HOCKING

WheelScan Mk IV

Operators Handbook

Hocking WheelScan MK IV
Operators Handbook
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Hocking NDT Limited
Inspec House
129-135 Camp Road
St Albans, Hertfordshire
UK, AL1 5HP
Tel: +44 (0)1727 840321
Fax: +44 (0)1727 844476
email: info@hocking.com
web site: www.hocking.com

Important Note

READ THE FOLLOWING INFORMATION PRIOR TO USE OF ANY PRODUCT MANUFACTURED BY HOCKING NDT LTD.

Hocking NDT Operators Handbooks provide functional information about a particular instrument or group of instruments. Proper set-up and use of this equipment and the performance of electromagnetic tests, however, requires familiarity with factors that are beyond the scope of Operators Handbooks. These factors include the following:

1. Selection of appropriate cables, probes, fixtures, mechanical handling equipment and other accessories.

2. Selection of proper test frequency, test mode and other test parameters.

3. Preparation of test surface.

4. Characteristics of the test material, for example: conductivity, hardness, permeability, geometry, magnetic properties, heat treatment etc.

5. Environmental factors such as temperature, humidity, dust and electrical interference.

6. Any individual factors that will depend on the particular test object or test being performed.

It is, therefore, imperative that operators are properly trained in both general procedure for electromagnetic testing and in the set-up and execution of the particular test to be performed.

It is the responsibility of the instrument user to ensure the test operators are trained to a sufficiently high standard, suitable equipment is used in the correct manner and that any tests are taken into account. Similarly, compliance with standards such as ASTM, ASNT, API, ASME, BS, etc. as well as the observance of any test procedure specified by any government, manufacturer or other regulatory authority is the responsibility of the user.

Periodic calibration and maintenance may be necessary to ensure proper operation of the equipment. Environmental conditions and regularity of use should be considered when determining the frequency of such checks, but if the Handbook recommends a minimum frequency for checks, then this should be observed.

The user should implement a program of periodic calibration, cleaning and maintenance to ensure optimum performance of the equipment.

Incidents such as physical shock, immersion in liquid, and exposure to damaging environments such as excessive heat, moisture, dirt, or dust, can adversely affect equipment performance. The equipment must be examined for damage and recalibrated after any such incident. Do not use any product which you know or suspect to be faulty.

Reference samples used for calibration should, ideally have the same material properties as the object to be tested, or a known relationship to it, established by laboratory tests on suitable samples. Equipment calibration should be checked frequently during testing to assure valid test measurements.

As a matter of good practice and wherever possible, suspected defects in critical areas should be cross checked using appropriate alternative indication techniques.

Any questions about the use, operation, specifications or special considerations relative to the particular Hocking NDT product you are using should be addressed to your local sales representative, the distributor, or Hocking direct.

Hocking NDT pursues a policy of continued development of its products. The Company reserves the right to change specifications without prior notice.

WARNING:

1. Dangerous voltages are present in some electronic equipment. Generally there are no user serviceable parts in the electronic equipment, additional power supplies and/or charger units. Disconnect all power supplies and remove batteries where possible before removing any covers.

2. In the interests of safety it is advisable not to work alone.

3. Power cables contain an electrical safety ground. Do not use with an un-grounded outlet.

DISCLAIMER

Hocking NDT products are sold subject to our standard conditions of sale and warranty. This is in lieu of any other warranty or condition implied by laws as to the quality of fitness for any particular purpose. We shall not be liable in contract, tort or otherwise in respect of any claim resulting from the use of or defects in, the goods or from any work done or omitted in connection with the goods.

Contents

1.0 Description of equipment

WheelScan Mk IV is a compact wheel inspection machine designed to meet the requirement for eddy current wheel inspection in civil and military applications. It is a combination of a specially designed, dedicated eddy current instrument, WheelScan E, mounted on a base unit which houses the mechanical, electrical and electronic sub-systems.

The purpose of the equipment is to scan the outer surface of an aircraft wheel half hub with an eddy current probe sensitive to both cracks and corrosion. The overall objective is to be able to test any aircraft wheel up 830mm diameter, manufactured from the alloys of either aluminium or magnesium, either in the stripped condition or when the metal surface is covered by the usual surface coating.

A wheel inspection using WheelScan Mk IV is almost totally automatic, making it simple to operate. This allows the system to be successfully used by operators across the widest range of skills. WheelScan is rugged, reliable and designed to meet the demands of even the busiest wheelshop.

Care has been taken to ensure that the sub-systems within the machine are modular and may be rapidly de-mounted and exchanged for servicing needs. The degree of operational simplicity achieved alongside its first class performance as a flaw detector have produced a machine which more than satisfies all the known requirements and standards for this type of inspection.

Key

A WheelScan E – eddy current crack detector
B Strip chart recorder
C Support column
D Half-hub
E Probe on scanning assembly
F Conveyor rollers
G Control panel
H Emergency stop button
J Drawer unit
K Access cover for electrical/electronic cabinet

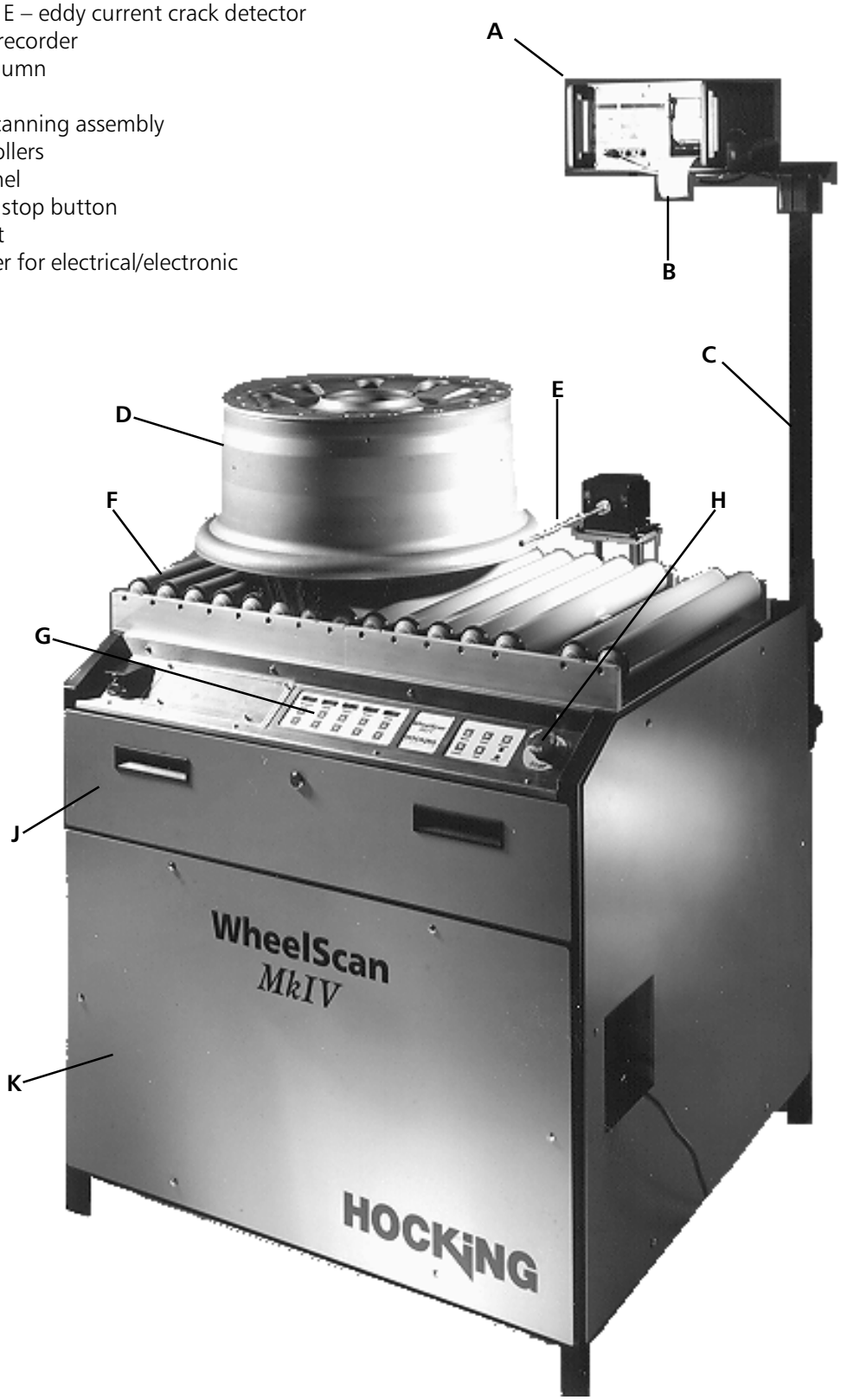


Fig 1.1 WheelScan Mk IV and key

1.1 Equipment supplied

The WheelScan Mk IV is of modular design and comprises of 8 main modules:

1. WheelScan E, eddy current crack detector unit
2. Electronic cabinet
3. Control panel assembly
4. Wheel Lift/Rotate assembly
5. X-Y scanner assembly
6. Roller assembly
7. Probe mount
8. Frame

In addition to the main modules the equipment is supplied with:

- Tape measure
- Operators Handbook
- Maintenance sheet
- Operation sheet
- Chart paper x 2 rolls
- Probes, leads and adapters should be ordered separately.

1.2 Specifications

Base unit (PRN 50I003)

Overall size	914 x 870 x 800mm (36 x 34 x 31½") H x W x D
Weight	200kg (440lb) approx.
Power Requirements	100/110 or 220/240 V AC, 40 to 60Hz, 300VA approx. Air is not required.
Work surface	Conveyor rollers
Lift heights	User definable from front control panel.
Rotation speeds	10, 30, 60 rpm. User selectable from front panel. (N.B. 10rpm for wheel eccentricity tests only)
Scan helix	1, 1.5, 2, 3mm pitch. User selectable from front panel.

Max. wheel dia.	830mm (32.6”)
Max. wheel weight	200kg (440lb)
Scan height	0 to 390mm (15.4”)
Ram height	246mm (9.7”) total travel, 215mm (8.7”) effective travel
Construction	Steel frame with rapidly removable panels and lifting/ strapping facilities. Modular electronics. Modular Lift/Rotate and scanning assembly and control panel. Drawer for probe accessory storage.
Control panel	Removable module. Digital display on all controls. Emergency stop button.
Overall control	Microprocessor control. Built in control of lift-off compensation, zeroing, calibration, chart recorder, automatic inspection sequence control with ‘AutoTrak’ profile following system.

