

BOEING 
COMMERCIAL JET
NONDESTRUCTIVE TEST

PART 1 - GENERAL

ORIENTATION AND PREPARATION FOR TESTING

1. Qualifications of Operator

- A. Interpretations of radiographs and the readout of other nondestructive testing equipment, such as ultrasonic and eddy current, require much skill, and must be performed only by trained and experienced personnel. The operator must have training in both the basic theory and the practical application of the NDT methods he is using and have a good working knowledge of aircraft structure. He also must have good comprehension of the failure characteristics of the various metals and types of parts used in aircraft structure, and be aware of limitations and capabilities of the nondestructive testing methods available to him.

2. Selection of Inspection Method

- A. Selection of the correct inspection method and equipment required depends upon several factors; accessibility, material of structure or part and type of defect sought. Before making selection, review sections 51-02-00 thru 51-06-00 for discussions of the various types of nondestructive testing. See Fig. 1 for a comparison of advantages and disadvantages of each type of test.

3. Coordination with Structural Repair Manual

- A. The structural repair manual for the aircraft being inspected should be used in conjunction with the nondestructive testing document for identification of materials and structural items.

4. Aircraft Structure and Component Location and Accessibility

- A. Many individual parts of the aircraft, which require inspection, are located in inaccessible areas. Structural components of the fuselage are generally beneath soundproofing blankets, or behind interior decorative panels. Many structural components of the wings, empennage, and other areas are also relatively inaccessible. Where access to an area requiring inspection is difficult, instructions for gaining access to the area are given with the specific inspection procedure. Inspection personnel should familiarize themselves with the layout of the airplane shown in airplane reference data illustrations. More detailed layouts of specific areas are shown in applicable structural repair manuals.



NONDESTRUCTIVE TEST

METHOD	APPLICATIONS	ADVANTAGES	DISADVANTAGES
X-RAY	USED FOR DETECTION OF DISCONTINUITIES (CRACKS, VOIDS, POROSITY, INCLUSIONS ETC.), EXAMINATION OF WELDS, INSPECTION FOR FOREIGN BODIES OR DEBRIS, DIAGNOSTIC EXAMINATION OF COMPONENTS (E.G. SWITCHES, ACTUATORS ETC.) AND DETECTION OF WATER IN HONEYCOMB STRUCTURE.	<ol style="list-style-type: none"> 1. ABILITY TO INSPECT FOR BOTH INTERNAL AND SURFACE DEFECTS 2. ABILITY TO INSPECT COVERED OR HIDDEN PARTS OR STRUCTURE 3. PROVIDES PERMANENT TEST RECORD 4. MINIMUM AREA PREPARATION REQUIRED 	<ol style="list-style-type: none"> 1. EXPENSIVE 2. AIRPLANE MAY HAVE TO BE DEFUELED 3. AREA MUST BE CLEARED OF OTHER PERSONNEL TO AVOID RADIATION HAZARD 4. METHOD IS PARTIALLY DIRECTIONAL, DEPENDS ON CRACK-X-RAY BEAM ORIENTATION 5. HIGH DEGREE OF SKILL REQUIRED FOR VARIED TECHNIQUE DEVELOPMENT, AND RADIOGRAPHIC INTERPRETATION 6. ACCESS TO BOTH SIDES REQUIRED
EDDY CURRENT	<ol style="list-style-type: none"> 1. USED TO DETECT SURFACE CRACKS 2. USED TO DETECT SUBSURFACE CRACKS AND CORROSION ON AN INNER SURFACE 3. USED FOR DETERMINATION OF ALLOY AND HEAT TREAT CONDITION AND THE EVALUATION OF FIRE DAMAGE 	<ol style="list-style-type: none"> 1. PORTABILITY 2. MODERATE COST 3. PROVIDES IMMEDIATE RESULTS 4. SENSITIVE TO SMALL IMPERFECTIONS 5. MINIMUM PART PREPARATION REQUIRED 	<ol style="list-style-type: none"> 1. SURFACE MUST BE ACCESSIBLE TO CONTACT BY PROBE 2. SUITABLE FOR INSPECTION OF METALS ONLY 3. NO PERMANENT RECORD 4. HIGH DEGREE OF SKILL AND FAMILIARITY REQUIRED IN HANDLING TEST EQUIPMENT
ULTRA-SONIC	USED TO DETECT SURFACE AND SUBSURFACE IMPERFECTIONS (E.G. CRACKS, DELAMINATIONS, POROSITY). USED TO MEASURE MATERIAL THICKNESS.	<ol style="list-style-type: none"> 1. SUITABLE FOR SURFACE AND SUBSURFACE IMPERFECTIONS 2. SENSITIVE TO SMALL IMPERFECTIONS 3. PROVIDES IMMEDIATE RESULTS 4. MINIMUM PART PREPARATION REQUIRED 5. MODERATE COST 6. INSPECTION FROM ONE SURFACE ONLY 	<ol style="list-style-type: none"> 1. SURFACE OF PART MUST BE ACCESSIBLE TO SONIC PROBE 2. ROUGH SURFACES INTERFERE WITH TEST RESULTS 3. METHOD IS DIRECTIONAL DEPENDING UPON SOUND BEAM - DEFECT ORIENTATION 4. HIGH DEGREE OF SKILL AND EXPERIENCE REQUIRED TO MAKE SET UP AND INTERPRET RESULTS FOR VARIOUS TEST CONDITIONS

Comparison of Methods
Figure 1



NONDESTRUCTIVE TEST

5. Preparation for Testing

- A. Normally little preparation is necessary. When an inspection is required in a fuel tank area, it may be necessary to defuel the airplane. Preparation may consist of gaining access to the inspection area by removal of access doors, structural items, equipment or furnishings. With the exception of X-ray inspection, it may be necessary to clean the inspection area and in some cases the removal of finish, such as paint or sealant, will be required. Precautions must be taken to prevent unauthorized personnel from entering the area during X-ray inspection because of the radiation hazard.
- B. When it is necessary to strip paint or finish from parts, determine the type of material from which the part is made, then refer to 20-30-02 of the appropriate overhaul manual for stripping procedures.

NOTE: Restore finish after inspection.

6. Equipment Manufacturers and/or Suppliers

- A. The following is a partial list of manufacturers and/or suppliers of nondestructive inspection equipment identified in this manual. This list does not include all the manufacturers/suppliers of nondestructive inspection equipment and is not intended to exclude the use of others who produce equipment of equal performance characteristics (as called out in the applicable inspection procedure).



NONDESTRUCTIVE TEST

NONDESTRUCTIVE TEST EQUIPMENT SUPPLIERS

EDDY CURRENT INSTRUMENT AND PROBE MANUFACTURERS

FOERSTER INSTRUMENTS, INC.
140 INDUSTRY DRIVE
RIDC PARK WEST
PITTSBURGH, PA 15275
USA
PHONE: [412] 788-8976
FAX: [412] 788-8964

QUEST INTEGRATED
1012 CENTRAL AVENUE SOUTH
KENT, WA 98032
USA
PHONE: [253] 872-9500
FAX: [253] 872-8967
E-MAIL: contactqi2@qi2.com

HOCKING KRAUTKRAMER BRANSON
50 INDUSTRIAL PARK ROAD
LEWISTOWN, PA 17044
USA
PHONE: [717] 242-0327
FAX: [717] 242-2606

ROHMANN GMBH
RUDOLF-DIESEL-STR. 13
D-67227 FRANKENTHAL
GERMANY
PHONE: 0 62 33-3789-0
FAX: 0 62 33-3789-77

HOCKING NDT, LTD.
129-135 CAMP RD.
ST. ALBANS
HERTFORDSHIRE, AL15HP UK
ENGLAND
PHONE: [0727] 40321
FAX: [0727] 45058

STAVELEY NDT
SUITE 205 SUNBEAM STUDIOS
SUNBEAM ST
WOLVERHAMPTON WV2 4NU
UNITED KINGDOM
PHONE: [01902] 20772
FAX: [01902] 20808

INSTITUTE DR. FORSTER
PRUFGERATEBAU
GMBH & CO. KG
IN LAISEN 70 POSTFACH 1564
D-7410 REUTLINGEN
GERMANY
PHONE: [07121] 140-0
FAX: [07121] 140488

STAVELEY INSTRUMENTS
421 NORTH QUAY
KENNEWICK, WA 99336
USA
PHONE: [509] 735-7550
FAX: [509] 735-4672

MAGNAFLUX
CENTURION NDT INC.
707 REMINGTON RD. SUITE 9
SCHAUMBURG, ILLINOIS 60173
USA
PHONE: [847] 884-4949
FAX: [847] 884-8772

TECHNA NDT
6707 S. 216th STREET
KENT, WA 98032
USA
PHONE: (253) 872-2415
FAX: (253) 872-2416

NDT ENGINEERING CORP.
(OLYMPUS NDT)
421 N. QUAY STREET
KENNEWICK, WA 99336
USA
PHONE: [509] 736-2751
FAX: [509] 735-4672

UNIWEST
330 WEST CLARK STREET
PASCO, WA 99301
USA
PHONE: [509] 544-0720
FAX: [509] 544-0868



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NONDESTRUCTIVE TEST EQUIPMENT SUPPLIERS (CONT)

EDDY-CURRENT PROBE MANUFACTURERS

ALL INSPECTION NDT, LTD.
59 LYNCHFORD RD.
FARNBOROUGH
HANTS, ENGLAND
PHONE: [252] 514721
FAX: [252] 518030

XACTEX CORP.
3704 STEARMAN AVE.
PASCO, WA 99301
USA
PHONE: [509] 545-6364
FAX: [509] 545-6597

EC/NDT
1020 SOUTH 344TH ST.
SUITE 214
FEDERAL WAY, WA 98003
USA
PHONE: [253] 815-0797
FAX: [253] 815-0827

ZETEC, INC.
1370 N.W. MALL
P.O. BOX 140
ISSAQUAH, WA 98027
USA
PHONE: [425] 392-5316
FAX: [425] 392-2086

GK ENGINEERING CORP.
21610 UNIT 1
LASSEN ST.
CHATSWORTH, CA 91311
USA
PHONE: [818] 347-1373
FAX: [818] 407-1983

NDT ENGINEERING CORP.
(OLYMPUS NDT)
421 N. QUAY STREET
KENNEWICK, WA 99336
USA
PHONE: [509] 736-2751
FAX: [509] 735-4672

TECHNA NDT
6707 S. 216TH ST.
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PHONE: [253] 872-2415
FAX: [253] 872-2416

VM PRODUCTS, INC.
P.O. BOX 44926
TACOMA, WA 98444
USA
PHONE: [253] 841-2939
FAX: [253] 841-3016



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NONDESTRUCTIVE TEST EQUIPMENT SUPPLIERS (CONT)

ULTRASONIC TRANSDUCER MANUFACTURERS *E1]

ALL INSPECTION NDT, LTD.
59 LYNCHFORD RD.
FARNBOROUGH
HANTS, ENGLAND
PHONE: [252] 514721
FAX: [252] 518030

XACTEX CORP.
3704 STEARMAN AVE.
PASCO, WA 99301
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PHONE: [509] 545-6364
FAX: [509] 545-6597

NDT ENGINEERING CORP.
(OLYMPUS NDT)
421 N. QUAY STREET
KENNEWICK, WA 99336
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PHONE: [509] 736-2751
FAX: [509] 735-4672

STAVELEY SENSORS, INC. **
91 PRESTIGE PARK CIRCLE
EAST HARTFORD, CT 06108
USA
PHONE: [860] 289-5428
FAX: [860] 289-3189

SEARCH UNIT (SU) SYSTEMS
DIVISION OF NDT ENGINEERING CORP.
(OLYMPUS NDT)
421 N. QUAY STREET
KENNEWICK, WA 99336
USA
PHONE: [509] 736-2751
FAX: [509] 735-4672

TECHNA NDT
6707 S. 216TH ST.
KENT, WA 98032
USA
PHONE: [253] 872-2415
FAX: [253] 872-2416

*E1] SEE ALSO "ULTRASONIC INSTRUMENT AND TRANSDUCER MANUFACTURERS".

** AUTOMATION INDUSTRIES INC. TRANSDUCERS CAN BE PURCHASED FROM STAVELEY SENSORS, INC. USE THE AUTOMATION INDUSTRIES INC. PART NUMBER AS WRITTEN IN THE NDT INSPECTION PROCEDURE WHEN YOU ORDER THE TRANSDUCER.



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NONDESTRUCTIVE TEST EQUIPMENT SUPPLIERS (CONT)

ULTRASONIC INSTRUMENT AND TRANSDUCER MANUFACTURERS

DUPONT NDT SYSTEMS, INC.
NDT INSTRUMENTS DIVISION
17811 GEORGETOWN LANE
HUNTINGTON BEACH, CA 92647
USA
PHONE: [714] 893-2438
FAX: [714] 897-3840

KRAUTKRAMER BRANSON
KB AEROTECH
50 INDUSTRIAL PARK ROAD
LEWISTOWN, PA 17044
USA
PHONE: [717] 242-0327
FAX: [717] 242-2606
TELEX: 842354

KRAUTKRAMER GMBH
ROBERT BOSCH STRASSE 3
P.O. BOX 1363
D-5030 HUERTH 5 (EFFEREN)
GERMANY
PHONE: 2233-6010
TELEX: 88866955

MAGNAFLUX
CENTURION NDT INC.
707 REMINGTON RD. SUITE 9
SCHAUMBURG, ILLINOIS 60173
USA
PHONE: [847] 884-4949
FAX: [847] 884-8772

PANAMETRICS
221 CRESCENT ST.
WALTHAM, MA 02254
USA
PHONE: [617] 899-2740
FAX: [617] 899-1552

SONATEST
4734 RESEARCH DRIVE
SAN ANTONIO, TEXAS 78240
USA
PHONE: [210] 697-0335
FAX: [210] 697-0767

STAVELEY NDT
SUITE 205 SUNBEAM STUDIOS
SUNBEAM ST
WOLVERHAMPTON WV2 4NU
UNITED KINGDOM
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FAX: [01902] 20808

STAVELEY INSTRUMENTS
421 NORTH QUAY
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USA
PHONE: [509] 735-7550
TELEX: [509] 735-4672

TOKIMEC INC.
2-16, MINAMI-KAMATA
OHTA-KU, TOKYO 144
JAPAN
PHONE: 03-3737-8621
FAX: 03-3737-8665

-OR-

C/O TECHNOPORT U.S.A., INC.
445 SOUTH FIGUEROA, SUITE 3770
LOS ANGELES, CA 90071
USA
PHONE: [213] 689-4747
FAX: [213] 689-0303

YOU CAN GET TOKIMEC INC. OR
TECHNOPORT INSTRUMENTS FROM:

ANA TRADING CORP. U.S.A.
AVIATION & MACHINERY DEPT.
333 SOUTH HOPE ST., SUITE 3100
LOS ANGELES, CA 90071
PHONE: [213] 620-1504
FAX: [213] 620-1448



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NONDESTRUCTIVE TEST EQUIPMENT SUPPLIERS (CONT)

X-RAY EQUIPMENT MANUFACTURERS

ANDREX RADIATION PRODUCTS
HALFDANSGADE 8 DK-2300
COPENHAGEN S.
DENMARK
PHONE: 45 3154 1540
FAX: 45 3154 9960

MAGNAFLUX
CENTURION NDT INC.
707 REMINGTON RD. SUITE 9
SCHAUMBURG, ILLINOIS 60173
USA
PHONE: [847] 884-4949
FAX: [847] 884-8772

FOR NAFTA:
PANTAK SEIFERT
231 SILVER SAND ROAD
EAST HAVEN, CT 06512
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EMAIL: bdermott@agfandtinc.com
PHONE: 1 [203] 468-3011
FAX: 1 [203] 468-3017

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PANTAK SEIFERT
BOGENSTRABE 41
D-22926 AHRENSBURG
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EMAIL: industrial.sales@roentgenseifert.de
PHONE: 49 4102/807-0
FAX: 49 4102/807-189

PHILIPS
INDUSTRIAL X-RAY SYSTEMS
ROENTGENSTRASSE 24-26 D 2000
HAMBURG 63
GERMANY
PHONE: [040] 50 78-0

PHILIPS ELECTRONIC INSTRUMENTS
INSPECTION SYSTEMS GROUP
5110 MEGINNES FERRY RD.
ALPHARETTA, GA 30202
USA
PHONE: [770] 751-4420
FAX: [770] 751-4456

STAVELEY INSTRUMENTS/QUALCORP
421 NORTH QUAY
KENNEWICK, WA 99336
USA
PHONE: [509] 735-7550
FAX: [509] 735-4672

X-IT
7676 CHARLES PAGE BLVD.
TULSA, OK 74127
USA
PHONE: [800] 245-0076
FAX: [213] 948-5904



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NONDESTRUCTIVE TEST EQUIPMENT SUPPLIERS (CONT)

CONDUCTIVITY MEASUREMENT MANUFACTURERS

REFERENCE STANDARD MANUFACTURERS *[2]

FISCHER TECHNOLOGY
750 MARSHALL PHELPS ROAD
WINDSOR, CT 06095
USA
PHONE: [860] 683-0781
FAX: [860] 688-8496

ALL INSPECTION NDT, LTD.
59 LYNCHFORD RD.
FARNBOROUGH
HANTS, ENGLAND
PHONE: [252] 514721
FAX: [252] 518030

HOCKING KRAUTKRAMER BRANSON
50 INDUSTRIAL PARK ROAD
LEWISTOWN, PA 17044
USA
PHONE: [717] 242-0327
FAX: [717] 242-2606

IDEAL SPECIALTY COMPANY
2531 E. INDEPENDENCE ST.
TULSA, OK 74100
USA
PHONE: [918] 834-1657
FAX: [918] 834-5338
TELEX: 350548 (ISCO.TUL)

HOCKING NDT, LTD.
129-135 CAMP ROAD
ST. ALBANS
HERTFORDSHIRE, AL15HP UK
ENGLAND
PHONE: [0727] 40321
FAX: [0727] 45058

NDT ENGINEERING CORP.
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421 N. QUAY STREET
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REUTLINGEN
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PHONE: 07121/140-265

TECHNA NDT
6707 S. 216TH ST.
KENT, WA 98032
USA
PHONE: [253] 872-2415
FAX: [253] 872-2416

K.J. LAW
42300 W. NINE MILE ROAD
NOVI, MI 48375-4103
USA
PHONE: [800] 521-5245
FAX: [313] 347-3345

VM PRODUCTS, INC.
P.O BOX 44926
TACOMA, WA 98444
USA
PHONE: [253] 841-2939
FAX: [253] 841-3016

MAGNAFLUX
CENTURION NDT INC.
707 REMINGTON RD. SUITE 9
SCHAUMBURG, ILLINOIS 60173
USA
PHONE: [847] 884-4949
FAX: [847] 884-8772

*[2] THESE ARE MANUFACTURERS OF REFERENCE STANDARDS THAT ARE SPECIFIED IN BOEING NDT PROCEDURES.



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FASTENER SUPPLIERS *[2]

ALLFAST FASTENING SYSTEMS, INC.
15200 DON JULIAN ROAD
CITY OF INDUSTRY, CA 91745
USA
PHONE: [626] 968-9388
FAX: [626] 968-9393

SIERRA PACIFIC SUPPLY
1801 WEST EL SEGUNDO BOULEVARD
COMPTON, CA 90222-1096
USA
PHONE: [310] 638-9318
FAX: [310] 638-8105

ULTRASONIC BOND INSPECTION EQUIPMENT

DUPONT NDT SYSTEMS, INC.
NDT INSTRUMENTS DIVISION
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FAX: [714] 897-3840

STAVELEY INSTRUMENTS
421 NORTH QUAY
KENNEWICK, WA 99336
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PHONE: [509] 735-7550
FAX: [509] 735-4672

FOKKER B.V - DEPT. INDUSTRIAL
PRODUCTS/APS
POSTBOX 12222
1100 AE AMSTERDAM - ZUIDOOST
THE NETHERLANDS
PHONE: 020-5647302

STAVELEY NDT TECHNOLOGIES
THE TECHNOLOGY CENTER
GLAISHER DRIVE
WOLVERHAMPTON SCIENCE PARK
WOLVERHAMPTON, UK, WV10 9RU
PHONE: [01902] 824180
FAX: [01902] 824181

JR TECHNOLOGY LTD.
81 NORTH END
MELDRETH, ROYSTON
HERTS, SG86NU
UNITED KINGDOM
PHONE: [01763] 260721
FAX: [01763] 260809

UNIWEST
330 WEST CLARK STREET
PASCO, WA 99301
USA
PHONE: [509] 544-0720
FAX: [509] 544-0868

MITSUI (U.S.A.)
1001 FOURTH AVENUE
SUITE 3950
SEATTLE, WA 98154-1196
USA
PHONE: [206] 223-5636
FAX: [206] 223-5651

WICHITECH INDUSTRIES, INC.
8980-L ROUTE 108
COLUMBIA, MARYLAND 21045-2115
USA
PHONE: [410] 715-1076
[800] 776-4277 TOLL FREE
FAX: [410] 715-1078

ROHMANN INC.
154 BROAD ST.
NASHUA, NH 03063
USA
PHONE: [603] 595-4220
FAX: [603] 595-4221

ZETEC, INC.
1370 N.W. MALL
P.O. BOX 140
ISSAQUAH, WA 98027
USA
PHONE: [425] 392-5316
FAX: [425] 392-2086

*[2] THESE ARE SUPPLIERS OF FASTENERS THAT ARE SPECIFIED IN BOEING REFERENCE STANDARD DRAWINGS.



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NONDESTRUCTIVE TEST EQUIPMENT SUPPLIERS (CONT)

PORTABLE C-SCAN EQUIPMENT MANUFACTURERS

ABB AMDATA, INC.
1000 DAY HILL ROAD
WINDSOR, CONNECTICUT 06095
USA
PHONE: [860] 688-2400
FAX: [860] 688-2722

INSPECTION RESEARCH &
TECHNOLOGIES LTD.
5 CONGRESS STREET
NASHUA, NH 03062
USA
PHONE: [603] 598-6688
FAX: [603] 598-6699

BOEING-MCDONNELL AIRCRAFT
AND MISSILES SYSTEMS
DEPT. 257, BLDG 102, M/S 1021111
P.O. BOX 516
ST. LOUIS, MO 63166
USA
PHONE: [314] 234-9028
FAX: [314] 777-2650

KRAUTKRAMER BRANSON
50 INDUSTRIAL PARK ROAD
LEWISTON, PA 17044-9990
USA
PHONE: [717] 242-0327
OR [717] 242-0331
TELEX: 842-354 KB AERO
FAX: [717] 242-2606

DUPONT NDT SYSTEMS, INC.
NDT INSTRUMENTS DIVISION
17811 GEORGETOWN LANE
HUNTINGTON BEACH, CA 92647
USA
PHONE: [714] 893-2438
FAX: [714] 897-3840

COMPOSITE REFERENCE STANDARD MANUFACTURERS *[2]

● METALLIC AND NON-METALLIC
REFERENCE STANDARDS:

APPLIED AEROSPACE STRUCTURES CORP.
3437 SOUTH AIRPORT WAY
STOCKTON, CA 95206
USA
PHONE: [209] 983-3245
FAX: [209] 983-3375

● NON-METALLIC REFERENCE
STANDARDS ONLY:

PRECISION AEROSPACE COMPOSITES
1516 FRYAR AVENUE
SUMNER, WA 98390
USA
PHONE: [206] 863-7868
FAX: [206] 863-7875

NDT ENGINEERING CORP.
(OLYMPUS NDT)
421 N. QUAY STREET
KENNEWICK, WA 99336
USA
PHONE: [509] 736-2751
FAX: [509] 735-4672

*[2] THESE ARE MANUFACTURERS OF REFERENCE STANDARDS THAT ARE SPECIFIED
IN BOEING NDT PROCEDURES.



