shunt resistor -OR-215% x <u>499K ohms</u> = 107% @ 1000K ohms 1000K ohms (1 meg ohms)

-OR-

215 x
$$\underline{499}_{1000}$$
 = 107

Likewise, if a field "Cal" number falls within the useable "Cal" number range but is close to the high or low end of the range, then the "Cal" number can be improved by the same method to reestablish the "Cal" number near the midpoint of the useable range. This allows for more high and low amplification adjustment at the Cal (or Gain) potentiometer of the signal conditioner.

Example: a field calibration for an HT-400 sensor with a nominal bridge resistance of 350 ohms yields a "cal" number of 30% @ 499K ohms. According to the reference table, this value is at the low end of the range. By using the same formula, the "Cal" number can be re-established at a higher point of the range:

 $30\% \times \frac{499 \text{K ohms}}{140 \text{K ohms}} = 107\% @ 140 \text{K ohms}$ -OR- $30 \times \frac{499}{140} = 107$

Note: Shunt resistor values are not limited to 140K, 499K and 1 meg ohms (used in the examples). The actual range and values of shunt resistors will vary depending on the type of Helm signal conditioner which is being used. The Helm field service department can be contacted for more information regarding shunt resistor value options.

RE-SCALING A FORCE TRANSDUCER TO A NEW CAPACITY

A Helm calibrated force transducer or calibration load cell can be re-scaled to a different capacity based on its factory "Cal" number. This changes the output scaling, but not the physical load capacity of the sensor. For example, this procedure can be done to maintain a convenient output scale when running tests or jobs at different load points. Assume a Helm force transducer has a factory "Cal" number of 40% @ 56.2K @ 100 tons. The desired loads are; 25, 45 and 80 tons. Full scale output at each test load can be achieved by manipulating the "Cal" number for each condition, rather than performing tedious conversion calculations based on one full scale load point after the load data has been acquired. The transducer can be re-scaled as follows:

Oriç	jinal "Cal" Nu	umber	x	original capacity new capacity	=	New Cal Number @ new capacity
Therefore:	40(%)	x <u>100T</u> 25T	=	160% @ 56.2K @	25 t	ons
	40(%)	x <u>100T</u> 45T	=	89% @ 56.2K @	45 to	ns
	40(%)	x <u>100T</u> 80T	=	50% @ 56.2K @	80 to	ns

NOTE: This procedure can be used as long as the new load point does not exceed the rated capacity of the transducer (or rated capacity of machine component for HT-400 sensors), and the "Cal" number falls within the useable range according to the nominal sensor bridge resistance (see pg. 29). A shunt resistor change at the signal conditioner may be required to keep the new "Cal" number in range. See the "Cal number conversion based on shunt resistor value" section of this manual (pg. 25).

CONVERTING A "CAL" NUMBER BASED ON A COMMON METER SCALE (FOR FIELD CALIBRATED FORCE TRANSDUCERS)

As mentioned in the "Dynamic Press Calibrations using Helm Calibration Load Cells" section of this manual, it is possible to calibrate Helm bolt-on strain gain sensors using the same PLM-4 unit in which the load cells are connected, provided enough open channels are available. In this case, the "Cal" numbers of the bolt-on sensors are controlled by the meter scale setting for the calibration load cell(s).

Example:

- (1) 30 ton O.B.I. press
- (2) HT-400 force transducers
- (1) LC-50T calibration load cell

PLM-4 meter scale: 050 PLM-4 meter range: LOW Nominal frame tonnage at capacity: 15 tons per side

Procedure:

- 1.) Calibrate the press to 30 tons using the load cell as the benchmark reference.
- 2.) Input an arbitrary "Cal" number of 50 (tons) for each HT-400 sensor. Note: Arbitrarily select a CAL SENSITIVITY (shunt resistor) setting which allows for enough gain adjustment to achieve the arbitrary "Cal" number of 50 at the channel meter display.
- 3.) Cycle the press (single stroke) and note the output display (in tons) for each HT-400 sensor.
- 4.) Convert the arbitrary "Cal" number to the required "Cal" number as follows:

Target Display (15 tons)		Arbitrary		Required
Actual Display in Tons	Х	"CAL"	=	"CAL"
using arbitrary "CAL"		Number		Number
number		(50 tons)		

