## PART 1 - GENERAL

## TAP TEST INSPECTION OF HONEYCOMB SANDWICH STRUCTURE

1. Purpose

   A. Use this general tap test procedure for damage and repair inspection on honeycomb structure with thin skins.

   B. This procedure will find 1.0 inch (25 mm) diameter, or larger, interply delaminations and skin-to-honeycomb disbonds on the near-side of nonmetallic honeycomb sandwich parts. The skin thickness must be three plies or less.

   C. This procedure will find 1.0 inch (25 mm) diameter, or larger, skin-to-honeycomb disbonds on the near-side of metallic honeycomb sandwich parts. The skin thickness must be 0.040 inch (1.0 mm) or less.

   D. This procedure can be used on structure with thicker skins than those identified in paragraphs 1.B and 1.C, but a reference standard is necessary. See paragraph 2.B for reference standard data.

   E. This procedure must be used by inspectors that can hear satisfactorily unless you use the instrumented tap testers identified in par. 2. The noise level in the inspection area must be sufficiently low to permit the inspector to hear changes in the sound during the tap test. A reference standard can be used to show that these conditions are satisfactory.

   F. If this tap test procedure is used to examine the honeycomb area of a part that has been repaired, then it also can be used to examine the bond between the repair ply(s) and the edgeband laminate (if the repair extends into the edgeband).

2. Equipment

   A. Tap Test Tool

      (1) The tap test tools below can be used for this procedure.

         (a) Boeing tap test tool ST8842. This tool is available from Boeing spares.

         (b) Tap test hammer as specified in MIL-HDBK-337, Figure 10-7, pages 10-15, dated December 1982.

         (c) A tap test tool that has a smooth brass, aluminum, or steel tap surface with a radius of 0.060 inch (1.5 mm) to 0.5 inch (12.5 mm) can be used. The tap test tool must weigh less than 4 ounces (114 grams).

(2) The instrumented tap testers specified below can also be used for this procedure.

NOTE: Refer to Part 1, 51-01-00, for data about the equipment manufacturers.

(a) $RD^3$ digital tap hammer; Wichitech Industries, Inc.

(b) Woodpecker WP-632; Mitsui (U.S.A.), JR Technology Ltd.

B. Reference Standard

(1) Reference standards are not necessary to examine honeycomb structures as specified in par. 1.B. and 1.C.

(2) For metallic honeycomb sandwich parts that have a skin thickness that is more than 0.040 inch (1.0 mm) thick, use reference standard NDT1038. See Part 4, 51-00-05, Fig. 1.

(3) For non-metallic honeycomb sandwich parts that have skins more than 3 plies thick, use honeycomb calibration guide ST8870-1 or ST8870-4. See Part 1, 51-04-00, Fig. 6 and 7.

NOTE: For non-metallic honeycomb reference standards, different defects will cause different sounds during a tap test. A reference standard that has a skin-to-core disbond with some of the core removed will give a stronger sound than an equivalent reference standard that does not have some of the core removed. If you use a reference standard that has some of the core removed, make sure to calibrate on an area of the reference standard that has a skin thickness that is two plies more than the skin thickness of the part to be examined. When you use the ST8870-1 and -4 calibration guides, for example, calibrate on the six-ply step if you want to examine a four-ply part. If you use a reference standard that does not have some of the core removed, calibrate on an area with the same skin thickness as the part.

(4) For nonmetallic honeycomb sandwich repairs that have skins more than 3 plies thick, you can use the repair reference standards given in part 1, 51-01-01. These standards can be used as an alternative to the ST8870-1 or ST8870-4 calibration guides.

(5) You can also make you own reference standard. The reference standard must have properties as follows:

(a) The skin thickness must be as specified in paragraph 2.B.(3).

(b) The honeycomb core thickness must be the same thickness as the core thickness in the inspection area with a tolerance of 50%.

(c) A disbond in the reference standard must have the same dimensions as the permitted disbond. Use one of the procedures that follow to make the disbond in the reference standard:

1) Mill a circular flat-bottomed hole to the skin-to-core bondline from the back side of the reference standard.

2) Make a knife cut in the skin-to-core bondline of the reference standard.

