Tapping Exfoliation Detector

MITSUI WOODPECKER WP-632AM

Instruction Manual

Please read this manual carefully before using the Woodpecker WP-632AM in order to understand its features and make full use of its functions & capabilities.

contents

1. Features

The detection of debonds in honeycomb structures or the delamination of laminates have been performed by skilled inspectors, who tap the testing surface with a hammer (e.g.- coin) and detect debonds by listening to the difference in tone. The Woodpecker WP-632AM displays this quantitatively by detecting the spring effect, i.e. - modulus change in the structure.

The Woodpecker WP-632AM functions and detects in the same way as the former WP-632 Handpiece. However, it has the additional facility of an LCD display with the option of mapping the area under test. It meets the latest JIS standard and other relevant regulations. The Woodpecker WP-632AM specification is as follows:

- Tapping system is same as previous models
- Standard and threshold values are set in the same way as the WP-632 and WP-632M.
- LED display is same as previous model
- The optional acquisition of positional data (X-Y coordinates) is to be acquired using an optical mouse module and result can be displayed on a PC/PDA in real time.

The tapping hammer is driven by a solenoid & the degree of the defect is detected by a sensor fitted to the hammer & a microprocessor built into the system. The degree of debond is displayed by a series of light emitting diodes (LED's: green, yellow, and red) & an alarm. Also, it converts the data into quantitative numbers, which show the differences compared to the standard value. In addition, Woodpecker WP-632AM can detect the position of core materials and/or reinforcement materials in a mixed structure. The WP-632AM also numerically shows the measured data & automatically stores up to 7700 points, which can be viewed or downloaded to a PC if required.

Therefore the Woodpecker WP-632AM represents a revolutionary advance in inspection. Unlike conventional manual tapping, it quantitatively shows the degree and transition of a debond even in a noisy environment. The device is accurate, light & compact, requiring little operator knowledge.

2. Applications

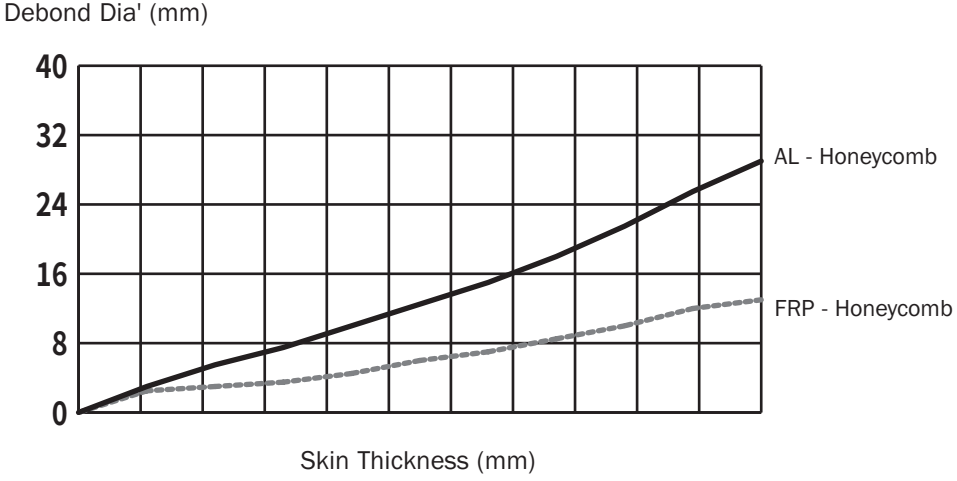
For the detection of:

- Debonds in honeycomb structure between skin & core
- Damage behind honeycomb, eg. crushed core
- The position & shape of inserts within honeycomb structures
- Inter laminar delamination
- Delamination of composite joints
- Position of strengthening members, eg. ribs & spars within composite structure
- Delamination of steel clad sandwich structure
- Debonded tiles

