

VERIMET® Model 7700

EDDY CURRENT INSTRUMENT OPERATION MANUAL

Version 2.2 — March 1998

Portable Eddy Current Tester



THE CHOICE
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SECTION 1

INTRODUCTION

1.1 OVERVIEW

The Verimet 7700 instrument, shown in Figure 1, is a nondestructive alloy and hardness testing instrument that utilizes eddy current principles. The Verimet 7700 instrument is manufactured by K. J. Law Engineers, Inc. and is intended for general purpose sorting and testing of ferrous materials. The instrument has been thoroughly checked and tested by the Quality Control Department and is warranted to meet or exceed the specifications under which it was manufactured.

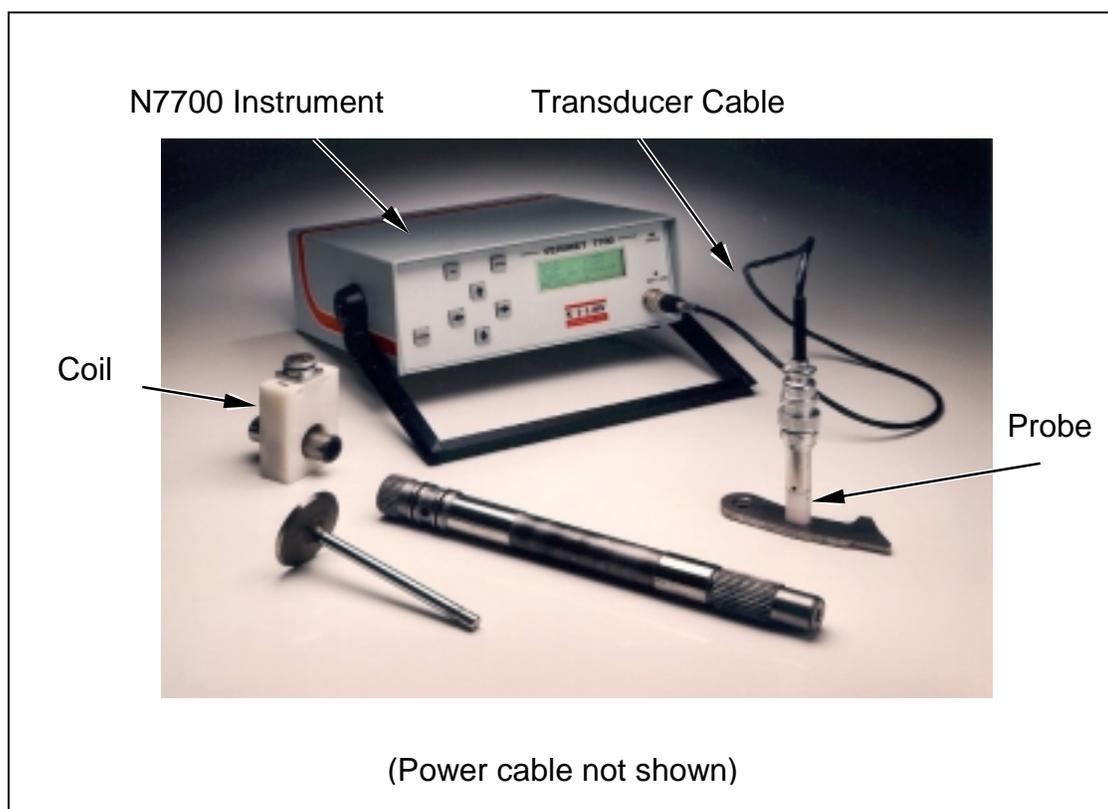


Figure 1. Verimet 7700 Instrument and Accessories

1.2 PHYSICAL DESCRIPTION

1.2.1 General

Physical description of the Verimet 7700 instrument is covered under the following headings:

- Connections (paragraph 1.2.2)
- Controls (paragraph 1.2.3)
- Display (paragraph 1.2.4)
- Indicators (paragraph 1.2.5)
- Fuses (paragraph 1.2.6)

1.2.2 Connections

1.2.2.1 Required Connections

For the Verimet 7700 to operate properly a transducer (probe or coil) must be connected to it. The transducer is connected to the instrument via a transducer cable. The transducer cable attaches to the transducer connector on the front panel of the instrument (Figure 2) and to the connector on the transducer. The instrument is then ready to operate using the internal battery. If the instrument is new and has never been used before, then the internal battery will need to be charged. For further information on battery charging refer to paragraph 3.3.

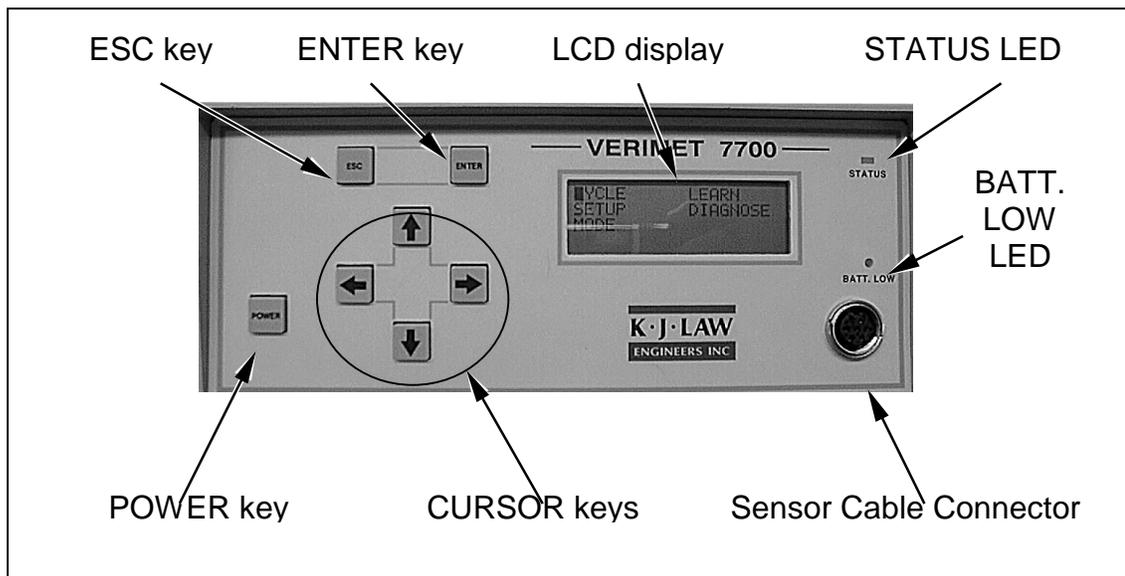


Figure 2. Verimet 7700 Instrument Front Panel

1.2.2.2 Optional Connections

The Verimet 7700 instrument is provided with an RS232 connector that allows the operator to interface the instrument with a computer and/or printer. It is also provided with a power cord connector that allows for battery recharging or 110 volt AC operation.

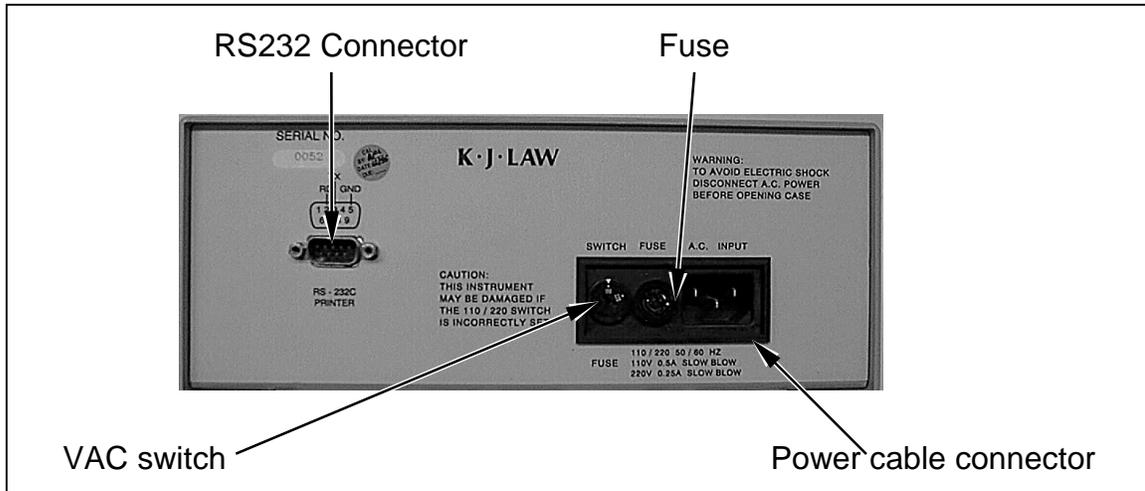


Figure 3. Verimet 7700 Instrument Rear Panel

1.2.3 Controls

The Verimet 7700 controls are located on the front panel of the instrument and consist of seven keys: POWER key, ESC (escape) key, ENTER key and four cursor keys, as shown in Figure 2. One exception is the VAC switch that is located in the back panel of the instrument and is shown in Figure 3. The function of each control is as follows:

- **POWER Key.** The POWER key toggles the instrument power on or off.
- **ESC Key.** The ESC key is used to cancel a selection or to drop back to the previously selected menu.
- **ENTER Key.** The ENTER key is used to select an option identified by the cursor.
- **Cursor Keys.** The cursor keys (up, down, left and right arrows) are used to move the cursor when selecting menu options or to increase or decrease values when a numerical input is required.
- **VAC Switch.** The VAC switch is used to select the line voltage (110 volt AC or 220 volt AC) for AC operation of the instrument.