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NONDESTRUCTIVE TEST EQUIPMENT SUPPLIERS (CONT)

THERMOGRAPHY INSTRUMENT MANUFACTURERS

Infrared Camera Manufacturers

INDIGO SYSTEMS CORPORATION
5385 HOLLISTER AVE #103
SANTA BARBARA, CA 93111
PHONE: [805] 964-9797
FAX: [805] 964-7708
WEBSITE: <http://www.indigosystems.com>

FLIR SYSTEMS, BOSTON
16 ESQUIRE ROAD
NORTH BILLERICA, MA 01862
USA
PHONE: [978] 901-8000
800-GO-INFRA (USA only)
E-MAIL: marketing@flir.com

RAYTHEON INFRARED
PHONE: [972] 344-4000
800-990-3275 (USA only)
E-MAIL: infrared@raytheon.com

MIKRON INSTRUMENT COMPANY, INC.
16 THORNTON ROAD
OAKLAND, NEW JERSEY 07436
USA
PHONE: [201] 405-0900
[800] 631-0176
FAX: [201] 405-0090
WEBSITE: <http://www.IRimaging.com/>

NEC SAN-EI INSTRUMENTS, LTD
1-25-12, AKEBONO-CHO
TACHIKAWA-SHI, TOKYO 190-8537
JAPAN
PHONE: +81-42-522-0529
+81-42-522-0538
E-MAIL: san-eios@muh.biglobe.ne.jp

Liquid Crystal Sheets

HALLCREST
1820 PICKWICK LANE
GLENVIEW, IL 60025-5741
USA
PHONE: 847-998-8580
800-527-1419
FAX: 847-998-6866
800-998-8551
E-MAIL: hcsales@hallcrest.com

Thermal Imaging NDT Systems

THERMAL WAVE IMAGING, INC.
845 LIVERNOIS ST.
FERNDALE, MI 48220-2308
USA
PHONE: 248-414-3730
FAX: 248-414-3764
E-MAIL: info@thermalwave.com



NONDESTRUCTIVE TEST

7. Reference Standards, Transducer and Probe Positioners

- A. The majority of inspection procedures in this manual require the use of one or more reference standards and/or positioners to accomplish instrument calibration. The detailed construction of each item can be found in the specific procedure in which it is used. Each item may be manufactured locally or procured from one of the suppliers listed in paragraph 6. A copy of the drawing page in the manual should be sent with each order to ensure that the items are made per the current drawing revision. Upon receipt of the order, it is the responsibility of the using facility to ensure that all items conform to the drawing requirements.
- B. Most of the reference standards in this manual are made from the same material as the part to be examined. Alternative materials can be used if the materials agree with the conditions that follow and the conditions (such as grain direction) that are specified on the reference standard drawings.
- (1) The electrical conductivity is the significant property for reference standards that are used during eddy current inspections of aluminum materials. The material is not important if the electrical conductivity is in the range of the material specified. Each reference standard drawing identifies the material to use to make the reference standard. All other materials with equivalent electrical conductivity can be used.
 - (2) Steel reference standards that are used for eddy current inspections must be identified as magnetic or non-magnetic. The specific type of steel material is not important. What is important is that magnetic steel reference standards must be used to do a test of magnetic parts and non-magnetic reference standards must be used to do tests of non-magnetic parts.
 - (3) For reference standards used during ultrasonic inspections of aluminum, the electrical conductivity is not important. The electrical conductivity (that is, the heat treat condition) of aluminum does not have a large effect on the velocity of ultrasonic sound. The velocity of ultrasonic sound in all of the usual aluminum alloys such as 2024 and 7075 is almost equal. These aluminum alloys are interchangeable for use as reference standards for ultrasonic inspections.



NONDESTRUCTIVE TEST

7. Reference Standards, Transducer and Probe Positioners (CONT)

(4) For reference standards used during ultrasonic inspections of steel, the type of steel material (which includes if it is magnetic or non-magnetic) is not important. The velocity of ultrasonic sound in all of the typical steel alloys is the same. Thus, all steels are interchangeable for use as reference standards during ultrasonic inspections of steels. Operators can use corrosion resistant steel (CRES) materials for protection from surface corrosion and pitting.

C. There have been reports of very high ultrasonic sound attenuation in materials used to make ultrasonic reference standards. The reports have all been related to alloy steel materials (for example, 4330, 4340) that were examined at 10 MHz. This high sound attenuation causes very strong noise signals to occur and very high instrument gain. In some reports, it was not possible to calibrate the instrument.

(1) A solution to this problem is to normalize the reference standard. To normalize the material, heat it in a furnace to 1650 degrees Fahrenheit for the time specified below and cool the part in air.

<u>Part Thickness</u> <u>(inches)</u>	<u>Minimum Time</u> <u>(minutes)</u>
Up to 0.25	35
0.251 to 0.500	55
0.501 to 1.000	70
1.001 to 1.500	90
1.501 to 2.000	105
2.001 to 2.500	130
2.501 to 3.000	150
more than 3.000	150 plus 23 for each 0.5 inch of added thickness

(2) During normalization a black oxide layer can occur on the parts. It is best to normalize the material before you machine so you can remove the oxide layer. To prevent the oxide layer during normalization, use a vacuum furnace and fill the furnace with an inert gas such as Argon to cool the part. Refer to BAC5617 for more data about normalization of alloy steels.



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7. Reference Standards, Transducer and Probe Positioners (CONT)

(3) It is necessary to normalize some, not all, of the ultrasonic reference standards in this manual as shown on the reference standard drawings. Normalize other reference standards if they attenuate too much of the sound.

D. Reference Standards and the procedures that use them are identified in the table that follows for all airplane models.

REFERENCE STANDARD BOEING PART NUMBER	AIRPLANE MODEL	MANUAL PART	PROCEDURE NUMBER	REFERENCE STANDARD BOEING PART NUMBER	AIRPLANE MODEL	MANUAL PART	PROCEDURE NUMBER
1	707	6	57-10-07, FIG.5	37	707	6	57-30-07, FIG.5
1	707	6	57-10-07, FIG.21	38	707	6	57-30-07, FIG.8
2	707	6	57-10-07, FIG.5	39	707	6	57-30-07, FIG.8
3	707	6	57-10-07, FIG.5	40	707	6	57-30-07, FIG.12
4	707	6	57-10-07, FIG.5	41	707	6	57-10-07, FIG.70
5	707	6	57-10-07, FIG.8	41	707	6	57-30-07, FIG.10
6	707	6	57-10-07, FIG.6	42	707	6	57-10-07, FIG.61
7	707	6	57-10-07, FIG.6	43	707	6	57-10-07, FIG.55
8	707	6	57-10-07, FIG.6				AND FIG.70
9	707	6	57-10-07, FIG.6	44	707	4	57-30-07, FIG.7
11	707	6	57-10-07, FIG.21	45	707	4	57-30-07, FIG.7
12	707	6	57-10-07, FIG.41	46	707	4	57-30-07, FIG.7
13	707	6	57-10-07, FIG.41	47	707	4	57-30-07, FIG.8
14	707	6	57-10-07, FIG.30	48	707	4	57-30-07, FIG.8
15	707	6	57-10-07, FIG.30				AND FIG.9
16	707	6	57-10-07, FIG.30	49	707	4	57-30-07, FIG.8
17	707	6	57-10-07, FIG.22	50	707	4	57-30-07, FIG.9
18	707	6	57-10-07, FIG.22	51	707	6	57-10-07, FIG.48
19	707	6	57-10-07, FIG.18	52	707	6	57-10-07, FIG.48
20	707	6	57-10-07, FIG.11	53	707	6	57-10-07, FIG.46
21	707	6	57-10-07, FIG.11	54	707	6	57-10-07, FIG.46
22	707	6	57-10-07, FIG.17	55	707	6	57-10-07, FIG.47
23	707	6	57-10-07, FIG.17	56	707	6	57-10-07, FIG.47
24	707	6	57-10-07, FIG.19	57	707	6	57-10-07, FIG.54
25	707	6	57-10-07, FIG.19	58	707	6	57-10-07, FIG.66
26	707	6	57-10-07, FIG.40	59	707	6	57-10-07, FIG.66
27	707	6	57-10-07, FIG.40	60	707	6	57-10-07, FIG.57
28	707	6	57-10-07, FIG.39				AND FIG.66
29	707	6	57-10-07, FIG.39	61	707	6	57-10-07, FIG.66
30	707	6	57-10-07, FIG.27	62	707	6	57-10-07, FIG.57
31	707	6	57-10-07, FIG.28	63	707	6	57-10-07, FIG.50
32	707	6	57-10-07, FIG.28	64	707	6	57-10-07, FIG.50
33	707	6	57-10-07, FIG.28	65	707	6	57-10-07, FIG.50
A34	707	6	57-10-07, FIG.31	66	707	6	57-10-07, FIG.50
35	707	6	57-10-07, FIG.32	67	707	6	57-10-07, FIG.49
36	707	6	57-10-07, FIG.32	68	707	6	57-10-07, FIG.49

Reference Standard to Non-Destructive Test Procedure Cross-Reference
Table I (Sheet 1)



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REFERENCE STANDARD BOEING PART NUMBER	AIRPLANE MODEL	MANUAL PART	PROCEDURE NUMBER	REFERENCE STANDARD BOEING PART NUMBER	AIRPLANE MODEL	MANUAL PART	PROCEDURE NUMBER
69	707	6	57-10-07, FIG.56	115	707	6	57-10-07, FIG.86 FIG.88 AND FIG. 89
70	707	6	57-10-07, FIG.56	117	707	4	57-10-07, FIG.11
71	707	6	57-10-07, FIG.56	118	707	4	57-10-07, FIG.11
72	707	6	57-10-07, FIG.56	119	707	4	57-10-07, FIG.11
73	707	6	57-10-07, FIG.56	120	707	4	55-10-07, FIG.4
74	707	4	57-10-07, FIG.2	120P	707	4	55-10-07, FIG.4
75	707	6	57-10-07, FIG.68	121	707	6	53-10-07, FIG.17
A76	707	6	57-10-07, FIG.73	121G	707	6	53-10-07, FIG.17
77	707	4	57-10-07, FIG.3	122	707	4	57-30-07, FIG.11
78	707	4	57-10-07, FIG.3	123	707	4	52-10-07, FIG.1
79	707	4	57-10-07, FIG.5 AND FIG.10	123	727	4	52-10-27, FIG.1
80	707	4	57-10-07, FIG.5	123	737	4	52-10-01
81	707	4	57-10-07, FIG.4 AND FIG.9	124	707/727	4	56-20-27, FIG.1
82	707	4	57-10-07, FIG.4	125		6	51-00-00, FIG.2
A83	707	6	52-30-07, FIG.3	125		6	51-00-05
A84	707	6	52-30-07, FIG.2	126		6	51-00-00, FIG.4
A85	707	6	53-30-07, FIG.3 AND FIG.5	126		6	AND FIG. 23 51-00-01
87	707	6	57-10-07, FIG.65	126	707	6	53-10-07, FIG.19
88	707	6	57-10-07, FIG.65	126	727	6	57-10-07, FIG.13
89	707	6	57-10-07, FIG.65	126	737	6	53-10-27, FIG.51
90	707	6	57-10-07, FIG.65				53-10-08,
91	707	6	57-10-07, FIG.65				53-10-39,
92	707	6	57-10-07, FIG.83				53-10-43,
93	707	4	57-10-07, FIG.6				53-10-45,
94	707	4	57-10-07, FIG.2 AND FIG.6				53-10-48,
95,PF4	707	4	57-10-07, FIG.2				53-10-49,
95,PF1,PF2	707	4	57-10-07, FIG.3 AND FIG.6				53-10-55,
96	707	4	57-10-07, FIG.6 AND FIG.7				53-10-57,
97	707	4	57-10-07, FIG.7				53-10-64,
98	707	4	57-10-07, FIG.9				53-10-65,
98PF3	707	4	57-10-07, FIG.7				53-10-67,
99	707	6	57-10-07, FIG.63				53-30-28,
100	707	4	57-10-07, FIG.8				55-10-02,
101	707	6	57-10-07, FIG.74				55-10-09,
102	707	6	57-10-07, FIG.74				55-10-13,
103	707	6	57-10-07, FIG.72				57-10-19,
104	707	4	57-40-07, FIG.2				57-10-22,
105	707	4	57-40-07, FIG.2				57-10-24,
106	707	4	57-40-07, FIG.2				57-10-27,
107	707	4	57-40-07, FIG.2				57-10-28,
108	707	4	57-40-07, FIG.2				57-30-05,
109	707	4	57-40-07, FIG.3				57-30-07,
110	707	6	57-10-07, FIG.76				57-50-03,
111	707	6	57-10-07, FIG.76	126	747	6	57-50-10,
112	707	6	57-10-07, FIG.82				57-50-11,
113	707	6	57-10-07, FIG.78				57-50-12
114	707	6	57-10-07, FIG.81				53-10-37,
							53-10-38,
							53-10-40,
							53-10-55,
							53-30-00, FIG.2
							53-30-24,
							57-10-36

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REFERENCE STANDARD BOEING PART NUMBER	AIRPLANE MODEL	MANUAL PART	PROCEDURE NUMBER	REFERENCE STANDARD BOEING PART NUMBER	AIRPLANE MODEL	MANUAL PART	PROCEDURE NUMBER
126	757	6	53-10-10, 53-10-11, 53-10-13, 53-10-14, 53-10-17, 53-40-01, 57-50-05, 57-50-06, 57-50-07, 57-51-07, 57-51-10	138P	707	4	32-20-07, FIG.2
126	767	6	53-10-04, 53-10-07, 53-10-08, 53-10-10, 53-30-15, 53-30-16, 53-50-05, 53-50-06, 53-60-05, 55-10-03, 55-10-04, 55-10-05, 57-10-03, 57-10-04, 57-20-05	139	707	4	32-20-07, FIG.2
126	777	6	51-00-01 NO.1,2	139P	707	4	32-20-07, FIG.2
126	787	6	51-00-01 NO.1	140	707	4	55-10-07, FIG.1
127		6	51-00-00, FIG.5, FIG.12 AND FIG.21	140P1A,P2	707	4	55-10-07, FIG.1
127		6	51-00-02 AND 51-00-10	141	707	4	55-10-07, FIG.2
127A		6	51-00-00, FIG.5 AND FIG.12	141P1,P2	707	4	55-10-07, FIG.2
127A		6	51-00-02 AND 51-00-10	142	707	4	57-10-07, FIG.1
128		6	51-00-00, FIG.7	143	707	4	57-10-07, FIG.1
128		6	51-00-06	144	707	4	57-10-07, FIG.1
128P		6	51-00-00, FIG.7	145	707	4	57-10-07, FIG.1
128P		6	51-00-06	146	707	4	57-30-07, FIG.1
130-XXX		6	53-50-00, FIG.1	147P	707	4	57-30-07, FIG.3
130-350		6	53-10-01	147	707	4	57-30-07, FIG.2
130A,B,C		6	53-50-00, FIG.1	148	707	4	57-30-07, FIG.5
130A,B,C		6	53-10-01	149	707	4	57-30-07, FIG.6
130C	777	6	53-10-01	150P1,P2	707	4	54-40-07, FIG.1
131	707	4	53-10-07, FIG.2	150	707	4	54-40-07, FIG.1
131P	707	4	53-10-07, FIG.2	151	707	4	54-40-07, FIG.1
132	707	4	53-10-07, FIG.3	152	707	4	54-40-07, FIG.1
132PR,PL	707	4	53-10-07, FIG.3	153	707	4	54-40-07, FIG.1
133P1,P2	707	4	53-40-07, FIG.1	154	707	4	54-40-07, FIG.1
133	707	4	53-40-07, FIG.1	155	707	4	54-40-07, FIG.1
134P1,P2	707	4	53-40-07, FIG.2	156	707	4	54-40-07, FIG.1
134	707	4	53-40-07, FIG.2	156P	707	4	57-30-07, FIG.10
135	707	4	53-10-07, FIG.4	157	707	4	53-10-07, FIG.5
136A,B	707	4	57-40-07, FIG.1	158	707	4	57-40-07, FIG.4
137A-C	707	4	57-30-07, FIG.4	159	707	4	55-30-07, FIG.1
138	707	4	32-20-07, FIG.2	160	707	4	57-40-07, FIG.5
				A161	707	6	53-10-07, FIG.2
				162	707	6	55-10-07, FIG.4
				163	707	6	57-10-07, FIG.2
				164	707	6	57-10-07, FIG.3
				165	707	6	57-10-07, FIG.3
				166	707	6	57-10-07, FIG.3
				167	707	6	57-10-07, FIG.3
				168	707	6	57-10-07, FIG.4
				169	707	6	57-10-07, FIG.4
				170	707	6	57-10-07, FIG.4
				171	707	6	57-10-07, FIG.4
				172	707	6	57-10-07, FIG.4
				173	707	6	57-30-07, FIG.1
				174A-C	707	6	AND FIG.2 57-30-07, FIG.3
				175	707	6	57-10-07, FIG.29
				176	707	6	57-30-07, FIG.6
				177	707	6	53-10-07, FIG.12
				178	707	6	57-10-07, FIG.1
				179	707	6	57-10-07, FIG.1
				180	707	6	57-10-07, FIG.1
				A181	707	6	55-10-07, FIG.1 AND FIG.2
				182	707	6	55-10-07, FIG.3 AND FIG.8
				183	707	4	32-10-07, FIG.2
				184P1,P2	707	4	57-30-07, FIG.1

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REFERENCE STANDARD BOEING PART NUMBER	AIRPLANE MODEL	MANUAL PART	PROCEDURE NUMBER
185	1	6	51-00-00, FIG.13 AND FIG.24
185	2	6	51-00-12, 51-00-21
185	727	6	57-40-27, FIG.2
185	737	6	57-50-03, 57-50-04, 57-50-05, 57-50-06, 57-50-09, 57-50-10
185	747	6	53-10-43
185	757	6	57-50-04
185	787	6	51-00-01 NO.1
186A THRU F	1	6	51-00-00, FIG.1
186A THRU F	2	6	51-00-04
186A	767	6	53-50-08
186A,B	767	6	53-30-09
186B	767	6	53-30-11
187	1	6	51-00-00, FIG.4 AND FIG.23
187	2	6	51-00-01
188A	1	6	51-00-00, FIG.4 AND FIG.23
188A	727	6	55-30-27
188A	737	6	53-10-50, 53-10-57, 53-10-64, 57-10-23, 57-10-28, 57-50-11, 57-50-14
188A	747	6	53-10-37, 53-10-48, 53-10-53, 53-10-55, 53-30-12, 53-30-24, 57-40-11, 57-40-12
188A	2	6	51-00-01, 51-00-19
188A	757	6	53-10-02, 53-10-09, 53-40-01, 53-60-02, 53-60-03, 53-60-05, 57-51-06, 57-51-07, 57-51-09, 57-51-10

REFERENCE STANDARD BOEING PART NUMBER	AIRPLANE MODEL	MANUAL PART	PROCEDURE NUMBER
188A	767	6	53-10-05, 53-10-07, 53-10-08, 53-10-10, 53-10-19, 53-30-07, 53-30-08, 53-30-10, 53-30-13, 53-50-05, 53-50-06, 53-50-07, 53-50-10, 53-50-11, 53-60-02, 53-60-05, 53-60-06, 53-60-07, 53-60-08, 53-60-09, 53-80-05, 55-10-05, 57-10-01, 57-50-07
188A	777	6	51-00-01 NO.1
188A	787	6	51-00-01 NO.1
189	737	6	53-10-65, 53-10-67, 55-10-10, 55-10-11, 57-50-12, 57-50-13, 57-50-14
189	747	6	53-10-37, 53-10-53, 53-30-24, 55-10-12
189	1	6	51-00-00, FIG.4 AND FIG. 23
189	2	6	51-00-01
189	757	6	53-10-17, 53-40-01
189	767	6	53-10-07, 53-10-08, 53-30-10, 53-50-06, 55-10-05
189	777	6	51-00-01 NO.1
189	787	6	51-00-01 NO.1
190 THRU 192	1	6	51-00-00, FIG.13 AND FIG.24
190 THRU 192	2	6	51-00-12
190 THRU 192	777	6	51-00-04 NO.1,2
192	737	6	57-50-06
192	2	6	51-00-21
192	787	6	51-00-03 NO.1

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REFERENCE STANDARD BOEING PART NUMBER	AIRPLANE MODEL	MANUAL PART	PROCEDURE NUMBER
194,194A	▷	6	53-30-00, FIG.1, FIG.3 AND FIG.4
194,194A	757	6	53-30-02, 53-30-03, 53-30-04
194,194A	767	6	53-30-01, 53-30-02, 53-30-03
194,194A	777	6	53-00-01
196	727	4	53-10-27, FIG.5
198ABCDEF	727	6	20-10-27
198ABCDEF	737,757	6	20-10-01
A201	727	6	55-10-27, FIG.3
202A,B	727	6	57-10-27, FIG.8
203	727	6	57-10-27, FIG.8
204	727	6	57-10-27, FIG.8
205A,B	727	6	57-10-27, FIG.8
206	727	6	57-10-27, FIG.19
208	727	6	57-10-27, FIG.19
A210	727	6	52-30-27, FIG.1
216	727	6	55-30-27, FIG.2
220A,B	727	6	53-10-27, FIG.36
230	727	6	53-10-27, FIG.21
231	727	6	53-10-27, FIG.28
233	727	6	53-10-27, FIG.15
236A-E	727	6	53-10-27, FIG.30
238SE,SSE	727	6	53-10-27, FIG.8
238SA-SD	727	6	53-10-27, FIG.8
238SSA-SSD	727	6	53-10-27, FIG.8
239	727	6	57-10-27, FIG.18
240	727	6	57-10-27, FIG.18
241	727	6	53-40-27, FIG.1
242	727	6	53-40-27, FIG.1
243	727	6	53-40-27, FIG.1
248	727	4	53-10-27, FIG.3
249	727	6	53-10-27, FIG.37
250,M	727	6	57-30-27, FIG.2
251 AND 251A	727	6	57-30-27, FIG.3
251A	727	4	57-30-27, FIG.1
253	727	4	53-10-27, FIG.4
254	727	6	57-40-27, FIG.2
255	727	6	53-10-27, FIG.29
A256	727	6	53-10-27, FIG.40
A257	727	6	53-10-27, FIG.40
A258	727	6	53-10-27, FIG.40
A259	727	6	53-10-27, FIG.40
A260	727	6	53-10-27, FIG.40
261	727	6	53-10-27, FIG.27
262	727	6	53-10-27, FIG.11
262A	727	6	53-10-27, FIG.11
263	727	6	53-10-27, FIG.6
264	727	6	53-10-27, FIG.42
A265A-E	727	6	52-30-27, FIG.4
A266	727	6	57-50-27, FIG.1
270A-B	727	6	54-20-27, FIG.1

REFERENCE STANDARD BOEING PART NUMBER	AIRPLANE MODEL	MANUAL PART	PROCEDURE NUMBER
271	727	6	32-30-27, FIG.2
272	727	6	55-10-27, FIG.2
273	727	6	53-10-27, FIG.26
275	727	4	32-30-27, FIG.1
275P	727	4	32-30-27, FIG.1
276	727	4	32-30-27, FIG.2
276P	727	4	32-30-27, FIG.2
277	727	4	32-30-27, FIG.2
278P	727	4	32-30-27, FIG.3
278	727	4	32-30-27, FIG.3
279P	727	4	32-30-27, FIG.3
279	727	4	32-30-27, FIG.3
280PA,PB,PC	727	4	32-30-27, FIG.4
280	727	4	32-30-27, FIG.4
281A-C	727	4	53-30-27, FIG.1
282	727	4	57-10-27, FIG.1
284P	727	6	57-10-27, FIG.21
284	727	6	57-10-27, FIG.21
285	727	6	57-10-27, FIG.20
286	727	6	57-10-27, FIG.20
287	727	4	32-10-27, FIG.1
290	727	6	53-30-27, FIG.5
291	727	6	54-40-27, FIG.1
292	727	6	53-10-27, FIG.46
293A,B	727	6	53-30-27, FIG.9
A294	727	6	53-30-27, FIG.10
295	727	4	53-30-27, FIG.2
295	727	6	53-30-27, FIG.8
296	727	6	53-30-27, FIG.7
297	727	4	32-30-27, FIG.5
298	727	4	32-30-27, FIG.5
A299	727	6	53-10-27, FIG.47
A305	737	6	57-10-18 AND 57-30-03
A306	737	6	57-10-07
312	737	6	53-10-17
313A,B	737	6	53-10-17
315	737	4	55-30-01
316	737	4	55-30-01
317	737	6	53-10-16
320	737	6	53-10-19
321	737	6	53-10-19
323A,B AND P	737	6	55-50-01
326	737	4	53-10-28
328A-D	737	6	53-10-38
335	737	6	53-10-31
336A-B	737	6	57-30-02
338A-B	737	6	53-10-35
341	737	6	53-10-40
343A-B	737	6	55-10-01
345	737	4	57-40-01
349	737	6	32-10-01
350	737	4	32-20-01
350P	737	4	32-20-01
351A,B	737	4	53-10-01
A352	737	6	53-10-04

Reference Standard to Non-Destructive Test Procedure Cross-Reference Table I (Sheet 5)

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REFERENCE STANDARD BOEING PART NUMBER	AIRPLANE MODEL	MANUAL PART	PROCEDURE NUMBER	REFERENCE STANDARD BOEING PART NUMBER	AIRPLANE MODEL	MANUAL PART	PROCEDURE NUMBER
353A-D	737	6	53-10-12 AND	431	747	6	53-10-19
		6	53-10-15	432	747	6	57-30-02
354A-C	737		57-30-04	433	747	4	32-10-01
355A-C	737	6	57-30-04	434A,B	747	6	53-10-06
356	737	6	53-30-04	435	747	6	57-10-20
357	737	6	55-30-04	436	747	6	57-10-20
358	737	6	55-10-06	437	747	4	53-10-01
359	737	6	55-10-06	438	747	4	53-10-01
362	737	4	53-20-01	439	747	6	57-10-22
363	737	4	53-30-03	440	747	4	57-10-11
365,G	737	4	71-20-01	441	747	4	57-10-10
367	737	6	71-20-01	442	747	4	53-10-02
A368	737	6	53-10-42	443	747	4	53-10-02
369	727	6	53-30-27, FIG.4	446	747	4	57-10-13
		6	AND FIG.6	447	747	4	57-10-13
369	737	6	53-30-05	448	747	4	57-10-13
369A	727	6	53-30-27, FIG.5	449	747	4	57-10-13
370	737	4	53-30-01,	450PA	747	4	54-40-05,
			53-30-02				54-40-06, AND
373A,P2	737	4	32-10-02				54-40-21
375	737	4	55-10-02	451P	747	4	54-40-04
A376	737	6	53-10-45	452P	747	4	54-40-04
378	737	6	53-10-44	453P	747	4	54-40-04
379	737	6	57-40-02	454/454P	747	4	54-40-01
380X	737	6	32-10-01	455	747	4	53-40-01
383,PX.X	737	6	53-30-07	456	747	4	53-40-01
384A,B	737	6	53-40-04	457	747	4	54-40-07
A386	737	6	53-10-45	458A-C	747	6	53-10-10
A389A	737	6	53-10-64	A459	747	6	53-10-13
A389A,B,C	737	6	53-10-41	460	747	6	57-10-28
401	747	4	57-10-01,	461PL	747	4	57-40-01
			57-30-02	461P/461PR	747	4	57-40-01
402	747	4	57-10-04	461-6,-9	747	4	57-40-01
403A,B	747	4	57-10-04	462PL50	747	4	57-40-01
404	747	6	57-10-08	462PR50	747	4	57-40-01
405	747	4	57-10-02	462G	747	4	57-40-01
406	747	6	57-10-09	462PR29	747	4	57-40-01
408	747	4	57-10-03	462PL29	747	4	57-40-01
409	747	4	54-30-03	463	747	6	53-10-27
410	747	4	57-10-05	464A-B	747	6	53-10-01
411	747	6	55-10-04	471	747	4	57-30-02
412	747	6	55-10-01	474	747	6	53-10-20
413	747	4	54-40-03	475	747	6	57-10-27
413A,AP	747	4	54-40-03	476	747	6	53-10-18
414	747	4	54-40-03	477	747	6	53-10-18
419P	747	4	54-40-03	478	747	6	53-10-18
419	747	4	54-40-03	479	747	6	53-10-22
420P	747	4	54-40-02	480	747	6	53-10-22
423	747	6	57-10-17	481	747	6	53-10-22
424	747	6	57-10-17	482	747	6	55-10-08
425A-C	747	4	54-40-03	483	747	6	55-10-08
426	747	4	55-10-01	484A,B	747	6	53-10-25
A428	747	6	53-10-15	485A,B	747	6	53-10-23
A429	747	6	53-10-15	486	747	4	54-40-08
A430	747	6	53-10-15	486PA,PB	747	4	54-40-08
				490	747	4	57-30-06
				491A-C	747	6	53-10-16 AND
							53-10-21

