DRAUGHT INDICATOR SYSTEM

OPERATING & INSTALLATION INSTRUCTIONS

MALIN 1500 – INCLINOMETER & SENSOR
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INTRODUCTION

The MALIN 1500 draught indicator is designed to provide a simple and accurate printed record of the ship’s draught, trim and sailing conditions, which will be acceptable to the authorities as a part of the log.

The draught indicator uses a pressure sensor and inclinometer with associated electronics to determine the ship’s draught and trim, with the data being updated seventy five times per minute.

As it is not practicable to place the sensing point at the ships marks the instrument makes allowances based on stored dimensions for the ship to give readings as if the instrument was sited at the marks. It then checks the results to ensure that the draught and trim are within safety limits.

The instrument can make corrections for the local water density if it is known that there are variations in certain ports, provided the actual density figure is entered at time of departure. It is still necessary to apply freshwater allowances.

After the ship has cast off, the Master must enter the condition number. The instrument which has been monitoring the ships trim and draught will then carry out a series of calculations in order to inform the Master that the ship can sail or that the limits of draught and/or trim have been exceeded.

When the ship is within limits a green light will come on and a report will be printed which should be signed and filed in the ship’s log.

If the ship is not within limits a red light will come on and the display will inform the Master which limit(s) has been exceeded.
NORMAL OPERATION

After the completion of loading, draw away from the slipway till the ship is fully afloat, and then carry out the following instructions. The display should be lit up showing the starting message **Draught Gauge  1500 Mk VI v 1.0**, if not check that the power is switched on.

1) Using the keypad press **ENTER**, the display should read **Draught Gauge Print Log**, if it does not, use the UP or DOWN keys to select **Print Log** and then press **ENTER**.

2) Use the UP or DOWN keys to select the correct Departure Port and press ENTER.

3) Use the UP and DOWN keys to select the correct Arrival Port and press ENTER.

4) The display will prompt with the density entered at the last departure port. If this is acceptable press **ENTER**, if not use the UP or DOWN keys to select the correct value before pressing **ENTER**.

5) The display will prompt with the last condition code used. If this is unchanged press **ENTER**, if not use the UP or DOWN keys to select the correct code number and then press **ENTER**.

6) Wait for the system to calculate draught trim.

7) Green light shows that the ship is within its limits and may sail.

   Red light shows that draught or trim limits have been exceeded. In this case return to slip to correct situation. Then repeat from paragraph 1) above.

8) Tear off and remove the print out, sign and file.

If the name of the Departure or Arrival Port is not shown, a blank port can be chosen so that the name can be entered by hand on the print out. Additional new port names can be added to the list if required, ask Malin instruments for details. A typical print out looks like this:-

```
M.V. EIGG
DEPART LISMORE
ARRIVE OBAN
DENSITY 1025
DATE 04/01/00
TIME 15:38:39
FWD DRAUGHT 1.22M
AFT DRAUGHT 1.30M
MID DRAUGHT 1.29M
MIDSHIPS DRAUGHT – 0.14M TO LIMIT
TRIM 0.08M BY THE STERN
CONDITION NUMBER 17
TRIM/DRAUGHT
WITHIN LIMITS
```
The ENTER key accepts the number or name shown on the display. It also instructs the instrument to proceed with the next calculation or routine. The ESC key returns the display to the previous menu item.

Some routines require the displayed information, menu or number to be altered. Use the UP or DOWN keys to select the required item or number.

Note. During any routine if there is a delay of more than 5 minutes when no keys are pressed, the light behind the display will go out, and the instrument will return to normal operation with the starting message Draught Gauge 1500 Mk V1 v 1.0 shown on the display.

THE MENU

The main menu headings shown on the display are: -

Print Log
Feed Paper
Test Print
Test Lights
Show Time
Set Clock
Calibrate
Setup
REPLACE PRINTER PAPER

Towards the end of a roll a red line will appear on the paper. At first convenient moment, fit a new roll.

1) Open the front of printer by gently twisting the right hand lever.

2) Cut (or tear) the remaining paper so that the old roll can be removed.

3) Push in the black button on the tube holding the paper roll and slide off the old roll.