3) Assemble and cure the reference standard with adhesive removed from the disbond area. Pre-cure the skin if it is a nonmetallic composite reference standard. This will prevent the skin from bonding to the core.

4) Assemble and cure the reference standard with an inclusion in the disbond area. Apply a release agent to the inclusion.

5) A discarded part can be used to make a reference standard.

3. Preparation for Inspection

A. Do a visual inspection of the part. Look for irregular surfaces, stress lines, erosion, broken surfaces, or other signs of damage.

B. Examine the structure of the inspection area. Refer to the Structural Repair Manual or engineering drawings to find out how the part was assembled. Do a check for core splices, potted areas, and fittings that could cause errors in the tap test inspection results.

C. For large inspection areas, we recommend that you make temporary lines on the surface of the inspection area to make a grid. This will help to make sure all areas are examined.

4. Calibration

A. Calibrate the equipment to examine a structure that has a skin thickness as specified in par. 1.B and 1.C as follows:

(1) Tap on a bonded area of the inspection part that you know is good. This sound will be compared with the sounds that occur during the inspection to identify defects. Make sure the bonded area has the same thickness as the inspection area.

(2) If you use an instrumented tap tester, do par. 4.A.(1) above but make a record of the tap signal. Compare this signal with the signals that occur during the inspection to identify defects.

B. Calibrate the equipment to examine structures that have thicker skins than those specified in par. 1.B and 1.C as follows:

(1) Do the calibration in the same work area as the inspection. Make sure the work area noise level during calibration does not increase during the inspection unless you use an instrumented tap tester.

(2) Identify an area of the reference standard that has the correct skin thickness. Table I identifies the current skin thickness for the applicable types of reference standards and reference standard defects.

| REFERENCE STANDARD: | REFERENCE STANDARD DEFECT TYPE: | CALIBRATION AREA: |
|---|---|---|
| Nonmetallic composite (includes ST8870-1 and ST8870-4) | Machined or cut core | Calibrate on an area that is two plies thicker than the inspection area |
| Nonmetallic composite | Removed adhesive or inclusion | Calibrate on an area that has the same thickness as the inspection area |
| Metallic composite (includes NDT1038) | Machined core, cut core, removed adhesive or inclusion | Calibrate on an area that has the same thickness as the inspection area |

CALIBRATION SKIN THICKNESSES
TABLE I

(3) Tap on a bonded area of the reference standard that has the correct skin thickness.

(4) Continue to tap with the same tap intensity as you move into the disbond area.

(5) Listen to the change in the tap sound frequency, or monitor the signal change if you have an instrumented tap hammer.

5. Inspection Procedure

A. Tap the full inspection area with a scan increment of one third of the permitted disbond diameter as specified in figure 1. Tap along contours of constant structure and thickness. On large areas you can use lines on the surface of the part as an aid to make sure the inspection area is fully examined.

B. Listen for changes in the tap sound frequency.

C. Make a mark at the external edges of the areas that cause changes in the tap sound frequency.

NOTE: To find disbonds which are within one ply of the surface, light taps may be necessary.

D. The procedure for instrumented tap testers is the same, but you must monitor changes in the signal display.

6. Inspection Results

A. See Table II for data on different tap signals and their causes.

B. If you have a reference standard, compare the change in tap sound frequency in the inspection area with the change you get on the reference standard.

C. Do a check of the areas that cause a change in the tap sound frequency. Use the procedures specified below:

(1) Compare the area with the same area on the other side of the airplane or on a different airplane to make sure the sound changes are not caused by structure.

(2) Use a different NDT procedure if it is necessary to examine the area more fully. We recommend the procedures specified below:

(a) Through-Transmission Ultrasonic (TTU). Part 4, 51-00-02.