1.2.4 Display

The Verimet 7700 uses a backlit, 20-column, 4-line liquid crystal display (LCD). All menus and options are selected using the LCD and the controls discussed in the previous paragraph.

1.2.5 Indicators

The Verimet 7700 is equipped with two indicator light emitting diodes (LED). Both LEDs are mounted on the unit front panel as shown in Figure 2. The functions of the two LEDs (STATUS and BATT. LOW) are as follows:

- STATUS LED. A tricolor LED (red for bad part, yellow for no part, and green for good part) indicates whether a part is present and whether the part is good or bad.
- BATT. LOW LED. This LED turns on when the internal battery is low and requires recharging.

1.2.6 Fuses

The instrument has a single 0.5 amp slow blow fuse (Figure 3) that is used during 110 volt AC operation. A single 0.25 amp fuse is used for 220 volt AC operation.

1.3 FUNCTIONAL DESCRIPTION

The Verimet 7700 instrument uses eddy current principles in order to identify metallurgical differences between accept and reject parts. The instrument operates by electromagnetically inducing an eddy current within the test part. The magnetic field generated by the induced current is measured to obtain information regarding the electrical and magnetic properties of the test part. Measuring those properties provides data used to determine metallurgical properties such as chemistry and heat treatment history.

SECTION 2

SAFETY CONSIDERATIONS

Before operating the Verimet 7700 instrument, please observe the following guidelines:

- Unplug this product from the wall outlet before cleaning. Do not use liquid cleaners or aerosol cleaners. Use a damp cloth for cleaning.
- Do not use this product near water.
- This product should be operated from the type of power source indicated on the marking label. If you are not sure of the type of power available, consult your dealer or local power company.
- This product is equipped with a 3-wire grounding-type plug, a plug having a third (grounding) pin. This plug will only fit into a grounding-type power outlet. This is a safety feature. If you are unable to insert the plug into the outlet, contact your electrician to replace your obsolete outlet. Do not defeat the purpose of the grounding-type plug.
- If an extension cord is used with this product, make sure that the total of the ampere ratings on the products plugged into the extension cord do not exceed the extension cord ampere rating. Also, make sure that the total ampere rating of all products plugged into the wall outlet does not exceed 15 amperes.
- Except as specifically explained in the User's Manual, do not attempt to service this product yourself. Opening or removing those covers that are marked "Do Not Remove" may expose you to dangerous voltage points or other risks. Refer all servicing in those compartments to service personnel.
- Unplug this product from the wall outlet and contact service personnel when the power cable is damaged or frayed.
- Unplug this product from the wall outlet and contact service personnel if liquid has been spilled into the product.
- Unplug this product from the wall outlet and contact service personnel if the product has been exposed to rain or water.
- If the product does not operate normally when the operating instructions are followed, adjust only those controls that are covered by the operating instructions. Improper adjustment of other controls may result in damage to the product. This damage may necessitate extensive service work by a qualified technician in order to restore the instrument's normal operating capabilities.

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SECTION 3

PREPARATION FOR USE

3.1 OVERVIEW

Before operating the Verimet 7700 instrument there are a number of preparatory procedures that must be completed. If the instrument has never been operated before, then the internal battery must be charged before standard operation. Preparation of the instrument is covered as follows:

- Instrument Connections (paragraph 3.2)
- Battery Charging (paragraph 3.3)

3.2 INSTRUMENT CONNECTIONS

Before operating the Verimet 7700, a probe or a coil must be connected to the instrument. The probe or coil is connected via the transducer cable. Connect the transducer cable to the probe or coil and the transducer connector on the front panel of the instrument (Figure 2). Note that the connector on the probe or the coil is different from the connector on the instrument; therefore, the cable must be oriented properly.

NOTE

If the instrument will be used for multiple reject groups sorting, then a computer or a serial printer must be available and connected to the instrument. For more information on computer or printer interfacing, refer to paragraphs 5.2 and 5.3.

3.3 BATTERY CHARGING

When the Verimet 7700 is new from the box, the internal batteries are not fully charged. Before operating the instrument with the internal batteries, they must be recharged. To do so, refer to the following procedure:

1. Plug the power cable to the power cable connector located on the back panel of the instrument. For operation other than 110 vac, see Section 7.6 before proceeding.
2. Plug the power cable into 110 volt AC / 60 Hz outlet (220 volt AC / 50 Hz outlet for European units).
3. Depress the POWER key on the front panel of the instrument to turn on the power.
4. Use the down arrow cursor key to move the cursor to the BATTERY option of the menu that appears on the LCD display.
5. Depress the ENTER key to select the BATTERY option.
6. Depress the ENTER key to begin charging the battery. The first line of the LCD display will read CHARGER:ON. The internal battery is now charging.

3.3 BATTERY CHARGING (continued)

NOTE

Charging the battery takes approximately 4 hours. Unless the instrument is in charging mode, the battery is trickle-charged only. When the instrument is in the charging mode and the charging sequence is active, the LCD will read CHARGER:ON. When the battery charging sequence is complete, the LCD will read CHARGER:DONE. To ensure optimum battery performance, it is recommended that the battery be fully recharged (CHARGER:DONE) each time the recharging procedure is performed. Proper battery charging will result in an extended battery life.

7. When the battery is fully charged, depress the ESC key to return to the main menu.

SECTION 4

OPERATION

4.1 OVERVIEW

The Verimet 7700 instrument is a menu-driven device that can be set up entirely through the front panel controls. This section contains an explanation of all available control panel commands and their corresponding instrument functions. Operation of the instrument is covered as follows:

- Menu Navigation (paragraph 4.2)
- Menu Path Tree (paragraph 4.3)
- Menu Options (paragraph 4.4)

4.2 MENU NAVIGATION

To navigate through the menus of the instrument, the ESC, ENTER and cursor keys are used. The cursor (a flashing black box on the LCD) indicates the active menu option. The cursor may be moved using the cursor keys. To select an option, position the cursor at the appropriate menu item or function on the LCD and depress the ENTER key. Depressing the ESC key will return the operator to the previous menu or cancel a selection. The front panel keys are shown in Figure 2.

4.3 MENU PATH TREE

The menu path tree diagram (Figure 4) illustrates the position of all menu options in the instrument's menu structure. To determine the path to each menu option, use the menu path tree diagram.

4.4 MENU OPTIONS

4.4.1 General

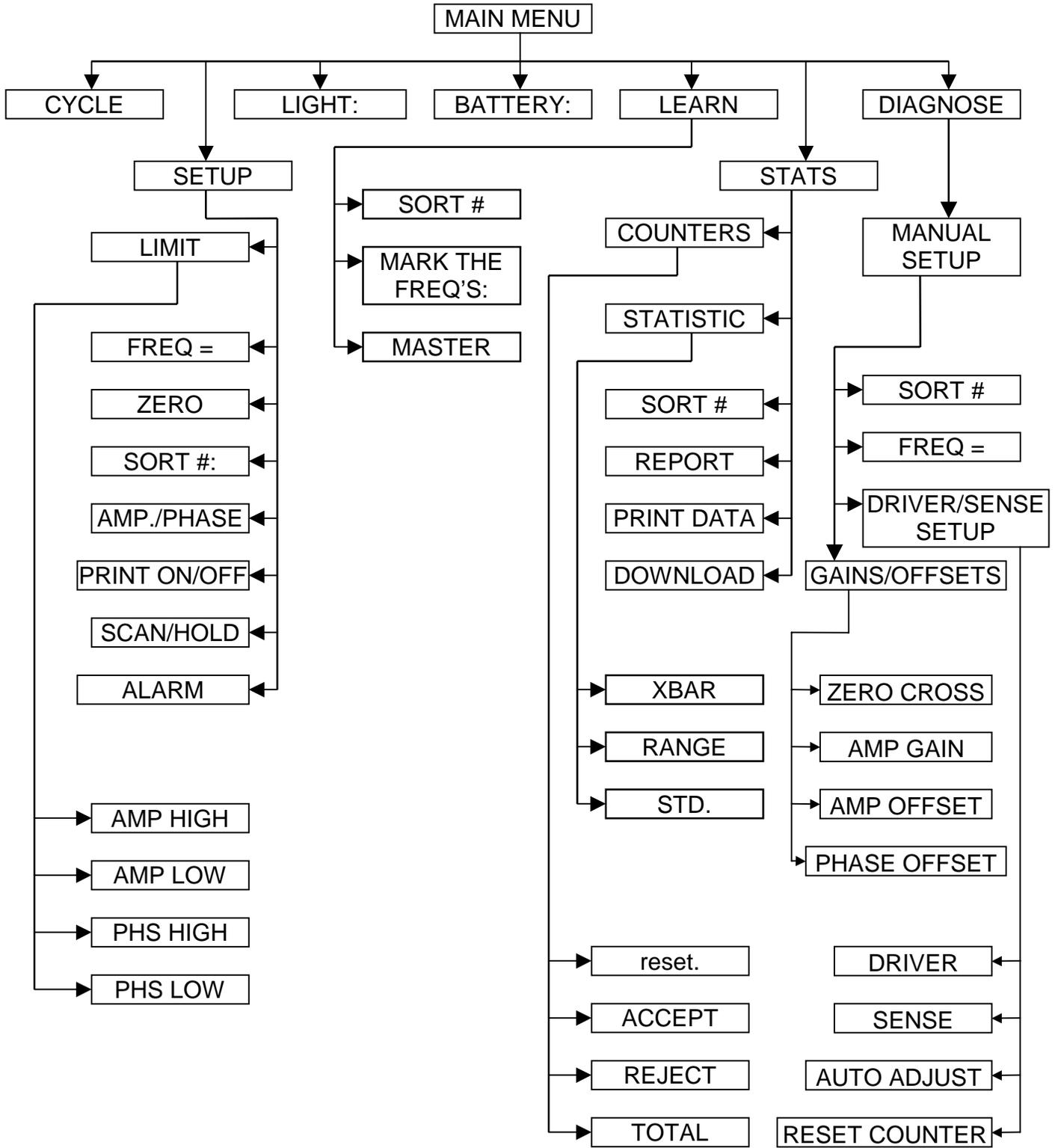
When the Verimet 7700 instrument is turned on (by depressing the POWER key), the LCD first displays the software version number screen and then the Main Menu (Figure 5). At this point the operator may access the instrument functions by navigating through the provided menus and options. The instrument functions are discussed as follows:

CYCLE Function (paragraph 4.4.2)
 SETUP Function (paragraph 4.4.3)
 LIGHT: Function (paragraph 4.4.4)
 BATTERY Function (paragraph 4.4.5)
 LEARN Function (paragraph 4.4.6)
 STATS Function (paragraph 4.4.7)
 DIAGNOSE Function (paragraph 4.4.8)

CYCLE	LEARN
SETUP	STATS
LIGHT: OFF	DIAGNOSE
BATTERY	

Figure 5. Main Menu Screen

Figure 4. Menu Tree Diagram



4.4.2 CYCLE Function

Selecting CYCLE at the Main Menu Screen opens the Cycle Screen shown in Figure 6. The Cycle Screen is used during part sorting and indicates the amplitude and/or phase readings pertinent to the material currently being scanned in the cycle mode. The STATUS LED (Figure 2), used in conjunction with the indicated amplitude, phase, or amplitude and phase readings is used to sort parts into accept or reject groups according to the threshold preset in the LEARN Function (paragraph 4.4.6). The amplitude and phase readings are followed by a less than (<) or a greater than (>) symbol. A less than (<) symbol indicates the reading is below the low limit, while a greater than (>) symbol indicates the reading is above the high limit. The operator may use the COUNT option for storing or deleting a count using the ENTER and down cursor keys. Only the last stored reading can be cleared using the down cursor key.

AMPLITUDE	PHASE
XXX. <	XXX. >
STORED COUNT =	X.
ENTER STORES /	DWN DEL

Figure 6. Cycle

Screen

4.4.3 SETUP Function

4.4.3.1 Description

Selecting the SETUP function from the Main Menu Screen brings up the Setup Menu Screen (Figure 7). The Setup Menu contains functions used to prepare and tune instrument operation according to the requirements of the application at hand. The Setup Menu options are covered in paragraphs 4.4.3.2 through 4.4.3.9.

LIMIT	AMP, PHASE
FREQ = XX	PRINT: OFF
ZERO	SCAN
SORT #: XX	ALARM: OFF

Figure 7. Setup Menu Screen

4.4.3.2 LIMIT Option

The Limit Screen (Figure 8) allows the operator to set up the high and low limits of the amplitude and/or phase range to be used during testing. Depending on whether amplitude, phase, or amplitude and phase are used, the operator has the choice to set the high and low limits for the amplitude, phase, or both, accordingly. The limit entries require numeric values that may be selected using the cursor keys (up to increase and down to decrease) after moving the cursor to the desired line and pressing ENTER. Once the correct value is set, the operator must depress the ESC key.

AMP HIGH LIM =	XXX.
AMP LOW LIM =	XXX.
PHS HIGH LIM =	X.X
PHS LOW LIM =	X.X

Figure 8. Limit Screen

4.4.3.3 FREQ= Option

Selecting the FREQ= (Frequency =) option from the Setup Menu changes the frequency used during the test. The desired frequency is selected using the ENTER key which scans through the available frequencies. The available frequencies are: 50, 100, 200, 300, 500, 1K, 2K, 3K, 5K, 10K and 20KHz.

NOTE

Changing the frequency at the FREQ= option to a frequency other than the one automatically set during the Learn sequence may result in an inaccurate sort. Manually selecting a scanning frequency requires knowledge of eddy current testing principles.

4.4.3.4 ZERO Option

Selecting ZERO zeroes the instrument for the part currently being tested. This option should also be used to zero the instrument when a probe is replaced. Zeroing the instrument compensates for variations in the probe and in the instrument electronics; this ensures an accurate reading.

4.4.3.5 SORT #:

Option. A sort number (Sort #:) pertains to a program that contains data for a particular sort setup. Selecting SORT #: changes the number of the sort type for which the instrument is being set up. There are 10 different sort program settings that may be stored in the instrument's memory. Depressing the ENTER key advances the sort number in increments of 1 until 10 is reached, then the count loops back to 01.

4.4.3.6 (AMP,PHASE), (AMPLITUDE), or (PHASE) Option

Selecting the (AMP,PHASE), (AMPLITUDE), or (PHASE) option (top / right selection of the Setup Menu) allows the user to toggle between the following three available choices:

- AMP,PHASE. During cycle mode (paragraph 4.4.2), both amplitude and phase readings will be displayed. Also, both amplitude and phase reject limits will be applied.
- AMPLITUDE. During cycle mode only the amplitude reading will be displayed. Only amplitude reject limits will be applied.
- PHASE. During cycle mode only the phase reading will be displayed. Only phase reject limits will be applied.

NOTE

Unless the operator is sufficiently familiar with the principles of eddy current testing, selecting a setting other than the setting pre-selected by the Learn function (Section 6) is not recommended. Varying this setting may result in an incorrect reading leading to a poor sort.

4.4.3.7 PRINT Option

In selecting PRINT, the print option may be toggled ON or OFF. For the print option to operate, the instrument must be attached to a computer or a printer. For further information on computer and printer interfacing, refer to Section 5.

4.4.3.8 (SCAN) or (HOLD) Option

The SCAN or HOLD option may be toggled between the following two choices:

- SCAN. The SCAN option sets the instrument to scan continuously and report the data when in cycle mode (paragraph 4.4.2).
- HOLD. The HOLD option sets the instrument to latch data from a single test sample. After the data are stored, the cycle may be restarted by removing the current part and testing the next one.

4.4.3.9 ALARM Option

In selecting ALARM, the alarm option may be toggled ON or OFF. The alarm in the ON position signals an audible alarm when a bad part is scanned. The alarm option is active only in the scan mode.

4.4.4 LIGHT: Function

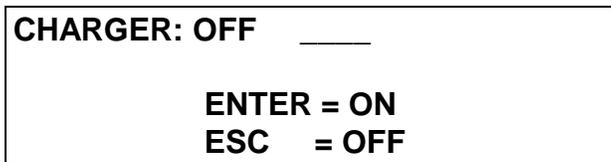
Selecting the LIGHT: function from the Main Menu Screen allows the user to toggle the display backlight ON or OFF.

4.4.5 BATTERY Function

The instrument will warn the operator of a low battery charge condition by turning on the BATT. LOW LED (Figure 2). Selecting the BATTERY function at the Main Menu Screen displays the Battery Recharging Screen (Figure 9). For the internal battery to be recharged, the power cable (Figure 1) must be connected to the power cable connector at the back panel of the instrument (Figure 3) and to an AC power source. If AC power is not supplied to the instrument, the battery will not recharge. To begin charging once the Battery Recharging Screen is displayed, press ENTER when the cursor is on "CHARGER : OFF." While the battery is charging, the screen will read CHARGER:ON. When the cycle is complete (approximately 4 hours), the screen will read CHARGER:DONE.

NOTE

The battery charger is active only while the Battery Recharging Screen is displayed. Exiting this screen stops the charging.



```
CHARGER: OFF  _____  
  
ENTER = ON  
ESC  = OFF
```

Figure 9. Battery Recharging Screen

4.4.6 LEARN Function

Selecting the LEARN function at the Main Menu Screen displays the LCD Learn Menu Screen (Figure 10) a warning message appears which notifies the operator that performing a Learn erases the old data for a sort and replaces it with the new data. Press ENTER after the warning message to move to the Learn Menu Screen. The Learn Menu provides for quick instrument setup. For further information on the Learn Menu options, refer to Section 6. The Learn Menu options are as follows:

SORT #: XX MARK THE FREQ'S : XX MASTER (←) MARK / (→) UNMARK

Figure 10. Learn Menu Screen

- **SORT #:**. Selecting the SORT #: option advances the number of the sort type that the instrument is being set up for. There are 10 different sort settings that may be stored. Depressing the ENTER key advances the sort number by 1 until 10 is reached, then the count loops back to 01.
- **MARK THE FREQ'S.** The left and right cursor keys are used for selecting the frequencies that will be used to scan the parts that are to be sorted. The desired frequency is selected using the ENTER key, which scans through the available frequencies. The available frequencies are: 50, 100, 200, 300, 500, 1K, 2K, 3K, 5K, 10K, 20KHz and ALL. When a desired frequency is displayed, depressing the left cursor key marks that frequency for use during the scan. To unmark a frequency that has been previously marked, use the right cursor key. If you select "ALL" this will mark all the frequencies.
- **MASTER.** Selecting MASTER at the Learn Menu starts a sequence that walks the operator through a step by step configuration of the instrument for the selected part. This option is covered in detail in Section 6.

4.4.7 STATS Function

4.4.7.1 Description

Selecting the STATS function at the Main Menu Screen displays the Statistics Menu Screen (Figure 11). The Statistics Menu provides for the statistical comparison of gathered data. The Statistics Menu options are covered in paragraphs 4.4.7.2 through 4.4.7.7.