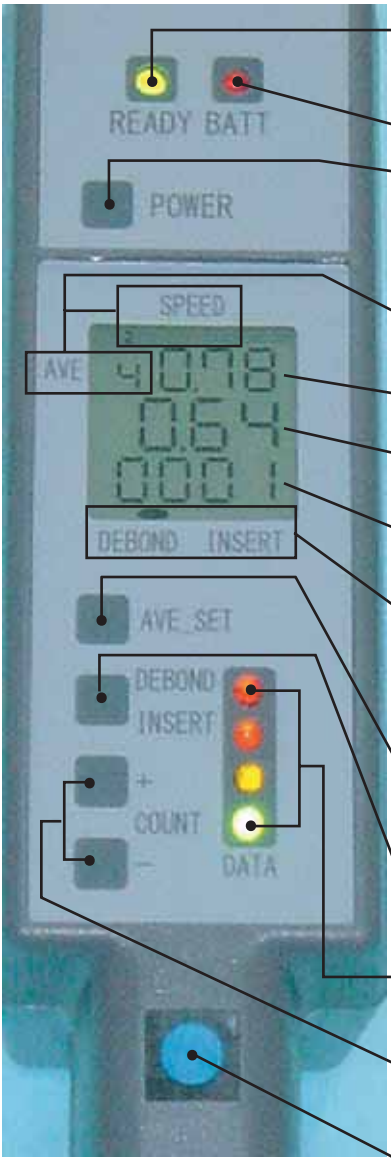
Note: The Woodpecker WP-632AM has been developed mainly for the detection of debonds in aerospace materials & is therefore suitable for honeycomb inspection having thinner skins & FRP or Al laminates, etc.

For flexible materials such as: rubber, paper or leather products, the impact force of the hammer may be absorbed. Detection may also be difficult when: the test materials is thick relative to the diameter of the debond, when the surface has a rough, sandpaper-like texture or is lined with a material such as paper or leather.

Examples of the results of inspection for aluminum honeycomb & laminated FRP honeycomb are shown in the graph below. The Woodpecker WP-632AM is designed for plates with a skin thicknesses up to 4mm (with acrylic Hammer Head) and below approximately 5mm (with Alminium Hammer Head).



3. Parts Identification



'READY' LED lit when 'Standard' set

'BATTERY' LED lit when batteries need replacing

Power 'ON' button

Display of Average number of taps / Frequency

Display of 'STANDARD'/Reference value

Display of 'MEASURED' value

Display of Tapping point number

Display of 'DEBOND' or 'INSERT' mode

AVE_SET button

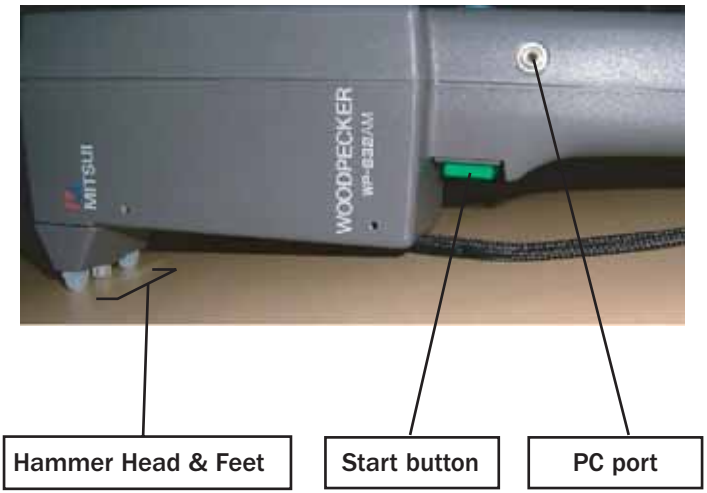
'DEBOND' or 'INSERT' button

Indication LED's: Green (1), Yellow (1) & Red (2)

'+' or '-' count button

'STANDARD'/Reference value button

3. Parts Identification (cont.)



A. Function of each button

'POWER' button:
Turns the power 'ON' after it has timed out (30 seconds)

'AVE_SET' button:
Selects the hammer speed. By pressing the button you can select the various options as follows:

The default set is AVE1-2 (average every tap, with a frequency of 2 Hz).