4) Remove any paper remaining in the door section by pressing the PAPER FEED pad or alternatively press the ENTER key and then use the UP or DOWN keys to select Feed Paper on the display and press and hold ENTER, carefully noting where the paper entered the top of the printer mechanism, as this is where the new paper will have to be fed in. If necessary, gently pull the paper from the front of the printer to get the remains out.

5) Slide the new roll onto the tube in place of the old roll, with the paper coming up the back of the roll and over the top towards the front of the printer. Check that the new roll will fit easily in the printer by gently closing the door, if it is too fat unwind and throw away surplus so that the roll will fit. Make sure that the black button is holding the roll in place.

6) Cut the end of the paper cleanly before trying to feed it through the printer. If scissors are not available fold the end and crease it sharply to give a straight edge, this extra thickness and firm edge often helps the printer to take up the paper.

7) Locate the slot between the two strips of stainless steel in the top of the printer and push the paper in as far as it will go.
8) Press the PAPER FEED pad, or alternatively press the ENTER key and use the UP or DOWN keys to select Feed Paper on the display and press and hold ENTER to feed the paper through the printer. When sufficient has fed through shut the door and tear off the surplus paper.

REPLACE PRINT RIBBON CASSETTE

The cassette should be changed when the writing becomes faint. We recommend removing the paper before changing the ribbon, so the routine follows that for replacing the paper roll.

1) Open the printer and remove the paper as described in paragraphs 1) to 4) on Page 6.

2) Split the door section by holding the outside with the left hand, while gently pressing the inner section at the open end upwards and to the right.

3) To eject the old cassette gently press the narrow right hand end towards the mechanism, the wide left hand end will pop out allowing it to be removed. Note the recess in which the fabric ribbon sits, allowing the paper to feed between the fabric and the cassette.

4) Make sure that the new fabric ribbon is taut in the cassette by turning the button at the left end and line up the cassette with the recess in the mechanism. Press the wide left hand end into position then press the right hand end into place. Close the inner door.

5) Refit the paper as described in paragraphs 5) to 8) on Page 6.

SET THE CLOCK

Each element of the date and time comprises two digits. When resetting the clock each is shown in turn as the current setting, and each has to be rest in turn as follows.

- Press ENTER and then use the UP or DOWN keys to select Set Clock on the menu
- Press ENTER and then use the UP or DOWN keys to set the New Year number
- Press ENTER and then use the UP or DOWN keys to set the new month number
- Press ENTER and then use the UP or DOWN keys to set the new day number
- Press ENTER and then use the UP or DOWN keys to set the new hour number
- Press ENTER again and the display will show setting clock

After a few moments the instrument will return to normal operation and the display will show the starting message Draught Gauge 1500 Mk V1 v 1.0

There is an internal battery so that the clock will continue to run when the power is switched off.
OPERATIONAL CHECKS

The system has been designed for continuous service. It will automatically power up when the ship’s 24 volt DC supply is connected and it will power down when this supply is switched off. There is no provision for an ON/OFF switch on the instrument.

Under normal running minimal routine maintenance is required. In practice it has been found that any discrepancies in displayed readings are soon noted, but for assurance the following points can be observed periodically.

THE DISPLAY

The backlit LCD display has two lines of text. Under normal circumstances the display will show the message **Draught Gauge 1500 Mk VI v 1.0**

POWER SUPPLY

The system is designed to work on a 24 volt DC supply. The actual voltage may vary as the ship’s batteries are charged or discharged, the equipment will operate satisfactorily between 20 volts and 32 volts.

DEPTH SENSOR

Examine the draught sensor and associated pipework and cables. Make sure that there are no leaks or physical damage, that the sensor is dry and that the connecting cable is not frayed or otherwise loose or damaged.

Air locks sometime occur in the pipework. The air lock check described on page 15 will clear these and identify blocked pipework.

The datum check described on Page 14 allows the pressure sensor to be checked for correct operation.

The calibration check described on Page 12 & 13 may give an indication of a transducer failure. Records of any changes in the calibration number should be entered on Page 21.

INCLINOMETER

Check that the 24 volt DC power supply is present.
Check that there is no physical damage, that the inclinometer housing is dry and that the connecting cables are not frayed or otherwise loose or damaged.

Check that the inclinometer mountings are tightly bolted.

**PRINTER**

To check the printer at any time.

Press ENTER and then use the UP or DOWN keys to select **Test Print** on the menu.
Press ENTER again and the printer will print a text message.
Press ESC to return to normal operation.