Specifications of eddy current unit WheelScan E (PRN 34I002)

Power supplied from base unit. Microprocessor controlled. Automatic lift-off compensation and zeroing.Bargraph display with automatic brightness control. Integral automatic two channel chart recorder. Simplified set-up procedure with alpha numeric display. One to three probes may be permanently connected on separate sockets and individually programmed. Very high speed response of instrument and chart recorder. User selectable filter (pre-selected for automatic scans)

Frequencies	100kHz, 200kHz, 500kHz, 1.0MHz, 1.5MHz, 2.0MHz
Probe inductance	220mH, 120mH, 47mH, 22mH, 10mH, 8.2mH +/- 20%
Frequency	Standard WheelScan probe 1.5MHz
Gain range	25dB to 60dB in 0.5dB steps.

WheelScan probes

6mm (0.25”) diam.	Product Reference Number 50PA16
9.5mm (0.375”) diam.	Product Reference Number 50PA24

Overall working environment

Operating temperature	0 to +45ºC
Storage temperature	-25 to +70ºC
Humidity	0 to 90% RH, non-condensing

Chart paper

50mm wide 30m roll, medium sensitivity thermal paper (KANZAKI KF200)
Internal core diameter 12mm. Product Reference Number S34/C826.

EC Standards

To maintain compliance with EC standards for EMC, grounded aluminium adapters should be used.

2.0 Setting up WheelScan Mk IV

2.1 Installation requirements

Dimensions:

	Width	Depth	Height
Pallet	1000mm	925mm	
Overall dims. unpacked unit excluding WheelScan E	870mm	800mm	914mm (floor to top of rollers)

Weight: 200kg

Power: 100, 115 V AC 60HZ or 200, 230 V AC 50Hz

Tools: Fork lift will be required in order to lift WheelScan from pallet

Metric allen key set

Spirit (torpedo) level

Standard tool kit

2.2 Unpacking and inspecting

To reach this Operators Handbook you will have removed the outer packaging surrounding your WheelScan Mk IV. If you found any transit damage record its location and inform the carrier.

You will now be able to see the WheelScan main unit. Using a flat bladed screwdriver remove the side panels of the unit (¼ turn on the holding catch).

Inside the main unit you will find the WheelScan E eddy current crack detector fixed to a transit base plate. Remove the three screws holding the plate to the base. Undo the knurled head screws securing the WheelScan E and remove it from the panel. Replace the plate and screw down to the base.

Check that all items listed on the packing note are present and undamaged. Do not discard any packaging as it may be required for later transportation. If any items are missing or damaged then report it immediately to your local agent or manufacturer and carrier.

2.3 Assembly for operation

Remove the entire WheelScan unit from the pallet and install it in its position of intended use ensuring you have access to the X-Y mechanism from the sides or rear when it is in place. If not, remove the unit from the pallet, remove transit bracket (see 2.1) replace panels and use a fork lift to put it into position.

On the main WheelScan unit the feet are adjustable to ensure a level working surface. Adjust the feet where necessary until the conveyor rollers are level (use a spirit level for accuracy)

Note: inspection accuracy will be affected if the working surface is not level.

Inside the main unit, next to the WheelScan E transit plate you will see a red bracket. This is the X-Y retaining clamp and should be removed by undoing the three screws. Do not leave the retaining bracket inside the unit, keep it in the unit drawer for any future transportation. Replace the side panels and secure by pressing the quarter-turn catch until it 'clicks' into position – if not, turn the catch through 90° and press home.

2.4 Connection of the WheelScan E Unit

The WheelScan E shelf and support will be at its lowest position. First remove the bag taped to the shelf with the cables in it. Raise the shelf by removing the two large bolts with plastic knurled heads, reposition the shelf and then re-fix using the knurled head screws. There are several sets of drilled holes for use on the main unit support, providing a choice of mounting heights for the WheelScan E.

To fix the WheelScan E unit to the shelf, put the two M4 plastic headed bolts through the hole in the shelf from underneath. These correspond with two holes on the base of the WheelScan E unit. When the WheelScan E is correctly mounted the handles on its front panel will be flush with the front edge of the shelf.

The Communications cable with the 15 way D plug should be connected to the rear of the WheelScan E unit, as should the Power Supply cable. These will be found on the rear of the main unit. Connect the probe cable (Lemo socket to BNC socket cable, PRN: 50A607) using the BNC connector plugged into the Probe A socket on the front panel of the WheelScan E. Leave the Lemo connector free for later connection to the probe. These cables should then be secured to the shelf support using the clips provided to avoid loose cables snagging (Ref Fig 2.1)

2.5 Connection of Probes

The probes and probe mounting assembly will be found in the accessories box in the drawer. Select the probe required and the probe mounting assembly (identified as a small black unit with a knurled collet) Loosen the collet on the probe mounting assembly and remove the 10mm transit dowel. You should retain this in the unit drawer for any future transportation. Insert the probe, socket end first, into the collet end of the probe mounting assembly, pushing it through until it starts to emerge from the rear of the assembly. Tighten collet.

The probe mounting assembly can now be connected to the main X-Y assembly, on the rear right of the unit, by pressfitting it on top of the X-Y assembly. Correct the probe position in relation to the calibration block by loosening the collet and adjusting the probe until its coils are central to the machined line on top of the calibration block. Tighten the collet when you are satisfied with the probe position. If the probe mounting assembly needs

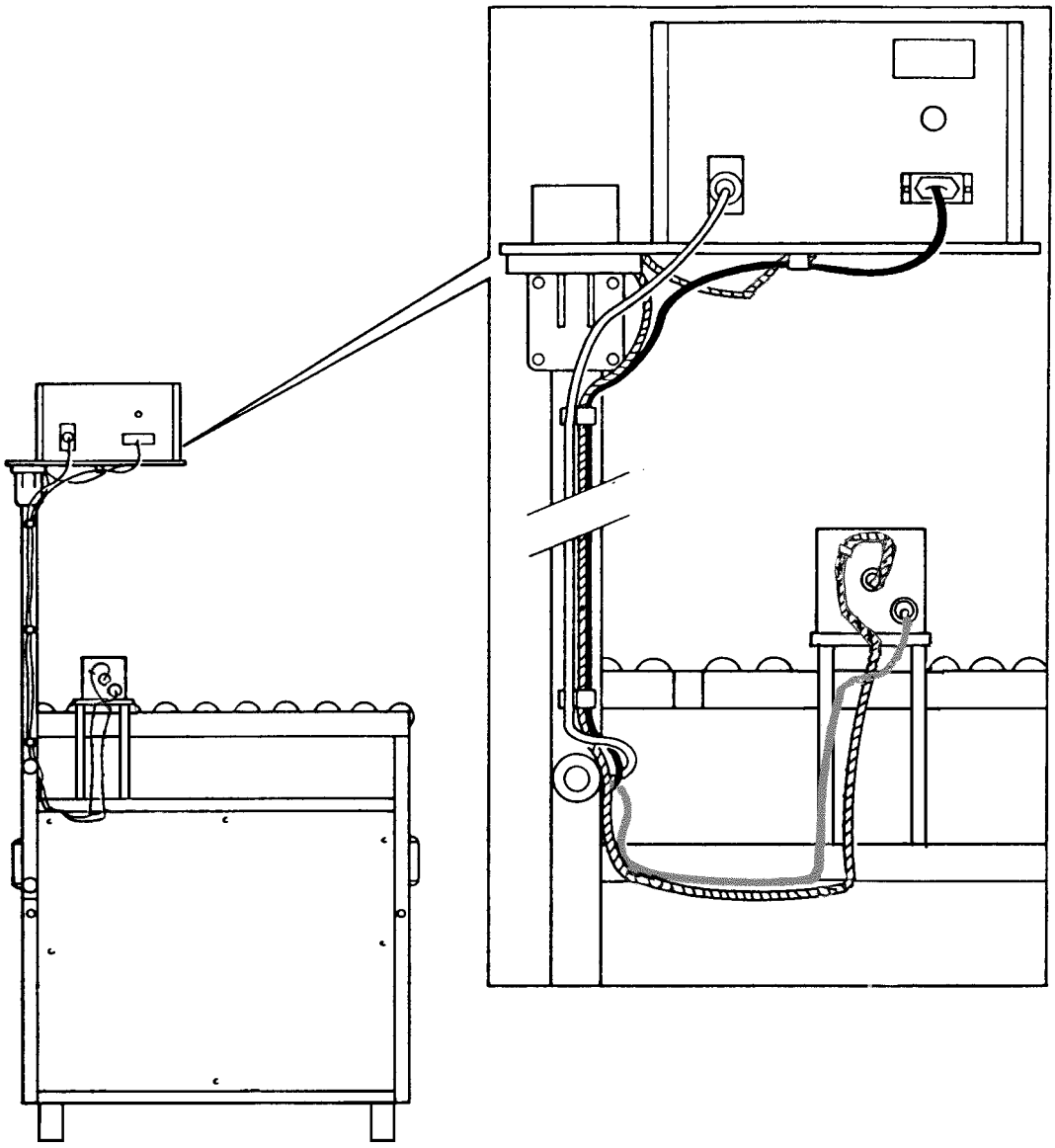


Fig 2.1 Probe Wiring

to be removed then a gentle pull will remove it from its fixing on the X-Y assembly.

Connect the cable from the Probe A socket on the front of the WheelScan E unit to the probe Lemo connector. Ensure that the probe lead is secured properly so that it will not snag anything when in operation, and so that it does not restrain the X-Y assembly.

CAUTION: The probe cable must be held in the cable clip on the probe mounting assembly with a free loop so there is no tension on the rear of the probe.

Pencil or bolt hole probes may be needed for examination of other parts of the wheel. These can be permanently connected to the WheelScan E via the Probe B and Probe C sockets on the front panel. When not in use these probes should be stored in the probe holder on the shelf. The holder provides two sets of holes that are marked B and C. The probes can be placed in the corresponding holes to avoid confusion of probe identity.

The Assembly, power and Control plug should be plugged into the socket on the rear of the probe mounting assembly. (SK1C)

2.6 Initial checks before connecting the power supply

Ensure mains (line) voltage is correct and the voltage selector switch is set to the correct local supply (taps on transformer may need to be changed, see 1.7.3) Verify that the residual current circuit breaker is switched on, i.e. the switch is at the 'I' position.

