REV	ECO#	DESCRIPTION OF REVISION
09		REMOVED SECOND STACK UP SHEET MARTIN_WAGNER 06/13/24
10		2D CLEAN UP MARTIN_WAGNER 06/13/24
11	0055503776	UPDATED FAI 59, 60 MARTIN_WAGNER 06/14/24
12	0057394488	ADDED FCCL MATERIAL SPEC TO NOTE 14, SHIFTED SERVICE LOOP BY 0.100, INCREASED B2B BEND RADIUS MARTIN_WAGNER 08/30/24
13	0059436489	UPDATED ROUTING OUTLINE, UPDATED FAI 59, 60, 2D CLEAN UP MARTIN_WAGNER 10/08/24
14		P2 RELEASE - UPDATED COIL PAD EXPOSED COPPER TO MATCH P1 LSCHIMMEL 10/09/24

NOTES: (UNLESS OTHERWISE SPECIFIED)

1. GEOMETRIC DATA FILES PROVIDED BY APPLE INC. SHALL BE USED FOR MASTER DATA. A DRAWING OF EQUAL FILENAME AND REVISION TO THE GEOMETRIC DATA SHALL BE USED TO DETERMINE GEOMETRIC CHARACTERISTICS AND TOLERANCES. DRAWING DIMENSIONS ARE SUBORDINATE TO GEOMETRIC DATA UNLESS SPECIFIED ON DRAWING TO BE MASTER, AS MAY BE THE CASE OF CABLE LENGTHS OR TABULATED VARIABLE DIMENSIONS. THE SUPPLIER MUST COMPLY WITH THE STANDARDS PERTAINING TO THE TOLERANCE METHOD APPLIED.

2. GD&T - GEOMETRIC TOLERANCE METHODS IN ACCORDANCE TO ASME Y14.5-2009. DATUM REFERENCE FRAMES RANK AS DATUM A PRIMARY, B SECONDARY AND C TERTIARY. FEATURE CONTROL FRAMES MAY RE-ORDER DATUMS PER THE FEATURES DATUM DEPENDENCE. DIMENSIONS THAT LOCATE GEOMETRIC TOLERANCE CHARACTERISTICS ARE BASIC (EXACT). NO TOLERANCES APPLY TO BASIC DIMENSIONS.

3. DIRECT TOLERANCE DIMENSIONING - INTERPRET DIMENSIONS THAT DO NOT LOCATE GD&T CHARACTERISTICS OR GD&T CONTROLLED FEATURES AS THE DIRECT TOLERANCE DIMENSION SYSTEM. THE LOCAL PLUS+/MINUS-, LOCAL LIMIT AND TITLE BLOCK TOLERANCES APPLY.

4. IN THE ABSENCE OF DRAWING DIMENSIONS AND DATUMS, THE GEOMETRIC DATA IS BASIC. THE PLANES OF THE ABSOLUTE COORDINATE SYSTEM DENOTE THE DATUM REFERENCE PLANES AS X-Y = DATUM A, Y-Z = B AND X-Z = C. ALL GEOMETRIC DATA SURFACES ⌓ 0.2 A B C.

5. PERFECT ORIENTATION AND/OR PERFECT LOCATION AT MMC AS REQUIRED FOR THE INTERRELATIONSHIP OF ALL DATUM FEATURES OF SIZE.

6. ON PARTS SUBJECT TO FREE STATE VARIATION, ALL TOLERANCES APPLY WHEN THE PART IS RESTRAINED ACCORDING TO FUNCTIONAL MATING CONDITIONS AS DEFINED BY THE DATUM REFERENCE FEATURE RANK OR FEATURE CONTROL FRAME DATUM RANK PER THE FEATURE INSPECTED. CONSULT PROPER APPLE INC. MANUFACTURING QUALITY ENGINEER (MQE) FOR APPROVAL/CLARIFICATION ON INDIVIDUAL PARTS.

7. TOLERANCES DESIGNATED WITH THE SYMBOL SPC SHALL BE PRODUCED WITH STATISTICAL TOLERANCE PROCESS CONTROLS. IN ORDER TO USE THE TOLERANCE ON A FEATURE, THE STATISTICAL PROCESS (CP, CPK, ETC) OF THE PART MUST BE VALIDATED AND APPROVED BY AN APPLE INC. MQE.

8. ALL TOOLING, FIXTURING AND OTHER UNIQUE ITEMS THAT ARE USED TO CREATE THIS PART ARE THE PROPERTY OF APPLE INC. AND SHALL BE PERMANENTLY MARKED IN ACCORDANCE WITH DOCUMENT SRAS-2018.

9. THE DESIGN OF ALL TOOLING OR FIXTURING REQUIRED FOR THE MANUFACTURING OR VERIFICATION OF THE PART SHALL BE APPROVED BY THE APPROPRIATE APPLE INC. ENGINEER PRIOR TO TOOL OR FIXTURE FABRICATION.

10. ALL HOMOGENEOUS MATERIALS MUST COMPLY WITH THE FOLLOWING ENVIRONMENTAL SPECIFICATIONS:
    * APPLE INC. REGULATED SUBSTANCES SPECIFICATION, 069-0135

    ALL ADHESIVES, COATINGS AND PAINTS, PRINTING INKS, AND CLEANING AGENTS USED IN THE MANUFACTURING OF THIS PART MUST COMPLY WITH THE APPLE VOC SPECIFICATION, 099-22549

    ALL MATERIALS WITH RECYCLED OR RENEWABLE CONTENT MUST COMPLY WITH THE APPLE RECYCLED & RENEWABLE MATERIAL SPECIFICATION, 099-15583

11. REFER TO THE PCB RELEASE PACKAGE PROVIDED BY APPLE INC. FOR MASTER GEOMETRY DATA. THIS DRAWING IS SUPPLEMENTAL TO THE MASTER DATA AND TO BE USED TO INDICATE CRITICAL MECHANICAL FEATURES AND TOLERANCES. TOLERANCES ON THIS DRAWING ARE ONLY INTENDED FOR DIMENSIONS ON THIS DRAWING AND NOT FOR ALL DATA IN THE RELEASE PACKAGE.