If no keys are pressed the system will return to normal operation of its own accord after a few minutes.

**LIGHTS**

To check the lights

Press ENTER and then use the UP or DOWN keys to select **Test Lights** on the menu.
Press ENTER again and both lights will come on.
Press ESC to switch them off and return to the menu.

**CLOCK**

To check the clock

Press ENTER and then use the UP or DOWN keys to select **Show Time** on the menu.
Press ENTER again to show the time and date.
Press ESC to return to the menu.

If the time or dates are incorrect, reset the clock using the routine on Page 7. There is an internal battery so that the clock will continue to run when the power is switched off.
FAULT MESSAGES & PROBLEMS

DEPTH SENSOR FAULT or INCLINOMETER FAULT

To do its calculations, the system requires both the sensor and the inclinometer to be working correctly. If either is faulty or if the connecting cables are damaged then the instrument can no longer calculate the draught.

The message **Draught Fault** on the display indicates that there is a fault in the depth sensor.

Check the wiring from the depth sensor to the plug and socket on the back of the instrument (see sketch on Page 17) making sure that the cable screen is continuous and that it is not earthed to the hull at any point.

If there is no fault in this wiring it is likely that there is physical damage to the sensor. In this case obtain and fit a service exchange depth sensor as described on Page 15.

The message **Inclinometer Fault** on the display indicates that there is a fault in the inclinometer.

Check that the 24 volt DC supply is present at the inclinometer and the wiring from the inclinometer to the plug and socket on the back of the instrument (see sketch on Page 17) making sure that the cable screen is continuous and that it is not earthed to the hull at any point. Also check the 1 amp fuse inside the inclinometer case.

If there is no fault it is likely that there is physical damage to the sensor. In this case obtain and fit a service exchange inclinometer as described on Page 16.

READINGS TOO DEEP or TOO SHALLOW

a) Bleed pipework to clear any airlocks.
b) Check that the sea value to the sensor is fully open.
c) Check for blockages in the inlet pipe and the vent pipework.
d) If readings continue to get deeper it may be due to transducer drift. Carry out a datum test as described on Page 14 to see if the sensor is failing.

VARIATION IN TRIM
If the Midships draught is correct but there are errors in the Forward and Aft draught readings it is likely that the inclinometer has moved.

Check that the inclinometer mounting is tight and has not moved, then check and recalibrate the system as described on Pages 12 & 13.

If the error cannot be corrected it is likely that there is physical damage to the inclinometer. In this case obtain and fit a service exchange inclinometer as described on Page 17.

READINGS INACCURATE

If the readings are inaccurate by a constant amount check and recalibrate the system as described on Pages 12 & 13.

DISPLAY FAULT

There are four possible faults, either the screen is blank without backlighting, the screen is blank although backlight is working, the screen is showing black squares instead of letters, or the screen appears normal but backlight is not working.

The most likely reason is a lack of power, check this first. Alternatively reset the unit by turning the power off, leave for at least one minute, and then switch the power back on.

PRINTER FAULTS

Paper has run out. As the paper nears the end of the reel you will notice a red stripe on the print out. Do not wait until all the paper is exhausted, change the paper at the first convenient opportunity. Fit a new roll of paper as described on Page 6.

Print is very faint. Printer ribbon is worn out. Fit a new ribbon as described on page 7.

POWER FAILURE

In the event of a power failure, the system automatically turns off. The close down can be observed as the display screen will go blank. On restoration of power the system will automatically restart. The internal battery will have kept the clock running.

Please contact Malin Instruments for technical advice or service exchange parts if the apparent fault persists.

N.B. When reporting faults, as much information as can reasonably be collected helps considerably in diagnosis.
CALIBRATION CHECK & RECALIBRATION

INTRODUCTION

Prior to delivery the system is set up with a series of dimensional constants which enable the instrument to make the corrections if the sensors away are fixed away from the ship’s marks. After installation the system is calibrated to the ship’s marks.

All measurements are to the ship’s marks on the perpendiculars, which should always be used for calibration.

When a calibration check or recalibration is to be carried out the following conditions should be observed.

1) The ship needs to be afloat.

2) The smoother the sea, the better the result.