CAUTIONS:

1. This apparatus contains an earth/ground leakage contact breaker, any interruption of the protective earth/ground conductor inside or outside the apparatus will prevent its safe operation.

2. Intentional interruption of the earth/ground conductor is prohibited.

3. The AC input plug should only be inserted in a socket outlet provided with a protective earth/ground contact.

4. The protective action should not be negated by the use of an extension cord without the protective earth/ground conductor.

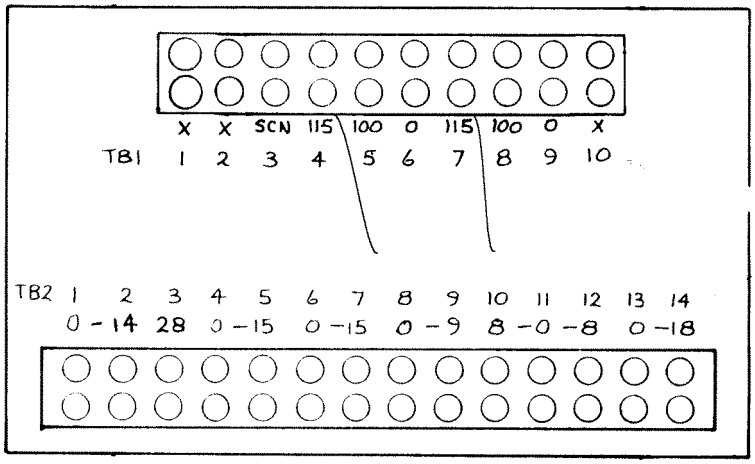
Remove the electronics panel and check that all boards are secure. Also check all wiring is correct and clear of moving parts. Replace all panels.

Changing the transformer taps

Note: as supplied the '120V' setting will allow operation with a supply of 100V to 130V and the '240V' setting operates over 200 to 260V.

If the AC supply is known to be below these levels then the transformer taps can be changed.

The brown wires in positions 4 and 7 (see diagram below) – marked 115V – should be moved one position to positions 5 and 8 – marked 100V. This will give operation over 90 to 110V on '120V' setting, or 180 to 220V on '240V' setting.



2.7 Switching on

Ensure that the Emergency Stop button on the right-hand side of the main panel is not depressed by twisting it clockwise. Connect AC line cord to AC input and press ON the ON/OFF switch immediately above it. The switch will be illuminated if power is being supplied to it.

Switching on the main unit power will cause the WheelScan E to switch on. Check that 'PROBE-A' is shown on the display. Ensure that the X-Y assembly is properly parked by pressing the END button.

1. Check for any unusual movements

2. Check probe head lamps respond to movement of probe by gently moving the probe up and down and side to side.

3. Set in some values and try a wheel test making sure that it follows the correct sequence of operation (see next).

If the unit follows the correct sequence of operation and there are no other problems, refer to Section 3.1.

The equipment generates and uses radio frequency energy for its operation. It has been designed, tested and manufactured to ensure conformity with EC standards relating to EMC, nevertheless appropriate care in siting and installing the equipment should be taken to avoid interference problems.

3.0 Controls

3.1 WheelScan main unit controls (Ref Fig A1.1)

Item	Description	Function
1	Lift **HEIGHT** Selector Buttons	Use the up and down buttons to set the height at which you wish the test to be carried out at. The height selected should be the lowest possible that allows the wheel to be lifted clear of the rollers.
2	Wheel Rotate Speed **(RPM)**	Use the up and down buttons to select the Selector Buttons rotational speed at which you wish the test to be carried out at. Choice of 10rpm (for eccentricity tests) 30rpm and 60rpm.
3	Scan **HELIX** Selector Buttons	Use the up and down buttons to select the scanning helix for the test. Changing the value when a test is in progress will not alter the scan helix performed.
4	**START** Height Selector Buttons	Use up and down buttons to select the height (mm or inches) above the rollers at which the probe will start scanning. The maximum height is 390mm (15.4")
5	**END** Height Selector Buttons	Use up and down buttons to select the height (mm or inches) above the rollers at which the probe will end its scan. The maximum height is 390mm (15.4")
6	Wheel **RAISE** Button	Raises Ram until selected wheel height is achieved. This is a toggle action button. A short press toggles the action of the control, i.e. if stationary and below the set limit, a short press on **RAISE** will start the Ram lifting, and a further short press will stop the Ram (the Ram will also stop if the set limit is reached) A long press of the button will raise the Ram while the button is pressed and will stop when the button is released, assuming that the set limit has not been reached. If the Ram has not been raised to the

Item	Description	Function
		full inspection height entered the display will flash. Simply press the **RAISE** button to achieve the correct height.
7	Wheel **LOWER** Button	Lowers Ram to set wheel down on conveyor rollers or worktop. Toggle action like **RAISE** button.
8	**START** Button	Pressing this causes the automatic inspection sequence to commence if wheel is raised to the selected **HEIGHT**.
9	**END** Button	Pressing this causes the automatic inspection sequence to terminate and the probe to be parked.
10	**PAUSE** Button	When a test is in progress, pressing this will cause the test to pause. The Pause indicator light will illuminate. A second press will cause the test to be resumed, and the Pause indicator light will extinguish. When Flawstop has been selected on the WheelScan E (via the Filter/Alarm button) the main unit will enter the **PAUSE** state when the bargraph on WheelScan E exceeds the alarm level. Pressing the **PAUSE** button will cause the test to resume. The **PAUSE** button can be held down until the 'alarm' has been passed to inhibit further automatic flaw stops.
11	Pause Indicator Light	Indicates that **PAUSE** (Ref Item 10) has been activated (extinguishes when sequence is resumed)
12	Error Indicator Light	Indicates when the probe travel has been obstructed.

When a wheel test is initiated with the **START** button, the present control settings are stored and the Scan Total is incremented by one. Next time the WheelScan is powered up the last used control settings are loaded from memory. If a problem occurs default setting values are used.

3.2 Transit bracket

Wheel tests are prevented when the transit bracket, used to prevent damage to the X-Y mechanisms, is in position.

The message 'Undo Tran_sit Brac_ket.' is displayed on the control panel, and the transit bracket should be removed before attempting to carry out wheel tests (see Section 1.6.3)

N.B. the Ram can still be raised or lowered when the transit bracket is in position.

Additional display messages

'Scan not Zero Push END' Power was removed before the Ram or Probe assembly had returned to the rest position.

'Too far left Push END' Probe travel to the left has exceeded the design limit.

'Too high Push END' Probe travel upwards has exceeded the design limit.

'RAM too high Push END' Ram travel upwards has exceeded the design limit.

3.3 Changing measurement display and selecting special functions

The five alpha-numeric displays indicate Ram HEIGHT, Wheel RPM, Scan HELIX pitch, Probe START position and Probe END position. The display mode (except RPM) can be adjusted to indicate imperial (0.01") or metric (mm) dimensions. The display mode can be recognised by the HELIX settings which will be either 1.0, 1.5, 2.0 and 3.0mm when in metric, or 0.04, 0.06, 0.08, and 0.12" when in imperial.

Changing the measurement display and other additional functions such as Display Intensity, Total Number of Scans and Software Version numbers can be accessed through subsidiary menus that are entered by a long press of the END and PAUSE button simultaneously while Ram and Probe systems are in the parked position. Further pressing of the PAUSE button will cycle through the available sub-menus and using the appropriate up and down buttons you can change the setting. The displays revert to normal operational mode if the END or START button, on the right-hand side of the control pad, is pressed.

3.4 WheelScan E controls (Ref Fig A1.2)

Item	Description	Function
1	Alphanumeric Display	Displays status of settings, e.g. probe selected, gain level, frequency value etc.
2	dB/Freq Button	Selects inspection signal Gain or Frequency values (adjusted by Push buttons 8 and 9)
3	Bargraph Display	Displays signal from probe. Scale of -40 to 100

Item	Description	Function
4	Alarm Indicator	Light indicates when an alarm threshold (set by Item 5) is exceeded
5	Filt/Alarm Button	Selects Filter IN or OUT or Alarm level setting (adjusted by increment and decrement buttons 8 and 9). It also allows the selection of 'Flawstop/Flawscan'. 'Flawstop' causes the main unit to enter the PAUSE state when an alarm condition is detected whereas 'Flawscan' allows the test to proceed without interruption.
6	Chart Recorder	Records flaw and lift-off signals from probe to provide hard copy of inspection results. The chart is annotated with the following information at the end of each test. METAL TYPE, FREQUENCY, GAIN, PHASE, FILTER SETTING, ALARM LEVEL, FLAWSTOP/FLAWSCAN
7	Paper Feed Button	Feeds paper out of the chart recorder at high speed for as long as you press this button.
8	Value Decrease	Steps down through selectable values of settings displayed on the Push Button alphanumeric display.
9	Value Increase	Steps up through selectable values of settings displayed on the Push Button alphanumeric display.
10	Probe Sockets	Three sockets for connection to probes. Probe A socket is for connection to standard WheelScan probe, Probe B and Probe C are for connection to alternative probes for other inspection procedures.
11	Select Probe	Selects probe input to be active, A, B or C (shown on alphanumeric Push Button display) When Probe A is selected, pressing the INC or DEC buttons will toggle the WheelScan between settings optimised for aluminium or magnesium wheels.
12	Zero Bal Push Button	Balances signal from probe and returns bargraph indication to zero

Item	Description	Function
13	Lift Off Button	Provides automatic lift-off compensation for probes B and C.
14	Probe Holder	Provided for holding probes B and C when not in use.

4.0 Operation

4.1 Preparing the mechanical system for use

It is assumed that the system has been assembled for use as described in Section 1.6. Care must be taken to ensure that all precautions have been taken to prevent damage to equipment and to avoid inaccurate test results.

Select a wheel adapter to suit the wheel being tested, and place this on the ram spigot. The choice of wheel adapter is affected by whether the wheel is to be tested flange up or flange down. If a custom made adapter of a particular wheel is not available, the universal adapter can be used. The locking pegs on this unit must be positioned to hold the wheel in a central position. Concentric rings are engraved in the adapter to assist with this process. Wheel earthing adapters (i.e. solid Aluminium) should be used for compliance with EMC directives.

Set the lift HEIGHT to the correct level by using the up and down buttons on the front panel (Fig A1.1, item 1). The wheel, when in a raised position should be lifted clear of the rollers but in the lowest position possible to do this.