		Speed / Frequency (Hz)			
Tapping Average	1	2	4	8	F = 16
	2	2	4	8	F = 16
	4	2	4	8	F = 16
	8	2	4	8	F = 16

3. Parts Identification (cont.)

'INSERT / DEBOND' button:
To select 'DEBOND' or 'INSERT' mode. The default mode is 'DEBOND'.

'COUNT_+' button:
Use 'COUNT_+' button' to scroll up through the data measured. This may be pressed to find a value from the first (0001) tow the last value (7700).

'COUNT_-' button:
Use 'COUNT_-' button to scroll down through the data measured. This may be pressed to find a value from the first (0001) to the last value (7700).

To erase all measured data, except the 'STANDARD'/reference value, by press the 'COUNT_+' and 'COUNT_-' buttons at the same time.

'STANDARD' / Reference value button:
The Woodpecker WP-632AM establishes & retains in the memory a reference value obtained by averaging the value of 8 taps. The 'READY' LED illuminates when the reference is retained in the memory.

'START' button:
The 'START' button has the dual function of both starting and stopping measurement. It is a trigger type of switch.

- To start (lock): Press the 'Start' button once.
- To stop (unlock): Press the 'Start' button again.

B. The INDICATOR LED's

The 'INDICATOR' LED's show the degree of disbond. The green LED, yellow LED, red LED 1, red LED 2 or both red LEDs 1 & 2 will illuminate depending on the degree of disbond.

In addition, a buzzer alarms whenever a red LED is on.

'READY' LED:
When you obtain the standard/reference value is set, the 'READY' LED illuminates to green. The unit is now ready to scan the area under test. If it illuminates red, press the 'AVE_SET' button again to obtain the standard/reference value.

'BATTERY' LED:
Battery LED illuminated when batteries need replacing/recharging. They need to be replaced immediately to maintain accurate data.

3. Parts Identification (cont.)

'DATA' LED's:

Condition of scanned area	LED	Spring constant ratio
Debond	Red1 + Red2 + buzzer	0.30
	Red2 + buzzer	0.50
	Red1 + buzzer	0.75
	Yellow	0.85
Bond	Green	1.00

C. The Display

'AVE' (AVERAGE):
Shows frequency (Hz) and average number of taps

'STANDARD' (Reference):
Shows 'STANDARD'/reference value

'MEASURED':
Shows 'MEASURED' value

'TAPPING POINT':
Shows the point number measured.

'DEBOND / INSERT':
Shows if you are in debond or insert mode.

4. Precautions

CAUTION

A) Follow the battery installation instructions carefully. Ensure the +ve & -ve are correctly installed into the 'BATTERY COMPARTMENT'. Either AA alkaline or AA rechargeable (nickel-metal hydride) batteries. Change batteries when the 'BATTERY' LED illuminates.

Data is kept when power is 'OFF'. However, data is lost when batteries are consumed, except 'AVE/SPEED' and DEBOND/INSERT'.

B) Set the 'DEBOND' / 'INSERT' switch to suit for the purpose of testing; 'DEBOND' to detect debond & 'INSERT' for core detection of inserts. The default mode is 'DEBOND'.

C) Use the strap to prevent dropping the handpiece.

D) The WP-632AM has memory (RAM) allowing up to 7700 points to be recorded. This initiates automatically, but if 7700 is exceeded the user can still keep operating the unit.

E) The 'STANDARD' / reference value needs to be reset each time a different material is examined or the skin thickness of the material changes.

F) Keep the hammer as perpendicular as possible to the surface being tested. The measuring allowance of inclination of hammer is about +/- 10 Celsius.

G) Detection may not be accurate if the surface to be tested is rough. In such cases, increase the 'AVE_SET' mode value to operate the Woodpecker at a slower speed.