3) As the draught indicator has to show the sea water draught, it is preferable to check the calibration when in a harbour with a sea water density of 1025. (Note that if the density is not 1025, the actual density will be needed to calculate the correction to the draught readings which have been taken).

4) The ship is in a steady state at rest and as near as possible on an even keel.

5) Taking readings from the draught indicator and the ship’s marks at the same time gives a more accurate result. (This can be achieved by using two-way radio or alternatively by recording draughts from the display every minute while similar figures are being recorded from the marks and later comparing the figures)

6) The result should be recorded in the form shown on Page 21 to show if there is any long term deterioration.

PROCEDURE

To obtain figures required.

1) Read the ship’s marks Forward, Aft, Port and Starboard. Take the average of the Port and Starboard readings to get the mean Midships draught.
If a ship has 2 sets of Aft marks on Port and Starboard quarters then the mean of the two figures should be taken.

2) At the same time note the corresponding values, which are shown on the draught indicator display when the Show Draught option is selected.

3) If ship is not in sea water (density 1025) correct the readings of the ships marks to give the equivalent draught in sea water using the ship’s hydrostatic tables. This is described in the section headed Density on Page 13.

4) Having obtained the two sets of corrected figures, any variations have to be adjusted by calibrating the draught indicator using the following routines.

A typical set of figures might be as follows:

<table>
<thead>
<tr>
<th>Reading</th>
<th>Ship’s mark</th>
<th>Draught indicator</th>
<th>Calibration value</th>
</tr>
</thead>
<tbody>
<tr>
<td>AFT</td>
<td>1.30m</td>
<td>1.38m</td>
<td>- 8</td>
</tr>
<tr>
<td>MID</td>
<td>1.20m</td>
<td>1.23m</td>
<td>- 3</td>
</tr>
<tr>
<td>FWD</td>
<td>1.40m</td>
<td>1.30m</td>
<td>+ 10</td>
</tr>
</tbody>
</table>

Carefully note whether the draught indicator values are too deep or too shallow at each point, and note which readings are positive or negative.

5) Press ENTER and use the UP or DOWN keys to select Calibrate
Press ENTER. The display will show Enter Code New Value = 0
To start the routine use the DOWN key to select the negative number -25
Press ENTER and the display will show Aft Cal No Value = 0
Press ENTER and use the UP or DOWN keys to select the new value
Press ENTER and use the UP or DOWN keys to select the new value
Press ENTER and use the UP or DOWN keys to select the new value
Press ENTER again, and then press ESC to return to the starting message.

Note. If no keys are pressed for about 5 minutes the system will automatically exit this procedure and whatever figures have already been entered will be used. If this happens and you have not finished you should repeat from paragraph 5) to complete the calibration.

DENSITY

The draught indicator has the ability to correct its readings to compensate for the effect of water where the density is not that of standard sea water so that the displayed draught corresponds to the ship’s marks. It is still necessary to apply the freshwater allowances given in the stability booklet after correcting for local density.

If this option is in use the Master will be prompted to enter the correct density each time the ship leaves port. The density is likely to be constant in each port, and can be measured using a hydrometer. Standard sea water has a density of 1025.
In normal operation (see Page 4) after entering the codes for present and destination ports the display will show **Density - nnnn** (where nnnn is the density of water at the last departure port).

If this figure is applicable to the current port press ENTER. If not correct use the UP or DOWN keys to change the value and then press ENTER.

**DRY DOCKING PROCEDURE**

When the ship enters a dry dock it is essential that the following procedures are carried out.

The draught sensor should be removed while in dry dock, and replaced before floating out.

Alternatively the sea valve connected to draught indicator sensor must be closed after draining down to prevent damage to the transducer from such shipyard activities as shot blasting, or the accumulation of paint or rubbish in the pipework which could cause a fault in the system. The opportunity should be taken to clear pipework of all marine growth.

If welding operations are required adjacent to any draught indicator equipment extreme care must be taken. **A welding current earthed through this equipment will destroy the electronics and transducer.** If welding is to be carried out on the vent pipes, the sensor and inclinometer units **must** be detached.

When the ship refloats, the sea valve and any valves to vent pipes must be open for the system to function. The test valve must be closed. **We recommend that a datum check is carried out and that the system is recalibrated before entering service.**

**DATUM CHECK**

This routine checks that the draught indicator is correctly reading a known depth of water. It will show any errors in the sensor, and will provide data for correction if necessary.