- 5.) Enter the new "CAL" number for each HT-400 sensor and cycle the press to verify proper tonnage display. Repeat the "CAL" number conversion process using new output values if necessary, or make minor GAIN adjustments until the target load is displayed.
 - NOTE: If the new "Cal" number is out of the useable range based on nominal sensor bridge resistance (see pg. 29), then a "Cal" number conversion is necessary based on shunt resistor values (see pg. 25).
- 6.) Once a useable "Cal" number is established and target output is achieved at the PLM-4 unit, the "CAL" numbers and gain sensitivity settings for the HT-400 sensors must be recorded along with the meter scale and range setting for the load cell for future reference.
 - NOTE: If a meter scale based on the press capacity is preferred for the HT-400 sensors, then convert the final "Cal" number as follows:

Using the same press example:

Final "Cal" Number		Load Cell Capacity (50 tons)		New "CAL" Number
Based on load cell	Х	HT-400 sensor "Capacity"	=	@ new meter scale
Meter Scale		(15 tons)		

The end result is a "CAL" number for each HT-400 sensor with a meter scale based on the press capacity and configuration, as if the sensors were calibrated by a separate PLM-4 unit and load cell. Again, the final "CAL" number for the HT-400 sensors must fall within the useable range based on nominal sensor bridge resistance for PLM-4 input. Convert this "CAL" number as previously described and make a final hit to verify proper tonnage at the meter displays. Record the final "Cal" number, calibration sensitivity and meter scale and range settings for future reference. This information is critical for safe and accurate die set-up and continuous load monitoring.

CONVERTING A "CAL" NUMBER BASED ON A COMMON METER SCALE (FOR FACTORY CALIBRATED FORCE TRANSDUCERS)

The PLM-4 unit can be used with multiple Helm force transducers of different sizes and capacity ratings. In order to achieve accurate tonnage display for all sensors (4 max.), a common meter scale must be established. This can be done by selecting one sensor as the control and establishing the meter scale for the control sensor. The "Cal" number for each additional sensor is then multiplied by the ratio of the meter scale tonnage of the control sensor, over the meter scale tonnage of the remaining sensor(s).

Example: Control sensor rated at 50 tons

Meter Scale	
at rated capacity	Meter Range
50	LOW

Additional sensor (unlike control) rated at 25 tons with a "Cal" number of 37%

$$37\% \times \frac{50T}{25T} = 74\%$$
 @ 50 tons - OR - 37 x $\frac{50}{25} = 74$

Final tonnage "Cal" number: 50 tons x 74% = 37 tons

$$(50) \times (.74) = 37$$

Result: Both sensors are now rated at 50 tons and have a common meter scale.

Note: When re-scaling any Helm force transducer to a new capacity, the actual applied load should not exceed the physical capacity of the sensor or machine.

USEABLE "CAL" NUMBER RANGE BASED ON NOMINAL FORCE TRANSDUCER BRIDGE RESISTANCE

Nom. Bridge Resistance (Single Sensor)	Useable "Cal" Number <u>* Percent</u>	Range Volts (reference)
700 ohms	24% - 195%	.640V - 5.201V
350 ohms	12% - 195%	.320V – 5.201V
175 ohms	6% - 97%	.160V – 2.587V

* Percent "CAL" numbers must be converted to tonnage "CAL" numbers for PLM-4 input.

NOTE: Nominal bridge resistance can be determined by referencing the load cell data sheet or by measuring the resistance across the (+) and (-) gage or (+) and (-) signal leads of the force transducer. The transducer cannot be connected to a signal conditioner or be under a physical load when measuring the bridge resistance.

"REVERSE LOAD" SET-UP FOR PEAK (DYNAMIC LOAD) APPLICATIONS

The "Reverse Load" feature of the PLM-4 Porta-Peak unit is intended for use when it is desired to monitor the negative portion of certain forming forces, displayed as positive output. Monitoring the "snap-through" forces associated with a blanking or piercing operation are typical examples when the reverse load feature would be used. When the NORMAL/REVERSE switch is in the REVERSE position, the PLM-4 reverses the polarity of the strain gage force transducers to achieve positive output display when negative forming forces occur.

The PLM-4 is <u>not</u> designed to capture the positive and negative forces within the same machine cycle. Therefore, the unit must be set-up for discreet operation. For normal positive forming force monitoring, consult the "system set-up" section of this manual. Assuming that the machine is calibrated, operational and the NORMAL/REVERSE switch is in the NORMAL position, the following procedure must be followed to capture reverse load readings:

"Reverse Load" Set-Up

- 1. Stop machine.
- 2. Switch NORMAL/REVERSE switch (back of unit) to REVERSE position.
- 3. Switch TRACK/PEAK switch (front of unit) to TRACK position.
- 4. Adjust zero BALANCE on all operational channels.
- 5. Switch TRACK/PEAK switch (front of unit) to PEAK position.
- 6. Depress RESET button (front of unit).
- 7. Restart press to monitor peak reverse load values.