COUNTERS REPORT STATISTIC SORT #: XX	PRINT DATA DOWNLOAD
---	--------------------------------------

Figure 11. Statistics Menu Screen

4.4.7.2 COUNTERS Option

Selecting COUNTERS from the Statistics Menu displays the Counters Screen (Figure 12). The Counters Screen displays the number of accepted and rejected parts, as well as the total number of all scanned parts. Selecting reset in the Counters Screen and depressing ENTER will clear all counters.

reset	AMP	PHASE
ACCEPT	XXX.	XXX.
REJECT	XXX.	XXX.
TOTAL	XXX.	XXX.

Figure 12. Counters Screen

4.4.7.3 STATISTIC Option

Selecting STATISTIC from the Statistics Menu displays the Xbar/Range/Standard Menu Screen shown in Figure 13.

	AMP	PHASE
X BAR	XX.X	X.X
RANGE	XX.X	X.X
STD	XX.X	X.XX

Figure 13. Xbar/Range/Standard Menu Screen

4.4.7.4 SORT #: Option

Selecting the SORT #: option from the Statistics Menu advances the number of the sort type for which the statistics are done. There are 10 different sort types that may be selected. Depressing the ENTER key advances the sort number by 1 until 10 is reached, then the count loops back to 01.

4.4.7.5 REPORT Option

Selecting the REPORT option from the Statistics Menu sends statistical report information to a printer. For further information on computer and printer connections refer to Section 5.

4.4.7.6 PRINT DATA Option

Selecting the PRINT DATA option from the Statistics Menu sends gathered information about the part type to a printer. For further information on computer and printer connections refer to Section 5.

4.4.7.7 DOWNLOAD Option

Selecting the DOWNLOAD option from the Statistics Menu allows the instrument to send data to a computer. For further information on computer and printer connections refer to Section 5.

4.4.8 DIAGNOSE Function

4.4.8.1 Description

Selecting the DIAGNOSE function at the Main Menu Screen displays the Diagnostic Menu Screen (Figure 14). The Diagnostic Menu allows the operator to test the transducer coil and instrument's gains, or to download the stored information to a computer and/or printer.



Figure 14. Diagnostic Menu Screen

4.4.8.2 MANUAL SETUP Option

Selecting the MANUAL SETUP option (from the Diagnostic Menu) displays the screen shown in Figure 15. This menu allows the operator to set various parameters (described below). The MANUAL SETUP menu has the following options:

- **SORT #.** Choosing this option allows the operator to select the sort/setup by pressing the ENTER key.
- **FREQ.** Choosing this option allows the operator to select the desired frequency by pressing the ENTER key.
- **DRIVER/SENSE SETUP.** Choosing this option brings up three more choices (Figure 16).
 - **DRIVER.** This option allows the operator to set the coil current drive by using the ENTER key and then the up and down arrow keys to set the value. Possible values are from 0 to 255. Press the ESC key when done.
 - **SENSE.** This option allows the operator to set the signal return by using the ENTER key and then the up and down arrow keys to set the value. Possible values are from 0 to 255. Press the ESC key when done.
 - **AUTO ADJUST.** This option allows the operator to automatically set the coil current and the signal return values to the required levels.
 - **RESET COUNTERS.** This option allows the operator to reset the statistical counters (number of accept and reject parts) to zero.
- **GAINS/OFFSETS.** Choosing this option allows the operator to access the instrument's individual parameters as shown in Figure 17, including zero crossover, amplitude gain, amplitude offset, and phase offset. These parameters may be changed as desired by using the arrow keys to cursor to the desired parameter, pressing ENTER, using the arrow keys to increase/decrease the values to the new setting, and then pressing ESC.

```
SORT #  
FREQ = XX  
DRIVER/SENSE SETUP  
GAINS/OFFSETS
```

Figure 15. Manual Setup Screen

```
DRIVER :  
SENSE :  
AUTO ADJUST  
RESET COUNTERS
```

Figure 16. Driver/Sense Setup Screen

```
ZERO CROSS =      XX.  
AMP GAIN =        X.X  
AMP OFFSET      XXXX.  
PHASE OFFSET    XX.X
```

Figure 17. Gains/Offsets Screen

4.5 PROCEDURE FOR TRANSFERRING A SETUP

The procedure described below is used for copying a setup from one instrument to another.

1. The following parameters will need to be recorded from the existing setup on the original N7700 instrument for use in creating the same setup on the "new" instrument:
 - Limits
 - Type of Sort (Phase, Amplitude, or Phase & Amplitude)
 - Frequency
 - Sort Number
 - Drive
 - Sense
 - Zero Cross
 - Amp Gain
 - Amp Offset
 - Phase Offset

Steps 2 through 20 describe the necessary actions for gathering and transferring these parameters.

NOTE

Steps 2 through 7 involve gathering information from the existing setup on the original N7700 instrument. Only the original N7700 instrument should be used in these steps.

2. From the main menu, cursor to SETUP and press ENTER to display the setup menu. Verify that the sort number (fourth line of left-hand column) is the one desired for transfer. If the current sort number is not the one to be copied, cursor down to the SORT # option and press ENTER until the proper sort number is displayed.
3. Record the frequency (second line of left-hand column), the sort number, and the type of sort (first line of right-hand column) from the instrument.
4. Move the cursor to LIMIT and press the ENTER key to show the limits screen. This screen displays the high and low limits for the amplitude and/or phase. Record these limits. Press the ESC key twice to return to the main menu.
5. Cursor to DIAGNOSE and press ENTER. With the cursor on MANUAL SETUP, press ENTER again to display the manual setup screen. Verify that the sort number and frequency match the values recorded in step 3 above.

4.5 PROCEDURE FOR TRANSFERRING A SETUP (continued)

6. Cursor to DRIVER/SENSE SETUP and press ENTER. Record the values for DRIVER and SENSE, then press ESC to return to the manual setup screen.
7. Cursor to GAINS/OFFSETS and press ENTER. Record the values for zero cross, amp gain, amp offset, and phase offset. Press ESC three times to return to the main menu. All the parameters needed for transfer to the new instrument are now recorded.

NOTE

Steps 8 through 19 involve transferring information to the "new" N7700 instrument. Only the new N7700 instrument should be used in these steps.

8. From the main menu, cursor to SETUP and press ENTER to show the setup menu. Verify that the sort number (fourth line of left-hand column) is the one which is to be over-written with the incoming setup. If it is not the correct sort number to be replaced, cursor to SORT # and press ENTER until the proper sort number is shown.
9. Cursor to the type of test (AMPLITUDE, PHASE, or AMP,PHASE) (first line of right-hand column) and press ENTER until the type of test matches the type recorded off of the original N7700.
10. Cursor to FREQ= and press ENTER until the frequency matches the frequency recorded from the original N7700.
11. Cursor to LIMIT and press ENTER to display the limits screen. Change the high and low limits to match those recorded from the original N7700. To change a limit, cursor to the desired limit line, press ENTER, and then use the up/down arrow keys to increase or decrease the limit to the desired number. Once the limit is set at the correct value, press ESC. After all the limits are set to the appropriate values, press ESC twice to return to the main menu.
12. Cursor to DIAGNOSE and press ENTER to display the diagnostics screen. With the cursor on MANUAL SETUP, press ENTER again to bring up the manual setup screen.
13. Verify that the sort number and frequency are the correct values, then cursor to DRIVER/SENSE SETUP and press ENTER.

4.5 PROCEDURE FOR TRANSFERRING A SETUP (CONTINUED)

14. Change the driver and sense values to match those recorded from the original N7700 instrument. To change the driver or sense value, cursor to the desired parameter, press ENTER, then use the up/down arrow keys to increase/decrease the reading as necessary. Once the correct value is set, press ESC.
15. Press ESC to return to the manual setup screen, then cursor to GAINS/OFFSETS and press ENTER.
16. Change the values for zero cross, amp gain, amp offset, and phase offset to match those recorded from the original N7700 instrument. To change one of these values, cursor to the desired parameter, press ENTER, then use the up/down arrow keys to increase/decrease the number as necessary. Once the correct value is shown, press ESC.
17. Press ESC three times to return to the main menu.
18. Cursor to SETUP and press ENTER to bring up the setup menu. Cursor to ZERO and press ENTER (note that for this step, the proper transducer should be connected to the instrument and master accept parts need to be available for zeroing).
19. Place a master accept (known good) part in the transducer. Once the instruments display panel shows "PART DETECTED" press ENTER. While zeroing the display panel will show "BUSY" and once zeroing is finished the display panel will show "DONE." When zeroing is complete, press ESC twice to return to the main menu.
20. The new N7700 is now programmed with the new setup. Before running the instrument in the standard cycle mode, verify that the setup behaves as desired (i.e. confirm that known good parts are accepted and that known bad parts are rejected). If the new setup does not accept/reject as necessary, repeat steps 1 through 19 and ensure that no parameters are mis-recorded or left out.

SECTION 5

COMPUTER AND PRINTER INTERFACING

5.1 OVERVIEW

The Verimet 7700 instrument may be connected to a printer or a computer through the RS232 interface connector located on the back panel of the instrument (Figure 3) using an RS232 cable. Further information on computer and printer interfacing is presented in the following:

NOTE

An RS232 cable is not included in the instrument package and must be purchased separately.