Press and hold the RAISE button (Fig A1.1, item 6) The Ram will rise and pick up the wheel half hub to be tested. If the Ram stops rising without the wheel lifting, select a higher value for the lift HEIGHT (see Section 4.3).

Once the wheel has been lifted clear of the rollers to a satisfactory height, the required RPM for the test can be set. The 10rpm value is provided only for eccentricity tests, and at this setting Probe A will not be scanned over the wheel.

Select the pitch required for the scan HELIX (Ref Fig A1.1, item 3) A larger value for this will result in a faster test, but with any flaws scanned fewer times. A convenient standard setting is 1.5mm (0.06”).

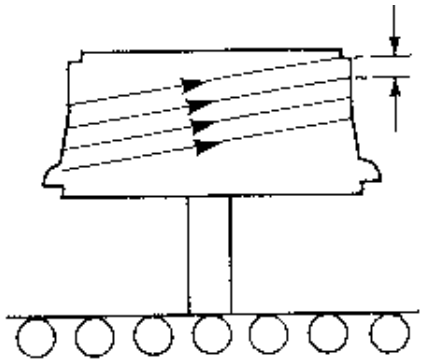
Set the value for the probe START height (Ref Fig A1.1, item 3) This is established by measuring the distance in millimetres/inches from the top of the rollers to the position on the wheel where the probe scan must start. Set this value by using the up and down buttons. This value can be set from 0 to 390mm (0 to 15.4”).

Note: All tests must start from the flange of the wheel (outer most point to be tested)

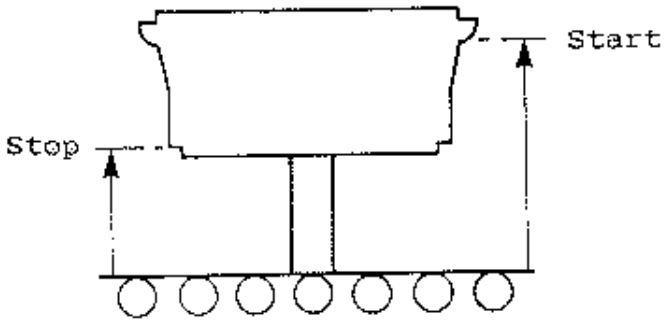
Set the value for the probe END height (Ref Fig A1.1, item 5) This is established by measuring the distance in millimetres/inches from the top of the rollers to the position on the wheel where the probe scan will end. Set this value by using the up and down buttons.

Ensure that the Pause Indicator Light is extinguished, and the probe is in the park position.

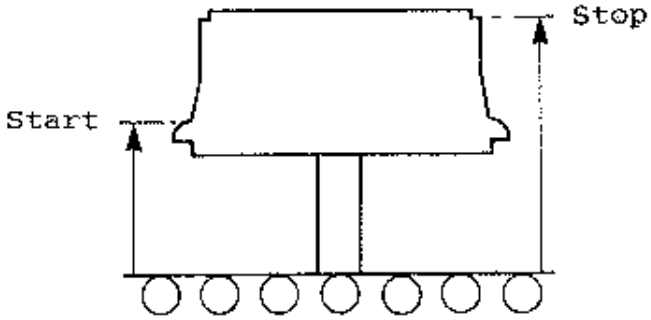
If the Pause Indicator Light is illuminated, press the PAUSE button, and it will extinguish. If the Error Indicator Light is illuminated, ensure that the probe is



Scan Helix Value



Start and Stop heights (Wheel in Flange Up Position)



Start and Stop heights (Wheel in Flange Down Position)

Fig 4.1 Wheel Test Parameters

free from pressure, and press the END button. This will cause the Ram to lower and the Error Indicator Light to extinguish.

If the Error Indicator Light is still illuminated, press the RAISE button and hold it down until the ram has raised the wheel fully, and the Error Indicator Light is extinguished.

If the Error Indicator Light is still illuminated after the above actions, switch the entire unit off and on again. If indicator lights are still not indicating correctly, then check through Section 5.2 'Troubleshooting'

Once the above steps have been taken, the wheel is raised, and the Error Indicator Light is not illuminated, the mechanical system is ready to perform a test, see Section 5.2.

4.2 Preparing the WheelScan E for use

It is assumed that the WheelScan E has been mounted as described in Section 1.6.2, and that the power supply has been connected and switched on as described in Section 1.6.6.

Before any parameters are adjusted, the probe that the settings are for, i.e. Probe A, B or C, should be selected. To select a probe, press the Probe ABC button until the desired name is displayed. If Probe A is selected use the INC or DEC buttons to select aluminium or magnesium wheel materials.

Once the probe has been selected, the Gain may be adjusted by pressing the dB/Freq button once. The value may be changed by use of the INC and DEC buttons. A second press of the dB/Freq button will display the frequency at which the unit is operating. This may be adjusted in the same way as Gain.

Note: Probe A is the WheelScan probe. The standard probe is designed to operate at 1.5MHz.

The Filt/Alarm switch functions in a similar way to the dB/Freq switch. Selecting filter allows a high pass filter to be switched on or off (the filter is automatically on for Probe A) The alarm level is either OFF, or set to a value between 10% and 100%. An indicator light on the front panel lights up when an alarm condition is registered, and an audible warning is also triggered. The volume level of the alarm is adjusted by means of a knob located on the rear of the unit.

FLAWSTOP or FLAWSCAN can be selected, by pressing the INC and DEC buttons when ALARM has been selected.

FLAWSTOP causes the main unit to enter the PAUSE state when the bargraph on WheelScan E exceeds the alarm setting. The wheel rotation stops with the probe at the height of the flaw that has caused the alarm to be triggered.

The filter is cut out under this condition and BAL may be pressed to re-zero the bargraph. Moving the wheel by hand will enable the position of the flaw to be located by observing the bargraph deflection.

Pressing the PAUSE button will cause the test to resume. The button may be held down until deflections are no longer triggering the alarm.

For automatic inspection there is no requirement to set the zero or lift-off compensation manually as it is performed automatically by the unit before each test. If Probe B or C is being used, the compensation can be set by placing the probe on the metal and then pressing the LIFT OFF button. The probe should be placed on an area of metal that is away from any edges, and that is free from flaws. After half a second the message 'LIFT PRB' is displayed. The probe should now be lifted clear of the metal. The unit will then set lift off compensation automatically.

If the unit has not been able to set the lift-off compensation then an error message will be displayed on the alphanumeric display, and you must repeat the process until the unit has set satisfactorily. When the unit has set, the display will revert to displaying the probe identification.

Once the parameters have been set they will be recalled automatically as each probe is selected in turn.

When a wheel of magnesium alloy is to be inspected, the unit may be optimised by pressing the INC or DEC key when the display is showing "PROBE A". The display will change to "PRB A Mg" and the unit will then compensate for the lower conductivity of magnesium alloy after initial calibration on the aluminium alloy calibration block. The setting may be reversed by pressing the INC or DEC key while "PRB A Mg" is displayed.

4.3 How to determine correct test settings

Before performing an automatic test on a new size or type of wheel you need to determine the test settings for maximum accuracy and reliability. Once you have calculated these settings keep a note of them for future reference.

Ram Lift Height

- Place the wheel, making sure you use the correct adapter, centrally over the lift Ram.
- Using the up and down buttons set lift HEIGHT (Fig A1.1, item 1) to a high setting, e.g. 215mm.
- Press the RAISE button on the right-hand side of the control pad (Fig A1.1, item 6). The Ram should lift the wheel above the rollers. If the wheel is not lifted off the rollers the wheel will have to be scanned with the other flange uppermost.
- When the wheel is clear of the rollers measure the distance between the rollers and the wheel – this should be about 5mm (¼").
- If the wheel is higher than this, subtract the difference from the HEIGHT setting. e.g. original HEIGHT setting is 215mm and the wheel finishes 50mm above the rollers. Subtract 5mm from 50mm for the correct clearance height, to give you 45mm. Subtract 45mm from the original HEIGHT setting of 215mm to give you the correct lift height of 170mm.

- Press the LOWER button (Fig A1.1, item 7) and the wheel will be lowered to the rollers. Enter in the new HEIGHT value and press the RAISE button. This time the wheel should be clear of the rollers by approximately 5mm (¼").

- Make a note of the HEIGHT setting against the wheel type for future reference.

Probe Start and End Heights

N.B. the probe can travel up or down but must always travel in towards the centre: so if the wheel flange is up the START height value should be greater than the END value. If the wheel flange is down, the START height value should be less than the END value.

- To set START height, raise the wheel off the rollers to the correct height as determined in the above explanation by pressing the RAISE button.

- When the wheel is at the correct height, measure the height from the rollers to the selected start point on the wheel. Enter the figure using the up and down keys under START on the control panel (Fig A1.1, item 4).

- Note: all tests must start from the flange of the wheel.

- To set the probe scan END height, whilst wheel is raised, measure the height from the rollers to the selected end point on the wheel. Enter the figure using the up and down keys under END on the control panel (Fig A1.1, item 5).

- When you have determined the correct figures you can lower the wheel by pressing the LOWER button. Make a note of the probe START and END heights for future reference.

RPM

You have a choice of three wheel rotation speeds 10rpm, 30rpm and 60rpm. 10rpm is for manual eccentricity tests only and the probe will not make contact with the wheel to carry out an automatic test. 30rpm will provide you with a more detailed scan than 60rpm, however, you should refer to your company standard. Use the up and down buttons under RPM (Fig A1.1, item 2) to choose the correct rpm. Make a note of the selected RPM for future reference.

Scan HELIX pitch

You have a choice of 1.0mm (0.04"), 1.5mm (0.06"), 2.0mm (0.08") and 3.0mm (0.12") scan helix pitches. The larger the scan helix, the faster the test is but there is also more risk of missing smaller flaws, or scanning a flaw fewer times. Therefore, a combination of a slower RPM value and a lower scan HELIX value will give you a more detailed inspection than a high speed and high helix value (ideal for fast, rough inspections). A convenient standard setting for the scan helix is 1.5mm (0.05"), however, you should refer to your company standard.

Enter your chosen scan helix by using the up and down buttons underneath HELIX on the control panel (Fig A1.1, item 3). Make a note of your chosen HELIX value for future reference.

You will now have all your test settings and will be able to carry out an automatic test.

4.4 How to perform an automatic wheel test

This description of how to perform an automatic wheel test assumes that you already have the test settings for lift HEIGHT, probe test START and END heights, wheel RPM and scan HELIX pitch. If you do not have these settings please refer to Section 4.3 now.