Reference Standard to Non-Destructive Test Procedure Cross-Reference
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REFERENCE STANDARD BOEING PART NUMBER	AIRPLANE MODEL	MANUAL PART	PROCEDURE NUMBER	REFERENCE STANDARD BOEING PART NUMBER	AIRPLANE MODEL	MANUAL PART	PROCEDURE NUMBER
497	767	6	53-00-04	4009	747	6	32-10-01
497C,G,P	747	6	53-30-00, FIG.2	A4010	747	6	53-10-33
497C,G,P	767	6	53-00-04	4011	747	4	54-40-03
499	747	2	57-40-02	4012	747	4	54-40-03
499	747	2	57-40-01	4016	747	4	54-40-03
503	757	6	53-30-01	4018P	747	4	54-40-02
504	757	6	54-40-01	4019	747	6	53-30-04
505	757	4	54-30-01	4020	747	4	53-30-01
506	757	4	57-40-01	4021P	747	4	54-40-03
601PA,PF	767	4	52-30-01	A4024	747	6	53-10-33
601	767	4	52-30-01	4025	747	6	53-10-36
602	767	4	32-10-01	4027	747	4	54-40-10
603	767	4	55-10-01	4028G,P	747	4	57-40-03
603P	767	4	55-10-01	4028	747	4	57-40-03
604A-B	767	6	53-60-01	4028P	747	4	57-40-05
605,605A	767	6	22-10-01	4029	747	4	55-50-01
A607	767	6	53-80-02	4029P	747	4	55-50-01
A607A	767	6	53-80-02	4030,A,B	747	4	54-40-08
608P1,P2	767	4	27-80-01	4031,A,B	747	4	54-40-08
608	767	4	27-80-01	4032	747	4	54-40-08
610	767	4	32-20-01	4033	747	6	53-10-35
1000A,B	707	6	55-10-07	4034	747	4	53-40-02
1001		6	51-00-00, FIG.15	4035	747	4	53-40-02
		6	51-00-15	4036G	747	4	57-40-05
1002		6	51-00-00, FIG.14	4036	747	4	57-40-05
		6	51-00-13	4037PA	747	4	54-40-05
	747	6	57-40-07,	4039PA	747	4	54-40-05
			57-40-10	4047P1,P2	747	4	54-40-05
	757	6	53-10-13	4047P3,P4	747	4	54-40-05
	747	6	57-40-08	4052	747	6	57-40-03,
	777	6	57-50-01				57-40-04
1003 THRU		6	51-00-00, FIG.14	4053A,B,C	747	4	53-40-03
1005		6	51-00-13	4057	747	6	53-30-02,
1004	737	6	57-50-09				53-30-03,
1004	747	6	57-40-10	4059	747	4	53-30-06
2001	727	4	28-10-27, FIG.1	4061	747	4	57-10-12
2002	727	4	53-10-27, FIG.6	4062A,B,C	747	6	57-10-15
2004ABCD	727	6	28-10-27, FIG.1	4064	747	6	57-10-23
2005	727	4	28-10-27, FIG.2				53-30-02,
2006	727	6	57-10-27, FIG.20	4065	747	6	53-30-06
4001A-E	747	4	54-30-02	4065	747	6	53-30-08
4001P	747	4	54-30-02	4068	747	6	53-30-09
4003	747	4	53-40-01	4071	747	4	54-40-10
4004	747	4	53-40-01	4072,C	747	6	53-30-05
4005	747	6	53-10-31	4074	747	4	54-40-02
4007P	747	4	54-40-05 AND	4075	747	4	54-40-02
			54-40-06	4076	747	4	54-40-05,
4007P (M)	747	4	54-40-05				54-40-06,
4008	747	6	53-10-28	4077	747	4	54-40-15
				4078	747	4	54-40-04
				4079	747	4	54-40-04
				4080	747	4	57-40-01
				4081	747	4	57-40-01
				4083	747	4	54-40-06,
							54-40-15

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NONDESTRUCTIVE TEST

REFERENCE STANDARD BOEING PART NUMBER	AIRPLANE MODEL	MANUAL PART	PROCEDURE NUMBER	REFERENCE STANDARD BOEING PART NUMBER	AIRPLANE MODEL	MANUAL PART	PROCEDURE NUMBER
4084	747	4	54-40-02	NDT525	757	4	54-50-01
4085	747	4	54-40-05	ANDT527	757	6	53-30-06
4086	747	4	54-40-05	NDT528	757	4	55-10-04
4087	747	4	54-40-05	NDT530	757	6	53-10-04
4088	747	4	54-40-05	NDT531	757	6	53-30-07,
4089	747	4	54-40-05				53-60-01
4243	747	6	57-10-31	NDT532	757	4	55-10-05
NDT126	767	6	57-50-03,	NDT533	757	4	55-10-03
			57-50-05	NDT535	757	4	55-10-01
NDT188A	767	6	57-10-01,	NDT536	757	4	53-40-01
			57-10-04	NDT537	757	4	57-10-02
NDT194B	1	6	53-30-00, FIG.1,	NDT539	757	6	55-10-02
			FIG.3 AND FIG.4	NDT542	757	4	55-10-07
NDT194B	757	6	53-30-02,	NDT546	757	4	57-20-02
			53-30-03,	NDT549	757	6	57-20-02
			53-30-04	NDT552	757	4	57-20-01
NDT194B	767	6	53-30-01,	NDT553	757	6	52-30-02
			53-30-02,	NDT554	757	6	53-10-07
			53-30-03	NDT555	757	6	53-10-19
NDT194B	777	6	53-00-01	NDT558	757	6	53-30-12
NDT297	727	4	32-30-27, FIG.5	NDT559	757	6	57-51-01
NDT298	727	4	32-30-27, FIG.5	NDT560	757	4	57-50-02
NDT298PR, PL	727	4	32-30-27, FIG.5	NDT560P1,P2	757	4	57-50-02
NDT322A	737	6	53-10-25	NDT561	757	4	57-50-02
ANDT388	737	6	53-10-48,	NDT561P1,P2	757	4	57-50-02
			53-10-49	NDT562	757	4	57-25-01
ANDT390A	737	6	53-10-46,	NDT564A,B	757	4	57-50-01
			53-10-47	NDT566	757	4	54-50-03
ANDT390B	737	6	53-10-46	NDT568	757	6	57-51-05
			53-10-47	NDT611 THRU	767	6	54-51-01
			53-10-51	NDT613			
NDT391	737	6	53-10-51	NDT614	767	4	57-20-01
NDT392	737	4	53-30-03	NDT615	767	4	53-80-01
NDT394,P	737	6	54-30-01	NDT616	767	4	27-40-01
NDT396	737	6	53-30-09,	NDT616P	767	4	27-40-01
			53-30-18,	NDT617	767	6	53-80-03
			55-10-07	NDT618	767	6	53-80-03
NDT398	737	4	53-10-01	NDT618A	767	6	53-80-03
NDT504A	757	6	54-40-01,	NDT619	767	4	27-40-01
			54-40-02	NDT619P	767	4	27-40-01
NDT504B	757	6	54-40-01,	NDT620	767	4	53-60-01
			54-40-02	NDT621	767	4	57-10-01
NDT504C	757	6	54-40-01,	NDT622	767	6	57-20-01
			54-40-02	NDT623	767	4	57-10-03
NDT504D	757	6	54-40-01,	NDT625	767	4	55-10-03
			54-40-02	NDT627	767	4	57-10-02
NDT511	757	6	57-10-02	NDT628	767	4	53-50-01
NDT512	757	4	57-10-01	NDT629	767	4	57-40-01
NDT514	757	6	57-20-01	NDT630	767	4	55-10-02
NDT515	757	4	57-21-01	NDT631	767	4	71-20-01
NDT516	757	6	57-23-01	NDT632	767	4	71-20-01
NDT518	757	4	57-21-02	NDT632	767	4	32-10-02,
NDT519	757	6	52-30-01	NDT636	767	6	32-10-03
ANDT520	757	6	52-30-02				32-10-01,
NDT521	757	4	55-10-02	NDT636	767	4	32-10-02
NDT522, P1	757	4	53-80-01	NDT637	767	6	32-10-04
NDT523	757	6	53-10-12,	NDT638	767	4	57-40-02
			53-60-04	NDT642	767	4	53-50-02,
NDT524	757	6	53-10-06,				53-50-03
			53-10-08				

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REFERENCE STANDARD BOEING PART NUMBER	AIRPLANE MODEL	MANUAL PART	PROCEDURE NUMBER	REFERENCE STANDARD BOEING PART NUMBER	AIRPLANE MODEL	MANUAL PART	PROCEDURE NUMBER
NDT643	767	6	57-20-03	NDT1006 THRU	1	6	53-30-00, FIG.5
NDT644	767	4	57-20-02	NDT1009			
NDT648	767	6	53-30-06	NDT1006 THRU	2	6	53-00-06
NDT650	767	6	57-04-01	NDT1009			
NDT651	767	6	57-04-01	NDT1008	727	6	53-30-27, FIG.15
NDT652	767	6	57-20-07	NDT1008	747	6	53-30-10
NDT655,G	767	4	54-50-03	NDT1009	727	6	53-30-27, FIG.15 AND FIG.16
NDT656,G	767	4	54-50-03	ANDT1015	1	6	53-30-00, FIG.5
NDT657	767	6	53-10-09	ANDT1015	2	6	53-00-06
NDT658	767	4	53-10-01	ANDT1015	777	6	53-00-06
NDT660	767	6	53-80-04	NDT1016	767	6	53-50-08
NDT661	767	4	53-30-01	NDT1016 THRU	1	6	51-00-00, FIG.16
NDT662	767	4	57-20-03	NDT1021			
NDT663A,B	767	6	53-10-13	NDT1016 THRU	2	6	51-00-16
NDT664	767	6	57-20-06	NDT1021			
NDT665	767	6	53-10-06	NDT1016 THRU	777	6	51-00-02 NO.3
NDT666A,B,C	767	6	57-20-08	NDT1021			
NDT667	767	4	54-50-05	NDT1016 THRU	787	6	51-00-02 NO.1
NDT668	767	6	57-50-01	NDT1021			
NDT669	767	4	32-10-05	NDT1017	757	6	57-50-02
NDT670	767	4	53-10-02	NDT1017	767	6	53-30-11, 53-60-09
NDT671	767	4	53-30-12	NDT1018	767	6	53-50-12
NDT672	767	6	54-50-01	NDT1019	767	6	57-50-04
NDT674	767	4	54-50-06	NDT1020	767	6	57-50-04
NDT675	767	4	54-50-06	NDT1021	767	6	53-50-12
NDT679	767	4	53-50-05	NDT1022 THRU	1	6	51-00-00, FIG.17
NDT680	767	4	32-10-06	NDT1027			
NDT685	767	6	53-10-18, 53-10-19	NDT1022 THRU	2	6	51-00-14
NDT686	767	6	53-50-09	NDT1027			
NDT687	767	4	57-50-08	NDT1022 THRU	777	6	51-00-07
NDT688	767	4	57-50-03	NDT1027			
NDT690	767	4	57-50-04	NDT1022 THRU	787	6	51-00-06
NDT691	767	6	57-50-08	ANDT1028	707	6	53-10-07, FIG.18
NDT693	767	4	53-50-04	ANDT1029A	707	6	53-30-07, FIG.12
NDT694	767	4	57-50-05	ANDT1029B	707	6	53-30-07, FIG.12
NDT695	767	4	57-50-05	NDT1031	707	6	57-10-07, FIG.93
NDT697	767	4	57-50-07	NDT1033	1	4	51-40-00, FIG.1
NDT698	767	4	57-50-03	NDT1033	2	4	51-00-01
NDT700X	767	4	57-50-02	NDT1033-N	787	4	51-00-01
NDT702	787	4	51-00-08, 51-00-09	NDT1034	707	6	53-30-07, FIG.13
NDT703	777	6	57-60-01	NDT1036, -P1, -P2 AND -P4	707	4	54-40-07, FIG.2
NDT706	777	6	53-10-01	NDT1037	1	6	51-00-00, FIG.21
NDT706P	777	6	53-10-01	NDT1038	1	1	51-05-01
NDT707	777	4	52-80-01	NDT1038	1,787	4	51-00-05
NDT709	777	4	57-60-01	NDT1038	2	1	51-05-01
NDT710	777	6	54-51-01	NDT1038	777,787	1	51-05-01
NDT711	777	6	54-51-01	NDT1039-t ₁ /t ₂	1,787	4	51-00-05
NDT712	777	6	54-51-01	NDT1039-t ₁ /t ₂	757	4	53-30-01
NDT713	777	6	53-10-02				
NDT714	777	6	53-10-03				
NDT723	777	4	78-30-03				
NDT724	777	4	78-30-03				
NDT1002	757	6	57-50-03				
NDT1002 THRU	787	6	51-00-05 NO.1				
NDT1005							

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REFERENCE STANDARD BOEING PART NUMBER	AIRPLANE MODEL	MANUAL PART	PROCEDURE NUMBER
NDT1085-XXX	1	6	53-30-23
NDT1085-XXX	2	6	53-00-10
NDT1085-XXX	777	6	53-00-08
NDT1086-P1,-P2	757	4	53-00-01
NDT1086-XXX	1	4	53-30-05
NDT1086-XXX	757	4	53-00-01
NDT1086-XXX	767	4	53-00-01
NDT1087-1	727	6	53-30-27, FIG.23
NDT1087-1	737	6	53-30-08
NDT1087-2	727	6	53-30-27, FIG.23
NDT1087-3	737	6	53-30-17
NDT1087-6	767	6	53-10-20
NDT1087-P1	1	6	53-30-00, FIG.9
NDT1087-P1	737	6	53-30-08
NDT1087-P1	2	6	53-00-11
NDT1087-P1	777	6	53-00-09
NDT1087-X	1	6	53-30-00, FIG.9
NDT1087-X	2	6	53-00-11
NDT1087-X	777	6	53-00-09
NDT1088-050/063	747	6	53-30-17
NDT1088-050/063	757	6	53-00-13
NDT1088-062/071	747	6	53-30-17
NDT1088-072/050	727,737	6	53-30-24
NDT1088-072/050	757	6	53-30-09
NDT1088-095/071	747	6	53-30-17
NDT1088-112/100	747	6	53-30-17
NDT1088-112/100	777	4	53-00-02
NDT1088-133/071	747	6	53-30-17
NDT1088-144/050	727,737	6	53-30-24
NDT1091	1	6	51-00-00, FIG.15
NDT1092-t ₁ /t ₂	1	9	51-00-03, 51-00-04
NDT1092-t ₁ /t ₂	757-777	9	51-00-03, 51-00-04
NDT1093-t ₁ /t ₂	1	9	51-00-03, 51-00-04
NDT1093-t ₁ /t ₂	757-777	9	51-00-03, 51-00-04
NDT1094-XXX,-A	1	4	53-30-06
NDT1094-XXX,-A	757-777	4	53-00-02
NDT1095	727-747	6	53-30-30
ANDT2007	727	6	53-10-27, FIG.48 AND FIG.49
ANDT2008	727	6	52-30-27, FIG.7
NDT2011-A	727	6	53-30-27, FIG.13
NDT2011-B	727	6	53-30-27, FIG.13
NDT2011-C	727	6	53-30-27, FIG.13
NDT2011-D	727	6	53-30-27, FIG.13

REFERENCE STANDARD BOEING PART NUMBER	AIRPLANE MODEL	MANUAL PART	PROCEDURE NUMBER
NDT2012	727	6	53-30-27, FIG.14
NDT2013	727	4	32-10-27, FIG.2
NDT2013-P2	727	4	32-10-27, FIG.2
NDT2014	727	4	53-30-27, FIG.3
NDT2015	727	4	53-30-27, FIG.4
NDT2016	727	6	54-40-27, FIG.2
NDT2017	727	4	57-10-27, FIG.3
NDT2018-A	727	6	53-30-27, FIG.13
NDT2018-B	727	6	53-30-27, FIG.13
NDT2018-C	727	6	53-30-27, FIG.13
NDT2018-D	727	6	53-30-27, FIG.13
NDT2019	727	6	57-40-27, FIG.3
NDT2023A,B,C	727	6	53-30-00, FIG.21
NDT2024 THRU	727	6	53-30-27, FIG.22
NDT2029			
NDT2031	727	6	55-30-27
NDT3001	727	4	53-10-27, FIG. 7
NDT3001	737	4	53-10-02
NDT3004	737	6	53-30-10, 53-30-11
ANDT3004	737	6	53-30-12
NDT3005	737	6	53-30-13
ANDT3006	737	6	53-30-14
NDT3008 THRU	737	6	54-40-01, 54-40-02
NDT3010			
NDT3011	737	6	53-30-10
NDT3012	737	4	53-10-03
NDT3014-A,-B	737	4	27-00-01
NDT3015	737	6	53-30-15
ANDT3016-B	737	6	53-10-54
NDT3019	727	6	53-30-27, FIG.17
NDT3019	737	6	53-30-16
NDT3020	737	6	53-30-17
NDT3021	737	4	57-50-01
NDT3021	737	6	57-50-01
NDT3023, P1,P2,P3	737	4	32-10-02
NDT3023	737	4	32-10-03
NDT3024	737	4	53-10-04
NDT3024A	737	4	53-10-04
NDT3030	737	4	57-10-01
NDT3036	737	6	55-10-08
NDT3038,-P1	737	4	57-50-02
NDT3039	737	4	53-30-04
NDT3041	737	6	57-50-15
NDT3043	737	4	57-50-03
NDT3044	737	4	57-50-03
NDT3045	737	6	57-50-19
NDT3046	737	4	53-20-01
NDT3047	737	6	53-10-62
NDT3048	737	6	53-10-56

Reference Standard to Non-Destructive Test Procedure Cross-Reference
Table I (Sheet 11)

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51-01-00
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NONDESTRUCTIVE TEST

REFERENCE STANDARD BOEING PART NUMBER	AIRPLANE MODEL	MANUAL PART	PROCEDURE NUMBER	REFERENCE STANDARD BOEING PART NUMBER	AIRPLANE MODEL	MANUAL PART	PROCEDURE NUMBER
NDT3049	737	6	53-10-67	NDT4099	747	6	54-40-11, 54-40-12
NDT3050	727	6	53-30-21	NDT4100	747	6	57-40-06
NDT3050	737	6	53-30-20, 53-30-29	NDT4101	747	6	54-40-09
NDT3052	737	6	57-10-25, 57-10-26	NDT4104	747	4	53-10-06
NDT3053	737	6	53-30-21	NDT4105	747	6	57-10-35
NDT3054	737	4	57-10-04	NDT4106-G1, -G2,-G3	747	4	54-30-05
NDT3062	737	4	57-10-02	NDT4107,-G5	747	4	54-30-06
NDT3065	1	6	53-30-22	NDT4108	747	4	54-30-06
NDT3065	747	6	53-30-18	NDT4109	747	4	54-30-08
NDT3065	2	6	53-00-09	NDT4115	747	4	54-30-07, 54-30-09, 54-30-10
NDT3065	777	6	53-00-04, 53-00-07	NDT4116	747	4	54-40-02
NDT3068	737	4	52-10-02	NDT4117	747	4	54-40-02
NDT3070	737	6	57-10-30	NDT4118	747	4	54-40-02
NDT3071	737	6	53-10-65	NDT4121	747	6	54-40-13
NDT3073	737	6	57-10-31	NDT4123	747	4	54-30-10
NDT3075	727	6	53-30-25, 53-30-26	ANDT4125	747	6	53-10-39
NDT3075	737	6	53-30-26, 53-30-27	ANDT4126	1	6	53-30-00, FIG.6
NDT3075	747	6	53-30-20	ANDT4126	2	6	53-30-05
NDT3077	737	6	53-10-69	NDT4128	747	4	54-40-12
NDT3078	737	6	53-10-38	NDT4129	747	4	54-40-12
NDT3080	737	4	55-30-02	NDT4130	747	6	54-40-13
NDT3081	737	4	55-10-01	NDT4131,P	747	4	54-40-11
NDT3082A,B,C	737	6	53-10-70	NDT4132	747	4	54-40-11
NDT3083	737	4	55-10-03	NDT4133	747	4	54-40-11
NDT3085A,B,C	737	6	57-10-32	NDT4144	747	6	57-40-09
NDT3086A,B,C	737	6	57-10-32	NDT4147	747	4	54-40-13
NDT3089	737	6	52-30-01	NDT4147P	747	4	54-40-13
NDT3090A	737	6	53-10-52	NDT4147PL	747	4	54-40-13
NDT3090B	737	6	53-10-52	NDT4147PR	747	4	54-40-13
NDT3090C	737	6	53-10-52	NDT4150	747	4	57-22-01
NDT3091	737	6	53-30-27	NDT4151	747	4	57-10-17, 57-10-21
NDT3091	747	6	53-30-20	NDT4152	747	4	53-10-07
NDT3092	737	4	53-10-05	NDT4153	747	4	57-30-08
NDT4058	747	6	27-10-02	NDT4153	747	4	57-30-09
NDT4090	747	6	54-40-08	NDT4154	747	4	54-40-14
NDT4093	747	6	54-40-06	NDT4155	747	4	54-40-14
NDT4094	747	6	54-40-08	NDT4156	747	4	54-40-14
NDT4096	747	6	54-40-12	NDT4157	747	4	54-40-14
NDT4097	747	6	54-40-12	NDT4162P	747	4	54-40-14
NDT4098	747	6	54-40-07, 54-40-10, 54-40-11, 54-40-12, 57-40-05	NDT4163P	747	4	54-40-14
				NDT4164P	747	4	54-40-14
				NDT4165P	747	4	54-40-14

Reference Standard to Non-Destructive Test Procedure Cross-Reference
Table I (Sheet 12)



NONDESTRUCTIVE TEST

REFERENCE STANDARD BOEING PART NUMBER	AIRPLANE MODEL	MANUAL PART	PROCEDURE NUMBER
NDT4170	747	4	53-30-02
NDT4171	747	4	54-40-09
NDT4171G	747	4	54-40-09
NDT4171P	747	4	54-40-09
NDT4173	747	6	53-30-11
NDT4174G1, G2, P	747	4	54-40-15
NDT4175	747	6	53-10-41
NDT4176	747	6	53-10-41
NDT4178	747	4	53-40-05
NDT4179	747	4	53-40-04
NDT4180	747	6	57-10-37, 57-10-38
NDT4182	747	4	54-40-16, 54-40-18
NDT4183	747	4	53-30-03
NDT4185	747	4	54-40-17
NDT4187	747	4	57-10-18
NDT4188	747	4	54-40-19
NDT4188G	747	4	54-40-19
NDT4189	747	4	54-40-20
NDT4190, A	747	6	53-10-34
NDT4191	747	4	54-40-21
NDT4192	747	4	54-40-21
NDT4195 THRU	747	6	54-40-14
NDT4199			
NDT4200	747	4	57-10-20
NDT4201	747	6	54-40-07
NDT4202	747	6	54-40-13
NDT4203	747	6	54-40-10 AND 54-40-13
NDT4204	747	6	53-10-45
NDT4205	747	4	57-40-07
NDT4206	747	4	54-40-22
NDT4208	747	4	54-40-23
NDT4209	747	4	53-10-08
NDT4210	747	4	51-20-01
NDT4211	747	4	53-10-08
NDT4212	747	4	53-10-09
NDT4214	747	6	53-30-08
NDT4215	747	6	53-10-15
NDT4217	747	6	53-30-14
ANDT4218	747	6	53-10-51
NDT4219	747	4	53-10-11
NDT4220	747	6	53-30-13
NDT4221	747	6	53-30-12
NDT4222	747	6	54-40-15
ANDT4223	747	6	53-10-33
NDT4224	747	4	54-40-24
NDT4224	767	4	54-50-05

REFERENCE STANDARD BOEING PART NUMBER	AIRPLANE MODEL	MANUAL PART	PROCEDURE NUMBER
NDT4225	747	6	53-10-47
NDT4226	747	4	57-10-22
NDT4228	747	6	54-40-16
NDT4229	747	6	54-40-16
NDT4230	747	4	53-10-10
NDT4231	747	4	57-10-18
NDT4232	747	4	55-10-03
NDT4233	747	4	55-10-03
NDT4234	747	4	55-10-03
NDT4235	747	4	55-10-03
NDT4236	747	6	53-30-16
NDT4237	747	6	53-30-16
NDT4238	747	6	53-30-16
NDT4239	747	6	53-30-16
NDT4240	747	4	27-20-01
NDT4240P	747	4	27-20-01
NDT4241	747	4	53-30-04
NDT4243	747	6	57-10-31
NDT4244	747	4	53-10-12
NDT4245	747	4	54-40-25
NDT4246	747	6	53-10-34
NDT4248	747	4	53-10-13
NDT4249	747	6	53-30-19
NDT6036	767	4	57-20-04
NDT6036G1, G2	767	4	57-20-04
NDT6036P1, P2	767	4	57-20-04
ST8870D	737	4	78-30-01
ST8870-1, -4	787	1	51-04-00, 51-05-01
		4	51-00-05
ST8870-7, -8, -9	777	4	78-30-01
ST8870-7, -8, -9	787	1	51-04-00
		4	51-00-01, 51-00-02
ST8871	787	1	51-04-00
ST8871	787	4	51-00-06, 51-00-07, 51-00-08, 51-00-09
ST8871B	787	4	51-00-07, 51-00-09
ST8871D	737	4	78-30-02

1 707, 727, 737, 747

2 757, 767

3 707, 727, 737, 747, 757, 767, 777, 787

Reference Standard to Non-Destructive Test Procedure Cross-Reference
Table I (Sheet 13)

EFFECTIVITY
MODEL: ALL

 **BOEING**
NONDESTRUCTIVE TEST

PART 1 - GENERAL

INSPECTION OF REPAIRS TO COMPOSITE STRUCTURES

1. Purpose

- A. To find delaminations or disbonds in repaired metallic and non-metallic composite structure.
- B. This procedure has been written to help operators identify inspection procedures that can be used to examine repairs made to composite structure. Calibration disbond diameters for each inspection are given. This procedure does not stop the use of other inspection procedures. Different inspection procedures that have been evaluated and found to be acceptable by the airline can be used. Alternate inspection procedures must be applicable to the repair to be examined.