- Computer Interfacing (paragraph 5.2)
- Printer Interfacing (paragraph 5.3)
- Statistical Printout Examples (paragraph 5.4)

5.2 COMPUTER INTERFACING

To interface the Verimet 7700 with a computer, connect the RS232 cable to the appropriate serial port of the computer and the RS232 connector on the back of the instrument. To establish communication between the computer and the instrument, communications software (using terminal mode) is required. **Example:** Using the HyperTerminal Communications software found on most computers running on the Windows 9x operating system, is given below. Regardless of which communications software is used, the serial port of the computer should be configured for 8 bits, no parity, 1 stop bit, and a baud rate of 9600. The transmissions between the instrument and the computer are in standard ASCII format, and do not require a communications protocol. Once the **PRINT** option in the SETUP menu has been set to "ON," the instrument is interfaced and ready to communicate with the computer.

HyperTerminal Software Example:

NOTE

Depending on the setup of the interfaced computer, some steps described below may not be required.

1. Turn OFF the N7700 and the computer.
2. Connect the RS232 port on the back of the instrument to the appropriate RS232 serial port of the computer.
3. Turn on both the 7700 and the computer.

5.2 COMPUTER INTERFACING (Continued)

4. Once Windows 95 has completed booting on the computer, click on the **Start** button, go to the **Programs** option, then go to the **Accessories** option, then go to the **HyperTerminal** option and click again.
5. Once the HyperTerminal window is displayed, double-click on the HyperTerminal execution file (the one with the “.exe” extension) to activate the HyperTerminal communications software.
6. The computer screen may display a “**You need to install a modem before you can make a connection. Would you like to do this now? Yes/No**” message. Click on the **No** option.
7. The Connection Description Window will be displayed on the computer screen. Type in a name for 7700 connections (such as “N7700”) inside the **ENTER NAME** box, click on an icon inside the **ICON** box, then click on “**OK**.”
8. The Phone Number Window will be displayed on the computer screen. Ignore the phone number, address, and country code boxes and select the appropriate communications port in the **Connect using** box. Note that in many cases, where the computer has an external mouse hooked up to communication port number 1 (COM 1), the N7700 hookup will be to COM 2. The correct COM port will depend upon the individual setup of the computer. Click on the “**OK**” button at the bottom of the window.
9. The COM 1 or COM 2 Properties Window will be displayed on the computer screen. Where necessary, set the parameters to the appropriate setting: Bits per second are 9600, data bits are 8, parity is none, stop bits are 1, and flow control is none. Click on the “**OK**” button when done.
10. The computer and instrument are now ready to interface. Any data saved or transmitted by the N7700 instrument will be displayed on the HyperTerminal window. Once all the desired information has been collected/sent to the computer, use the “Save As” option to name the file and save it as a text file (with a “.txt” extension).

5.3 PRINTER INTERFACING

The Verimet 7700 instrument may be connected to any serial printer having a 128 K buffer that will accept standard ASCII input. Connect the instrument to the printer using an RS232 serial cable. The serial port of the printer should be configured for 8 bits, no parity, 1 stop bit, and a baud rate of 9600. The printer is ready to print all data sent from the instrument. Consult the manufacturer if there are any questions about printers that are compatible with the Verimet 7700.

5.4 STATISTICAL PRINTOUT EXAMPLES

When connected to a printer or a computer, the Verimet 7700 instrument may be used to generate the following:

- Selecting the REPORT option at the Statistics Menu will print an output similar to the one shown in Figure 18.

FREQUENCY = 3000		REPORT OF SORT #1	
		AMPLITUDE	PHASE
HIGH LIMIT =		71.4	1.2
LOW LIMIT =		-67.0	-1.3
MIN VALUE =		-136.1	-0.0
MAX VALUE =		-0.0	2.5
RANGE =		136.0	2.5
XBAR =		-68.2	1.2
ST. DEV =		71.0	1.3
ACCEPT CNT =		5.0	5.0
REJECT CNT =		5.0	5.0
TOTAL CNT =		10.0	10.0

Figure 18. REPORT Output to a Printer

- Selecting the PRINT DATA option at the Statistics Menu will print an output similar to the one show in Figure 19.

COUNT	AMPLITUDE	PHASE	SORT #	STATUS
1	-135	2.52	1	REJECT
2	-135	2.48	1	REJECT
3	-135	2.48	1	REJECT
4	-136	2.48	1	REJECT
5	-136	2.51	1	REJECT
6	-1	-0.02	1	ACCEPT
7	0	-0.06	1	ACCEPT
8	0	-0.04	1	ACCEPT
9	-1	0.00	1	ACCEPT
10	-1	-0.03	1	ACCEPT

Figure 19. PRINT DATA Output to a Printer

5.4 STATISTICAL PRINTOUT EXAMPLES (CONTINUED)

- Selecting the DOWNLOAD option at the Statistics Menu will output data to a computer (as shown in Figure 20). This output is essentially the same as the output generated by the PRINT DATA option (except that column titles are not sent).

1	-2	-0.1	1	ACCEPT
2	0	-0.0	1	ACCEPT
3	0	0.0	1	ACCEPT
4	0	-0.0	1	ACCEPT
5	1	-0.0	1	ACCEPT
6	0	0.0	1	ACCEPT
7	-1	0.0	1	ACCEPT
8	0	-0.0	1	ACCEPT
9	0	0.0	1	ACCEPT
10	0	-0.0	1	ACCEPT

Figure 20. DOWNLOAD Output to a Computer

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SECTION 6

SETUP OF THE VERIMET 7700 INSTRUMENT USING THE LEARN MODE

6.1 GENERAL

This section provides detailed instruction on initial instrument preparation and setup. The instructions in this section must be followed closely to ensure optimum instrument performance. Instrument preparation and setup is covered as follows:

- Basic Eddy Current Theory (paragraph 6.2)
- Typical Eddy Current Testing Applications (paragraph 6.3)
- Factors Affecting Eddy Current Response (paragraph 6.4)
- Transducer Selection and Proper Use (paragraph 6.5)
- Preparing Parts for Eddy Current Testing (paragraph 6.6)
- Statistical Summary Printout (paragraph 6.7)
- Single Reject Group Sort Setup Procedure (paragraph 6.8)
- Multiple Reject Groups Sort Setup Procedure (paragraph 6.9)
- Documenting and Storing Accept and Reject Group Masters (paragraph 6.10)

6.2 BASIC EDDY CURRENT THEORY

Although eddy current testing is the most versatile nondestructive test method, it is probably the least understood. Simply stated, an eddy current is a circular alternating electrical current. Factors that affect the magnitude and timing of the eddy current response in a part are: the alloy, heat treatment history, cracks, part geometry, and temperature. By knowing in advance how eddy currents react to variances in these factors, they can be monitored to determine the metallurgical status of the part.

6.3 TYPICAL EDDY CURRENT TESTING APPLICATIONS

Eddy current testing is widely used for alloy sorting, heat treatment verification, and case depth measurement. Table 1 lists the three most common eddy current testing applications and pertinent data per application. Detailed descriptions of those are as follows:

- Alloy Sorting. Commonly used with ferromagnetic materials.
- Heat Treatment History. Factors such as microstructure, grain size, surface hardness, and residual stress influence the electrical conductivity and magnetic permeability of the eddy current response. It is possible to monitor heat treatment errors such as no heat treatment, missed quench, no tempering, and over- and under-tempering using eddy current testing.
- Case Depth. Eddy current testing can be used in sorting parts by measuring case depth.

6.3 TYPICAL EDDY CURRENT TESTING APPLICATIONS (continued)

Table 1. Typical Eddy Current Testing Applications

APPLICATION	EXAMPLE	SORTING ABILITY
Alloy	Steel Alloy 1090 vs. 1070	Minimum 10 points carbon difference
Case Depth	Misplaced Pattern Deep Case Shallow Case	Minimum 0.005 inch case depth difference
Surface Hardness	No Heat Treatment Over-Tempering Under-Tempering	Minimum 5 HRC difference

6.4 FACTORS AFFECTING EDDY CURRENT RESPONSE

Eddy current response using the Verimet 7700 is affected by two major factors, the frequency and the transducer used. The two are discussed as follows:

- Frequency. Inspection frequency for eddy current testing can range from 5 Hz to 10 MHz. The Verimet 7700 can scan at frequencies up to 20 kHz. The inspection frequency is usually determined by the depth of eddy current penetration required in order to accomplish the sort. In general, the lower the frequency, the deeper the penetration of the eddy currents. For most applications, sorting for case depth requires frequencies less than 500 Hz. When sorting for surface hardness, test frequencies between 100 Hz and 10 kHz are used.
- Transducer. The type of transducer used (coil or probe) depends on the purpose of the inspection and the test location. For general inspections such as alloy, case depth, or surface hardness measurements, an encircling coil is used. For localized inspections, such as soft spot detection, a probe is required.

6.5 TRANSDUCER SELECTION AND PROPER USE

During eddy current testing it is important for the operator to understand how to use the coil and probe transducers and the factors that affect the accuracy of the acquired reading. Since the factors vary between a coil and a probe, further explanation is necessary.

- **Coil Transducer.** A coil transducer (Figure 21) is a transducer that encircles the test part. The placement of the test part in the coil is important and must be consistent throughout the sort. It is preferable to place the test part in the center of the encircling coil. Figure 21 illustrates the proper placement of a test part inside a coil. The distance **A** between the part and the inner coil walls is referred to as the "fill factor" and should be kept consistent from part to part in the same sort.
- **Probe Transducer.** A probe transducer is used mostly for localized testing. Proper use of a probe is illustrated in Figure 22. The distance **A** between the probe face and the part surface is referred to as "liftoff." The liftoff must be kept consistent from part to part during a sort. The distance **2B** between the probe and an edge in the part's geometry must also be taken into consideration and generally must be twice the diameter **B** of the probe.