Measure the vertical distance from the horizontal centre line of the sensor mounting flange to the test valve which is fitted to the pipework above the sensor. This height should be entered on the form on Page 20.

Shut the sea valve. Then open the test valve making sure that the sensor is covered and does not get wet, as water is likely to spray in all directions. Allow water to drain from test valve to leave a fixed head of water at the sensing point.

Allow the draught indicator to settle for 5 minutes.

Press ENTER and use the UP or DOWN keys to select **Raw Values** and press ENTER again. Make a note of the **Depth Raw** value shown on the display. This is the actual
depth measured by the sensor in cms. Press ESC to return to the start menu. When the test is complete close test valve and open sea valve.

If there is a small variation between the actual and calculated head of water which cannot be explained by the local water density, we recommend that the calibration is checked.

If the difference between the actual and observed readings is in excess of 10cm the sensor is probably malfunctioning. When a sensor fails the readings will either change by tens of centimetres over a period of a few days or fail suddenly showing **Line Fault**. In this event fit a service exchange sensor, following the routine on Page 15.

**AIR LOCKS CHECKS**

Provided careful attention has been given to venting, air locks should not occur. If there is a persistent problem we recommend that the pipework is modified. An air lock is more likely to form in the vent pipe if this does not rise continuously to deck level.

If the display reading appears to be too deep a check should be made for air in the system.

1) Close the sea valve to the depth sensor. Then carefully open the test valve above the sensor unit. Make sure that the sensor does not get wet, as water is likely to spray in all directions. Loosen the M16 bolts fixing the sensor and allow all water to drain from the system.

2) When drained, open the sea valve a little, to refill the pipework. Let the water flow freely before tightening the M16 bolts and closing the test valve. The sea valve can then be fully opened.

3) If there is only a small flow of water it is likely that the penetration or sea valve is partially blocked. Remove the sensor before trying to clear this.

**REPLACEMENT OF DRAUGHT SENSOR**

The following procedure must be followed when a sensor is changed.

1) Make a note of the $T_X$ and $T_G$ figures on the new sensor. These define the particular characteristics of this sensor, which must be entered from the keypad.

2) Close the sea valve, disconnect the cable, unbolt and remove the old sensor.

3) Bolt the new sensor in place, as shown on drawing No. SB 1349. Check that the nylon screws are tight. Reconnect the cable plug and socket. Open the sea valve and check for leaks.

4) Now enter the offset $T_X$ and gain $T_G$ values for the new sensor in the draught indicator.
Press ENTER and use the UP or DOWN keys to select **Setup**
Press ENTER. The display will show **Enter Code** New value = 0
To start the routine use the DOWN key to select the negative number -115
Press ENTER and use the UP or DOWN keys to select **Sensor Gain**
Press ENTER and use the UP or DOWN keys to select the new **Tg** gain value
Press ENTER and use the UP or DOWN keys to select **Sensor Offset**
Press ENTER and use the UP or DOWN keys to select the new **Tx** offset value
Press ENTER again, and then press ESC to return to the starting message

5) Check that the system is functioning correctly. If necessary carry out a datum check and recalibrate the system. Enter the details of the new sensor on Page 20.

**REPLACEMENT OF INCLINOMETER**

The following procedure must be followed when an inclinometer is changed.

1) Make a note of the Inclinometer Gain **Tg** and Offset **Tx** values for the new unit. These define the particular characteristics of the new unit and must be entered from the keypad.

2) Disconnect the 24 volt DC supply and system connections on the old inclinometer. Remove the lid to gain access to the 4 screws, which fix the unit to the bracket on the bulkhead. Unbolt the old unit.

3) Fit the new unit, temporarily leaving the lid off, and reconnect the 24 volt DC supply and signal cable connectors. Then check and adjust the inclinometer as follows.
   a) Press ENTER and use the UP or DOWN keys to select **Show Raw Values** and press ENTER again. Note the displayed value of **Inc Raw**. With the ship on an even keel this should be within ±100 of the **Tx** offset of the replacement inclinometer.
      If the reading is outside this range it is necessary to rotate the inclinometer in its mounting to get as close to the given **Tx** offset value as possible. Then note the actual reading.
   b) At the inclinometer loosen the clamp retaining the inclinometer to the base plate and rotate it very slightly using the directions indicated on the baseplate (+ to increase reading, – to decrease reading). After each movement tighten the nuts and recheck the reading.
   c) When a satisfactory reading has been obtained make a note of the value of this new Inclinometer Offset **Tx**. Press ESC to return to normal operation. Make sure the nuts are tight and carefully replace the lid on the inclinometer unit.