After ensuring that the probe is in a parked position load the wheel half hub onto the roller tray making sure you have the correct adapter or universal adapter centred over the lift Ram spigot.

Centralise the wheel half hub over the lift Ram.

On the WheelScan E eddy current instrument check that the Gain is set correctly by pressing the dB/Freq button (Fig A1.2, item 2) once. A second press on the dB/Freq button allows you to check that the Frequency is correct (for an automatic test it should be set at 1.5MHz) If a different Frequency is displayed change it by using the INC and DEC buttons (Fig A1.2, items 8 and 9).

Using the up and down arrow keys on the left-hand side of the WheelScan main control pad enter your settings for wheel lift HEIGHT, probe test START and END heights, wheel RPM and scan HELIX pitch.

When you have entered all of these values correctly, press the wheel RAISE button on the right-hand side of the control pad (Fig A1.1, item 6). The lift Ram will rise and lift the wheel half hub clear of the rollers by approximately 5mm (¼").

N.B. a short press will start the Ram and it will raise the wheel half hub to the selected start height. A long press of the button will raise the Ram only while the button is pressed (until it reaches the designated start height) If the RAISE display flashes the Ram will not have been raised to the full programmed height. Press the RAISE button to complete raising the Ram.

The WheelScan is now ready to perform an automatic wheel test.

Push the START button on the right-hand side of the control pad (Fig A1.1, item 8) and the test will begin.

The probe will go through its calibration routine and when it is complete the calibration block signal will appear on the WheelScan E chart recorder printout.

The wheel half hub will begin to rotate at the required rpm and the probe head will come across to meet the wheel at the designated start position. Check that when the probe head meets the wheel that the pressure sensor

on the probe head lights as the probe touches. This will track from the horizontal and vertical plane as the probe tracks up and down the wheel.

When the probe reaches its designated end height the probe will return to its parked position after carrying out another calibration routine, the wheel rotation will stop and the Ram will lower the wheel back on to the roller tray. The signal from the calibration block will register on the WheelScan E chart recorder and the test will finish.

4.5 How to stop an automatic wheel test

If at any point during the test you wish to abandon it completely press the END button on the right-hand side of the control pad (Fig A1.1, item 9). After abandoning the test the probe will return to its parked position, the wheel rotation will stop and the Ram will lower the wheel back on to the roller tray.

If at any time you wish to stop the power to the unit completely push the Emergency Stop button on the right-hand side of the control panel. This is a twist release button which will resume power to the unit but will not re-start the test if it was half-way through. Push END and the probe will return to its parked position and the Ram will lower the wheel to the roller tray.

If you wish to pause a test simply push the PAUSE button on the right-hand side of the control pad (Fig A1.1 item 10). The test will stop at the point the button is pushed and the Pause Indicator Light will illuminate (Fig A1.1, item 11) The test will resume once the PAUSE button is pushed again.

If you encounter any difficulties when performing an automatic test please refer to Section 5.2 ‘Troubleshooting’.

5.0 Maintenance and Troubleshooting

5.1 Maintenance

WheelScan Mk IV is designed to require little maintenance. Preventative actions, such as siting the WheelScan away from areas of high heat, atmospheric dust and areas where it may be knocked, will increase its reliability further. However, the areas listed below will still require some routine lubrication and inspection. This is intended as a guide only – frequency of all items is based on an 8 hour working day processing 50 half hubs. You will need to adjust these times according to your working conditions and through-put for best performance.

All hardware in WheelScan Mk IV is METRIC and the proper tools must be used. The set screws mentioned are Allen head. Crosshead screws are 'posidrive' (not Phillips).

Extreme care must be taken when panels have been removed since moving parts and/or live parts can be exposed. All routine servicing must be done with the power removed from the machine.

Many quality systems will require regular re-calibration, contact your supplier for details.

Daily

Probe tape	Check condition of PTFE tape on probe and replace if necessary. Performance and probe life will be be reduced if protective tape is allowed to deteriorate.
Probe park position	Check probe parks between rollers, is parallel to rollers and does not touch the base.
General cleanliness	Ensure lift Ram and exposed parts of probe movement assembly are clean and in good condition. Clear any accumulated debris from rollers and surfaces, especially from around bearings. Ensure that there is no excessive or unusual movement in the Ram shaft or probe movement assembly.

Monthly

Wheel Lift-Ram and X-Y assembly	Set wheel lift height to 200mm approx. Set probe Start height to 350mm approx. Raise Ram. Press Start button, when probe reaches set height hit emergency stop button and unplug AC power. Remove back panel, this will expose the X, Y, drive and wheel lift mechanisms.

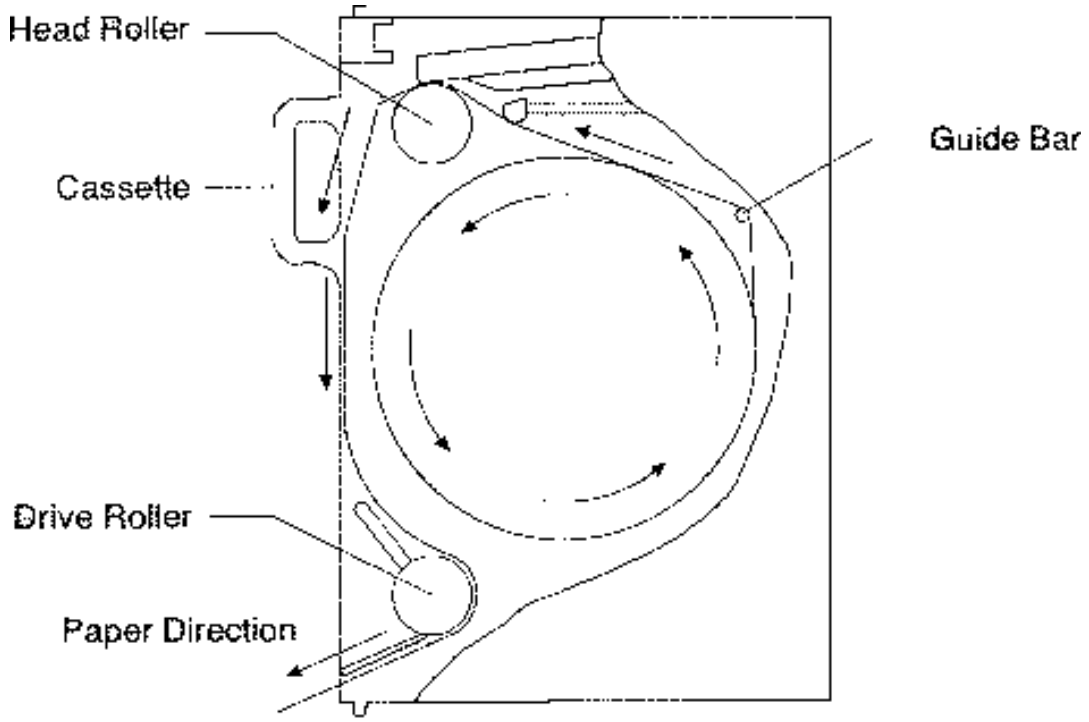


Fig 5.1 Chart Recorder Paper Replacement

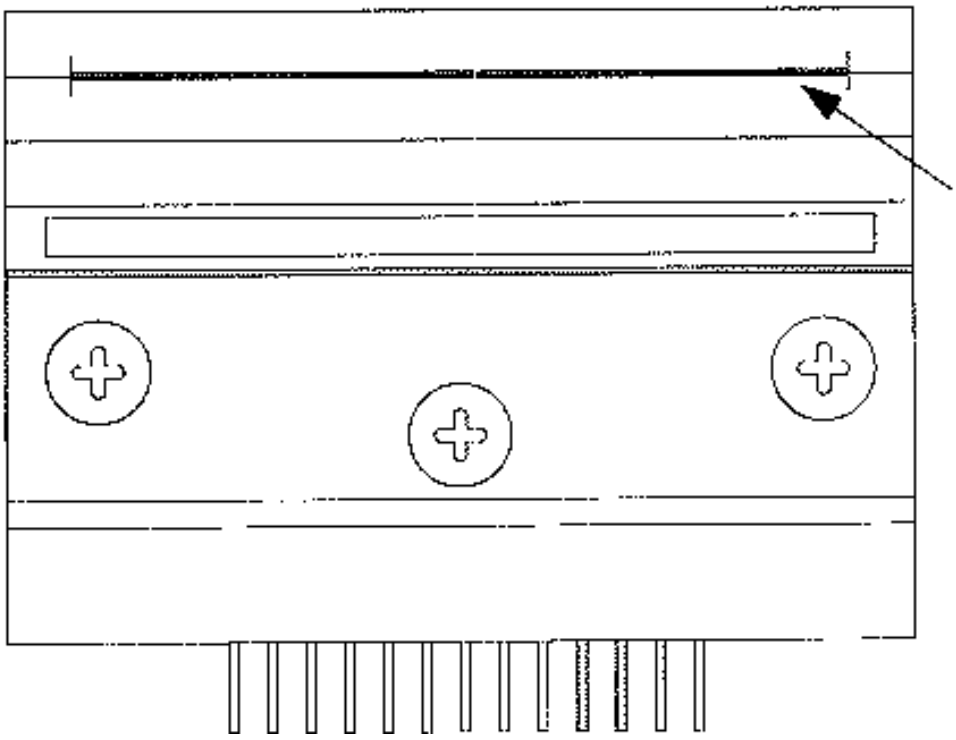


Chart Recorder Head Location

Apply light molly grease to the grease nipples provided on the vertical and horizontal bearing blocks and lead screws on the X-Y assembly.

Apply light oil to shaft above lower and upper bronze bearings on wheel lift mechanism.

Replace panels and re-apply power. Press END.

For safety reasons do not run WheelScan without covers fitted.

The panels have grounding leads which must be re-attached when the panels are replaced.

6 Monthly

Lift clamp When servicing the lift Ram, as above, check that the 5 screws securing the clamp that connects the Ram to the lift shaft are tight.

WheelScan E thermal print head Clean thermal head using cotton bud and alcohol.

Annually

WheelScan E batteries Replace . Good batteries may be reused, but it is normally cheaper to replace them than to test old batteries.

Probe heights at start and end points Check probe reaches correct start and end heights. Start and end measurements may be made during a routine wheel test. Measure from top of rollers to centre of probe tip.

'Set-up' block Check for wear on the 'set-up' (cal) block. Replace if worn.