H) Move the Woodpecker carefully to prevent damage to the feet or hammer head where steps exist on the surface of the item under test.

I) Detection may not be accurate and damage may occur to the surface to be tested if the foot or hammer head is excessively worn. Replace worn parts immediately.

J) Detection may not be accurate if dust or dirt is on the surface to be tested. Make sure the surface is clean and dry before testing.

K) Remove the batteries if the Woodpecker is not going be used for an extended period.

5. Operation

A) Power 'ON'

- Install the batteries as specified (the backlight will stay on for 30 seconds). If the batteries are installed & the screen is off press the 'POWER' button.
- All data show as '0' on first use
- Power will turn off automatically if unit is not used for 30 seconds after installation of batteries or pressing the 'POWER' button. Press the power button to continue. If measurements have already been taken, the display shows the previous data.

B) Setting the measurement value and tapping speed

Use the 'AVE' button to select the hammer speed. By pressing the button you can select the various options. Use low 'AVERAGE 1 or 2' for smooth surface, and high 'AVERAGE 4 or 8' for rough surface.

Measurement Values:

- In the AVE (average) 1 mode, the measurement value when the hammer taps once is compared with the memorised reference value.
- Similarly, in the AVE 2, AVE 4 & AVE 8 modes, the average measurement value of 2, 4 or 8 taps, are respectively compared with the reference value.
- Choose the AVE mode most appropriate for the structure & condition of the surface being tested.
- Use low AVE modes (1 or 2) for uniform surfaces & high AVE modes (4 or 8) for surfaces that are not so uniform.

Tapping Speed:

- Four settings can be chosen for each AVE mode: 2Hz, 4Hz, 8Hz & F (Fast - 16Hz).
- For quick scanning, set the tapping speed to F, using low AVE (1 or 2).
- To increase accuracy by scanning slowly, perform the reverse operation, eg., a high AVE mode with a slow tapping speed.

C) Setting the mode for detection

Select to work in 'DEBOND' or 'INSERT' mode by pressing the 'DEBOND/INSERT' button. The default is DEBOND.

D) Memory

The Woodpecker WP-632AM has a built in memory which initiates automatically. It allows up to 7700 points to be recorded, but if 7700 is exceeded the user can still keep operating the unit. To clear the memory: 1) Press the '+' & '-' count buttons simultaneously (the 'Standard'/reference value will be kept) OR 2) Remove/change batteries (delete entire data). For using the software see separate instructions sheet.

E) Setting the 'STANDARD' / Reference Value

The Woodpecker WP-632AM establishes & retains in the memory a reference value obtained from the average of 8 taps. The green 'READY' LED illuminates when the reference is retained in the memory. The red 'READY' LED illuminates when the unit fails to obtain the standard value. In such case, press the blue 'MEMORY' button and measure the value again.

5. Operation (contd.)

TIPS: You may move the Woodpecker WP-632AM slightly when you measure the average value. This allows you to obtain a better average.

1. Ensure power is 'ON' (see paragraph 'A' on page 9).
2. Press the blue 'MEMORY' switch & move the unit slightly to pick up the average value of the area.
3. The Woodpecker WP-632AM establishes, displays & retains in the memory the reference value set.
4. The green 'READY' LED illuminates. The unit is now ready to scan the area under test.
5. The 'STANDARD' / reference value can be reset by following this procedure, when not in scanning mode.

Ensure a suitable location is used as the reference value or use a test piece. By examining 2-3 areas in DEBOND mode, a better average can be measured / determined. An area can be used as the reference in both 'DEBOND' & 'INSERT' modes for strict measurements.