2. Equipment

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

A. Reference Handbook

- (1) The Society of Automotive Engineers (SAE) has a handbook that can be referred to for more data related to the inspection of composite repairs. This handbook, the "Composite Repair NDT/NDI Handbook", document number ARP 5089, can be purchased from SAE at:

SAE
400 Commonwealth Dr
Warrendale, Pa 15096-0001
USA

Phone: (724) 776-4970
Fax: (724) 776-0790

B. Reference Standard

- (1) To help with inspections of non-metallic composite repairs, repair reference standards are available from Boeing. As an alternative, new Commercial Airplane Composite Repair Committee (CACRC) reference standards are also available from SAE. You can use these reference standards to cause example indications with bondtesters, pulse-echo instruments, through-transmission instruments, and tap testers. The reference standards are not calibration standards, which are used to set the instrument sensitivity. Refer to the procedures specified in Fig. 9 for data about calibration standards.



NONDESTRUCTIVE TEST

(a) Boeing reference standards

- 1) You can make the reference standards shown in Fig. 1 thru 6 or make an order for them from composite reference standard manufacturers.
- 2) The repair reference standards are available in many configurations (see Fig. 2). For general composite repair inspections, Boeing recommends the basic set of four reference standards below:
 - a) Reference standard C12-DIS-3C1N (carbon skins with honeycomb core and skin-to-core disbonds).
 - b) Reference standard C12-DEL-3C1N (carbon skins with honeycomb core and with interply delaminations).
 - c) Reference standard C12-PCS-3C1N (carbon skins with honeycomb core and with potting and core splice areas).
 - d) Reference standard C12-POT-3C1N (carbon skins with honeycomb core and skin-to-potting disbonds).
- 3) For solid laminate inspections, it is permitted to use the laminate step wedges specified in Part 4, 51-00-01.

NOTE: These laminate step wedges are cured in an autoclave. They have less ultrasonic attenuation than repaired laminate structure cured with a vacuum bag.

(b) Commercial Aircraft Composite Repair Committee (CACRC) reference standards

- 1) The CACRC committee has designed industry reference standards (see Fig. 7 and 8) applicable to aircraft from all manufacturers. You can make these reference standards or make an order for them from manufacturers of composite reference standards.
- 2) Drawings and instructions for CACRC reference standards can be purchased from the Society of Automotive Engineers (SAE). Use the document numbers specified below:
 - a) Aerospace Recommended Practice ARP5606 (composite honeycomb NDI reference standards)
 - b) Aerospace Recommended Practice ARP5605 (solid composite laminate NDI reference standards)

3. Preparation for Inspection

- A. If you cannot get access on the part to do the inspection, remove it from the airplane.



NONDESTRUCTIVE TEST

- B. Get the repair records that show the initial damage location, the repair dimensions and the type of repair.
- C. Try to find out how the repair was made. Identify the thickness of the repair plies or doublers used, the location of core plugs and potting compound, and the surface area of the part where heat was applied.
- D. Get the engineering drawings, if possible, that show the part structure in the repair area.
- E. Examine the repair and use the flowchart in Figure 9 to identify the correct inspection procedure or procedures to use. Use the procedures specified in the flowchart to do the inspection.

4. Instrument Calibration

- A. Use the calibration disbond diameters shown in Figure 10 to calibrate your instrument. Refer to the procedures shown in Figure 9 for data about the reference standards to use.

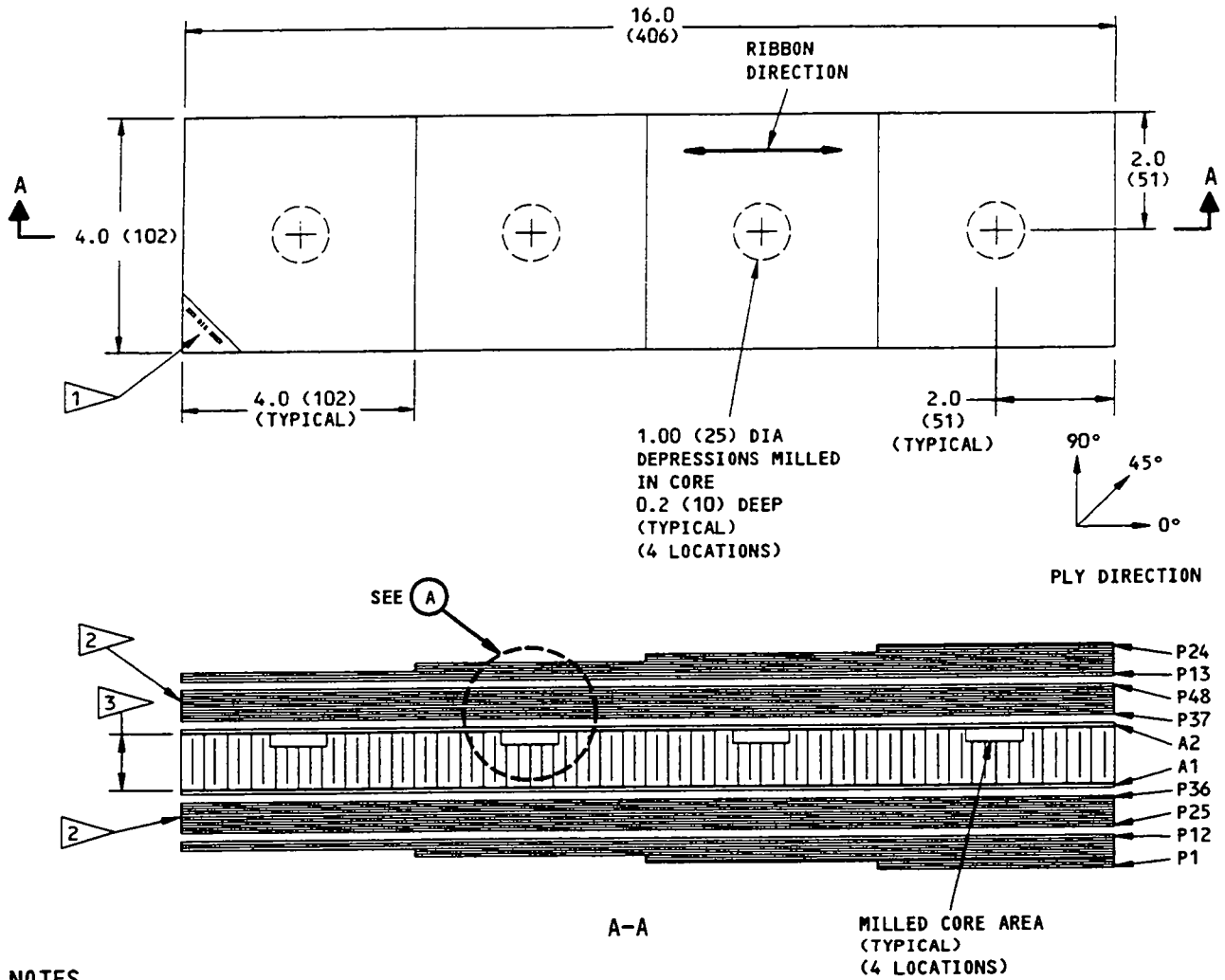
5. Inspection Procedure

- A. Do a scan of the repair area and the area around the repair as follows:
 - (1) Use one of the scan patterns shown in Figure 11. Use scan pattern 1 for inspection with through-transmission or low-frequency bondtest procedures. Use scan pattern 2 for inspection with pulse-echo or high-frequency bondtest procedures. For tap test inspections, refer to NDT Part 1, 51-05-01 for the correct scan pattern.
 - (2) Use scan increments that are one third of the defect's diameter when you do scan pattern 1 or 2. For example: to find 1-inch (25 mm) defects, do the scan in increments of 0.30 inch (8 mm) (see Fig. 11). When possible, we recommend that you use a guide or a straightedge to control the movement of the transducer during these inspections.
 - (3) Examine at least 6 inches (152 mm) all around the area where heat was applied to be sure that the heat application did not damage the structure near the repair. See Figure 12.

6. Inspection Results

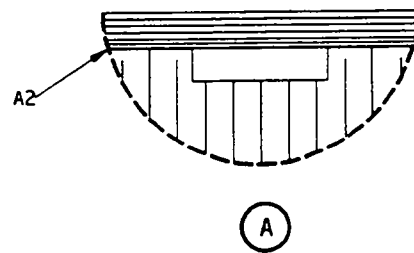
- A. If you get disbond indications larger than what is permitted, you must examine the repair area some more. Disbonds in the repair area will cause responses that are almost the same as the response you got during calibration when you examined the calibration defect.
- B. You can use other inspection procedures to examine the indication, but the procedure shown in the flowchart for the repair type must be the procedure you use to accept or reject the indication. For example: you cannot accept an indication with a bondtester that you have rejected with a through-transmission inspection.

NONDESTRUCTIVE TEST



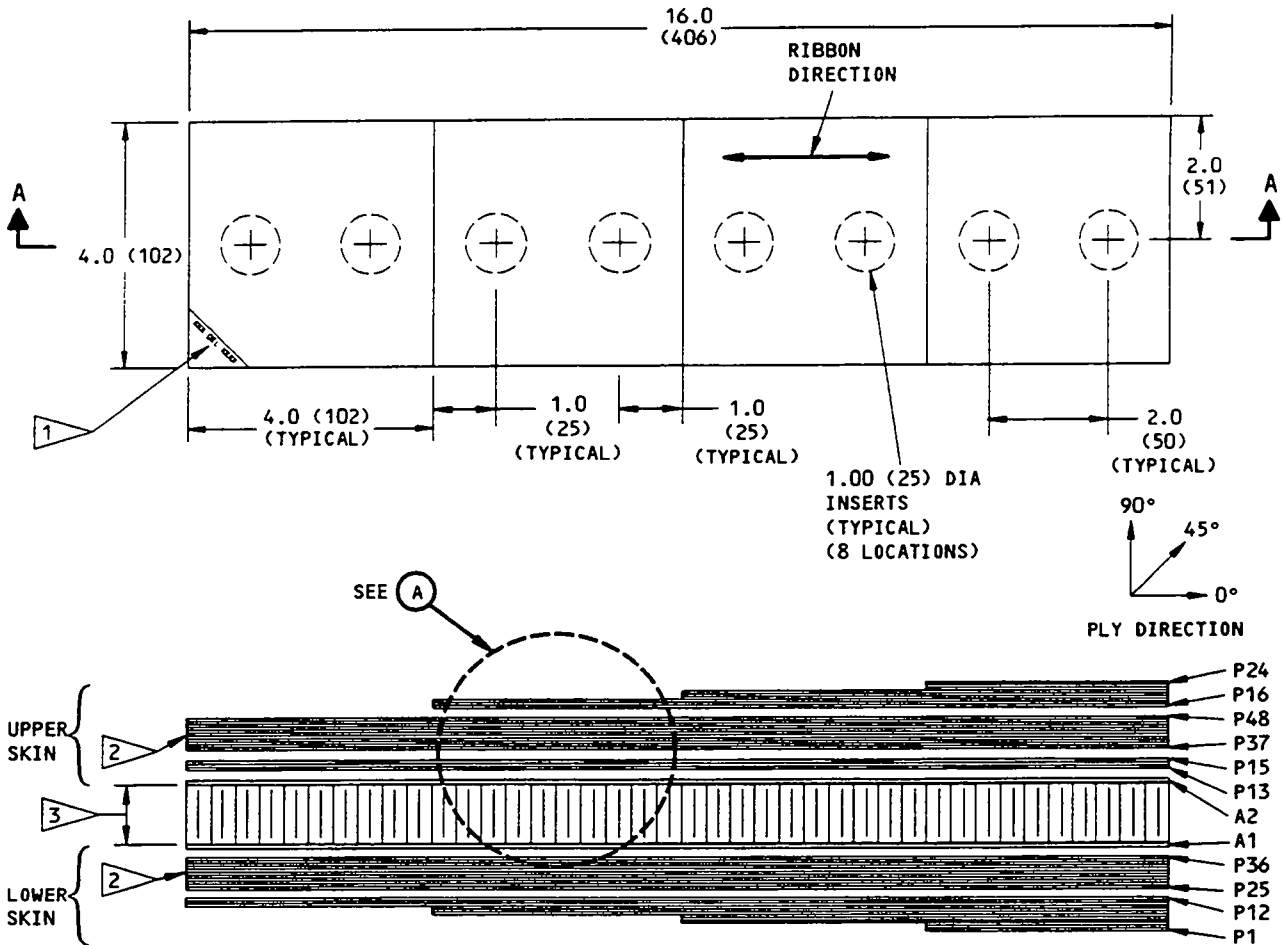
NOTES

- ALL DIMENSIONS ARE IN INCHES (MILLIMETERS ARE IN PARENTHESES)
- HOW TO MAKE THE DEFECTS FOR THIS REFERENCE STANDARD:
 1. CUT THE HONEYCOMB WITH A 1.00 (25) TREPPANING TOOL. THEN MILL THE CORE TO A DEPTH OF 0.2 (5) WITH A CIRCULAR SANDING DISK IN A DRILL PRESS.
 2. SECONDARY BOND THE MILLED CORE TO THE PRE-CURED SKINS. MAKE SURE THAT THE MILLED SIDE OF THE HONEYCOMB IS ON THE TOOL (SO THE ADHESIVE FILM STAYS AGAINST THE SKIN).
- SEE FIGURE 1 (SHEET 5) FOR INSTRUCTIONS ABOUT HOW TO MAKE THIS REFERENCE STANDARD.




XXX-DIS-XXXX Series Reference Standard
 Figure 1 (Sheet 1)

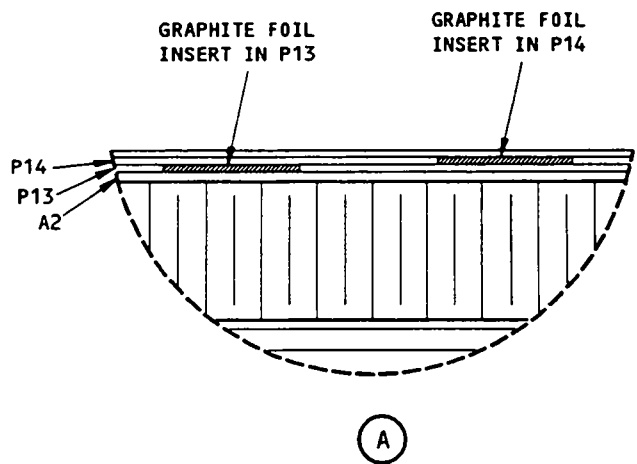
NONDESTRUCTIVE TEST



NOTES

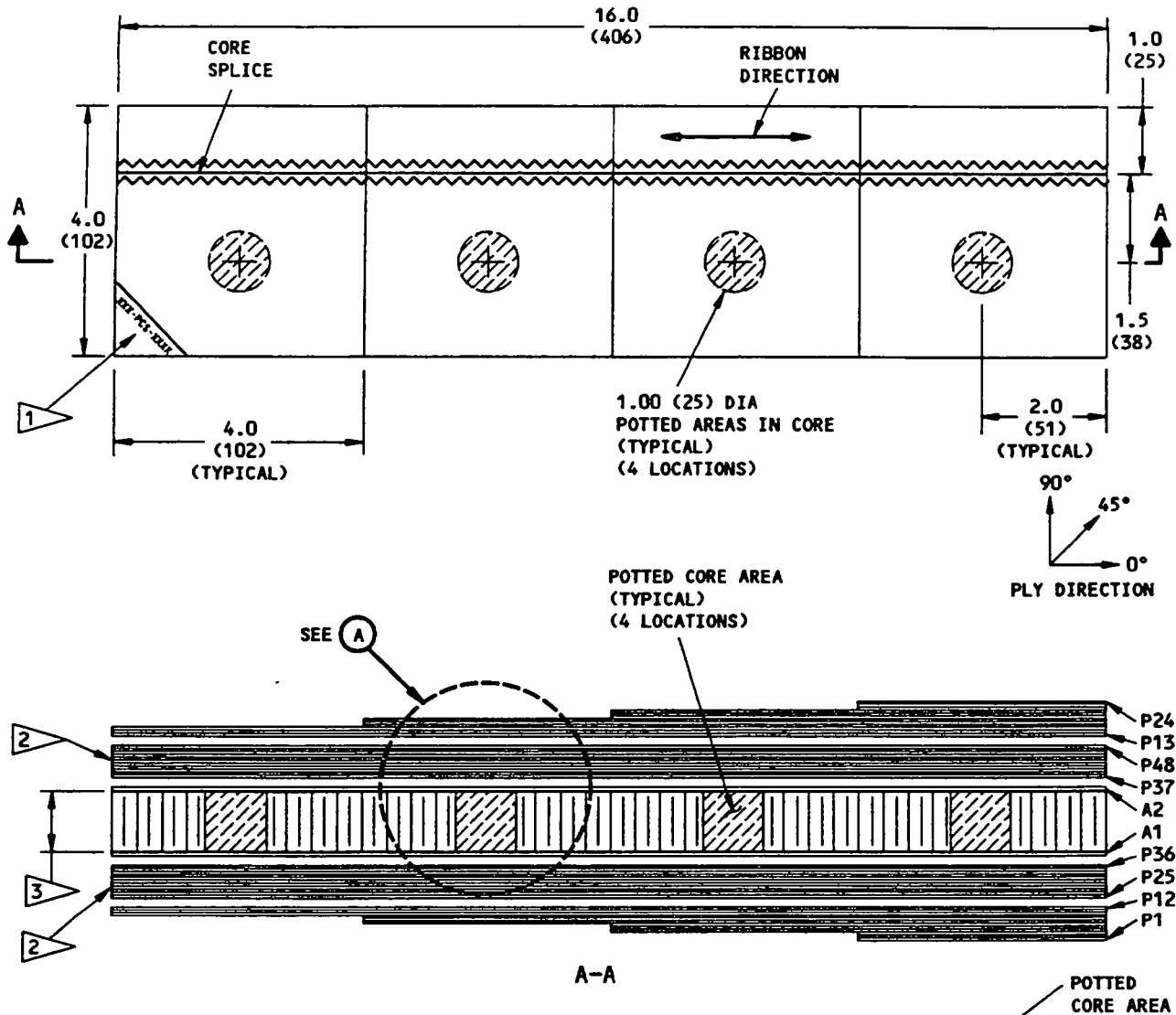
- ALL DIMENSIONS ARE IN INCHES (MILLIMETERS ARE IN PARENTHESES)
- HOW TO MAKE THE DEFECTS FOR THIS REFERENCE STANDARD:
 1. PUT THE DEFECTS IN THE UPPER SKIN WHEN YOU PRE-CURE THE SKINS.
 2. USE 0.010 (0.25) GRAPHITE FOIL INSERTS FOR THE DEFECTS IF THE REFERENCE STANDARD HAS CARBON SKINS. CUT 1.0 (25) HOLES IN PLYS 13 AND 14 TO ACCEPT THE INSERTS. (REFER TO )
 3. DIP THE INSERTS IN A RELEASE AGENT BEFORE YOU PUT THEM IN THE PLY LAYUP. USE TWEEZERS TO HOLD THE INSERTS.
 4. USE 0.001 (0.03) CLEAR PARTING FILM INSERTS IF THE REFERENCE STANDARD HAS FIBERGLASS SKINS. PUT INSERTS BETWEEN P13 AND P14 AND BETWEEN P14 AND P15.
- SEE FIGURE 1 (SHEET 5) FOR INSTRUCTIONS ABOUT HOW TO MAKE THIS REFERENCE STANDARD.

A-A



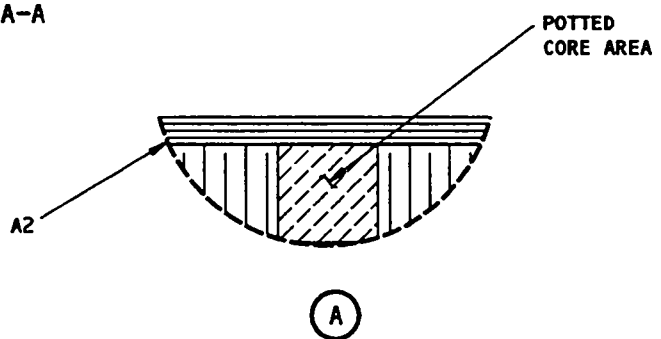
XXX-DEL-XXXX Series Reference Standard
Figure 1 (Sheet 2)

BOEING 
COMMERCIAL JET
NONDESTRUCTIVE TEST



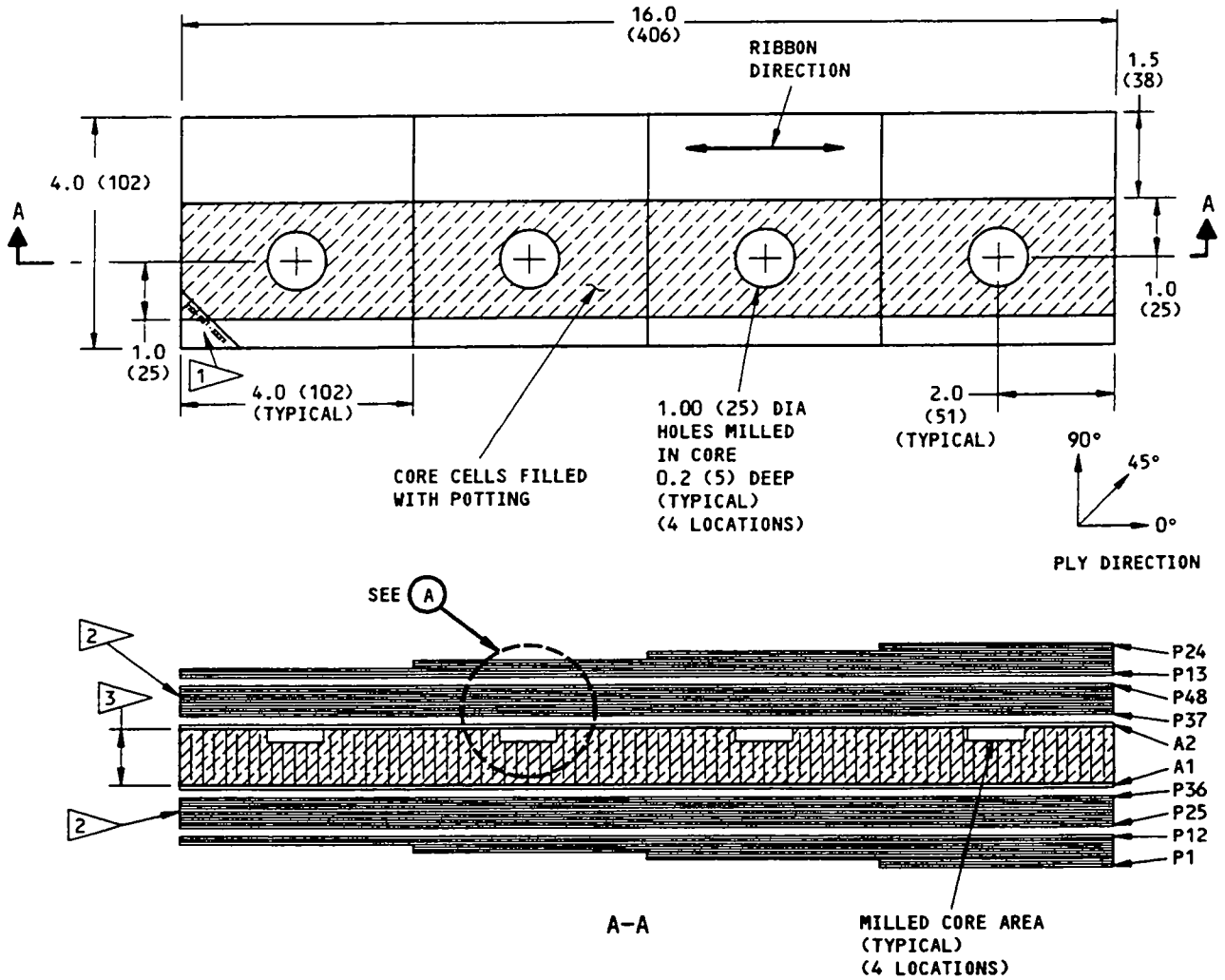
NOTES

- ALL DIMENSIONS ARE IN INCHES (MILLIMETERS ARE IN PARENTHESES)
- HOW TO MAKE THE AREAS FOR THIS REFERENCE STANDARD THAT WILL CAUSE INDICATIONS DURING CALIBRATION:
 1. POT AND SPLICE THE HONEYCOMB CORE. CURE THE CORE.
 2. SECONDARY BOND THE PRE-CURED SKINS TO THE CORE.
- SEE FIGURE 1 (SHEET 5) FOR INSTRUCTIONS ABOUT HOW TO MAKE THIS REFERENCE STANDARD.