Probe head assembly Check the lamps on the front of the probe head light when the tip of the probe is deflected by about 3mm (1/8") in the corresponding horizontal and vertical directions.

Paper replacement (Ref Fig 5.1)

Paper in the WheelScan E chart recorder should always be replaced with thermally sensitive paper of the approved type, i.e. Kanzaki KF200 medium sensitivity thermal paper, 50mm wide 30m roll. Internal core diameter 12mm (Product Reference Number S34/C826)

To load the paper, open the cassette by hinging it forward with the aid of the two handles on the printer cassette. If the cassette does not hinge forward easily, gently squeeze the two handles and pull the cassette. To remove the empty core from the recorder push it to one side and dislocate the end of the core from the lugs.

Unwind the paper from packing and insert new roll by locating end of core over lugs. Pull out 15cm (6") of paper and feed over guide bar and head roller. Firmly close the cassette and feed end of paper under drive roller while depressing paper feed button until the paper feeds out of the recorder unit. The recorder is now ready for use.

Head cleaning instructions (Ref Fig 5.1)

The head used within the printer has a single row of printing elements which heat up to react with a special chemical coated on the surface of the thermal paper. After a period of time, dependant on both print duration and quality of paper, a deposit of black dust will accumulate behind the resistive elements. This will result in a deterioration of the print quality.

When this occurs the head should be cleaned with either a cotton bud or light gauze dampened with isopropyl alcohol. Extreme care should be taken to avoid damage. With correct maintenance and the use of good quality paper, the head can be expected to have a lifetime in excess of 30km of paper.

5.2 Troubleshooting

No displays illuminated on WheelScan Mk IV mainframe

- Is the Line voltage input connected ?
- Is the Residual Current Earth Leakage Circuit Breaker switched on ?
- Is the Emergency Stop switch released ? If not twist the knob to the right.

No indicator lights illuminated on the WheelScan E Eddy Current instrument

- Is the power lead connected to the rear socket ?
- Also check as in (3.2.1)

Pressing START has no effect

- Is the wheel in a fully raised position ? If not the RAISE display will be flashing. Press the RAISE button and hold down until the wheel is at its operational height and the display has stopped flashing.
- Are the START and END Heights set to the correct values ?

Pressing START causes the wheel to rotate but there is no probe movement

- Press END and set the RPM to either 30 or 60.

Pressing START does nothing for a few seconds and then the probe starts to move with several pauses

- Ensure that the WheelScan E 'D' connector is correctly inserted. If it is then check that the WheelScan E chart recorder has not run out of paper. If it has run out, see 3.1.5 for replacement instructions.

  If the paper has not run out then either the lead or WheelScan E is defective. It may be necessary, after correcting a connection fault, to switch the entire unit off and on again to ensure everything is set correctly.

- Check the probe drive frequency on WheelScan E has been set to the correct value for the test.

Probe movement ceases

- Check that the probe is not obstructed and the probe lead is not caught up. When the obstruction has been removed press END and the probe should park.

The probe scans in the wrong direction or the probe ceases movement when the bead seat position is reached with no other indications

- Press the END button. Check that the START Height and END Height settings are correct, i.e. if the flange is downwards the END setting must be greater than the START setting. If the flange is upwards the START setting must be greater than the END setting.

The START position is very different from a previous test

- Check that the wheel has the flange the same way up as in previous test.

- Check that the START height is the same value as in previous test.

WheelScan E flashes a message "BALANCE" or "LIFT-OFF"

- Check that the scan probe cable is connected to Socket A and also to the probe.

- Check that the correct frequency has been selected. It may be necessary to press END on the main unit and wait for the probe to return to its parked position before this can be checked.

Excessive noise on flaw trace

- Check all connections, grounding etc. between probe and instrument. A characteristic noise is occasionally caused by components associated with the brake fittings (lugs, wear plates, shields, bolts etc.) having become magnetised. This effect can be eliminated by demagnetising the ferromagnetic parts by a suitable technique, e.g. an AC magnetic yoke.

Additional display messages

'Undo Tran_sit Brac_ket.'	The transit bracket has not been removed. See Section 1.6.3 for removal instructions.
'Scan not Zero Push END'	Power was removed before the Ram or Probe assembly had returned to the rest position.
'Too far left Push END'	Probe travel to the left has exceeded the design limit.
'Too high Push END'	Probe travel upwards has exceeded the design limit.
'RAM too high Push END'	Ram travel upwards has exceeded the design limit.

The above checks will eliminate the majority of common faults. If incorrect operation persists contact your local distributor or the manufacturer direct.

5.3 Operating sequence

This description of the WheelScan operating sequence should be used to assist in identifying correct operation in the event of a failure and should not be seen as operating instructions. This sequence assumes all settings and the wheel have been used on previous occasions without problem.

Switch unit ON and press END.
The five displays should show previous settings.
Change settings as required.
WheelScan E indicates 'PROBE A'

Preparation for test

Fully raise wheel by pressing RAISE (keep finger on RAISE until wheel stops).
Ram stops rising at the correct stop position. Press START button

Lift-off and calibration

Lift-off – automatic set phase
WheelScan E chart feeds.
WheelScan E indicates 'CALIB'
Probe moves left onto the calibration block.
Probe moves right to the X park position.

Calibrate on test block
Probe moves left onto the calibration block
Probe moves up to the block stop
Probe moves down to the Y park position
Probe moves right to the X park position.

Test wheel

Wheel starts to rotate at selected rpm.
WheelScan E indicates 'ON-TEST'.
Probe moves up until the starting height is reached.
Probe moves left to the wheel surface and pauses for 1 second.
Probe begins to follow the wheel profile and continues until the end height is reached.

End of test

When the end height is reached WheelScan E indicates 'CALIB'
Probe moves right to the X park position
Wheel stops rotating
Probe moves down to the Y park position.

Calibrate on test block

Probe moves left onto the calibration block
Probe moves up to the block stop
Probe moves down to the Y park position
Probe moves right to the X park position

Close down

Wheel lowers
WheelScan E chart prints data
WheelScan E indicates 'PROBE-A'

End

6.0 Interpretation of chart recordings

Introduction

The printouts on the following pages all represent records of standard wheel tests. In each test the scan path followed is the same, the probe starts at the wheel rim, moves into the bead seat and then inspects the barrel of the wheel.

The printouts themselves have several consistent features, irrespective of test parameters or wheel types. On the left and right hand sides of the test traces the calibration signals appear. These are recorded when the probe performs its calibration routine over the 0.5mm slot in the calibration block before and after the test.

The test printout comprises of two main components, the upper trace, which is the flaw signal trace, and the lower trace, which is the lift-off signal.

The flaw signal trace indicates discontinuities in the wheel being tested and is compensated for lift-off, i.e. it is affected to only a small extent if the probe lifts slightly from the metal, e.g. paint thickness variations. Sudden lifting of up to 0.25mm of the probe from the metal surface causes only small deflections in this trace. slow changes in lift-off, or slow changes in metal geometry close to the probe (e.g. entering and leaving the bead seat area) are filtered out. Large signals on the lift-off channel possibly indicate invalid signals on the flaw channel.

The lift-off signal trace indicates where the probe has left the surface of the metal. This signal is designed to have a 4 times higher sensitivity to rapid changes than to slow changes in lift off. This enables sudden changes in lift-off to be clearly seen, while slow changes, e.g. due to the bead seat, do not drive the trace off the chart.

The sensitivity of the lift-off signal is fixed. It does not vary with the gain setting for the flaw signal. Moreover, the different diameter Hocking 1.5MHz scanning probes provide very similar lift-off sensitivity. The lift-off signals are produced for lift-off values beyond the ability of the instrument to compensate.

The lift-off signal thus assists in the analysis of the flaw signal trace. For example, if the small multiple deflections of the flaw signal in the region of the bead seat area are accompanied by small multiple lift-off deflections, this could suggest that these lift-off deflections may be the cause of the movements of the flaw signal trace. Where doubt exists a pencil probe can be used to scan any suspect area, or an appropriate NDT method used to confirm the indications.