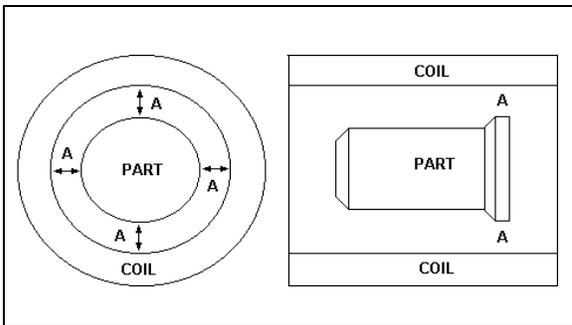


Figure 21. Part Placement in a Coil Transducer (Typical)

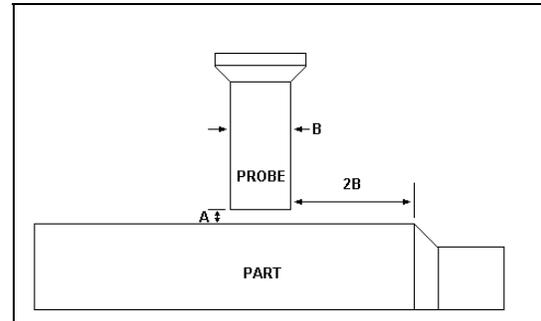


Figure 22. Probe Transducer Placement (Typical)

6.6 PREPARING PARTS FOR EDDY CURRENT TESTING

Before setting up the instrument, a set of master parts must be collected. The master parts must be carefully cleaned. Any materials that may affect the accuracy of the readings must be removed. The master parts must meet the following conditions:

- All master parts must be of known metallurgical condition.
- All samples in a group must be of the same process level as the production parts to be tested.
- A minimum of three parts are required in each group for the instrument to calculate a stable average for sorting. However, it is recommended that a statistical sampling of up to 25 random parts accept and reject be used. Lower counts may result in less consistent results.
- Process errors of the masters must be legitimate. For example, soft parts due to over-tempering can not be substituted for a sort of soft parts due to no quench.

6.7 STATISTICAL SUMMARY PRINTOUT

The sample printout shown in Figure 23 is generated by setting the PRINT option at the Setup Menu Screen to ON. (A printer must be connected to the instrument.) The printout is usually several pages in length. This type of printout will be required if the instrument is set for a multiple reject groups sort. The sample printout as shown in Figure 23 is divided into sections of data as follows:

- Segment **A** in a typical summary printout contains the results from the good parts scan at various frequencies.
- Segment **B** in a typical summary printout contains the results from the parts in a reject group scan at various frequencies.
- Segment **C** in a typical summary printout contains a comparison of the results from the good parts and a reject group of parts scanned at various frequencies.

NOTE

If more than one reject group of parts was used during the instrument setup, the Statistical Summary Printout will contain a Segment B and a Segment C for each reject group.

6.8 SINGLE REJECT GROUP SORT SETUP PROCEDURE

When setting up the instrument for sorting with a single reject group, the statistical printout is not required. The setup, therefore, does not require a printer. To set up for a single reject group sort, perform the following procedure:

1. Depress the POWER button to turn the instrument on. The Main Menu Screen appears. At this point, a printer may be connected to the instrument, but it is NOT REQUIRED for this test.
2. Move cursor to LEARN (use arrows to move cursor) and depress ENTER. The next menu appears.
3. Select a SORT# from 1-10. This is done by depressing the ENTER button to increment the SORT#.
4. If no previous sorting information is known about the parts, select all the frequencies. This is done as follows: move the cursor to MARK THE FREQUENCIES and depress the LEFT ARROW. The frequency displayed will be marked for testing. Depress ENTER to get the next frequency and mark it by depressing the LEFT ARROW. Continue until all the frequencies are marked. To unmark any frequency, depress ENTER until it is displayed, then depress the RIGHT ARROW. After the desired frequencies are chosen, move the cursor to MASTER and depress ENTER, or you can select "ALL" to mark all the frequencies.

6.8 SINGLE REJECT GROUP SORT SETUP PROCEDURE (continued)

5. The displayed message now says to POSITION MASTER and CYCLE ON MASTER. Since the cursor is at CYCLE, position a good MASTER part and depress ENTER. The instrument now cycles through the frequencies until the message DONE appears. With the cursor at CYCLE ON AIR, remove the part and depress ENTER. The word BUSY appears while the instrument is working. When through, the ACCEPT PART SETUP message appears. Also a "HEADER" is sent to the printer. Press ENTER to continue.
6. The COLLECT DATA MODE display appears. The instrument is ready to test ACCEPT parts. For the instrument to work properly, at least three parts from a group must be used. Position the part and depress the ENTER key to run a test and store the data in memory. After the test, the ACCEPT COUNT changes to the number one and data are sent to the printer. Position the next part and depress the ENTER key to run the next test. Continue until all ACCEPT parts are tested.
7. To test REJECT parts, depress ESC for the REJECT PART SETUP, then depress ENTER. Follow the same procedure for the ACCEPT parts (Steps 5 and 6). When through, depress ESC. The instrument calculates results and sends the information to the printer.
8. After calculation, the message asking to test MORE REJECT GROUPS appears. Since there are no more reject groups to be tested, press ESC to return to the Main Menu Screen.
9. At this point, the instrument is ready to test. It has automatically selected the best test parameters including values and limits. It has used a statistical calculation in determining these parameters. Verify the test values on MASTER parts by positioning a good MASTER part, selecting CYCLE from the Main Menu Screen, and depressing ENTER. (Note the condition of the STATUS indicator. Amber indicates "no part," green indicates an "accept part," and red indicates a "reject part.") The type of test (PHASE or AMPLITUDE) and the value for the part will be displayed. Perform the same test with a MASTER REJECT part simply by positioning the part. The instrument automatically tests the part and displays the results. Note that the cursor is positioned to the right of the value. If a reject part is tested, a symbol will appear indicating whether the value is greater than or less than the reject limit.

6.9 MULTIPLE REJECT GROUPS SORT SETUP PROCEDURE

When setting up the instrument for sorting with two or more reject groups, additional steps must be performed. The setup of multiple reject groups also requires that a printer be connected to the instrument. The printer is used to generate a statistical printout. The procedure provided in this section is an extension of the procedure provided in paragraph 6.8. For multiple reject groups setup, refer to the following:

1. To set up the instrument for a sort of two or more reject groups of parts, a printer must be connected to the instrument. See Section 5 for printer setup. When the printer is connected, follow Steps 1 through 7 in Paragraph 6.8. At Step 8 in Paragraph 6.8, continue the setup by depressing ENTER. The REJECT PART SETUP message appears again. Depress ENTER and continue testing with the next part group. At the end of this group, depress ESC. If more groups are to be tested, depress ENTER twice and continue testing. After the last group, depress ESC to return to the Main Menu Screen.
2. To determine the best sort for all the groups, data sent to the printer must be tabulated. Printed tabulation sheets are provided in Appendix C (Sheets A and B). Make copies of these sheets for recording the data as outlined in Steps 3 through 12.
3. Review the statistical summary printout; it gives the values for FREQUENCY, AMPLITUDE, PHASE and part COUNT. The printout also records the TYPE of part tested (accept or reject). Next, the STATISTICAL SUMMARY is printed. This is followed by the instrument selecting the best sort for the two groups tested. This same information is printed for all the REJECT groups tested. The information necessary to tabulate comes from the STATISTICAL SUMMARY of each group. Figures 24 and 25 illustrate the statistical summary printouts for two sample reject groups. The statistical summary printouts for any particular reject group may be identified as Segment C in Figure 23.
4. Next, take a look at the tabulation sheet, Sheet A (Figure 26). It has a heading for basic information followed by all of the frequencies that the instrument is capable of using. This is further subdivided into AMPLITUDE and PHASE. There is a heading for signal to noise (S/N) and at the left side there is a numbered row for each reject group. There is also a row for averaging the S/N columns.

STATISTICAL SUMMARY								
***** REJECT *****					***** ACCEPT *****			
FREQ.	TYPE	ST. D.	XBAR	RANGE	ST. D.	XBAR	RANGE	SN1
50	amp	1.2	11.4	3.4	2.8	0.0	7.2	0.9
50	phase	0.0	0.1	0.1	0.0	0.0	0.1	0.1
100	amp	2.7	13.7	6.4	3.0	2.5	8.4	0.9
100	phase	0.1	0.3	0.3	0.0	0.0	0.0	0.7
200	amp	3.2	17.0	8.7	3.8	3.0	10.3	0.9
200	phase	0.1	0.1	0.3	0.0	0.0	0.1	0.2
300	amp	4.7	23.5	12.5	4.3	1.3	11.9	0.8
300	phase	0.1	0.1	0.4	0.0	0.0	0.2	0.1
500	amp	5.9	20.0	15.4	3.3	-2.3	8.6	0.8
500	phase	0.1	0.2	0.5	0.0	0.1	0.1	0.5
1000	amp	7.1	16.3	18.3	4.5	0.1	12.0	0.4
1000	phase	0.2	0.9	0.5	0.1	0.0	0.3	0.8
2000	amp	8.7	6.3	22.8	5.6	-1.0	14.8	0.1
2000	phase	0.2	0.9	0.4	0.1	0.0	0.3	1.2
3000	amp	9.9	-3.5	25.4	6.6	-1.4	18.1	0.0
3000	phase	0.2	1.6	0.5	0.1	0.0	0.2	1.5
5000	amp	10.8	-12.6	27.8	6.0	-2.6	16.3	0.1
5000	phase	0.1	1.9	0.4	0.1	0.0	0.3	1.7
10000	amp	11.0	-24.5	27.5	7.7	-4.1	21.4	0.3
10000	phase	0.2	2.6	0.6	0.2	0.1	0.6	1.5
20000	amp	11.9	-34.3	30.2	7.7	-3.4	20.9	0.5
20000	phase	0.3	3.1	0.8	0.2	0.0	0.6	1.6