Re-Establishing "Normal Load" Set-up

To switch the PLM-4 unit from Reverse Load to Normal Load operations:

- 1. Stop the machine.
- 2. Switch NORMAL/REVERSE switch (back of unit) to NORMAL position.
- 3. Switch the TRACK/PEAK switch (front of unit) to TRACK position.
- 4. Adjust zero BALANCE on all operational channels.
- 5. Switch the TRACK/PEAK switch (front of unit) to PEAK position.
- 6. Depress the RESET button (front of unit).
- 7. Restart press to monitor peak normal load values.

DIE CAST AND INJECTION MOLDING APPLICATIONS

The Die Cast version of the Helm PLM-4 Porta-Peak load monitor is intended for use with a Helm model SB squaring block or Helm model T-2640 tie bar sensors. The Helm model SB squaring block is used for verification of machine clamp force tonnage, platen squareness and parallelism. Helm model T-2640 sensors are primarily used for continuous load monitoring of actual tie bar tonnage. Contact the Helm factory for specific application details for the squaring block and tie bar sensors.

The Die Cast version of the PLM-4 unit contains the same front panel as the standard unit. The typical sensor/channel designation is: Ch. 1 – Bottom Operator, Ch. 2 – Top Operator, Ch. 3 – Bottom Helper and Ch. 4 – Top Helper. This configuration refers to each of the four machine tie bars, or the corresponding load columns on the Helm model SB Squaring Block, with respect to the machine operator (see pg. 33 for illustration).

On the rear panel, only one sensor input connector is present. This is a 16 pin female amphenol bulkhead connector which accepts live strain gage sensor inputs for up to four channels. This connector mates directly with the interconnect cable supplied with the Helm model SB Squaring Block, or the interconnect kit which is supplied with Helm model T-2640 tie bar sensors (where applicable). See illustration, pg. 34 and connector wiring code diagram, pg. 35.

The Die Cast version of the PLM-4 unit functions essentially the same as the standard unit, including optional computer interface functions. Refer to the computer interface functions section of this manual (pg. 12). Since Die Casting and Injection Molding forces are static in nature, the peak and JDC – Job Data Control functions are not useable. However, they are present in the event the PLM-4 unit is to be used in a dynamic application.

Force transducer "Cal" numbers are represented in tons, as on the standard model. For convenience, the "Cal" numbers for the Helm model SB Squaring Block are converted to tons from the factory, since the primary signal conditioner is the PLM-4 unit for the squaring block. However, the "Cal" numbers for the model T-2640 tie bar sensor require field calculations. If a model SB Squaring Block is present, then machine tie bar sensors can be calibrated using the squaring block as a calibration load cell. If no squaring block is present, then the "Cal" numbers for the tie bar sensors are calculated based on machine parameters and a factory benchmark calibration. This process yields a percent "Cal" number which is ultimately converted to a tonnage "Cal" number for input to the PLM-4 unit. Generally, this calculated "Cal" number procedure requires the involvement of Helm personnel. The Helm Die Cast Product Manager is the primary factory contact for assistance and application information.

The meter scale and range are set as follows: For Helm model SB squaring block, divide the rated capacity of the squaring block by four, which represents the force on each of the load columns. This dividend is the meter scale value. If the meter scale is 150 tons or less, then the exact meter scale value is entered at the scale selector while the meter range switch is in the "LOW" position. For meter scale values greater than 150 tons, drop the last digit and enter the remaining two numbers at the meter scale selector, then put the meter range switch to the "HIGH" position by pulling outward on the toggle arm to unlock the switch, then toggling upward.

Examples:	Squaring Block <u>Capacity</u>	Meter <u>Scale</u>	Meter <u>Range</u>
	300 tons	075	LOW
	600 tons	150	LOW
	800 tons	020	HIGH
	1000 tons	025	HIGH
	1000 tons	020	HIGH

For Helm Model T-2640 tie bar sensors connected to a PLM-4 unit, divide the rated machine capacity by the number of machine tie bars to determine the proper meter scale. Enter the meter scale and range as described above.

Once the Helm Model SB Squaring Block or the model T-2640 tie bar sensors are properly installed (see separate instructions), the sensors can be connected to the PLM-4 unit for operation. Refer to the "system set-up" section of this manual for operating instructions (except for meter scale and range settings, and force transducer input connections).