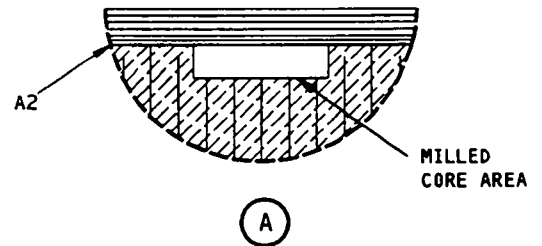
XXX-PCS-XXXX Reference Standard
 Figure 1 (Sheet 3)

BOEING 
COMMERCIAL JET
NONDESTRUCTIVE TEST



NOTES

- ALL DIMENSIONS ARE IN INCHES (MILLIMETERS ARE IN PARENTHESES)
- HOW TO MAKE THE DEFECTS FOR THIS REFERENCE STANDARD:
 1. POT THE HONEYCOMB CORE. CURE THE CORE.
 2. MILL 1.0 (25) DIAMETER HOLES IN THE POTTED AREA IN THE CORE TO A DEPTH OF 0.2 (5).
 3. SECONDARY BOND THE MILLED CORE TO THE PRE-CURED SKINS. MAKE SURE THAT THE MILLED SIDE OF THE CORE IS ON THE TOOL (SO THE ADHESIVE FILM STAYS AGAINST THE SKIN).
- SEE FIGURE 1 (SHEET 5) FOR INSTRUCTIONS ABOUT HOW TO MAKE THIS REFERENCE STANDARD.



XXX-P0T-XXXX Series Reference Standard
 Figure 1 (Sheet 4)


NONDESTRUCTIVE TEST

PROCEDURE TO MAKE THE REFERENCE STANDARDS:


CORE

1. Identify your core properties (see Fig. 2).
2. Get the correct core material (see Fig. 3).
3. Cut the core to the correct dimensions (see Fig. 4).
4. Prepare and cure the core if necessary (see Fig. 1).

SKINS

1. Identify your skin properties (see Fig. 2).
2. Get the correct skin material (see Fig. 3).
3. Cut the plies to the correct dimensions (see Fig. 4).
4. Cut two peel ply layers (see Fig. 4).
5. Lay up the plies and peel ply for the upper and the lower skins (note, for XXX-DEL-XXXX reference standards, see Fig. 1, Sheet 2 for insert locations).
6. Cure the two skin assemblies on a stepped tool with a vacuum bag. Use an oven (recommended) or heat blankets. 

SKIN-TO-CORE ASSEMBLY







1. Get the correct adhesive film (see Fig. 3).
2. Cut two adhesive layers A1 and A2 (see Fig. 4).
3. Remove the peel ply from the skins.
4. Secondary bond the skins to the core. Use a stepped tool and a vacuum bag.
5. After the assembly is cured, put a 0.50 inch (13 mm) by 0.50 inch (13 mm) square of foam tape on each step of the reference standard. The tape is used as an attenuation reference during the ultrasonic inspection. 
6. Do an ultrasonic inspection of the honeycomb sandwich assembly. See Fig. 6 for the acceptance limits.

NOTES

A = Adhesive Film
P = Plies

- ALL DIMENSIONS ARE IN INCHES (MILLIMETERS ARE IN PARENTHESES)
- TOLERANCES:

<u>INCHES</u>	<u>MILLIMETERS</u>
X.XX = ±0.025	X.X = ±0.5
X.X = ±0.050	X = ±1.0

-  LABEL EACH REFERENCE STANDARD WITH THE CORRECT CODE AS SPECIFIED IN FIG. 2.
-  ADD THESE EXTRA PLYS FOR X24-XXX-XXXX SERIES REFERENCE STANDARDS ONLY.
-  MAKE A SELECTION OF THE CORE DEPTH FROM FIG. 2.
-  YOU CAN GET 0.010 (0.25) GRAPHITE FOIL FROM: EGC ENTERPRISES INC.
7315 INDUSTRIAL PARKWAY
MENTOR, OHIO 44060, U.S.A.
TEL. 800-324-0211
(ASK FOR GTB SHEET MATERIAL)
-  IT IS RECOMMENDED THAT YOU USE THE COATED FIBERGLASS RELEASE FILM ON THE TOOL IF YOU MAKE FIBERGLASS REFERENCE STANDARDS. YOU CAN GET THIS FILM FROM:
 - AIRTECH INTERNATIONAL
2542 EAST DEL AMO BLVD
P.O. BOX 6207
CARSON, CA 90749
PHONE: (213) 603-9683
PRODUCT NAME: A012
 - CHEMFAB
HI-TEMP MATERIALS GROUP
509 EAST STATE PARKWAY
SCHAUMBURG, IL 60173
PHONE: (708) 490-9800
PRODUCT NAME: 350-10S
-  USE VINYL FOAM TAPE, PART NUMBER 4416, MADE BY THE 3M COMPANY, OR AN EQUIVALENT TAPE THAT DOES NOT TRANSMIT ULTRASOUND.

Manufacturing Procedure for the Repair Reference Standards
Figure 1 (Sheet 5)


NONDESTRUCTIVE TEST


PROPERTY	AVAILABLE OPTIONS (CHOOSE ONE)	IDENTIFICATION CODE
SKIN MATERIAL	CARBON FIBERGLASS	C F
SKIN THICKNESS	3,6,9 AND 12 PLIES 15,18,21 AND 24 PLIES	12 24
INDICATION GENERATOR	SKIN-TO-CORE DISBONDS INTERPLY DELAMINATIONS POTTING AND CORE SPLICE SKIN-TO-POTTING DISBONDS	DIS DEL PCS POT
CORE DENSITY (GRADE)	2.0 LBS (GRADE 2.0) 3.0 LBS (GRADE 3.0) 4.0 LBS (GRADE 4.0) 5.0 LBS (GRADE 5.0) 6.0 LBS (GRADE 6.0) 9.0 LBS (GRADE 9.0) 12.0 LBS (GRADE 12.0)	2 3 4 5 6 9 12
CORE DEPTH	0.25 INCH 0.5 INCH 1 INCH 1.5 INCH 2 INCH 2.5 INCH 3 INCH	A B C D E F G
CORE CELL SIZE (TYPE)	0.125 (TYPE V) 0.187 (TYPE I) 0.25 (TYPE II)	1 2 3
CORE MATERIAL (CLASS)	NOMEX (CLASS 4) GLASS REINFORCED (CLASS 1)	N G

EXAMPLE: PART NUMBER C12-DEL-3C2N IS A 3 PLY TO 12 PLY INTERPLY DELAMINATION REFERENCE STANDARD WITH 3.0 LB DENSITY, 1 INCH THICK CORE. THE SKIN IS MADE OF CARBON MATERIAL. THE CORE IS NOMEX AND HAS A CELL SIZE OF 0.187.

Reference Standard Options
Figure 2

NONDESTRUCTIVE TEST

MATERIAL	BOEING SPECIFICATION
CARBON SKIN FIBERGLASS SKIN	BMS 8-256, TYPE IV, CLASS 2, 3K-70-PW (350°F CURE) BMS 8-139, CLASS 1 OR 2, GRADE 2, TYPE 1581 (350°F CURE)
HONEYCOMB CORE	BMS 8-124 (SEE FIG. 2 FOR GRADE TYPE AND CLASS)
ADHESIVE FILM	BMS 5-129, GRADE 5 (250°F CURE) BMS 8-245, GRADE 3 (250°F CURE). FIBERGLASS STEP WEDGES ONLY 
PEEL PLY (DRY)	BURLEASE CODE 51789 (BURLINGTON CO.) OR EQUIVALENT
POTTING	BMS 5-28, TYPE 7
CORE SPLICE	BMS 5-90, TYPE III, CLASS 250, GRADE 100

 BMS 8-245 MAKES A SATISFACTORY BOND IF YOU CURE IT AT 250°F (121°C) AS SPECIFIED IN THE STRUCTURAL REPAIR MANUAL SECTION FOR GLASS FABRIC 250°F CURE REPAIRS. USE BMS 8-245 BECAUSE IT WILL NOT BLEED THROUGH THE FIBERGLASS SKINS.

**Material Specifications
Figure 3**

NONDESTRUCTIVE TEST

PLY NUMBER	CUT SIZE (BEFORE CURE)	TRIMMED SIZE (AFTER CURE)	PLY DIRECTION
P1,P3	6.0 (152) X 5.0 (127)	4.0 (102) X 4.0 (102)	0 OR 90 DEGREES
P2	6.0 (152) X 5.0 (127)	4.0 (102) X 4.0 (102)	+ OR - 45 DEGREES
P4,P6	6.0 (152) X 9.0 (229)	4.0 (102) X 8.0 (203)	+ OR - 45 DEGREES
P5	6.0 (152) X 9.0 (229)	4.0 (102) X 8.0 (203)	0 OR 90 DEGREES
P7,P9	6.0 (152) X 13.0 (330)	4.0 (102) X 12.0 (305)	0 OR 90 DEGREES
P8	6.0 (152) X 13.0 (330)	4.0 (102) X 12.0 (305)	+ OR - 45 DEGREES
P10,P12	6.0 (152) X 18.0 (457)	4.0 (102) X 16.0 (406)	+ OR - 45 DEGREES
P11	6.0 (152) X 18.0 (457)	4.0 (102) X 16.0 (406)	0 OR 90 DEGREES
P13,P15	6.0 (152) X 18.0 (457)	4.0 (102) X 16.0 (406)	+ OR - 45 DEGREES
P14	6.0 (152) X 18.0 (457)	4.0 (102) X 16.0 (406)	0 OR 90 DEGREES
P16,P18	6.0 (152) X 13.0 (330)	4.0 (102) X 12.0 (305)	0 OR 90 DEGREES
P17	6.0 (152) X 13.0 (330)	4.0 (102) X 12.0 (305)	+ OR - 45 DEGREES
P19,P21	6.0 (152) X 9.0 (229)	4.0 (102) X 8.0 (203)	+ OR - 45 DEGREES
P20	6.0 (152) X 9.0 (229)	4.0 (102) X 8.0 (203)	0 OR 90 DEGREES
P22,P24	6.0 (152) X 5.0 (127)	4.0 (102) X 4.0 (102)	0 OR 90 DEGREES
P23	6.0 (152) X 5.0 (127)	4.0 (102) X 4.0 (102)	+ OR - 45 DEGREES
P25,P27,P29,P31,P33,P35	6.0 (152) X 18.0 (457)	4.0 (102) X 16.0 (406)	0 OR 90 DEGREES
P26,P28,P30,P32,P34,P36	6.0 (152) X 18.0 (457)	4.0 (102) X 16.0 (406)	+ OR - 45 DEGREES
P37,P39,P41,P43,P45,P47	6.0 (152) X 18.0 (457)	4.0 (102) X 16.0 (406)	+ OR - 45 DEGREES
P38,P40,P42,P44,P46,P48	6.0 (152) X 18.0 (457)	4.0 (102) X 16.0 (406)	0 OR 90 DEGREES
A1,A2	6.0 (152) X 18.0 (457)	4.0 (102) X 16.0 (406)	N.A.
PEEL PLY	6.0 (152) X 18.0 (457)	4.0 (102) X 16.0 (406)	N.A.
HONEYCOMB CORE	6.0 (152) X 18.0 (457)	4.0 (102) X 16.0 (406)	N.A.

NOTE: N.A. = NOT APPLICABLE

Adhesive, Core and Ply Dimensions
Figure 4





BOEING 
COMMERCIAL JET
NONDESTRUCTIVE TEST


THIS FIGURE WAS DELETED DURING THE
NOVEMBER 5, 1996 REVISION

Acceptance Limits for the Ultrasonic Inspection of the Pre-Cured Skins Before
the Peel Ply is Removed
Figure 5



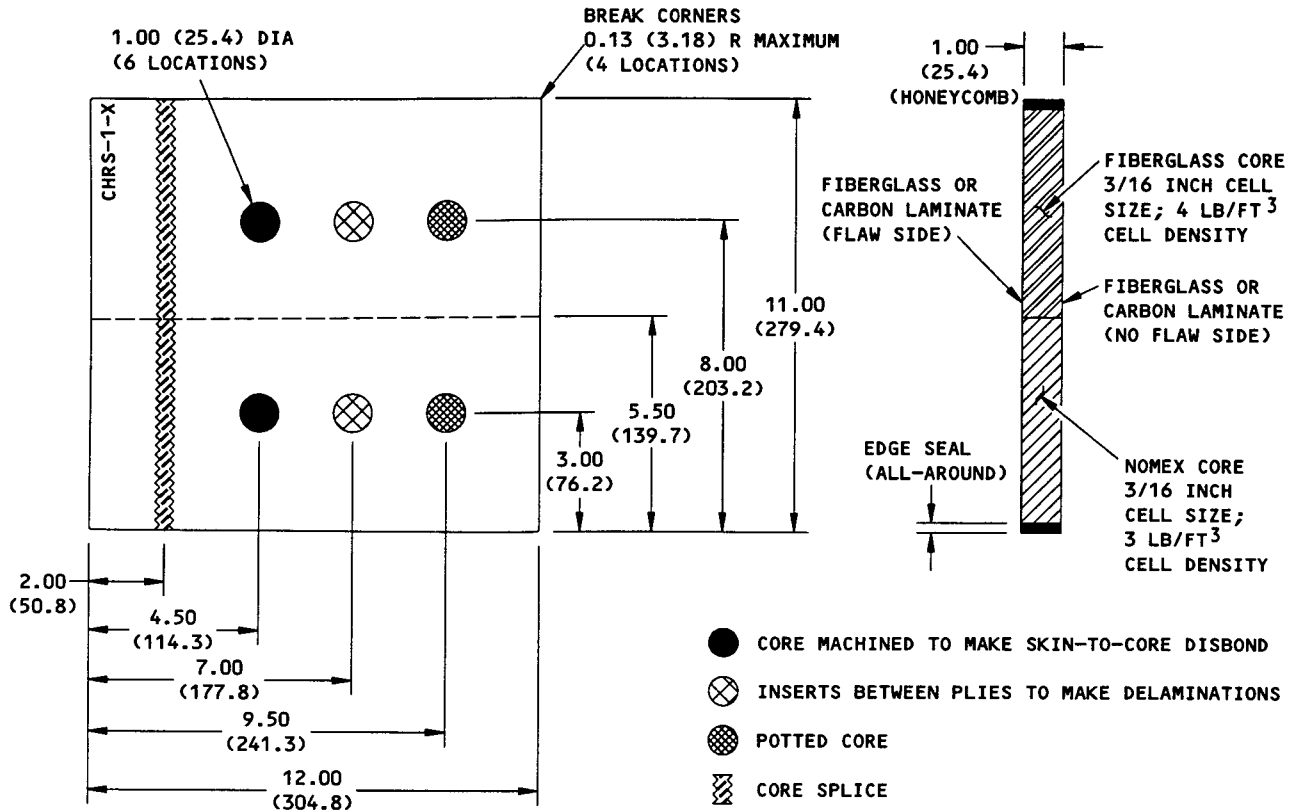
NONDESTRUCTIVE TEST

REFERENCE STANDARD	ACCEPTANCE LIMITS
XXX-DIS-XXXX	THE ULTRASONIC ATTENUATION OF THE DEFECT AREAS MUST BE AT LEAST 12 dB LARGER THAN THE ATTENUATION OF HONEYCOMB AREAS WITHOUT DEFECTS. 
XXX-POT-XXXX	THE ULTRASONIC ATTENUATION OF THE DEFECT AREAS MUST BE AT LEAST 6 dB LARGER THAN THE ATTENUATION OF HONEYCOMB AREAS WITHOUT DEFECTS. THE ULTRASONIC ATTENUATION OF THE POTTED AREAS MUST BE AT LEAST 6 dB LESS THAN THE ATTENUATION OF THE ADJACENT HONEYCOMB AREAS WITHOUT DEFECTS. 
XXX-PCS-XXXX	THE ULTRASONIC ATTENUATION OF THE POTTED AREAS MUST BE AT LEAST 6 dB LESS THAN THE ATTENUATION OF THE ADJACENT HONEYCOMB AREAS WITHOUT DEFECTS. 
XXX-DEL-XXXX	THE ULTRASONIC ATTENUATION OF THE DEFECT AREAS MUST BE AT LEAST 6 dB LARGER THAN THE ATTENUATION OF THE ADJACENT HONEYCOMB AREAS WITHOUT DEFECTS. 

 USE A 1 MHz THROUGH-TRANSMISSION ULTRASONIC INSPECTION SYSTEM.

- NOTES:**
- (1) THE ULTRASONIC ATTENUATION OF HONEYCOMB AREAS WITHOUT DEFECTS MUST BE AT LEAST 12 dB LESS THAN THE ATTENUATION OF THE FOAM TAPE ON THE REFERENCE STANDARD.
 - (2) ULTRASONIC INDICATIONS OUTSIDE THE DEFECT AREAS MUST BE NO LARGER THAN 0.50 INCH (13 MM) IN DIAMETER. AN ULTRASONIC INDICATION IS AN AREA WITH ULTRASONIC ATTENUATION THAT IS AT LEAST 6 dB LARGER THAN THE ATTENUATION OF THE ADJACENT AREAS WITHOUT DEFECTS.

Acceptance Limits for the Ultrasonic Inspection of the Reference Standards
Figure 6



NOTES:

- ALL DIMENSIONS ARE IN INCHES (MILLIMETERS ARE IN PARENTHESES).
- THERE ARE FOUR SPECIMENS MADE WITH THIS DESIGN, EACH WITH A DIFFERENT SKIN THICKNESS. THE NUMBER OF PLYS FOR THE DIFFERENT THICKNESSES ARE 3, 6, 9 AND 12. ONE SIDE WILL CONTAIN FLAW INSERTS AND THE OTHER SIDE WILL HAVE NO FLAWS
- REFERENCE STANDARDS ARE AVAILABLE WITH CARBON SKINS OR FIBERGLASS SKINS

CACRC Composite Honeycomb Reference Standards
Figure 7



FRONT SIDE

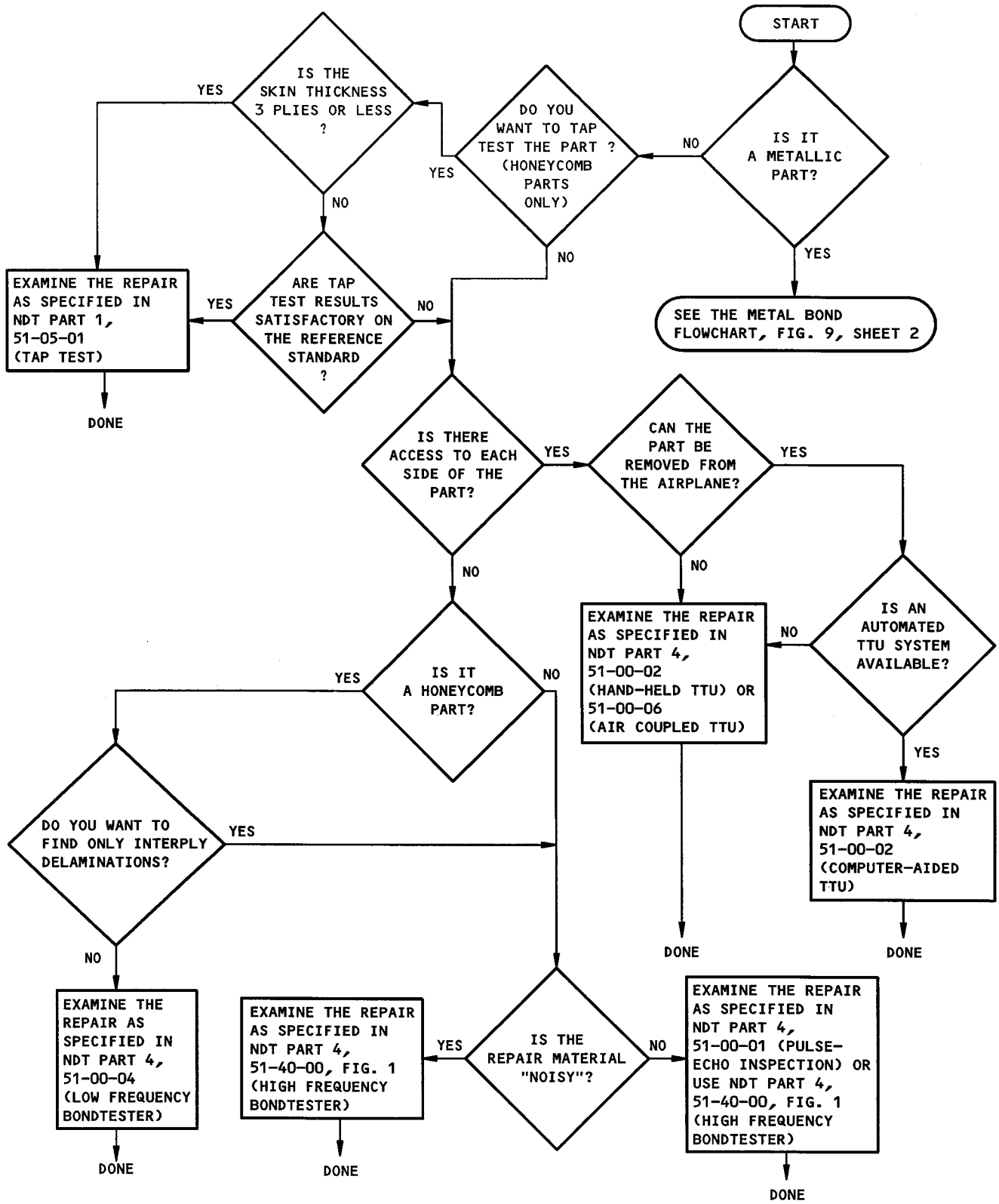


BACK SIDE

CACRC COMPOSITE LAMINATE REFERENCE STANDARDS
FIGURE 8

BOEING

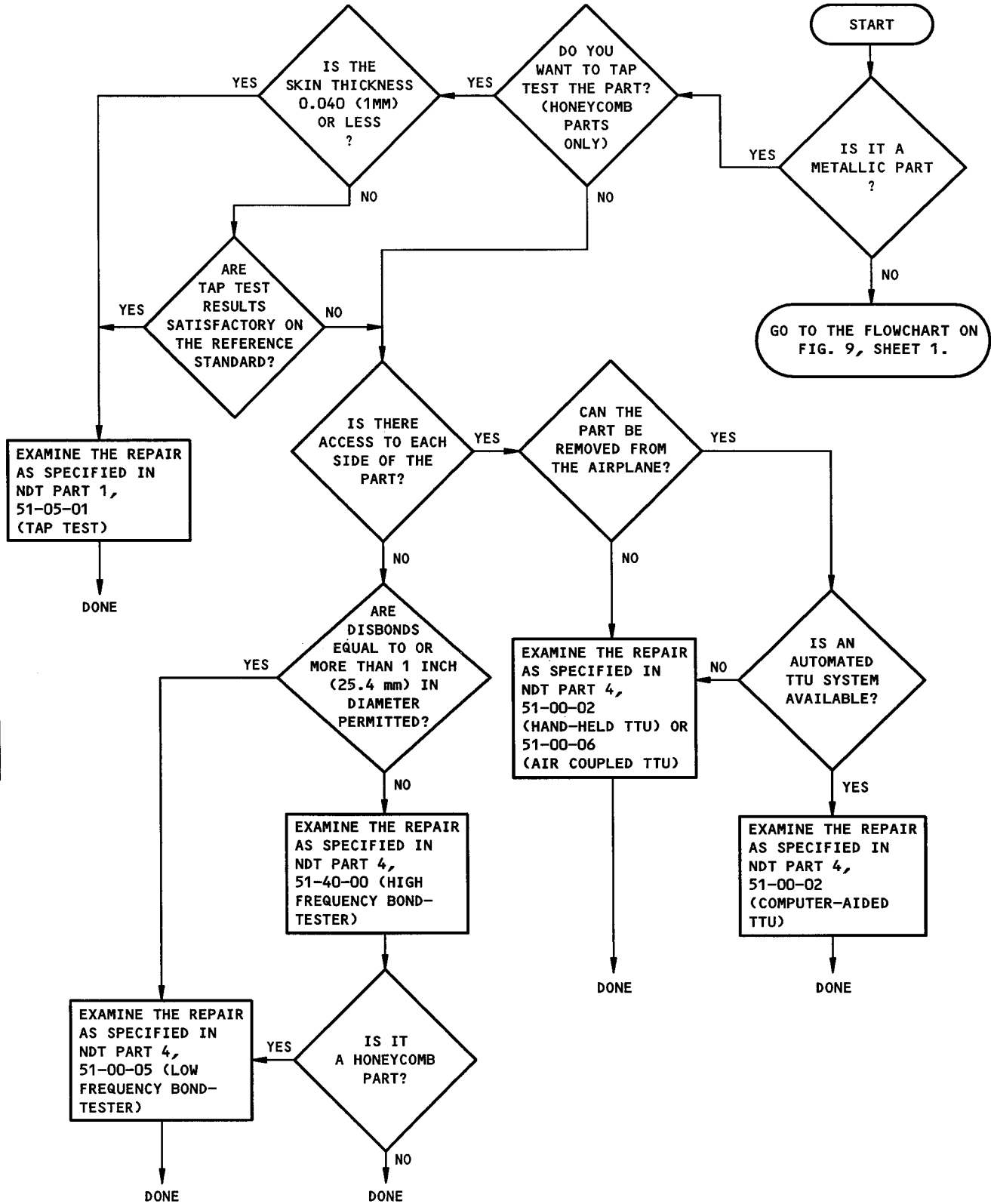
NONDESTRUCTIVE TEST



Repair Inspection Flowchart - Non-Metallic Structure
Figure 9 (Sheet 1)