FREQUENCY = 5000
 AMPLITUDE
 HIGH LIMIT = 2
 LOW LIMIT = -7
 PHASE
 HIGH LIMIT = 0.9
 LOW LIMIT = -0.8

Figure 24. Statistical Summary Comparison Sample Printout for Reject Group 1

STATISTICAL SUMMARY								
***** REJECT *****					***** ACCEPT *****			
FREQ.	TYPE	ST. D.	XBAR	RANGE	ST. D.	XBAR	RANGE	SN1
50	amp	2.7	8.3	6.3	2.8	0.0	7.2	0.4
50	phase	0.0	0.1	0.1	0.0	0.0	0.1	0.0
100	amp	2.8	8.2	7.0	3.0	-2.5	10.3	0.5
100	phase	0.1	0.1	0.2	0.0	0.0	0.0	0.4
200	amp	3.7	9.6	9.6	3.9	-3.0	10.3	0.5
200	phase	0.1	0.0	0.2	0.0	0.0	0.1	0.1
300	amp	4.0	14.6	10.7	4.3	1.3	11.9	0.5
300	phase	0.0	0.3	0.2	0.0	0.0	0.2	0.5
500	amp	4.6	8.1	11.7	3.3	-2.3	8.6	0.4
500	phase	0.1	0.4	0.2	0.0	0.1	0.1	1.0
1000	amp	5.8	3.4	14.8	4.5	0.1	12.0	0.1
1000	phase	0.1	0.4	0.2	0.0	0.1	0.1	1.0
2000	amp	6.4	-6.3	16.6	5.6	-1.0	14.8	0.1
2000	phase	0.1	1.1	0.2	0.1	0.0	0.3	1.4
3000	amp	6.1	-13.7	16.0	6.6	-1.4	18.1	0.3
3000	phase	0.1	1.1	0.4	0.1	0.0	0.2	1.2
5000	amp	7.4	-20.9	18.8	6.0	-2.6	16.3	0.4
5000	phase	0.1	1.1	0.4	0.1	0.0	0.2	1.2
10000	amp	7.9	-26.8	21.0	7.7	-4.1	21.4	0.4
10000	phase	0.1	1.5	0.4	0.2	0.1	0.6	1.0
20000	amp	8.3	-33.0	21.2	7.7	-3.4	20.9	0.6
20000	phase	0.3	1.6	0.7	0.2	0.0	0.6	0.8

FREQUENCY = 2000
 AMPLITUDE
 HIGH LIMIT = 1
 LOW LIMIT = -3
 PHASE
 HIGH LIMIT = 0.6
 LOW LIMIT = -0.5

Figure 25. Statistical Summary Comparison Sample Printout for Reject Group 2

6.9 MULTIPLE REJECT GROUPS SORT SETUP PROCEDURE (continued)

5. From the printout, start with the first reject group tested. On the far right of the printout is the S/N ratio for all the frequencies used. The ratio for both amplitude and phase is printed. Record all of the S/N values under their corresponding headings on the first tabulation sheet, Sheet A (Figure 26). Repeat this procedure for all of the remaining reject groups. Next, average each S/N column if all the values in that column are one or greater. If all S/N values are not one or greater, ignore that column. An S/N ratio of less than 1 indicates that there is an overlap in readings between the accept and reject groups.
6. Remember that only one frequency can be selected for the final test. Select the column with the best average S/N ratio of one or greater. If no column has a value of one or greater, a single frequency (using amplitude or phase) cannot sort all the parts. However, it may be possible to sort with one frequency using both amplitude and phase. If this is not the case, continue with the next step. If this is so, do the following. Carefully observe both the AMPLITUDE and PHASE columns under a given frequency. If some parts can be sorted by amplitude and the rest by phase, then that frequency can be used with both amplitude and phase, providing all the values are one or greater.
7. To judge what the possible spread of readings might be within each group of parts, a statistical calculation must be done. This is necessary to see that reject group readings do not overlap good group readings. A second tabulation sheet, Sheet B, (Figure 27) with a line graph is provided.
8. At the left-hand side of the sheet, record the frequency and type of test that was determined by using the S/N ratio. From the statistical summaries, record the Xbar and the STANDARD DEVIATION for all of the parts. Even though the accept data are repeated for each test, it is only necessary to record them once.
9. In the next column on the sheet, $3(\text{Std. Dev.})$, multiply the standard deviation by 3 for all the groups. In the $\text{Xbar}+3(\text{Std. Dev.})$ column, add the Xbar value to the just-calculated $3(\text{Std. Dev.})$. Finally, subtract 3 times the standard deviation from the Xbar and record these values in the column marked $\text{Xbar}-3(\text{Std. Dev.})$.
10. To get a visual picture of what the data mean, line graphs are used. Note that only the zero point is marked. Values along the line are determined by observing the Xbar values and the range above and below these values.
11. Start by marking the Xbar value for the accept group. Next, mark the values for $\text{Xbar}+3(\text{Std. Dev.})$ and $\text{Xbar}-3(\text{Std. Dev.})$. Use this procedure to mark all of the reject groups. If no reject group overlaps the accept group, the sort is reasonable. If there is some overlapping, a judgment can be made as to how good the sort will be.

Verimet 7710

Company K. J. Law

Job No. 081494

Part No. 12345

N7700 MULTIPLE GROUP SORT

Instrument S. N. 0001

K-J-LAW
ENGINEERS, INC.

Date 1-22-97

Sheet A

		SORT CONDITIONS																						
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	
Freq. Type Ratio Group	50	100	150	200	250	300	350	400	450	500	550	1k	1k	2k	2k	3k	3k	4k	4k	5k	5k	6k	6k	
	Ampl.	Phase	Ampl.	Phase	Ampl.	Phase	Ampl.	Phase	Ampl.	Phase	Ampl.	Phase	Ampl.	Phase	Ampl.	Phase	Ampl.	Phase	Ampl.	Phase	Ampl.	Phase	Ampl.	Phase
	S/N	S/N	S/N	S/N	S/N	S/N	S/N	S/N	S/N	S/N	S/N	S/N	S/N	S/N	S/N	S/N	S/N	S/N	S/N	S/N	S/N	S/N	S/N	S/N
#1	.9	.1	.9	.7	.9	.2	.8	.1	.8	.5	.4	.8	.2	1.2	∅	1.5	.1	1.7	.3	1.5	.5	1.6		
#2	.4	∅	.6	.4	.5	.1	.5	.5	.4	1.0	.1	1.1	.1	1.4	.3	1.2	.4	2.7	.4	1.0	.6	.8		
#3																								
#4																								
#5																								
#6																								
AVG																								

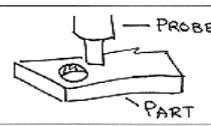
KEY		NOTES/COMMENTS	TRANSUCER SETUP SKETCH
Group	Description		
Reject #1	No heat		
Reject #2	No tempering		
Reject #3			
Reject #4			
Reject #5			

Figure 26. Multiple Group Sort Sample Sheet A

Verimet 7710

Company K. J. Law

Job No. 081494

Part No. 12345

N7700 MULTIPLE GROUP SORT

Instrument S. N. 0001

K-J-LAW
ENGINEERS, INC.

Date 1-22-97

Sheet B

Sort Selected	Group	Xbar		Std. Dev.	3(Std. Dev.)	Xbar+3(Std. Dev.)	Xbar-3(Std. Dev.)
		Ampl.	Phase				
Freq. <u>5 k</u>	Accept						
Ampl. <u>NA</u>	Reject-1	∅.∅	∅.1	∅.3	∅.3	-∅.3	
Phase <input checked="" type="checkbox"/>	Reject-2	1.9	∅.1	∅.3	2.2	1.6	
NOTES:	Reject-3	1.2	∅.1	∅.3	1.5	∅.9	
	Reject-4						
	Reject-5						
	Reject-6						

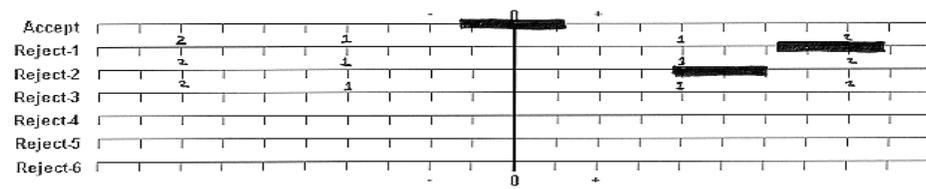


Figure 27. Multiple Group Sample Sheet B

6.9 MULTIPLE REJECT GROUPS SORT SETUP PROCEDURE (continued)

12. To set the instrument for the sort, select the LEARN mode and mark only the frequency determined by the tabulation. If the sort was all phase or all amplitude, select the REJECT GROUP that was the closest to the ACCEPT GROUP. Run a test using both of these groups. The instrument will automatically adjust all parameters including limits and gain. Return to the Main Menu Screen and select CYCLE. The instrument is now ready to test all parts. If the sort required both amplitude and phase, the following must be done:
 - a. In the LEARN mode, mark the determined frequency.
 - b. Select the REJECT GROUP that was closest to the ACCEPT group under amplitude conditions.
 - c. Run a test and record the limits. Use the procedure provided in paragraph 6.8 with the printer attached.
 - d. Select the REJECT GROUP that was closest to the ACCEPT group under phase conditions.
 - e. Run a test using the procedure in paragraph 6.8. The limits for phase are automatically set in the instrument.
 - f. From the Main Menu Screen, select SETUP.
 - g. From the Setup Menu Screen, select AMP, PHASE, then select LIMIT.
 - h. Adjust the AMPLITUDE limits to the values previously recorded.
 - i. Return to the Main Menu Screen and select CYCLE.
 - j. The instrument is now ready to test all parts.