PLM-4



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CONNECTOR WIRING CODE FOR HELM MODEL PLM-4 PORTA-PEAK UNIT (DIE CAST VERSION) STRAIN GAGE FORCE TRANSDUCER CONNECTIONS

16 Pin Female Amphenol Connector (on PLM-4 unit)



- Notes: 1.) Front view terminal orientation of the female connector (shown) matches the back view of the mating male connector (not shown).
 - Using the connector code (above) will yield positive output in tension from any Helm model T-2640 tie bar sensor, and positive output in compression from a Helm model SB Squaring Block.
 - 3.) For positive output in compression, switch the (+) and (-) gage wires at the mating connector or junction terminal box (not shown), <u>or</u> use the reverse load feature on the PLM-4 unit, except for Helm model SB Squaring Blocks.
 - 4.) Standard Helm force transducer color code for factory supplied cable, including Helm molded cordsets:

Green	-	(+GAGE)
Black	-	(-GAGE)
White	-	(+Signal)
Red	-	(-Signal)
Shield	-	(Noise Drain)

5.) Final termination point for the noise drain circuit is at the Helm signal conditioner only. One noise drain circuit is required for each force transducer throughout the interconnect system.

MISCELLANEOUS HELM FORCE TRANSDUCER APPLICATIONS

All Helm force transducers can be connected to the Helm model PLM-4 Porta-Peak unit for load monitoring and analytical purposes. This includes any Helm standard or custom force transducer or calibration load cell.

Most Helm factory calibrated force transducers are assigned a "Cal" number in percent, which is required when using most Helm signal conditioners other than the PLM-4 unit. Percentage "Cal" numbers for Helm force transducers <u>must</u> always be converted to a tonnage value when using the PLM-4 unit (see page 23). Depending on the application, other "Cal" number conversions may be required. For example, these conversions may be required to re-scale a sensor to a different capacity, "equalize" the calibration values of different types of sensors connected to the same PLM-4 unit, or re-establish a "Cal" number based on a different shunt resistor condition. These types of application conversions must be applied to the factory percentage "Cal" number. Also, the converted percentage "Cal" number must fall within the useable "Cal" number range, based on the nominal sensor bridge resistance (see page 29). Converting a percent "Cal" number to tons must always be the final step when manipulating "Cal" numbers, primarily to avoid scaling errors.

Meter scale settings are also represented in tons on the PLM-4 unit. For factory calibrated Helm force sensors, the meter scale is usually equal to the capacity rating of the sensor, or a load point selected by the end-user. If the selected load point is to be represented as full scale at the PLM-4 unit, then the sensor can be re-scaled to the selected load point (see page 26). When one or more Helm force transducers of the same size and capacity are used, the sensors can be treated as calibration load cells when entering meter scale and range values (see "System Set-up", Step #6a, page 9, for details). If sensors of different size and capacity are to be used with the same PLM-4 unit, then a common meter scale must be established for all the sensors (see pages 27, 28).

For additional information about converting calibration reference values for special applications, refer to the "Shunt Calibration Number Conversions" section of this manual. For any questions regarding the application of miscellaneous Helm force transducers and the Helm model PLM-4 Porta-Peak unit, contact the Helm field service department.

STANDARD CONNECTOR WIRING CODE FOR HELM MODEL PLM-4 PORTA-PEAK UNIT

STRAIN GAGE FORCE TRANSDUCER CONNECTIONS

7 Pin Female Amphenol Connector (on PLM-4 unit)

FRONT VIEW



- Notes: 1.) Front view terminal orientation of the female connector (shown) matches the back view of the mating male connector (not shown).
 - 2.) Using the connector code (above) will yield positive output in tension from any Helm standard force transducer, except for calibration load cells.
 - 3.) For positive output in compression, switch the (+) and (-) gage wires at the mating connector or junction terminal box (not shown), or use the reverse load feature on the PLM-4 unit, except for Helm calibration load cells.
 - 4.) Standard Helm force transducer color code for factory supplied cable, including Helm molded cordsets:

Green	-	(+GAGE)
Black	-	(-GAGE)
White	-	(+Signal)
Red	-	(-Signal)
Shield	-	(Noise Drain)

5.) Final termination point for the noise drain circuit is at the Helm signal conditioner only. One noise drain circuit is required for each force transducer throughout the interconnect system.