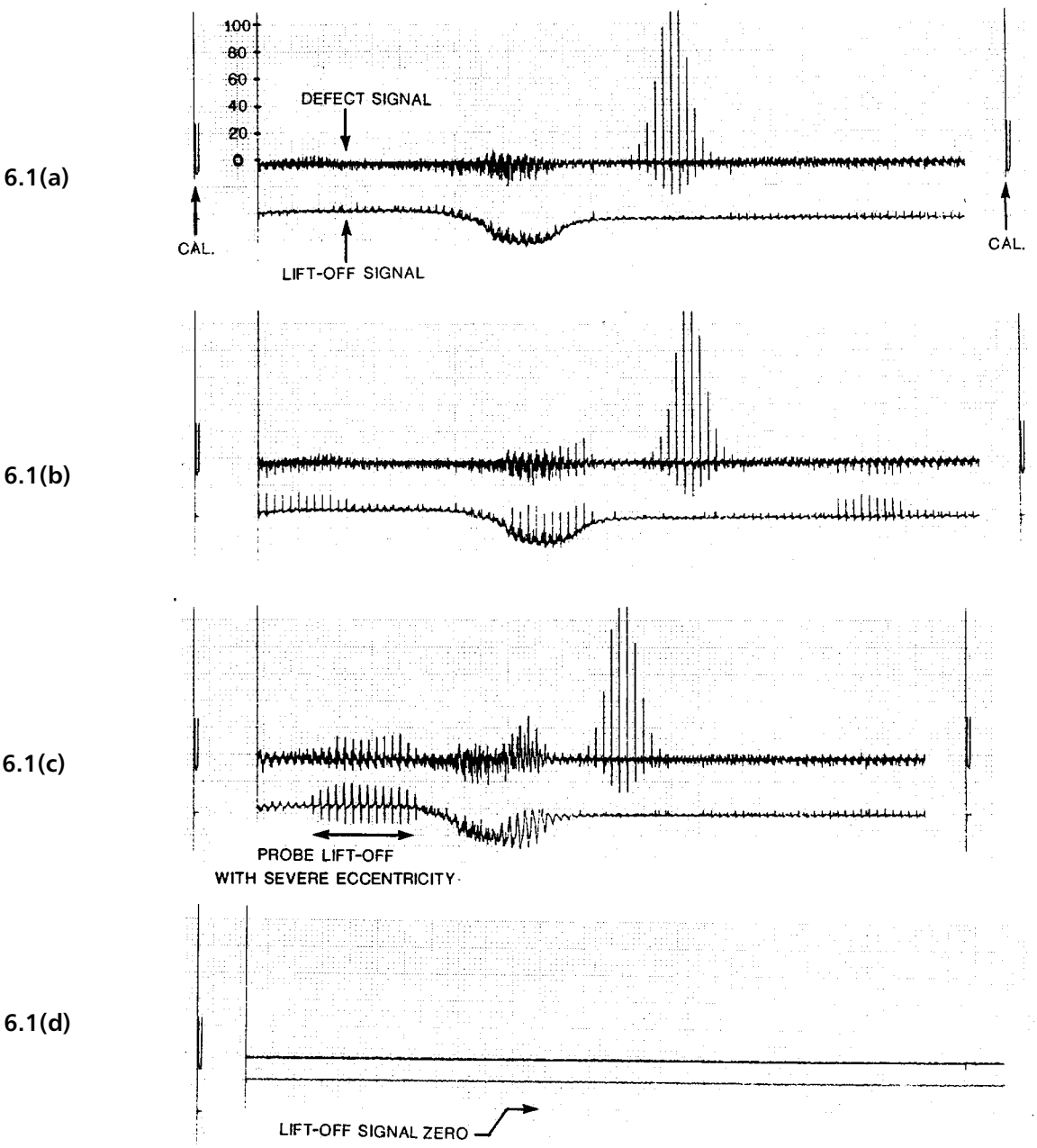


Fig 6.1 Chart Recordings

6.1 Interpretation of chart recordings

Fig 6.1 (a)
Fig A1.1 (a) illustrates a record from a 400mm diameter half-hub scanned at 30rpm, with a 1.5mm helix. A 9.5mm diameter probe was used, at 1.5MHz and 50dB gain.

Multiple indications of a flaw are seen on the barrel 25mm from the bead seat. The peak signal is equivalent to that obtained from a 1.5mm slot. The probe passes the flaw once per revolution giving typically the sharp transients seen, reaching maximum when the probe runs directly over the flaw, then reducing as the probe moves further away. Five major divisions correspond to 100% deflection of the display of WheelScan E.

Where the probe lifts from the metal surface, the lift-off trace moves upwards. Small indications are visible caused by surface irregularities. In the bead seat area, more metal surrounds the probe and the lift-off trace moves downwards. In the region of the surface breaking crack, there are negligible changes in the lift-off signal, and this adds confirmation to the clear indication that a crack is present.

Fig 6.1 (b)
This is a repeat of the scan of Fig A1.1 (a), but with 3 small pieces of 0.2mm tape added to the surface, one on the rim, one in the bead seat, one on the barrel. The concave area of the bead seat has caused an effective increase in tape thickness to approximately 0.25mm. The typical responses of the flaw trace can be seen.

Certain slower signals (once per revolution) can just be seen in the bead seat of both Fig A1.1 (a) and Fig A1.1 (b). These are caused by slight eccentricity of the wheel. As the probe approaches the bead seat the slight cyclical variation in geometry, as the probe moves in and out, causes the movements of the flaw signal trace.

Fig 6.1 (c)
This is a repeat of the scan of Fig A1.1 (a), but with wheel rotation having gross eccentricity axially. The wheel rim is moving up and down by approximately 8mm as it rotates. Some radial eccentricity occurred as a result of this but was limited to about 2mm. In the region of the rim, the wheel is lifting away from the probe over part of each rotation. The lift-off trace shows this clearly. As the probe begins to emerge from the bead seat area, large cyclical geometry variations are caused due to the up and down movement of the wheel. The effects are visible both in the lift-off trace and the flaw signal trace.

Fig 6.1 (d)
This is a scan at the same sensitivity as Figs A1.1 (a), (b) and (c), but with the probe in the air. The flaw signal moves along its zero line. The lift-off signal has risen by 1 large division. If the probe had lifted off suddenly by this amount, the lift-off signal would show a transient of 4 times this amount, i.e. 4 major divisions.

6.2(a)

6.2(b)

6.2(c)

6.2(d)

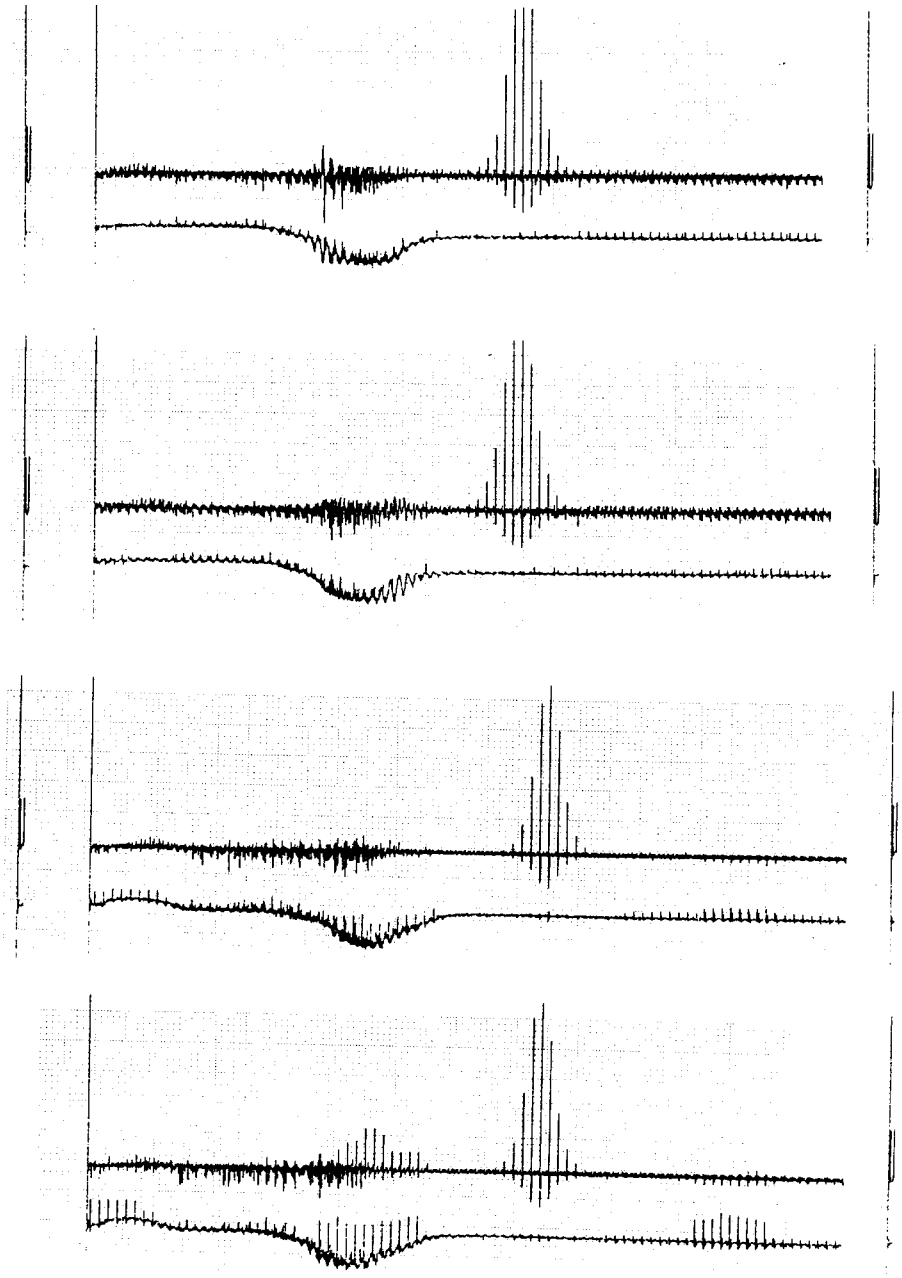


Fig 6.2 Chart Recordings

6.2 Interpretation of chart recordings

Fig 6.2 (a)
This is a similar scan to Fig A1.1 (a), but with the wheel rotating with radial eccentricity of 2-3mm. The lift-off trace shows the resulting geometry variations as the probe enters the bead seat area.

Fig 6.2 (b)
A similar scan to Fig A1.2 (a), but now the wheel rotates with an axial eccentricity of approximately 2-3mm.

The resulting geometry variations are a maximum as the probe leaves the bead seat area.

Fig 6.2 (c)
The scan is similar to Fig A1.1 (a), but the probe diameter has been changed from 9.5 to 6.3mm. This probe has somewhat higher gain to flaws, so the gain (dB) has been reset at 47dB. The surface breaking crack is now indicated with fewer passes, as the lateral sensitivity of the probe is reduced.

Three areas of 0.1mm tape are present on the wheel surface.

Fig 6.2 (d)
A further scan with a 6.3mm diameter probe, similar to Fig A1.2 (c), but the 3 areas of tape on the surface are now 0.2mm high (and effectively 0.25mm high on the bead seat)