NONDESTRUCTIVE TEST



Repair Inspection Flowchart - Metallic Structure
Figure 9 (Sheet 2)

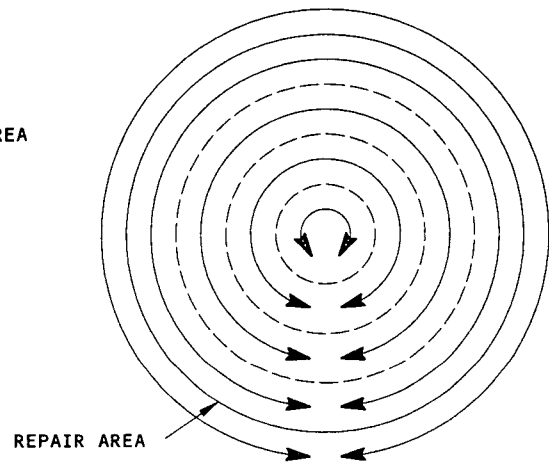
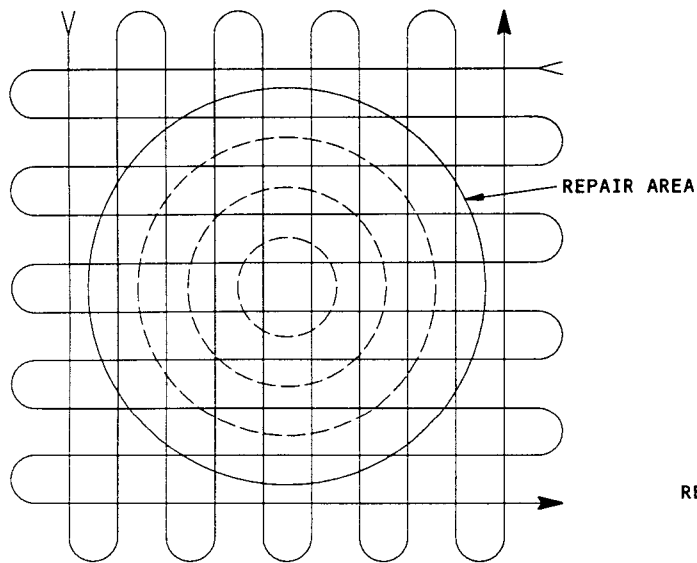
 **BOEING**
NONDESTRUCTIVE TEST

INSPECTION PROCEDURE	CALIBRATION DISBOND DIAMETERS ¹	
	METAL AND NON-METAL LAMINATES (DELAMINATION)	METAL AND NON-METAL HONEYCOMB SANDWICH (SKIN-TO-CORE DISBOND)
THROUGH-TRANSMISSION ULTRASONIC	0.50 INCH (12.7 mm)	0.50 INCH (12.7 mm)
LOW FREQUENCY BONDTESTER (NO COUPLANT)	1.00 INCH (25.4 mm)	1.00 INCH (25.4 mm)
HIGH FREQUENCY BONDTESTER (COUPLANT)	0.50 INCH (12.7 mm)	NOT RECOMMENDED
PULSE-ECHO ULTRASONIC	0.50 INCH (12.7 mm)	NOT RECOMMENDED
TAP TEST	NOT RECOMMENDED	1.00 INCH (25.4 mm) ²

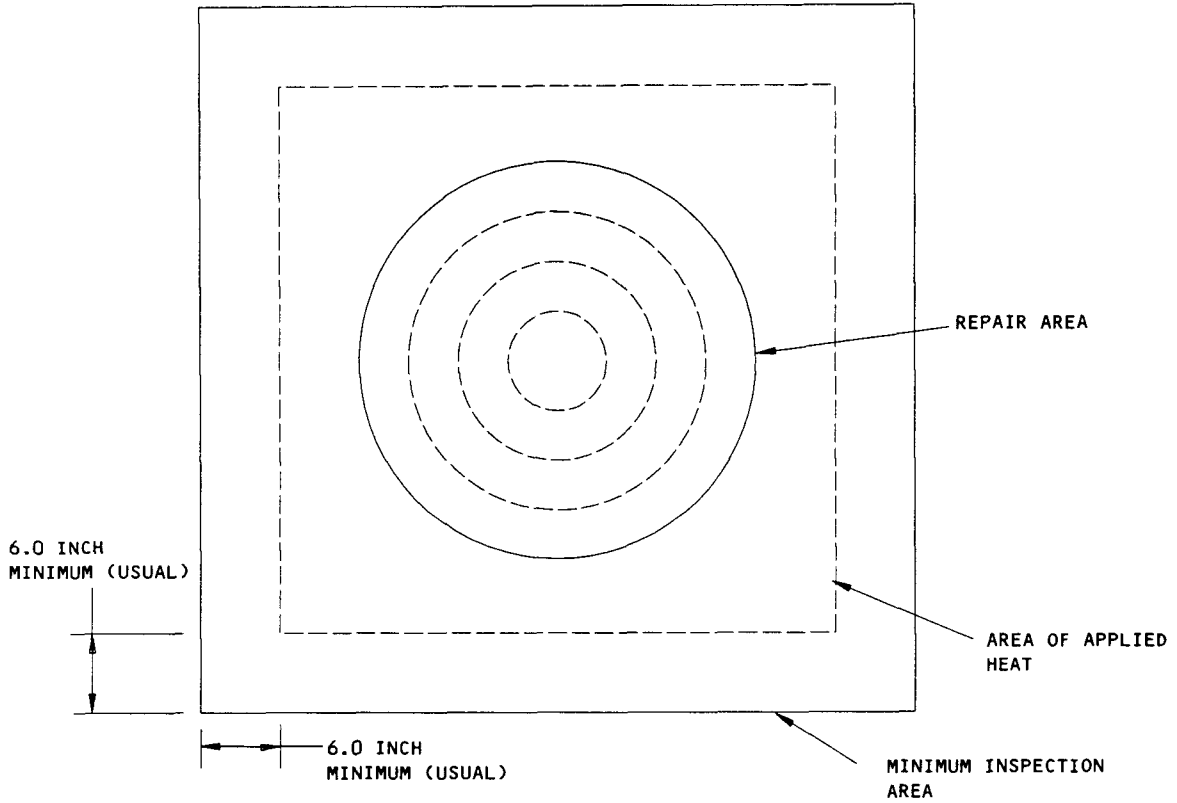
¹ THESE ARE THE DEFECT DIAMETERS TO BE USED FOR CALIBRATION. THEY ARE NOT ACCEPTANCE LIMITS. REFER TO THE STRUCTURAL REPAIR MANUAL (SRM) OR YOUR ENGINEERING GROUP FOR ACCEPTANCE LIMITS FOR REPAIRS.

² REFERENCE STANDARDS ARE NOT NECESSARY WHEN THE SKIN THICKNESS IS LESS THAN OR EQUAL TO 3 PLIES FOR NONMETALLIC STRUCTURE OR LESS THAN OR EQUAL TO 0.040 INCH FOR METALLIC STRUCTURE. REFER TO NDT PART 1, 51-05-01 FOR TAP TEST REFERENCE STANDARD DATA.

Calibration Disbond Diameters for the Inspection of Repairs
Figure 10



Scan Patterns
Figure 11



Inspection Area
Figure 12

EFFECTIVITY
MODEL: ALL

PART 1 - GENERAL

NDT EXAMINATION OF COMPOSITE STRUCTURE FOR IMPACT DAMAGE

1. Introduction

- A. This procedure identifies the general NDT procedures that can be used to find and identify the quantity of impact damage to composite structures.
- B. There are four procedures that can be used to find and identify the quantity of damage to composite structures:
 - (1) Visual -- Areas are visually examined for signs of physical damage.
 - (2) Pulse-Echo Ultrasonics -- Laminate and skin-to-core areas are examined for delaminations that occur between the plies by pulse-echo ultrasonics.
 - (3) Bondtest Ultrasonics -- Bondtesters are used to examine the condition of skin-to-core bonds.
 - (4) Radiography -- X-ray is used to identify damage to the internal structure.

2. Preparation for Inspection

- A. Identify the areas damaged by impact as follows:
 - (1) Visually examine the surface area of the part for defects. A complete visual examination will identify the surface damage that occurs because of impact damage (see Fig. 1). The types of defects to look for are specified below:
 - a) Cracked, crazed and chipped paint
 - b) Dents in the surface of the structure
 - c) Cracked or fractured plies
 - d) Damage that results in a decrease in the ply thickness
 - e) Damage that results in total ply removal in areas such that you can see the internal damage to the honeycomb core structure.
 - (2) Make a mark on the part to identify the damaged areas found during the visual inspection.



NONDESTRUCTIVE TEST

- B. Refer back to the procedures that referenced the use of this procedure for additional preparation instructions applicable to your inspection.

3. Inspection Procedures

A. Pulse-Echo Ultrasonics

- (1) Pulse-echo ultrasonics can be used to find interply delaminations in laminates and skin-to-core structures when there is access to only one side of a part.
- (2) See Part 4, 51-00-01, "Inspection of Laminated Structures" for a general inspection procedure for solid laminates and skin-to-core structures that are as much as 0.250 inch thick.
- (3) During a pulse-echo inspection, examine at least 5.0 inches of good structure around each defect area identified in paragraph 2. Examine these areas as follows:
 - a) Move the transducer from a good area into the defect area.
 - b) If the defect area is found to be larger than identified before, make a mark on the part to identify the new defect area.
 - c) Continue to examine the area until a 5.0 inch good area is identified around the defect area.

B. Bondtest Ultrasonics

- (1) Bondtesters can identify skin-to-core disbonds when there is access to only one side of a part.
- (2) See Part 4, 51-00-05, "Bondline Delamination Inspection in Honeycomb Structure", for a general inspection procedure of honeycomb structure.
- (3) During a bondtest inspection, examine at least 5.0 inches of good structure around each defect area identified in paragraph 2. Examine these areas as follows:
 - a) Move the probe along the surface of the part from the good area into the defect area. Do not examine areas found to have interply delaminations.
 - b) If the defect area is found to be larger than identified before, make a mark on the part to identify the new defect area.

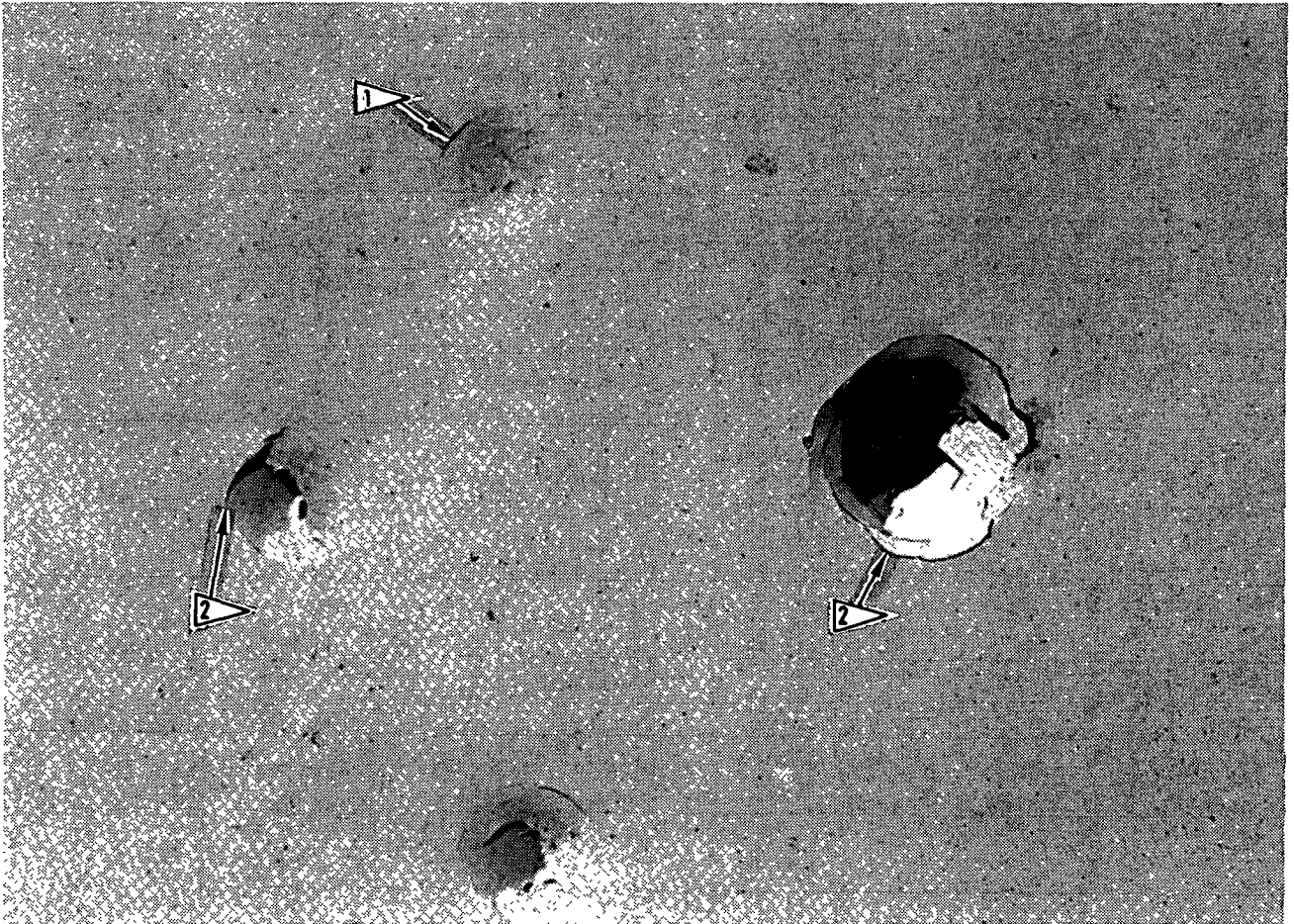


NONDESTRUCTIVE TEST



- c) Continue to examine the area until a 5.0 inch good area is identified around the defect area.

C. Radiography

- (1) X-rays of a composite structure can identify:
 - a) Broken structure when movement or separation of the internal components occurs.
 - b) Water contamination in honeycomb
 - c) Crushed or damaged cores.
- (2) See Part 2, 51-00-02, "Subsurface Fracture in Composite Structure", Part 2, 51-00-01, "Water Detection in Honeycomb Structure", Part 2, 51-00-03, "Inspection of Honeycomb Structure", for general X-ray inspection procedures.
- (3) Make sure that an X-ray inspection examines at least 5.0 inches of good structure around each defect area identified in paragraph 2.
 - a) If the defect area is found to be larger than identified before, make a mark on the part to identify the new defect area.
 - b) Continue to X-ray the area until a 5.0 inch good area is identified around the defect area.

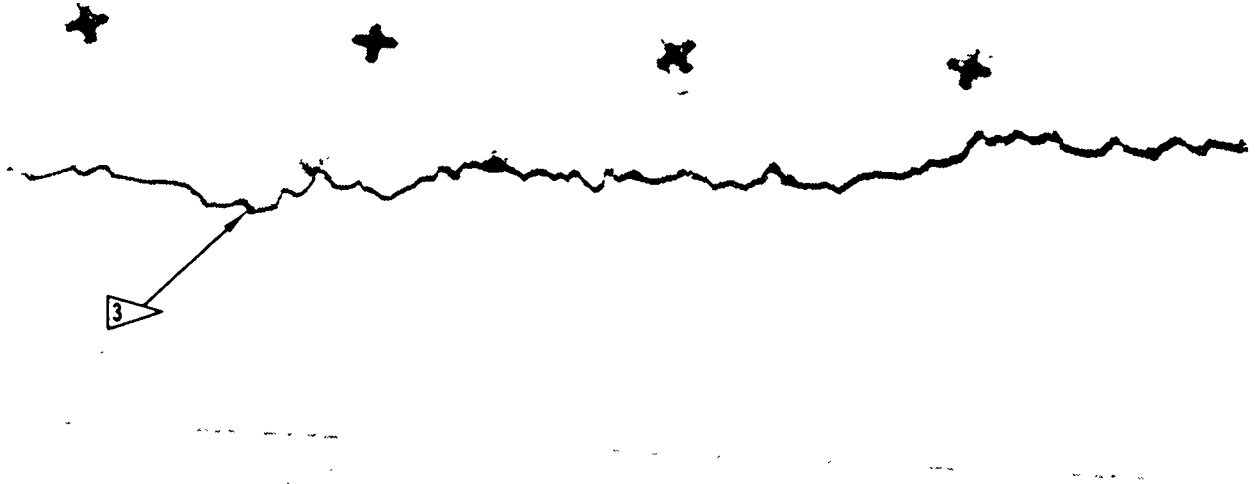


NOTES


-  **1** CRACKED, CRAZED AND CHIPPED PAINT.
-  **2** DENTS ON THE SURFACE OF THE STRUCTURE.

Typical Impact Damage
Figure 1 (Sheet 1)

BOEING
NONDESTRUCTIVE TEST

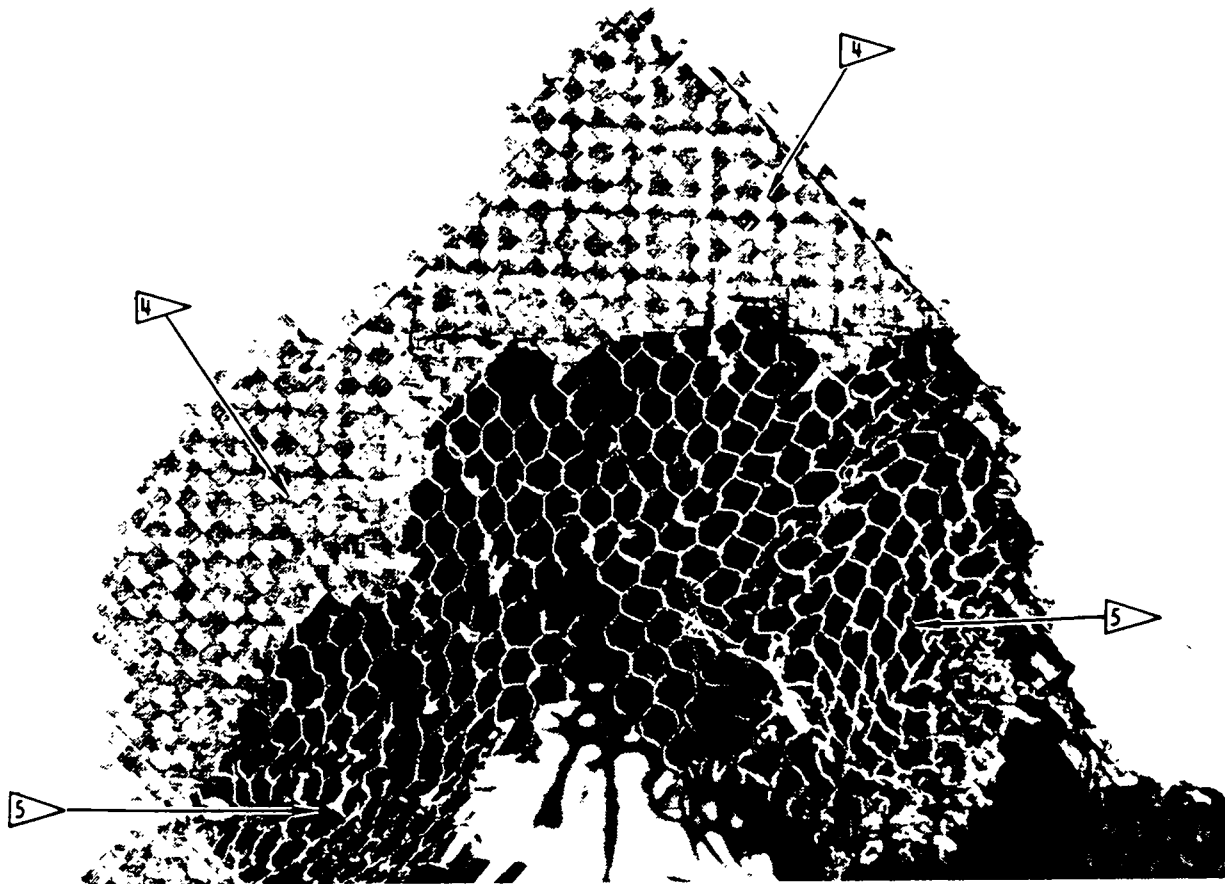


NOTES

 CRACKED OR FRACTURED PLIES.

Typical Impact Damage
Figure 1 (Sheet 2)

BOEING
NONDESTRUCTIVE TEST



NOTES

- 4 SOME OF THE PLYS ARE MISSING.
- 5 ALL THE PLYS ARE GONE IN AN AREA SUCH THAT YOU CAN SEE THE HONEYCOMB STRUCTURE.

Typical Impact Damage
Figure 1 (Sheet 3)

EFFECTIVITY
MODEL: ALL



PART 1 - GENERAL
INSTALLATION OF RIVETS INTO REFERENCE STANDARDS

1. Purpose

- A. Use this procedure to install rivets into the reference standards.
- B. This procedure was taken from Boeing Specification BAC5004-1 and the applicable model Structural Repair Manual section on rivet installation. Refer to these documents for more data.

2. Installation of Solid Rivets

- A. Use Fig. 1 to identify the correct rivet length. To make a selection of the rivet length, use the rivet diameter and the grip length (reference standard stack-up thickness).
- B. Solid rivets can be installed with an applicable squeeze-riveting tool or a rivet gun and bucking bar. Some rivets (for example, the BACR15FT rivet) are installed with tools that can be different than tools for most rivets. Make sure that you have the correct tools for each type of rivet that you install.
 - (1) Do not over-drive the rivets as this can cause cracks.
 - (2) If a rivet gun and a bucking bar are used, they must be large enough to drive the rivets quickly. Three to four seconds of drive time is best. Seven seconds is the maximum. It is recommended that bucking bars be very smooth when you install all types of rivets.

3. Inspection of Installed Rivets

- A. Do the inspections that follow after you install the rivets.
 - (1) Measure the button dimensions as shown in Fig. 2.
 - (a) Out-of-round and tipped rivet buttons are permitted if the button dimensions meet those identified in Fig. 2, Table I. For out-of-round buttons, measure the minimum diameter.
 - (b) Clinched or bent-over buttons are not permitted if the hole is visible. See Fig. 2, Detail 1 for an example of a clinched rivet.
 - (c) Bell-shaped buttons are caused by incomplete driving and are not permitted. See Fig. 2, Detail 2 for an example of a bell-shaped button.
 - (2) Examine the rivet heads and buttons to make sure there are no cracks.
 - (a) A deformed manufactured head caused by the die is permitted if there are no sharp discontinuities in the deformed surface.
 - (3) Look for gaps under the rivet heads as shown in Fig. 3.
- B. Remove rivets that do not meet the conditions specified in par. 3.A and install new rivets.