STANDARD CONNECTOR WIRING CODE FOR HELM MODEL PLM-4 PORTA-PEAK UNIT

STRAIN GAGE FORCE TRANSDUCER CONNECTIONS

5 Pin Male Turck Eurofast Connector (on PLM-4 unit)



CONNECTOR CODE				
PIN 1 PIN 2 PIN 3 PIN 4 PIN 5	- - - -	(SHIELD) (+SIGNAL) (-SIGNAL) (-GAGE) (+GAGE)		

- Notes: 1.) Front view terminal orientation of the male connector (shown) matches the back view of the mating female connector (not shown).
 - 2.) Using the connector code (above) will yield positive output in tension from any Helm standard force transducer, except for calibration load cells.
 - 3.) For positive output in compression, switch the (+) and (-) gage wires at the mating connector or junction terminal box (not shown), <u>or</u> use the reverse load feature on the PLM-4 unit, except for Helm calibration load cells.
 - 4.) Standard Helm force transducer color code for factory supplied cable, including Helm molded cordsets:

-	(+GAGE)
-	(-GAGE)
-	(+Signal)
-	(-Signal)
-	(Noise Drain)
	- - - -

5.) Final termination point for the noise drain circuit is at the Helm signal conditioner only. One noise drain circuit is required for each force transducer throughout the interconnect system.

STANDARD CONNECTOR WIRING CODE FOR HELM MODEL PLM-4 PORTA-PEAK UNIT

STRAIN GAGE FORCE TRANSDUCER CONNECTIONS

5 Pin Male Weidmuller Connector (on PLM-4 unit)



- Notes: 1.) Front view terminal orientation of the male connector (shown) matches the back view of the mating female connector (not shown).
 - 2.) Using the connector code (above) will yield positive output in tension from any Helm standard force transducer, except for calibration load cells.
 - 3.) For positive output in compression, switch the (+) and (-) gage wires at the mating connector or junction terminal box (not shown), or use the reverse load feature on the PLM-4 unit, except for Helm calibration load cells.
 - 4.) Standard Helm force transducer color code for factory supplied cable, including Helm molded cordsets:

Green	-	(+GAGE)
Black	-	(-GAGE)
White	-	(+Signal)
Red	-	(-Signal)
Shield	-	(Noise Drain)

5.) Final termination point for the noise drain circuit is at the Helm signal conditioner only. One noise drain circuit is required for each force transducer throughout the interconnect system.

If target press load verification at job set-up (die change) is desired over continuous load monitoring, then the Helm bolt-on Strain Gain sensor can be connected to a Quick-disconnect terminal assembly, which attaches to the Helm model T-21 sensor enclosure. The sensor is field-wired to a 7 pin female amphenol connector, which mates to a Helm Porta-Peak cable. The connector is included with the Helm model WRS cover assembly. The "flip-top" lid of the WRS cover protects the connector from damage and contamination when not in use. Refer to the Helm "Installing Strain Gain Transducers" manual for complete installation details pertaining to bolt-on Strain Gain sensors and protective enclosures.



- Notes: 1.) Using the connector code (above) will yield positive output in tension from a Helm bolt-on strain gain sensor.
 - 2.) For positive output in compression, switch the (+) and (-) gage wires at the 7 pin female amphenol connector (shown) or use the reverse load feature on the PLM-4 unit.
 - 3.) Standard Helm force transducer color code for factory supplied cable, including Helm molded cordsets:

Green	-	(+GAGE)
Black	-	(-GAGE)
White	-	(+Signal)
Red	-	(-Signal)
Shield	-	(Noise Drain)
Shield	-	(Noise Drain)

4.) Final termination point for the noise drain circuit is at the Helm signal conditioner only. One noise drain circuit is required for each force transducer throughout the interconnect system.

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SPECIFICATIONS

Standard PLM-4 Porta-Peak Unit

120 VAC or 220 VAC $\pm 10\%$ 50-60
Hz Universal Power Supply
One 1/2 amp @ 250 VAC
Four Amphenol 7 pin, four Turck
5 pin, four Weidmuller 5 pin
Full bridge standard, 1/4 and 1/2 bridge
circuits with optional Helm adapter
8 volts DC. Short circuit protected
Front panel selectable for four
standard resistor values: 140K,
56.2K, 499K, 1Meg
80 to 1600 each channel
1% of meter full scale
Indefinite
Four BNC style connectors provide
track-out signal. Short circuit
protected.
100% full scale = 2.667 VDC

Standard Calibration Load Cells

Nominal output at full capacity	. 2 millivolts per volt of excitation
Repeatability	. Within 0.1% of rated capacity
Maximum dynamic overload	. 150% of rated capacity
Zero balance	. 0.01 millivolt per volt of excitation
Bridge resistance	. 700 ohms
Typical excitation voltage	. 8 volts D.C.
Maximum excitation voltage	. 15 volts D.C.
Input Connectors	. Amphenol 7 pin (#97-3102A-16S-1P)
	or Turck 5 pin (FS 4.5)
Height Tolerance	. Cells purchased individually will be
	matched in height within ± 0.002 inch.
	Cells purchased as a set will be
	specially ground to match within
	0.0002 inch.
Flatness and Parallelism	. within 0.0002 inch