F) Scanning

1. Move the Woodpecker WP-632AM to the area that you would like to test. Place the 'FEET' on the structure.
2. Push the green 'START' button. This has a function of both starting & stopping the 'HAMMER':
   Start: Push the 'START' button once **Stop:** Push the 'START' button again
3. Hold the WP–632AM lightly and scan the surface with deadload. To keep accuracy, it is desirable to use a scanning speed of 16 cm / second or less.
4. The display shows the 'MEASURED' value and this is automatically saved with a 'POINT' number (up to 7700).
5. The 'INDICATOR' LED's shows the degree of debond. The green LED, yellow LED, red LED 1, red LED 2 or both red LEDs 1 & 2 will illuminate depending on response of the structure being tested. In addition, a buzzer alarms whenever a red LED is on.

G) Continue the scanning

- If you want to input the new data in addition to the existing ones, simply press the start button again to continue. The unit will retail up to the 7700 points. Above 7700, the display shows 'FULL'; however, you can continue measurement.
- If you wish to input the new data, you may press the 'COUNT_+' and 'COUNT_-' button at the same time to erase the memory. You may want to send the data to a PC for storage (follow separate instructions).

H) Look up the memory

You can look at previous data by pressing 'COUNT_-' button. When you count back to '0000', you have reached to the last count number measured. You can scroll up to the last number measured.

I) How to delete all data

Press 'COUNT_+' and 'COUNT_-' at the same time to reset the memory.

6. Care and Cleaning

Clean the surface of the case with an alcohol-based substance. Do not use any other solvents, such as:

- Alkali or alkaline salt solvents
- Amines
- Ketones (acetone methyl-ethyl-ketone)
- Aromatic hydrocarbons (benzene, toluene, xylene)
- Esters
- Halogen based solvents (carbon tetrachloride trichlene, dioxane, methylene-chloride, chloroform)

7. Parts Replacement

The 'FEET' & 'HAMMER HEAD' are consumable parts to prevent damage to the surface of item under test & should be replaced timely when they become excessively worn as per following instructions:

- Replace the 'FEET' using fingers & do not use spanners or other tools so as not to damage main unit with unnecessary force.
- To remove the 'HAMMER HEAD' (either Acrylic or Aluminum), hold the upper portion with a pliers or similar tool & turn the 'HAMMER HEAD' anticlockwise with your fingers.
- Two sets of replacement 'FEET' are enclosed (1 x nylon, 1 x Teflon) with each new unit as spares.
- Extra 'FEET' & 'HAMMER HEAD's are sold separately.

8. Customer Support

- Warranty Certificate (included separately):
  Take note of the warranty period and clauses in the Warranty.

- Warranty period:
  One year from the date of shipment from Japan. The warranty does not cover consumable parts (hammer head, foot, batteries).

- Service during the warranty period:
  If a problem cannot be solved though WP-632AM is operated in accordance with the instruction manual, send the WP-632AM and the warranty card to the sales agency, where purchased, for repair.

  Please include the following information:

8. Customer Support (cont.)

Your: name, address, telephone number, email address, Date of purchase, A full description of the problem, and Serial number of the unit (found in the Battery Compartment)

- Service after the warranty period: upon request. Your sales agency offers a repair service for a fee.
- An annual function check is recommended.

9. Specifications

- Size: 100 mm high x 46 mm wide x 276 mm long (nominal)
- Weight: 350 grams (without batteries)
- Power: 4 x size AA batteries
- Power Consumption: 1.0 Watts
- Battery Life: 10 hours continuous use (approx.)

10. Rules and Regulations

- Japanese Industrial Standard (JIS)
- ISO 9001:2000'
- RoHS 2005 No.2748 "ENVIRONMENTAL PROTECTION"
- EMC Tested to EN61326, Class B

11. Warranty and Disclaimer

The Product described herein is warranted against defects in material, design & workmanship for a period of one year following the date of shipment from Japan unless misused or damaged through lack of reasonable care and attention.

All other statutory & implied warranties including, those without limitation or otherwise implied, are hereby disclaimed with respect to said product and adjudicated under Japanese Law.

Importers & distributors are required to give appropriate instructions to their customers & purchasers for the use of said product, such as those contained herein.

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