BOEING
 NONDESTRUCTIVE TEST

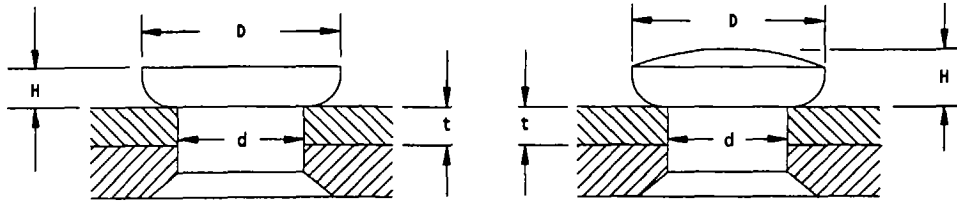
GRIP (T) RANGES FOR RIVET LENGTHS AND DIAMETERS							RIVET LENGTH L	
5/32 OR 5 DIA	3/16 OR 6 DIA	7/32 OR 7 DIA	1/4 OR 8 DIA	9/32 OR 9 DIA	5/16 OR 10 DIA	3/8 OR 12 DIA	SIZE	DASH NO.
0.035							3/16	-3
0.036 0.093	0.068						1/4	-4
0.094 0.152	0.069 0.127	0.107	0.078	0.058			5/16	-5
0.153 0.211	0.128 0.185	0.108 0.166	0.079 0.136	0.059 0.117	0.087	0.038	3/8	-6
0.212 0.270	0.186 0.244	0.167 0.225	0.137 0.195	0.118 0.176	0.088 0.146	0.039 0.097	7/16	-7
0.271 0.327	0.245 0.303	0.226 0.283	0.196 0.254	0.177 0.234	0.146 0.205	0.098 0.156	1/2	-8
0.328 0.387	0.304 0.362	0.284 0.342	0.255 0.313	0.235 0.293	0.206 0.264	0.157 0.215	9/16	-9
0.388 0.446	0.363 0.420	0.343 0.401	0.314 0.371	0.294 0.352	0.265 0.322	0.216 0.273	5/8	-10
0.447 0.505	0.421 0.479	0.402 0.460	0.372 0.430	0.353 0.411	0.323 0.381	0.274 0.332	11/16	-11
0.506 0.563	0.480 0.538	0.461 0.518	0.431 0.489	0.412 0.469	0.382 0.440	0.333 0.391	3/4	-12
0.564 0.622	0.539 0.597	0.519 0.577	0.490 0.548	0.470 0.528	0.441 0.499	0.392 0.450	13/16	-13
0.623 0.681	0.598 0.655	0.578 0.636	0.549 0.606	0.529 0.587	0.500 0.557	0.451 0.508	7/8	-14

GRIP RANGES AND RECOMMENDED RIVET LENGTHS FOR STANDARD ALUMINUM SOLID RIVETS

Selection of Rivet Lengths
Figure 1



NONDESTRUCTIVE TEST

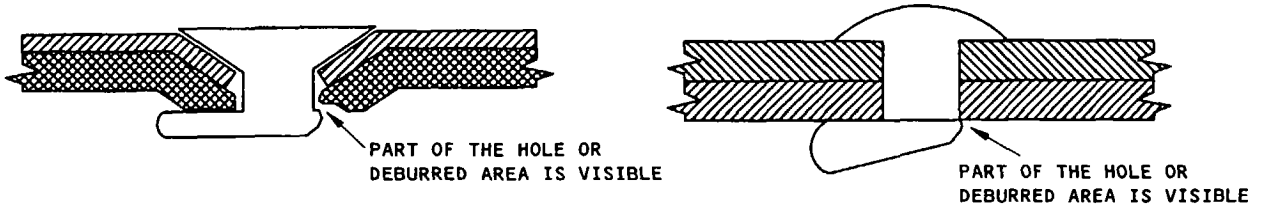


STANDARD FLAT DRIVEN HEAD

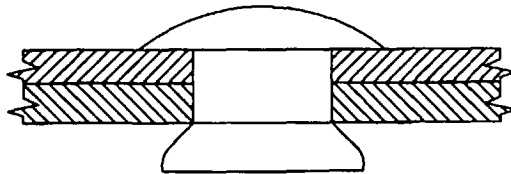
UNIVERSAL DRIVEN HEAD

NOMINAL RIVET DIAMETER	D MINIMUM DRIVEN RIVET BUTTON DIAMETER		H DRIVEN RIVET BUTTON THICKNESS OR HEIGHT		
	ALL RIVETS EXCEPT AS NOTED	BACR15GF AND 7050 ALUMINUM ALLOY RIVETS	BACR15GF BACR15CE BACR15DS NAS1097	ALL OTHER RIVETS	ALL RIVETS
	1.3d	1.4d	MINIMUM	MINIMUM	MAXIMUM RECOMMENDED
1/16	0.081	0.088	0.025	0.025	0.040
3/32	0.122	0.131	0.038	0.038	0.060
1/8	0.165	0.175	0.050	0.050	0.080
5/32	0.203	0.219	0.050	0.062	0.100
3/16	0.245	0.264	0.060	0.075	0.120
7/32	0.285	0.311	0.070	0.085	0.140
1/4	0.325	0.350	0.080	0.100	0.160
9/32	0.365	0.397	0.090	0.110	0.180
5/16	0.406	0.438	0.125	0.125	0.200
11/32	0.450	0.481	0.135	0.135	0.210
3/8	0.488	0.525	0.150	0.150	0.210
13/32	0.530	0.569	0.165	0.165	0.215

TABLE I



**CLINCHED RIVETS ARE NOT PERMITTED
DETAIL I**



**BELL-SHAPED RIVETS ARE NOT PERMITTED
DETAIL II**

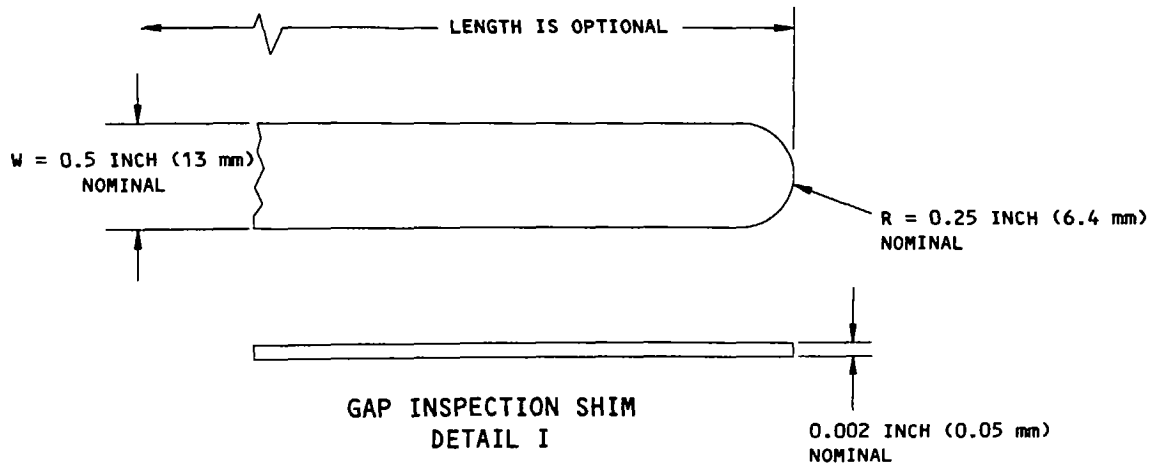
**Dimensions for Driving Solid Shank Rivets
Figure 2**

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CMN NDT
Aug 5/03

Part 1
51-01-04
Page 3

BOEING
NONDESTRUCTIVE TEST



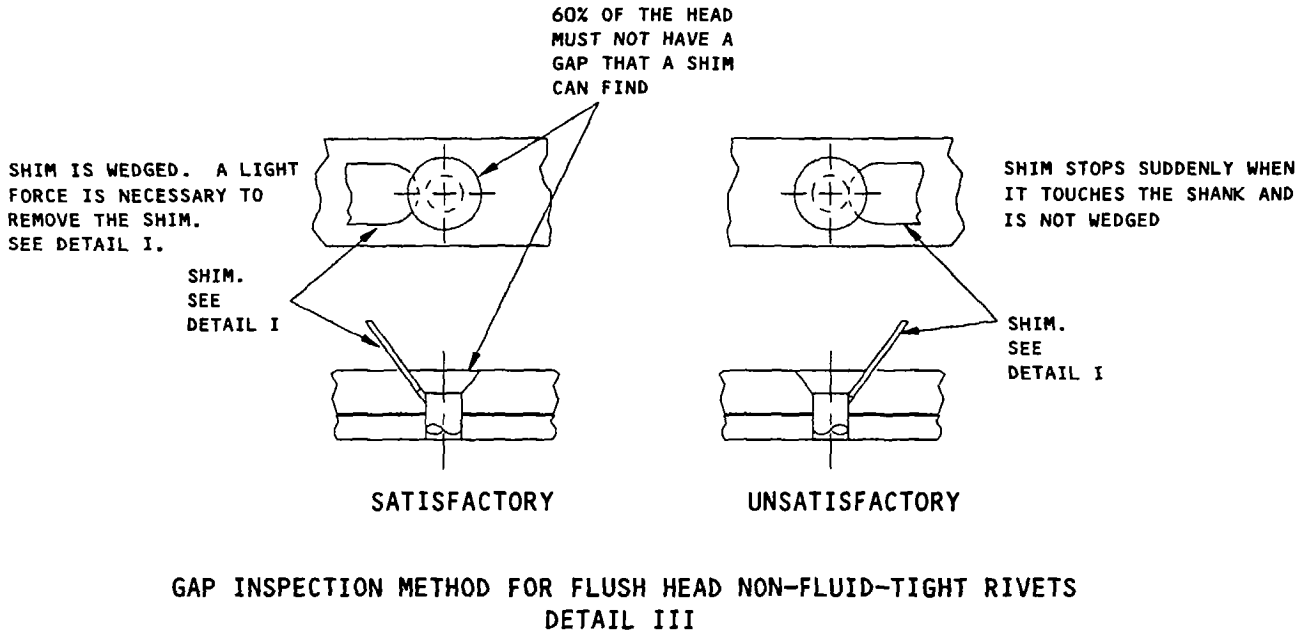
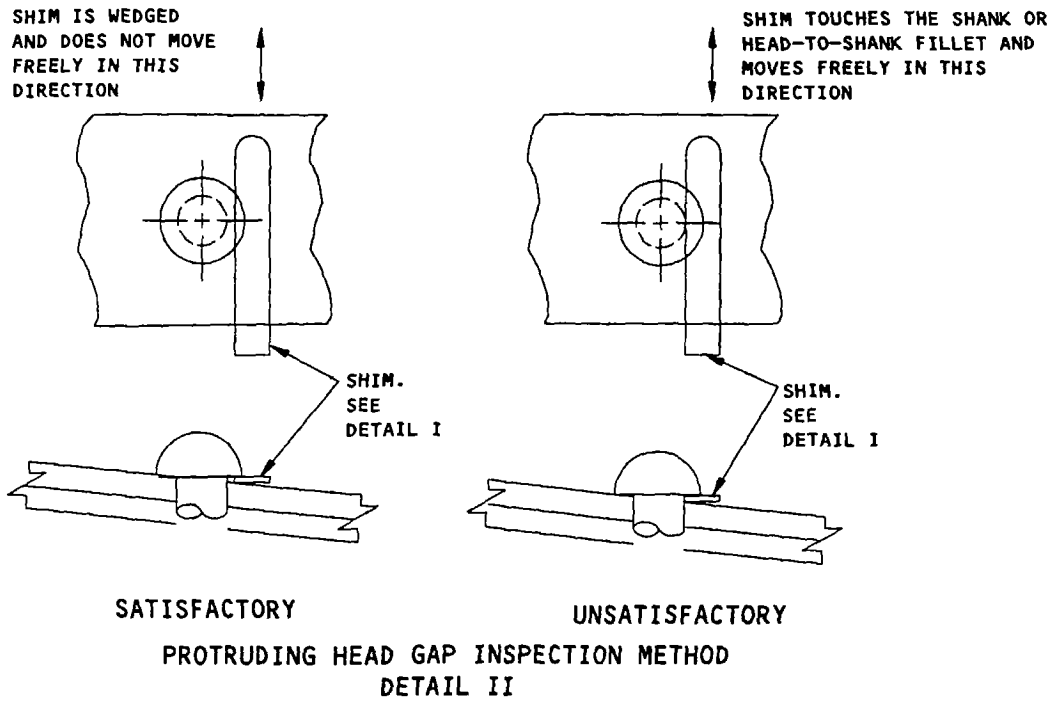
INSPECTION	GAP ANALYSIS
PROTRUDING HEADS	• SEE DETAIL II
FLUSH HEADS	• SEE DETAIL III
FLUSH DRIVEN BUTTONS (ALL RIVETS)	• SEE DETAIL IV

TABLE I

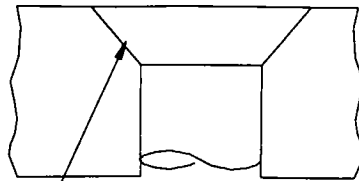
Gap Analysis for Rivet Heads and Buttons
Figure 3 (Sheet 1)



NONDESTRUCTIVE TEST



Gap Analysis for Rivet Heads and Buttons
Figure 3 (Sheet 2)



NO MEASURABLE
GAP IS ALLOWED

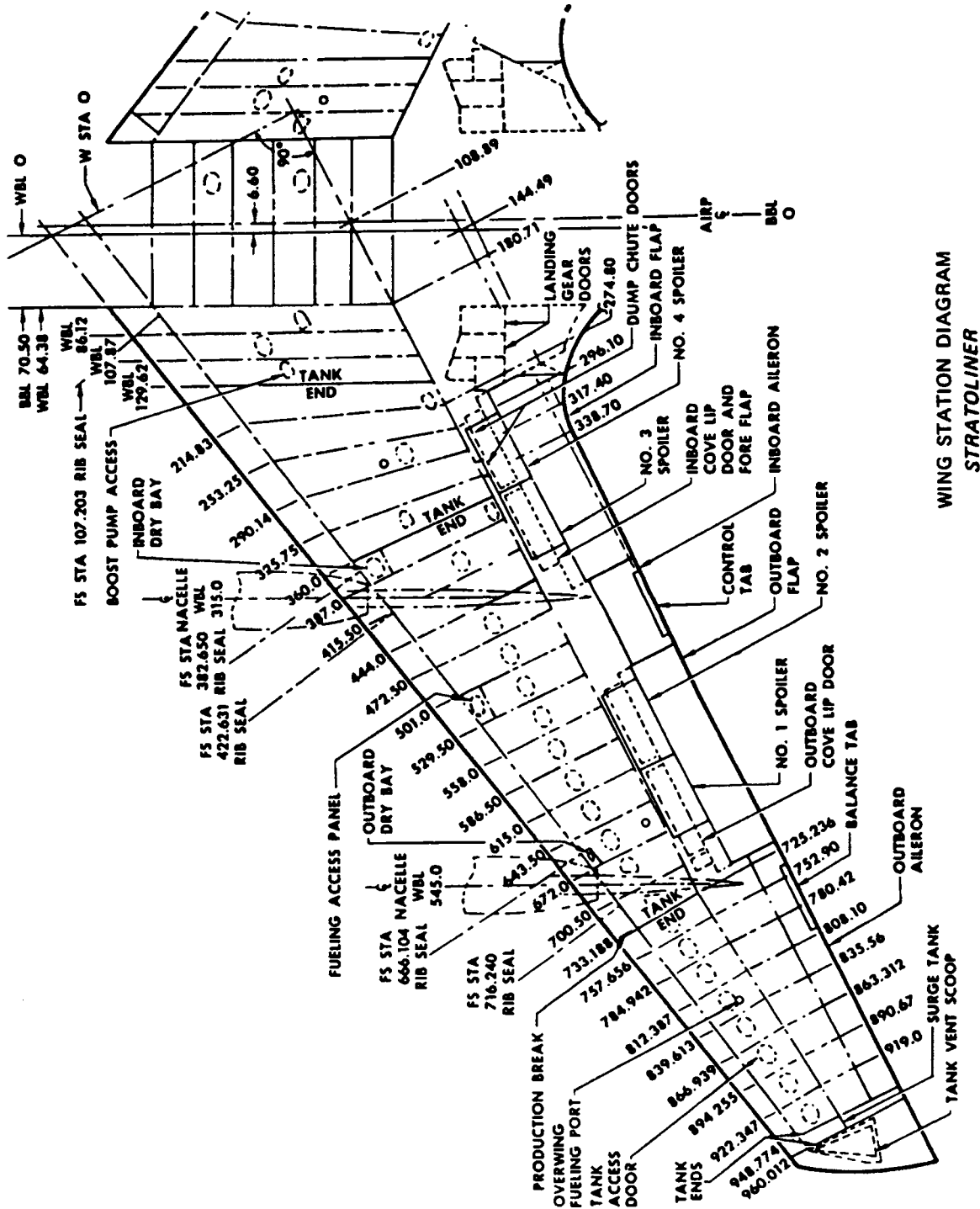
GAP INSPECTION METHOD FOR
FLUSH DRIVEN BUTTONS (ALL RIVETS)
DETAIL IV

Gap Analysis for Rivet Heads and Buttons
Figure 3 (Sheet 3)



NONDESTRUCTIVE TEST

PART 1 - GENERAL



WING STATION DIAGRAM
STRATOLINER

Airplane Reference Data
Figure 1 (Sheet 1)

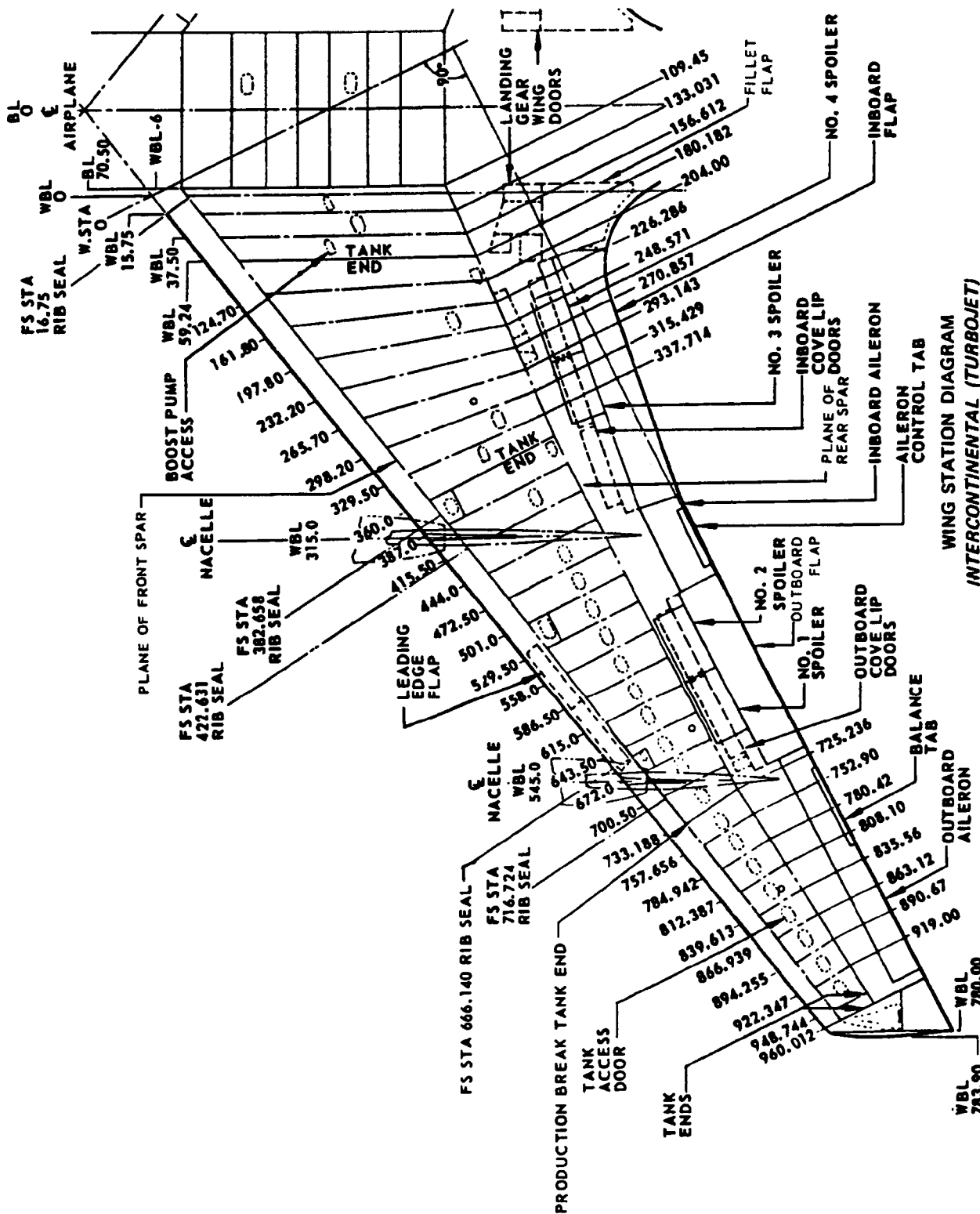


NONDESTRUCTIVE TEST

EFFECTIVITY

707 Intercontinental
(turbojet)

PART 1 - GENERAL



Airplane Reference Data
Figure 1 (Sheet 2)

1352823

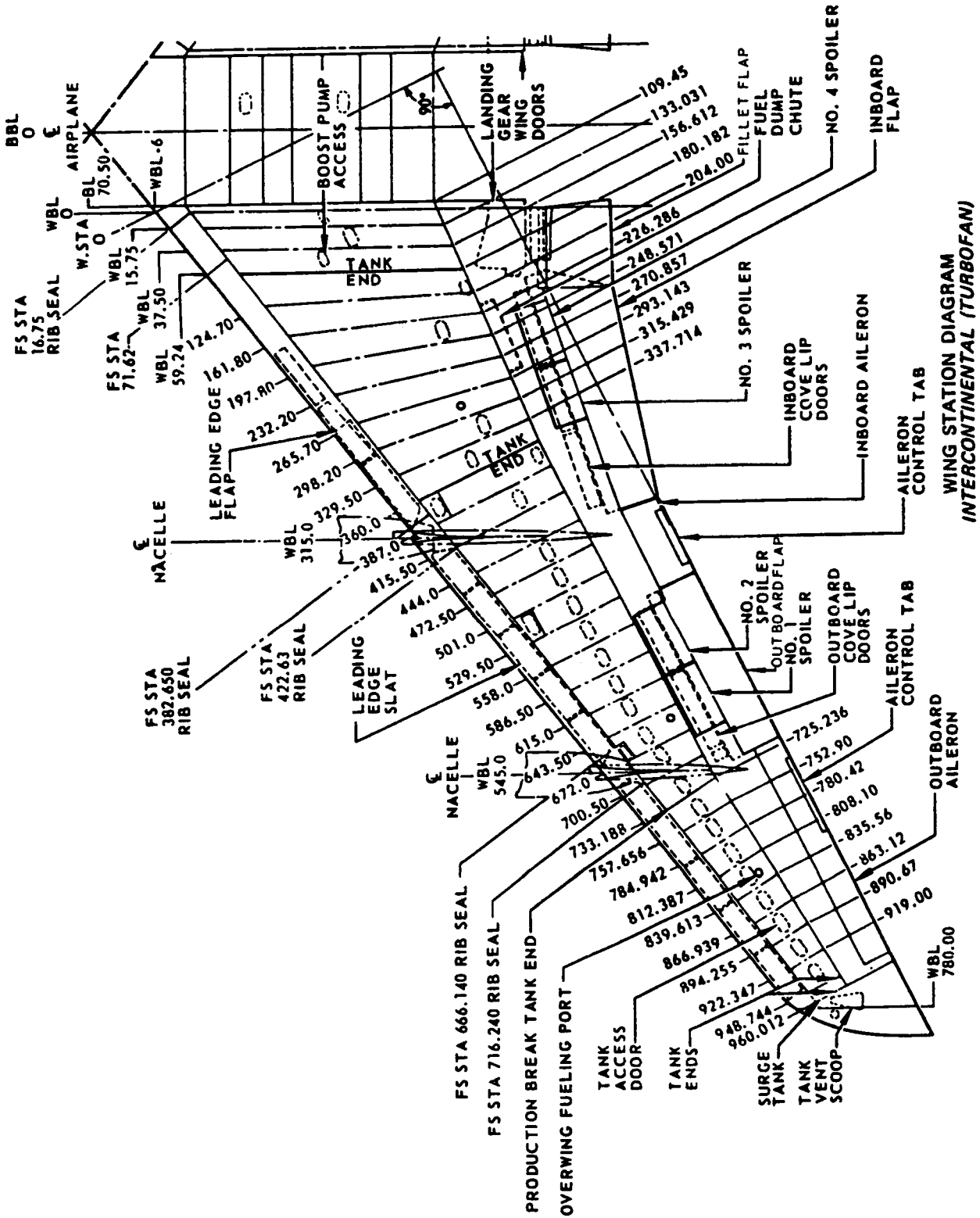
Part 1
51-01-07
Page 2

707 NDT
Apr 5/07



NONDESTRUCTIVE TEST

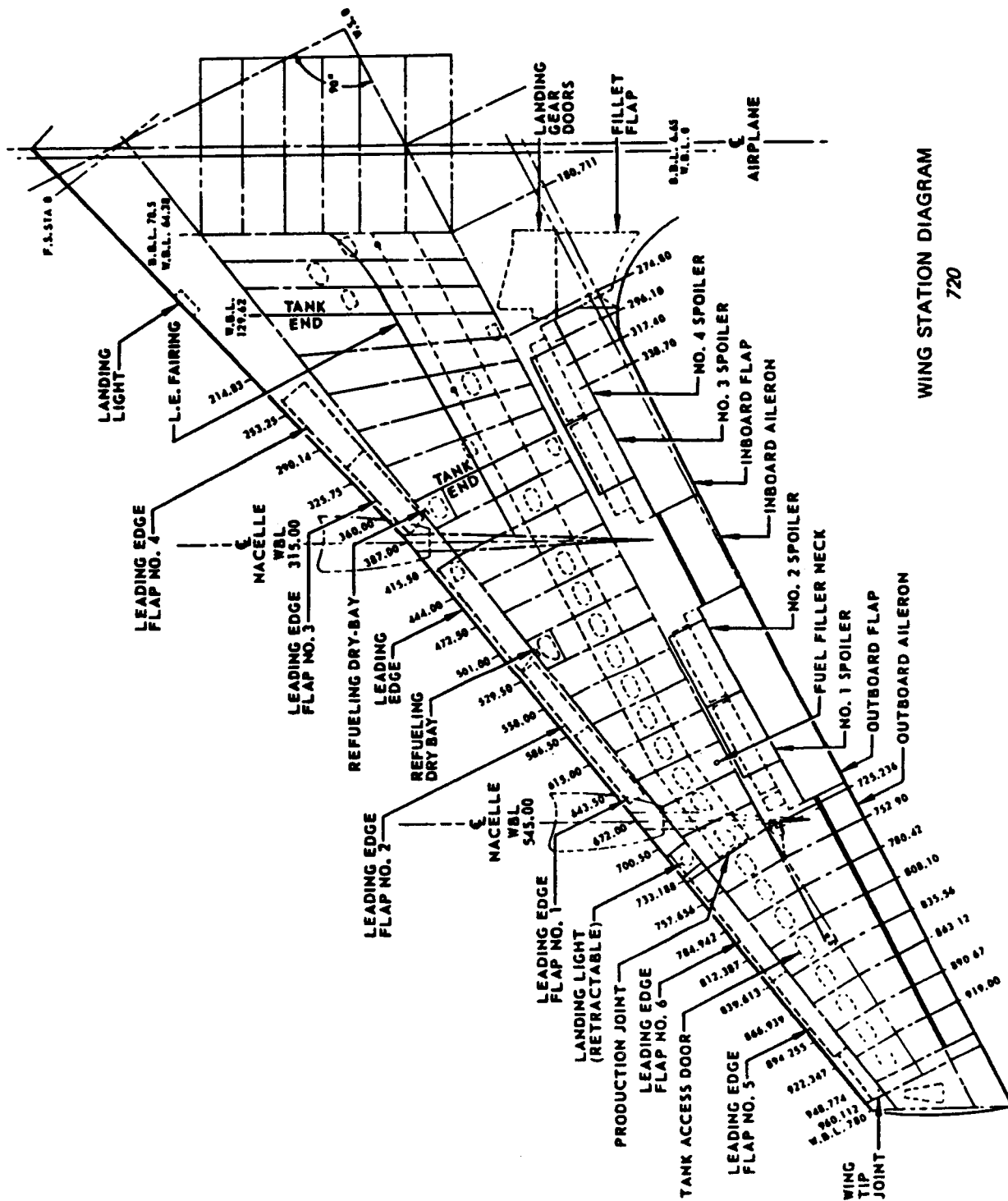
PART 1 - GENERAL



Airplane Reference Data
Figure 1 (Sheet 3)