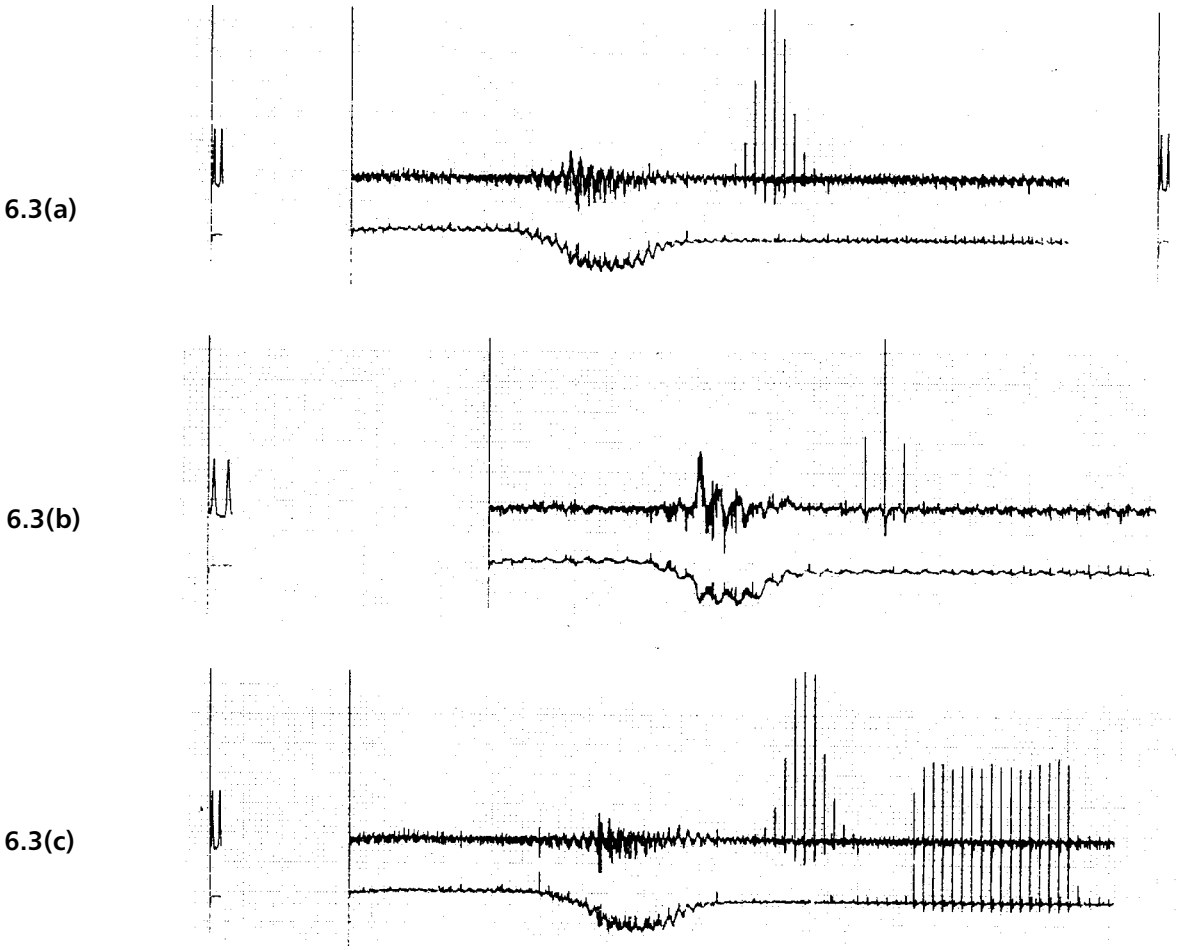


Fig 6.3 Chart Recordings

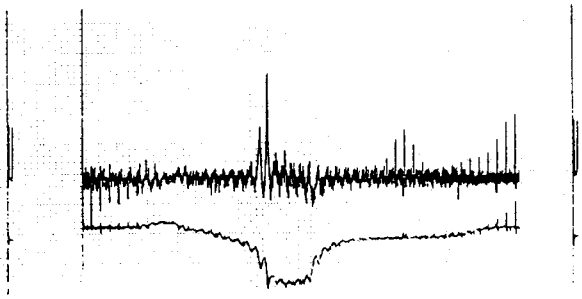
6.3 Interpretation of chart recordings

Fig 6.3 (a)
This is a scan at 60rpm. Conditions otherwise are similar to Fig A1.1 (a).

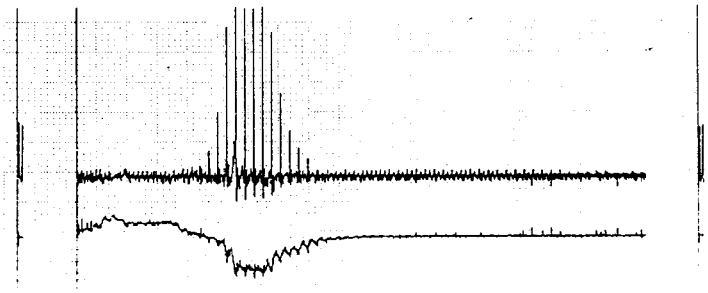
Fig 6.3 (b)
A further scan at 60rpm, but with the helix increased to 3mm. Note the reduced number of passes showing up the crack. Some eccentricity is present in the wheel rotation, showing up particularly in the bead seat area. These effects are magnified at 60rpm, compared to 30rpm.

Fig 6.3 (c)
A scan similar to Fig A1.3 (a), but in the barrel area the probe has been caused to move off the surface by 0.5mm for a short length of each rotation. Large lift-off spikes are present on both traces.

6.4(a)



6.4(b)



6.4(c)

Fig 6.4 Chart Recordings

6.4 Interpretation of chart recordings

Fig 6.4 (a)
A 200mm half hub has been scanned, at 30rpm, 1.5mm helix with 9.5mm diameter probe, set at 1.5MHz, 50dB.

Some eccentricity in the rotation shows up in the bead seat area. The flaw signal shows two peaks at the beginning of the bead seat. These are sharp transients, but they exist over large parts of the wheel rotation.

Approximately 25mm from the bead seat, a small crack signal has appeared, corresponding to a signal equivalent to a 0.3mm calibration slot.

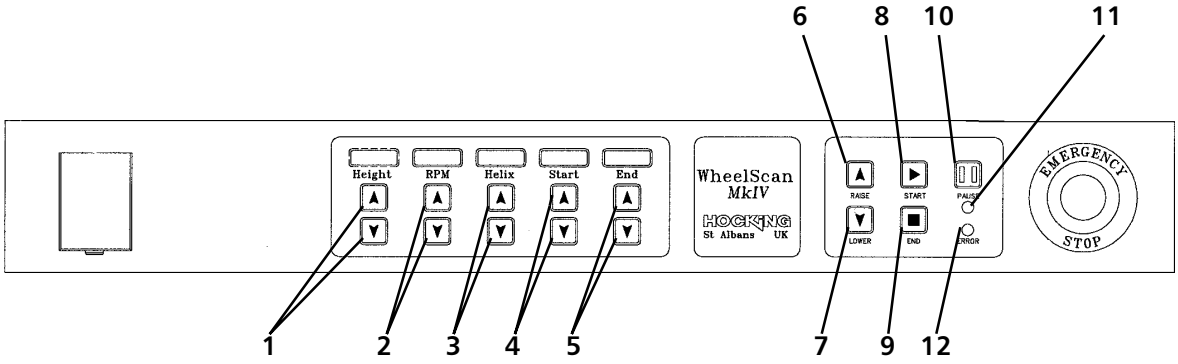
The transients at the extreme (right hand) end of the trace have corresponding transients on the lift-off trace, and are due to proximity to the edge of a hole in the hub.

Fig 6.4 (b)
This is a scan of a 250mm diameter half hub with similar settings to Fig 6.4 (a) above. The flaw in the bead seat area is clearly seen. The lift-off signal shows the normal depression due to the bead seat, and also a raised area due to the convex portion of the wheel rim.

Fig 6.4 (c)
This shows a scan appended with comments and settings. The first half of the print out allows for wheel identification and comments. The second half printout gives the settings used during the test.

Appendix

Fig A1.1 WheelScan Mk IV Front Control Panel



Key

1 Lift HEIGHT selector buttons

2 Wheel rotate speed (RPM) selector buttons

3 Scan HELIX selector buttons

4 Probe START height selector buttons

5 Probe END height selector buttons

6 Wheel RAISE button

7 Wheel LOWER button

8 Operation START button

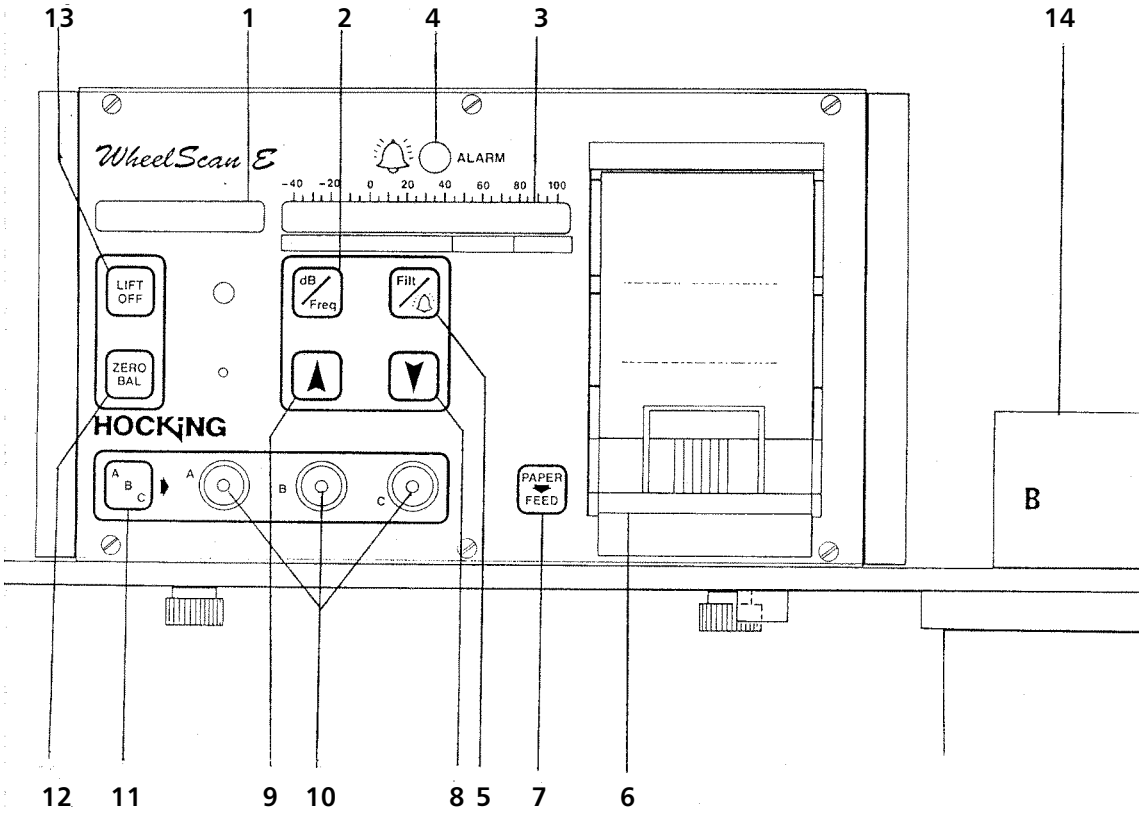
9 Operation END button

10 PAUSE button

11 Pause Indicator Light

12 Error Indicator Light

Fig A1.2 WheelScan E Front Control Panel



Key

1 Alphanumeric display

2 dB/Freq button

3 Bargraph display

4 Alarm indicator

5 Filt/Alarm button

6 Chart recorder

7 Paper feed button

8 Value decrease push button

9 Value increase push button

10 Probe sockets

11 Select probe push button

12 Zero Bal push button

13 Lift-off button

14 Probe holder

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