6.10 DOCUMENTING AND STORING ACCEPT AND REJECT GROUP MASTERS

After a set of parts has been used as a master, that set of parts must be marked and documented for storage. It is recommended that the operator also record the values from the Setup Menu Screen. It is important for future instrument setup to generate a library of masters in order to provide access to master parts with known metallurgical qualities.

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SECTION 7

MAINTENANCE AND TROUBLESHOOTING

7.1 OVERVIEW

This section discusses periodic maintenance and general troubleshooting of the Verimet 7700 instrument as follows:

- Periodic Maintenance (paragraph 7.2)
- Troubleshooting (paragraph 7.3)
- Battery Replacement (paragraph 7.4)
- Fuse Replacement (paragraph 7.5)
- 220 Volt Operation (paragraph 7.6)
- Transducer Replacement (paragraph 7.7)

7.2 PERIODIC MAINTENANCE

Periodically, the Verimet 7700 instrument front and back panels, the transducer, and all connectors must be wiped clean of dirt and dust buildup using a damp cloth. The battery should also be recharged regularly to ensure optimum operation.

NOTE

Excessive dirt buildup or metallic buildup will affect the transducer reading capability and generate inaccurate sort results.

7.3 TROUBLESHOOTING

Table 2 presents general troubleshooting of the instrument. The table identifies a problem(s) and includes probable causes, as well as corrective actions to eliminate the problem(s) at hand.

Table 2. Instrument Troubleshooting

Trouble	Probable Cause	Corrective Action
Instrument does not turn on when the POWER key is depressed.	<ol style="list-style-type: none"> 1. The battery is not charged. 2. The battery is damaged. 	<ol style="list-style-type: none"> 1. Connect the power cable to the power cable connector and recharge the battery. 2. Replace the battery. Refer to paragraph 7.4.
BATT. LOW LED is flashing.	<ol style="list-style-type: none"> 1. The battery is not charged. 	<ol style="list-style-type: none"> 1. Connect the power cable to the power cable connector and recharge the battery.
The instrument does not operate when plugged to an AC source.	The fuse is blown.	Replace open fuse.
The instrument display reads NO PART.	<ol style="list-style-type: none"> 1. A transducer is not connected. 2. The transducer cable is not making a good contact. 3. A transducer is damaged or faulty. 4. The transducer cable is damaged or faulty. 	<ol style="list-style-type: none"> 1. Connect the appropriate transducer as required. 2. Check the transducer cable connections. Clean if required. 3. Replace the transducer. 4. Replace the transducer cable.

Table 2. Instrument Troubleshooting (continued)

Trouble	Probable Cause	Corrective Action
The instrument is not operating properly.	<ol style="list-style-type: none"> 1. The instrument is not set up as required. 2. A transducer is not connected. 3. The transducer cable is not making a good contact. 4. A transducer is damaged or faulty. 5. The transducer cable is damaged or faulty. 	<ol style="list-style-type: none"> 1. Set the instrument as required by the application. 2. Connect the appropriate transducer as required. 3. Check the transducer cable connections. Clean if required. 4. Replace the transducer. 5. Replace the transducer cable.

NOTE

If a problem is not covered in troubleshooting Table 2, contact K. J. Law Engineering Technical Services at (800) 521-5245 for assistance.

7.4 BATTERY REPLACEMENT

In some cases, the instrument battery may need to be replaced. The following procedure provides step-by-step instruction to properly replace the instrument's internal battery.

1. Unplug all connections to the instrument, including the power cable.
2. Flip the instrument upside down and remove the four housing screws.
3. Place the instrument on its face and slide the cover up and off the chassis.
4. Unplug the battery connector from the main board connector J9.
5. Slide the old battery out of the battery tube.
6. Slide the new battery into the battery tube.
7. Connect the new battery cable to the main board at connector J9.
8. Press the battery into the tube against the spring and slide the cover over chassis.
9. Replace the housing screws.
10. Recharge the new battery before use.

7.5 FUSE REPLACEMENT

To replace the fuse, refer to the following:

1. Ensure that the power cable is disconnected from the instrument.
2. With a flathead screwdriver, turn the fuse insert 1/4 turn counterclockwise. The fuse insert will pop out of the fuse holder.
3. Replace the old fuse at the end of the fuse insert.
4. Place the fuse insert into the fuse holder.
5. Press the fuse insert into the fuse holder and turn 1/4 turn clockwise until locked.

7.6 220 VOLT OPERATION

To operate the instrument at 220 volts, perform the following:

1. Ensure that the power cable is disconnected from the instrument.
2. With a flathead screwdriver, turn the VAC switch counterclockwise to the 220V position.
3. Replace the fuse with a 0.25 amp slow blow fuse (see paragraph 7.5).
4. Connect a 220 volt power cable to the instrument (see Section 8).

7.7 TRANSDUCER REPLACEMENT

In some cases, a transducer may require replacement due to damage, etc. In such cases, it is recommended that the following procedure be performed:

NOTE

When replacing a transducer, the replacement should be the same type of transducer as the one being replaced. Ensure that all transducers are replaced only by those with the manufacturer's same part number.

1. Turn off the instrument by depressing the POWER key.
2. Disconnect and remove the damaged transducer.
3. Connect the new transducer.
4. Turn on the instrument by depressing the POWER key.
5. At the Main Menu Screen, select the SETUP option.
6. At the Setup Menu Screen, move the cursor to the ZERO option using the cursor keys.
7. Position the transducer on an accept master for the current sort.
8. Depress the ENTER key. The LCD will momentarily display BUSY, then DONE.
9. Transducer replacement is complete. Return to the Cycle mode and continue the sort.

SECTION 8

SPARE PARTS

This section provides a list of spare parts and optional items that may be required for proper operation of the instrument under certain conditions. Contact the manufacturer for further information on the listed items.

- RS232 cable (DB9 to DB25)
- Transducer Cable (PN 40770E107)
- 0.5 amp slow blow fuse (110 volt operation)
- 0.25 amp slow blow fuse (220 volt operation)
- 110 volt power cable (PN 17506)
- 220 volt power cable (specify voltage source)
- Internal battery pack (PN LWC250183)
- Additional probes or coils as needed for testing

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GLOSSARY

A

American Standard Code for Information Interchange (ASCII) A system of codes used to represent text information.

Amplitude The peak to peak measurement of a sinusoidal wave. The Verimet 7700 tests peak to peak changes in the eddy current wave when the amplitude testing is active.

Arrow Keys Keys on the front panel of the instrument move the cursor box around the display. Also used to increase or decrease values of certain selections.

B

Baud Rate Transmission/reception rate at which the serial port communication is conducted. The Verimet 7700 uses 9600 baud communication rate.

C

Coil Transducer A transducer used for testing shafts or small parts. The coil transducer encircles the part.

Cursor A box on the LCD that indicates the active menu choice. The cursor is used to navigate the instrument menus and select the appropriate options (see Arrow Keys).

E

Eddy Current An electromagnetically induced electrical current generated on a conductive piece of material.

ENTER A key on the instrument front panel used to accept selected menu functions or options.

ESC A key on the instrument front panel used to return to the previous menu or cancel a selection.

**GLOSSARY
(continued)****F**

Feasibility Testing Testing performed using a set of test samples of known metallurgical characteristics in order to define the optimum test setup for sorting process errors. This test is required for all applications.

Frequency The number of cycles in a given period of time. In eddy current testing, it is the number of cycles of alternating current per second.

M

Main Menu A listing of the primary commands used in the operation of the Verimet 7700.

Master 1. A part with known eddy current responses used to verify that the instrument is operational. 2. A procedure performed to adjust the instrument's internal electronics to a test transducer and an accept part.

Menu A list of functions and options available to the operator.

N

Nondestructive Testing A verification process that does not alter the test part in any way.

P

Phase The position within the 360 degree cycle of a sinusoidal wave with respect to another wave or a reference point. The Verimet 7700 tests changes in the phase (phase shift) of the eddy current frequency with respect to the frequency of the inducing current.

Probe Transducer A probe transducer is used mostly for localized testing or testing of hard to reach areas.

S

Serial Port A means of connecting the microprocessor to external devices such as a printer or another computer. Serial ports provide for two-way communication between the microprocessor and an external device.

Sort Number A set of preset test parameters that may be recalled for sorting under particular conditions. The Verimet 7700 allows for ten setups to be saved in the instrument's memory.

**GLOSSARY
(continued)****T**

Transducer A device that converts energy from one form to another. Transducers used with the Verimet 7700 induce and detect eddy current variances, thus providing test information to the instrument.

V

Verimet 7700 A nondestructive alloy and hardness testing instrument that utilizes eddy current principles for sorting and testing of ferrous materials.

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APPENDIX C
MULTIPLE REJECT GROUPS SETUP TABULATION SHEETS

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