4) Enter the offset **Tx** and gain **Tg** values and gain values for the new inclinometer in the draught indicator.
   Press ENTER and use the UP or DOWN keys to select **Setup**.
   Press ENTER. The display will show **ENTER Code** New value = 0
   To start the routine use the DOWN arrow to select the negative number -115
   Press ENTER and use the UP or DOWN keys to select **Inc Gain**
Press ENTER and use the UP or DOWN keys to select the new $T_g$ gain value
Press ENTER and use the UP or DOWN keys to select Inc Offset
Press ENTER and use the UP or DOWN keys to select the new $T_x$ gain value
Press ENTER again, and then press ESC to return to the starting message

5) Check that the system is functioning correctly. If necessary check and recalibrate the system. The details of the new inclinometer should be entered on Page 20.

**Note.** When replacing Draught Sensors or Inclinometers, if no keys are pressed for about 5 minutes the system will automatically exit this procedure and will use whatever figures have already been entered. If this happens and you have not finished you should repeat from paragraph 4) in the respective instructions to complete the installation.

**REPLACEMENT OF PRINTER**

The following procedures must be followed when a printer is changed

1) Switch off and unplug the 24 volt DC power supply. Remove the plastic bezel at the front end of the instrument, and then remove the front panel taking care not to pull or damage the ribbon cables and connectors.
2) Unplug the ribbon cable from the top of the black printer box, noting which way round it fits.
3) The printer is fixed to the front panel by a bracket with two screws in the back of the printer box. Undo these screws, remove the earthing wire and the metal bracket and slide the printer out through the front panel.
4) Slide the new printer through the front panel, and fix the bracket and earthing wire with the two screws. Do not over tighten these screws as this may distort the plastic box.
5) Reconnect the ribbon cable into the new printer. Replace the front panel and bezel. Check that there is paper and that a ribbon cassette is fitted in the printer. Reconnect the power supply. The instrument will restart automatically and the starting message **Draught Gauge 1500 Mk VI v 1.0** will be displayed.

**ELECTRICAL CONNECTIONS**

The instrument is connected to the ship’s 24 volt DC power supply by a two pin “Bulgin” mini-buccaneer cable socket. **The Negative must be connected to the N terminal, and the Positive must be connected to the L terminal.** There is no provision for an ON/OFF switch in the instrument. The inclinometer also requires a 24 Volt DC supply, this is connected via a three pin “Bulgin” mini-buccaneer cable socket. **The Negative must be connected to the N terminal, and the Positive must be connected to the L terminal, no connection is made to the E terminal.**

The Sensor and Inclinometer are each connected to the instrument by two core screened cables. At the instrument these cables each terminate in a three pin “Bulgin” mini-buccaneer cable sockets, with the two conductors connected to the N & L terminals, and the screen connected to the E terminal. Note that the cable screens must be continuous from the instrument to the sensor and inclinometer, and to avoid interference they must not be
earthed to the hull at any point. The connections at the sensor and inclinometer are by two pin “Bulgin” mini-buccaneer cable sockets, the two conductors being connected to the N & L terminals, while the screen is cut back and is not connected.

Appendix A – SPARES

1) Items which are often locally available, but can be supplied by Malin Instruments.
   a) Paper Rolls
      Standard “till” rolls, size 2¼ins or 57mm, with an overall diameter of not more than 2ins or 50mm. Larger diameter can be used if the surplus paper is wasted.
   b) Printer Ribbons
      Epson code number ERC-09.
   c) Cable sockets for Sensor, Inclinometer and Power Supply.
      “Bulgin mini-buccaneer” cable shells with 2 & 3 pin screw terminal inserts.
   d) Fuses, all 20mm cartridge
      5V and 24V power 1 Amp
      Printer 3 Amp
      Sensors 50mAT
      Inclinometer 1 Amp

2) Items which are only supplied by Malin Instruments, which can be installed locally.
   a) Sensors.
      Service exchange draught sensors comprising pressure transducers with matching electronics are available.
   b) Inclinometers.
      Service exchange inclinometers with matching electronics are available.
   c) Printer Mechanism.
      Replacement printers are available.