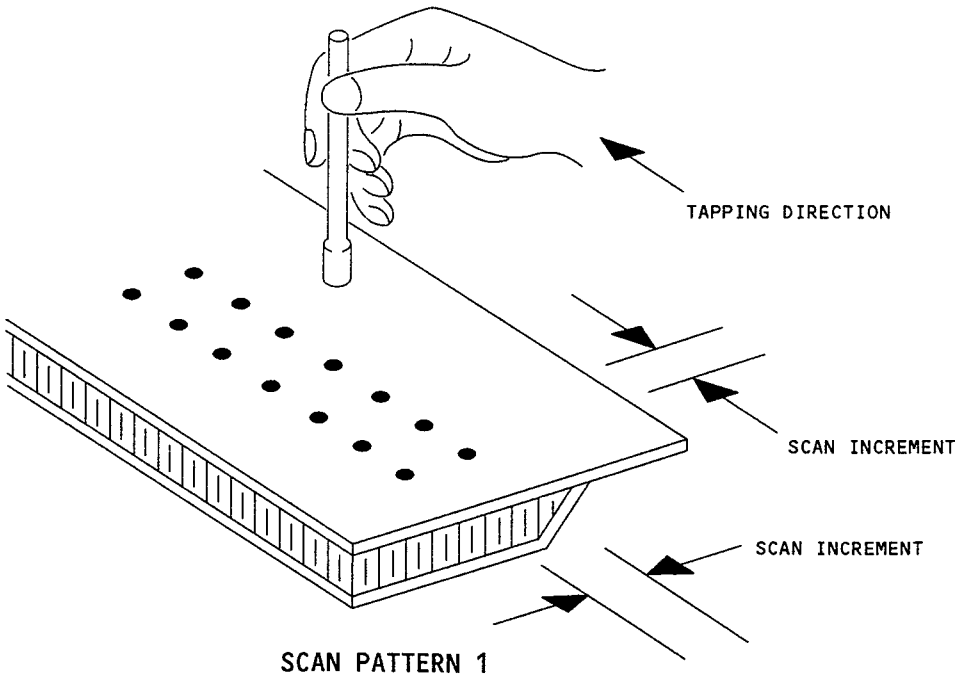
(b) Low frequency bondtester. Part 4, 51-00-05.

(c) Radiography. Part 2, 51-00-03. (Use radiography only to check for structural details or core crush. Radiography will not find skin-to-core disbonds or core fracture).

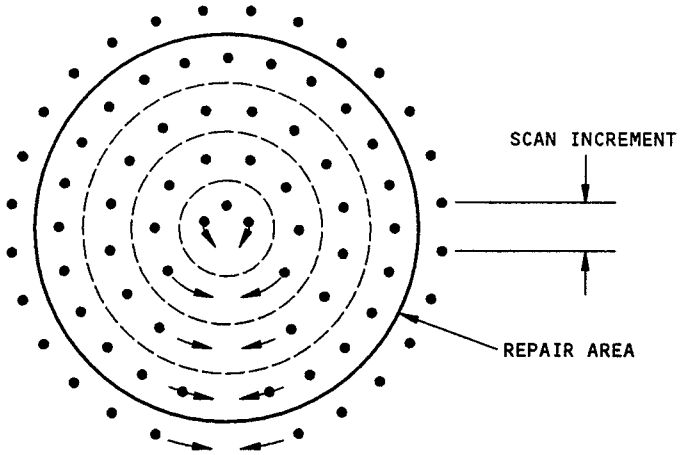
| Structure | Tap Sound | Instrumented Tap Hammer Signal 1 |
|---|---|---|
| Good structure | Constant tap sound frequency | Constant tap signal |
| Disbonded area | Lower tap sound frequency | Higher tap signal |
| Crushed core | Lower tap sound frequency | Higher tap signal |
| Increased ply thickness | Higher tap sound frequency | Lower tap signal |
| Potted core | Higher tap sound frequency | Lower tap signal |
| Core splice | Higher tap sound frequency | Lower tap signal |
| Fittings below skin | Higher tap sound frequency | Lower tap signal |

1 The "signal height" is related to the position of the LED on the light bar or the digital numeric reading.

Tap Signals and Their Causes
Table II




SCAN PATTERN 1




SCAN PATTERN 2

NOTES

- USE SCAN PATTERN 1 FOR INSPECTIONS OF STRUCTURES THAT HAVE NOT BEEN REPAIRED.
- USE SCAN PATTERN 2 FOR INSPECTIONS OF REPAIRED AREAS.
- USE A SCAN INCREMENT THAT IS ONE-THIRD OF THE DEFECT DIAMETER.

Scan Patterns
Figure 1