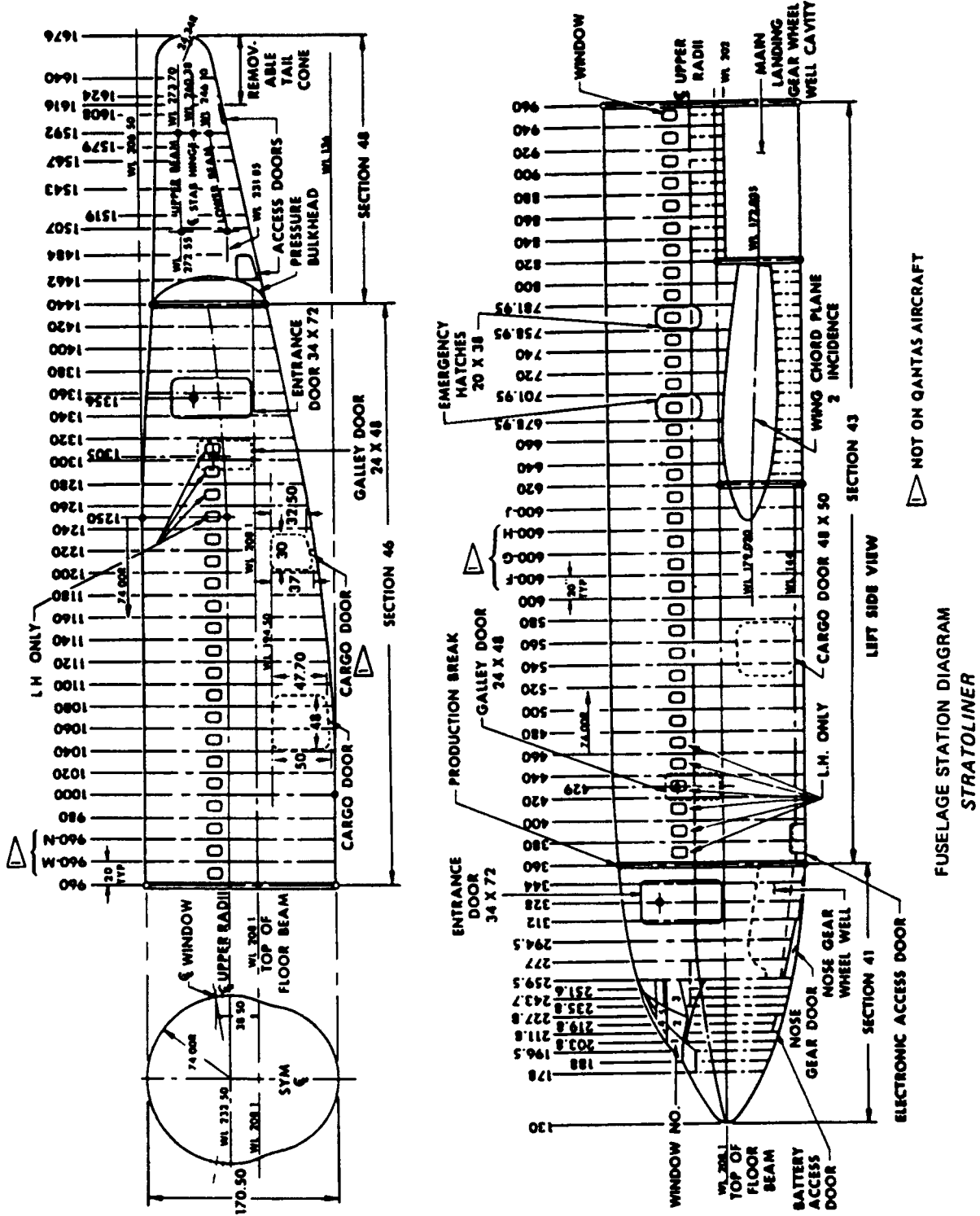
NONDESTRUCTIVE TEST

PART 1 - GENERAL



WING STATION DIAGRAM
720

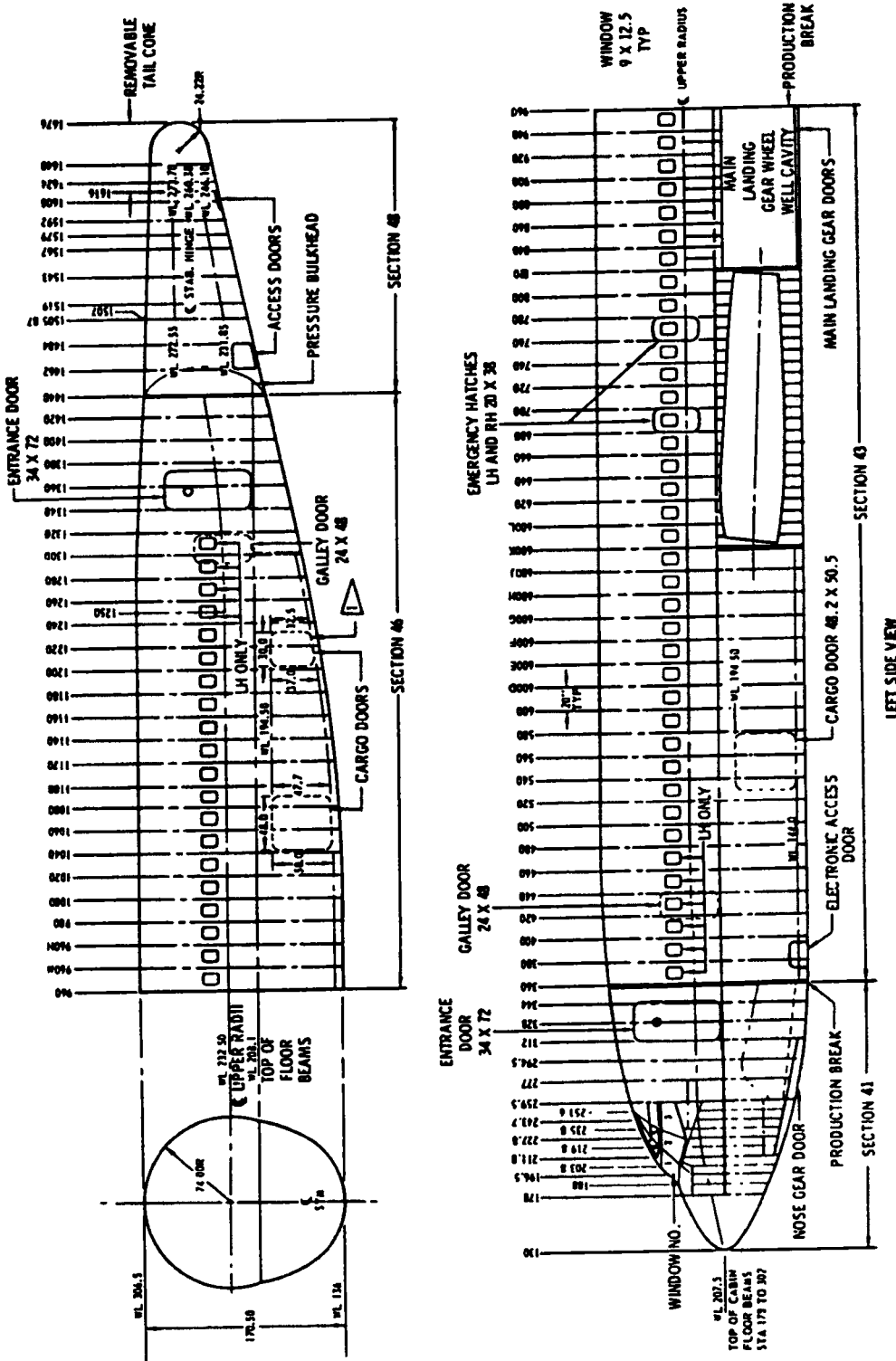
Airplane Reference Data
Figure 1 (Sheet 4)



Airplane Reference Data
Figure 1 (Sheet 5)

NONDESTRUCTIVE TEST

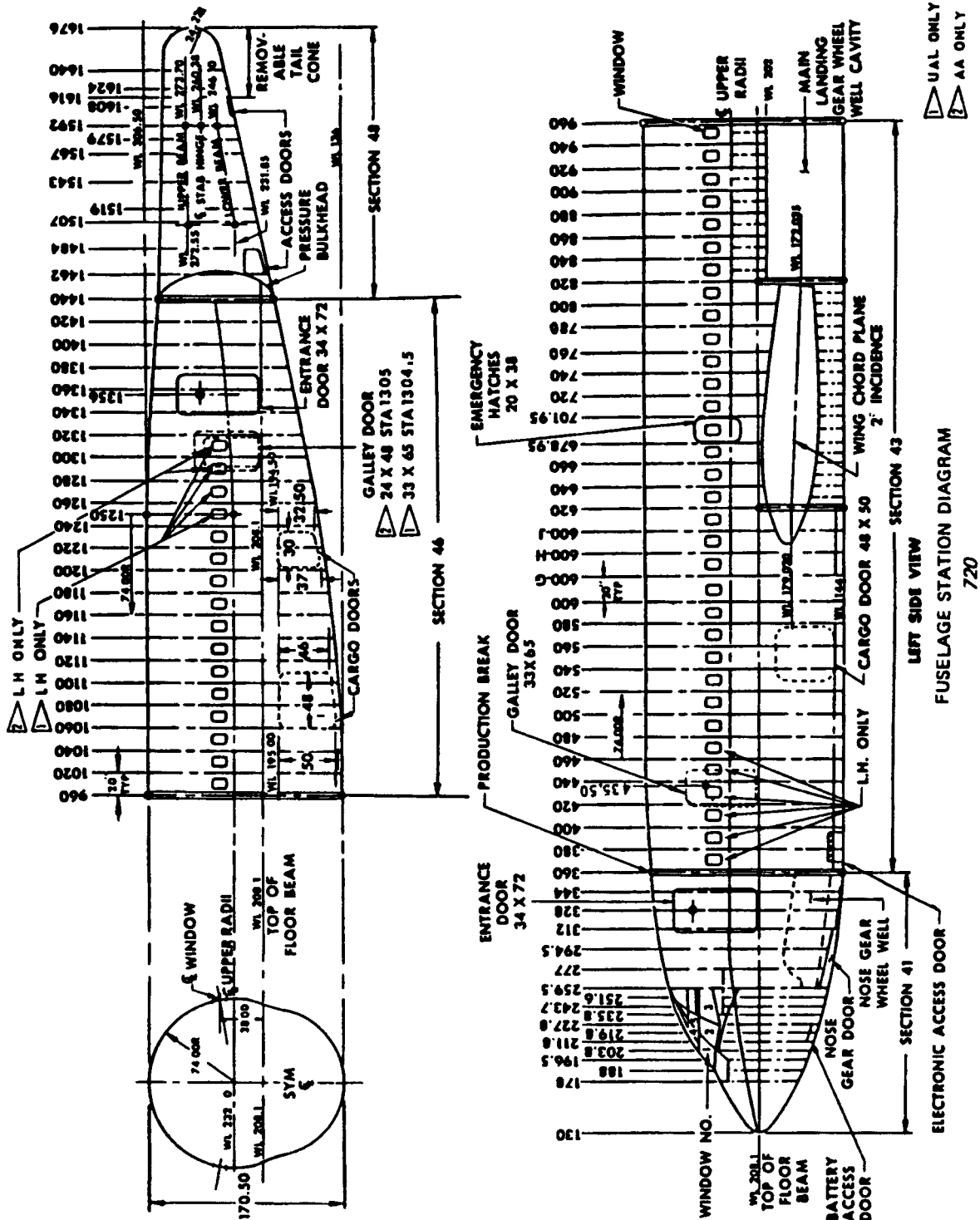
PART 1 - GENERAL



△ FOR PAA, AF, BOAC, DLN, VARIG, AII, SABENA AND SAA AIRPLANES

FUSELAGE STATION DIAGRAM
INTERCONTINENTAL

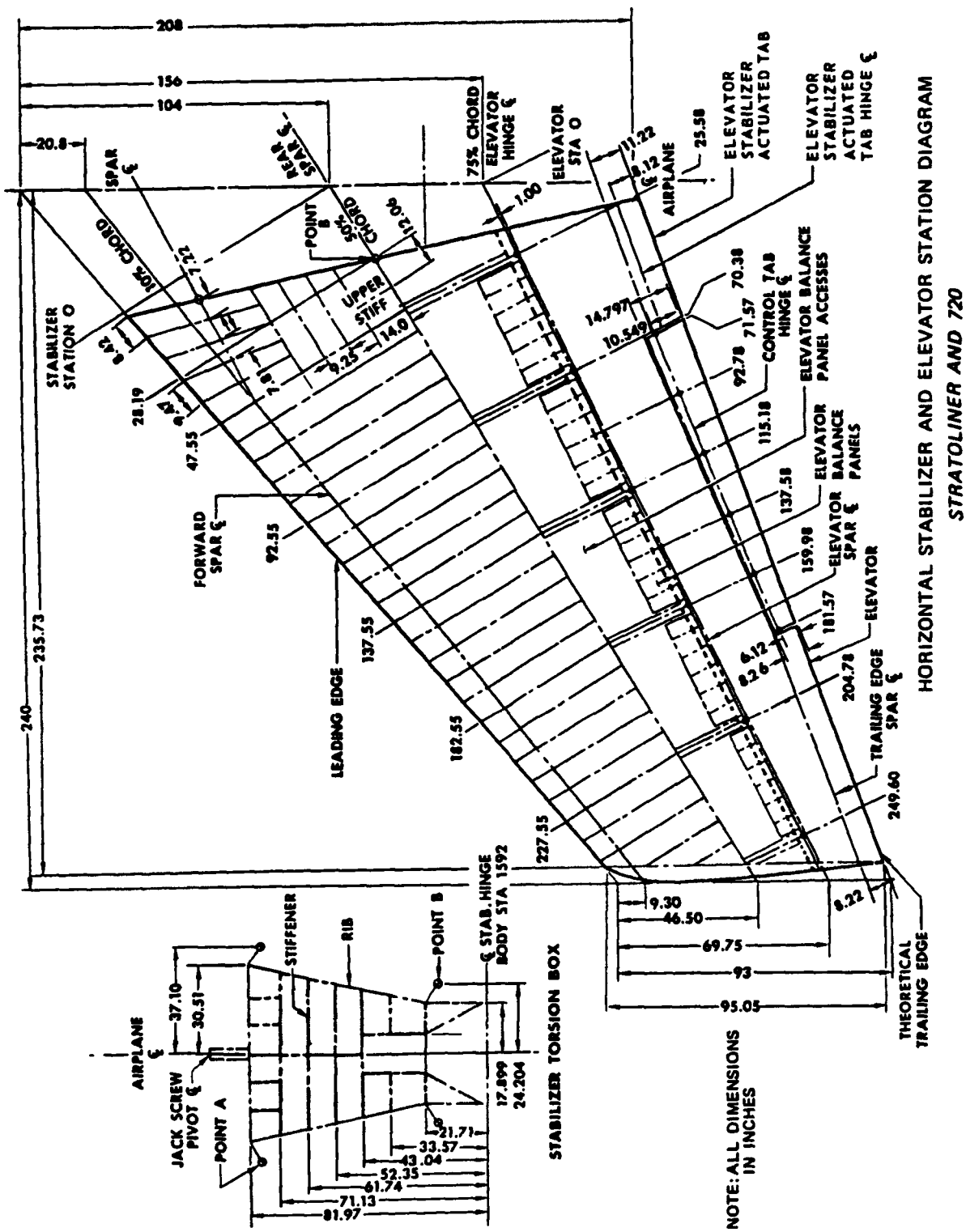
Airplane Reference Data
Figure 1 (Sheet 6)



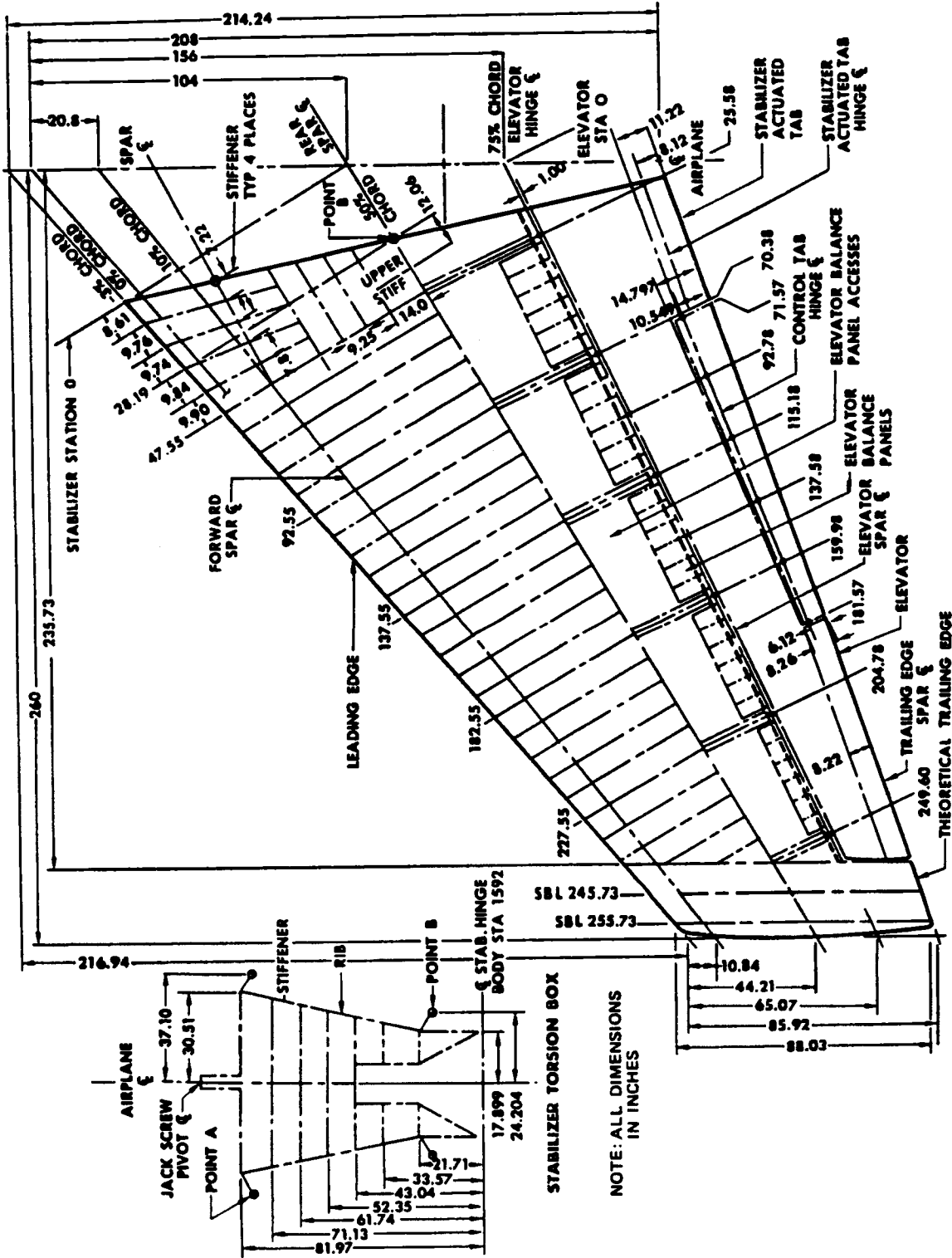
Airplane Reference Data
Figure 1 (Sheet 7)

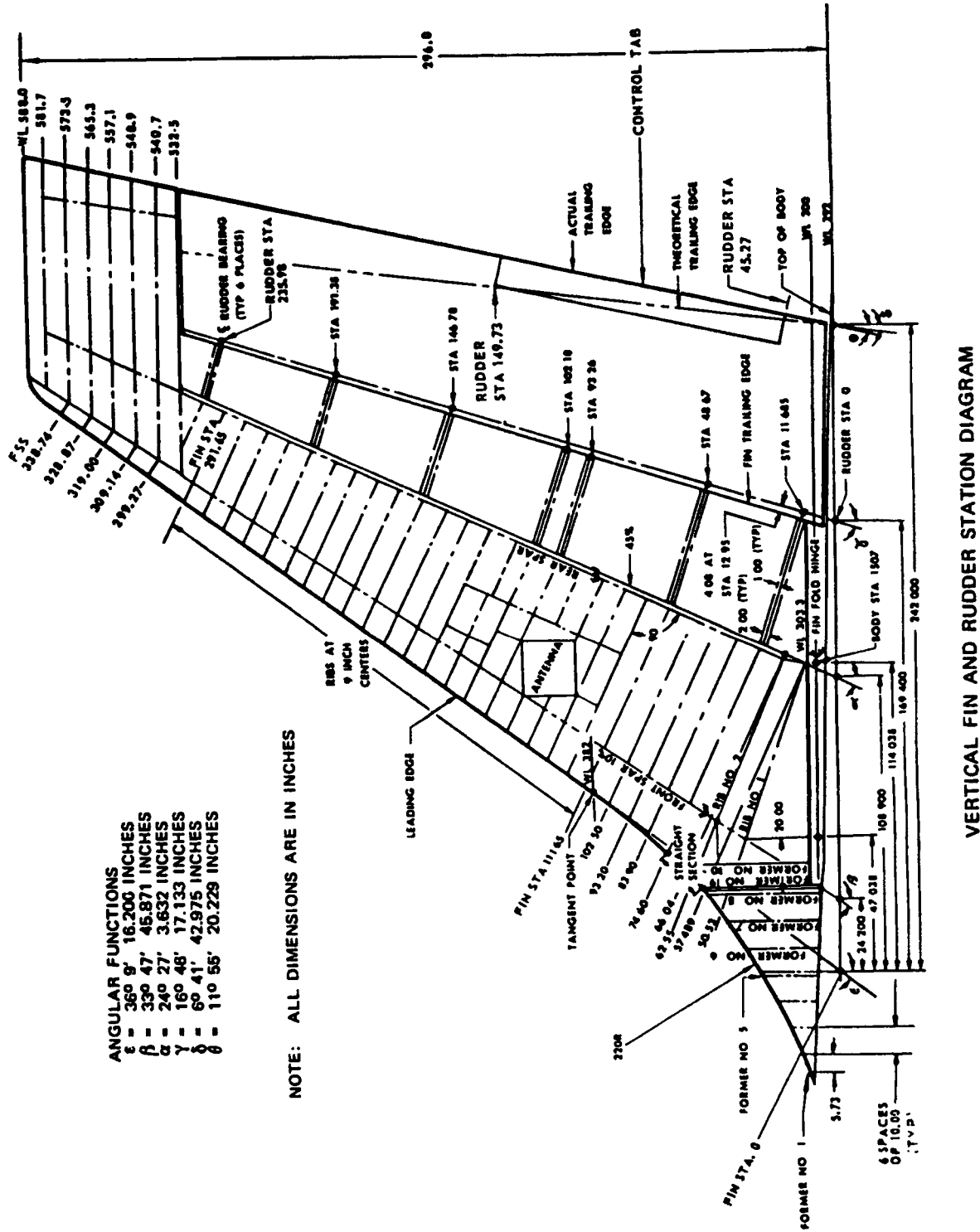
NONDESTRUCTIVE TEST

PART 1 - GENERAL



Airplane Reference Data
Figure 1 (Sheet 8)





NOTE: ALL DIMENSIONS ARE IN INCHES

VERTICAL FIN AND RUDDER STATION DIAGRAM

Airplane Reference Data
Figure 1 (Sheet 13)