3) Items where replacements are available for fitting by Malin Instruments engineers.
a) Long term consumables. 
Replacement backlit display, Go/No Go lights and battery for the clock. 
All of these have an expected life of in excess of 5 years.

b) Printed Circuit Boards and Components. 
In the event of component failure or accidental damage replacement parts are available.

If you experience any difficulty on obtaining spares, please contact Malin Instruments Ltd.,

Appendix B – INSTALLATION

The leading dimensions of the ship and position of the draught sensor should be recorded in the form shown in Appendix C on Page 20.

Typical details of the pipework for the draught sensor are shown on drawing No. SB 1349.

Note that the sensor must be located in a dry accessible position, the test valve must be below the water level and the open ended vent pipe must rise continuously to the main deck. Statutory regulations with regard to hull penetrations and sea valves must be observed and appropriate, acceptable material must be used. Prior to making any penetrations to a ship, the proposed details of the relevant piping valves and positions should be submitted to the Department of Transport, Marine Directorate, for approval of the installation in principle.

The mounting bracket for the inclinometer is shown on drawing No. SB 1348. This may be mounted on any suitable longitudinal bulkhead, preferably where there is little vibration, with access to a suitable 24 volt DC supply.

The draught indicator should be mounted in the wheelhouse at a convenient location close to a 24 volt DC supply. A bracket is provided so that it can be suspended from the deck head and adjusted to a suitable angle, alternatively it can sit on any suitable horizontal surface. Overall dimensions of the unit (excluding cable connections and hanging bracket) are 21cm wide x 33cm deep x 13cm high. Weight approx 4 kg.

Welding. The sensor and inclinometer must be removed before any welding operations to the adjacent pipework or brackets. A welding current will destroy electronics.

Electrical installation details are shown on drawing No. SB 1346. Cabling from the sensor and inclinometer to the draught indicator is by means of a lightweight screened twisted pair to BS4066 Part 3 or BS5308 Part 2 Type 1 approved for use in British ships. This cable can be supplied by Malin Instruments Ltd.

If the cable is less than 8mm diameter it may be plugged directly to the sensor, inclinometer or draught indicator. Otherwise it should be terminated in a waterproof junction box and a short length of suitable screened two core cable should be used to connect to the unit,
following the connection details given on Page 17. It is of greatest assistance at the time of installation if all cables are correctly labelled.

The cable screens must be continuous from the inclinometer and sensor to the draught indicator, and they must not be in contact with any metalwork other than designated terminals. A failure to ensure this will result in an earth loop leading to sensor failure.

The routines for fitting the draught sensor and inclinometer given on Page 15 & 16 should be followed with a new installation. The actual entry of ship’s data and calibration of the system should be carried out by the installation engineer when the vessel is afloat.

Appendix C – RECORDED DATA

TABLE OF DATA ENTERED IN SYSTEM

<table>
<thead>
<tr>
<th>Description</th>
<th>Measurement</th>
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<tbody>
<tr>
<td>Ships Name</td>
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<tr>
<td>Sensor to Keel distance</td>
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<tr>
<td>Sensor to Forward Marks</td>
<td>Measured to 0.10 Metres</td>
</tr>
<tr>
<td>Sensor to Aft Marks</td>
<td>Measured to 0.10 Metres</td>
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<tr>
<td>Sensor to Test Valve</td>
<td>Measured to 0.01 Metres</td>
</tr>
<tr>
<td>Nominal Expected Draught</td>
<td>Measured to 0.01 Metres</td>
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<tr>
<td>Maximum Allowable Midships Draught</td>
<td>Measured to 0.01 Metres</td>
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<tr>
<td>Total Allowable Trim by the Head</td>
<td>Measured to 0.01 Metres</td>
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<tr>
<td>Total Allowable Trim by the Stern</td>
<td>Measured to 0.01 Metres</td>
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# SENSOR & INCLINOMETER DETAILS (See Pages 15 & 16)

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<th>Inclinometer Offset</th>
<th>Gain</th>
<th>Comments</th>
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## Record of calibration numbers – Continued

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