12. REFER TO APPLE INC. SPECIFICATION DOCUMENT 080-2265 FOR DESIGN REQUIREMENTS
    REFER TO APPLE INC. SPECIFICATION DOCUMENT 080-3842 FOR CONNECTOR INSPECTION REQUIREMENTS
    REFER TO APPLE INC. SPECIFICATION DOCUMENT 062-9728 FOR SAFETY REQUIREMENTS

13. MAXIMUM STRAIN ALLOWED FOR ANY LOCATION ON THE PCBA: ±500 MICROSTRAIN DURING PCB ASSEMBLY, ASSEMBLY PROCESS, SERVICING AND HANDLING. APPLE INC. STANDARD 080-2263 SECTION 4.0 & IPC-JEDEC9704.

[14] FLEX 2 LAYERS: SEE SHEET 2 FOR THICKNESS & LAYER TRANSITION DETAILS
    STENCIL THICKNESS: FOLLOW CPP
    COPPER MATERIAL: HA COPPER
    FCCL MATERIAL: ARISAWA PKRW0518RAH

[15] ALL DESIGNATED MAX HEIGHTS ARE TO INCLUDE THE COMPONENT AT ITS MAX SIZE, SOLDER PASTE AND WARPAGE. HEIGHT MEASUREMENT IS TAKEN FROM TOP OF SOLDERMASK.

[16] NO COMPONENT PLACEMENT ALLOWED IN REGIONS SHOWN.

[17] ADHESIVE: TESA 68548 0.010 mm ±0.002 THICK (FAI 100)
    MINIMUM PEEL FORCE: 0.4n AT IQC/OQC MEASUREMENT
    REFER TO ERS 099-19729
    5 PCS FIRST ARTICLE INSPECTION, CPK CAPABILITY NOT REQUIRED.

[18] ADHESIVE MATERIAL: WR9205, 0.050 mm ±0.010 THICK. (FAI 101)
    MINIMUM PEEL FORCE: 1.5N AT OQC/IQC
    REFER TO ERS 099-19729
    5 PCS FIRST ARTICLES OF INSPECTION, CPK CAPABILITY NOT REQUIRED

[19] RELEASE LINER MATERIAL: LPT50ZC#EE (PET)
    RELEASE LINER THICKNESS: 0.030 TO 0.050 mm
    RELEASE LINER COLOR: TRANSLUCENT BLUE.
    RELEASE LINER TO COMPLETELY COVER ADHESIVE.

[20] APPLY UNDER FILL TO COMPONENTS AS INDICATED.
    UNDERFILL MATERIAL: HENKEL 3808
    INSPECTION: FILLET AROUND 4 SIDES OF PACKAGE TO AT LEAST 1/4 PACKAGE HEIGHT
    UNDERFILL CONTAMINATION IS NOT ALLOWED IN B2B PINS, TEST POINTS OR EXPOSED COPPER REGIONS USED FOR ASSEMBLY.

[21] VENDOR NAME/INFO, TRACKING CODE, BOARD APN & APPLE INC. LOGO ALLOWED ONLY IN REGIONS SHOWN. PRINT WITH PERMANENT WHITE INK.

[22] 2D APPLE BARCODE TO BE SHOWN IN THE DEFINED AREA.
    BARCODE MUST BE SCANNABLE WITHIN 500ms USING COGNEX DM302 SCANNER (OR APPLE ENGINEERING APPROVED EQUIVALENT).
    BARCODE TO HAVE WHITE BACKGROUND WITH BLACK INK.
    REFER TO APPLE SPEC 081-2110 FOR BARCODE DEFINITION.

[23] DO NOT PRE-BEND IN LOCATIONS SHOWN. SHIP FLAT IN TRAYS.
    SHIPPING LAYOUT TO BE DEFINED BY APPLE ENGINEERS.

[24] UNLESS OTHERWISE INDICATED, ALL VESTIGE TABS TO BE 0.150 mm MAX.

25. DIMENSIONS LABELED FOR DATA COLLECTION WITH DC REQUIRE INSPECTION ON 32 SAMPLES.

[26] ADHESIVE: HAF TESA 58474, 0.100 mm ± 0.010 THICK (FAI 102)
    MINIMUM PEEL FORCE: 1.8N AT OQC, 1.5N AT IQC MEASUREMENT REFER TO ERS 099-19729
    5 PCS FIRST ARTICLES OF INSPECTION, NO CPK CAPABILITY REQUIRED

[27] SOLDER BUMP HEIGHT 70 +15/-50 uM
    US Sn Ag Cu BASED SAC305 Pb-FREE SOLDER OR APPLE APPROVED EQUIVALENT.
    MAX ADHESIVE SQUEEZE OUT 100 uM.

[28] SOLDER BUMP HEIGHT TO COVERLAY 18.5 ± 27.5 uM
    US Sn Ag Cu BASED SAC305 Pb-FREE SOLDER OR APPLE APPROVED EQUIVALENT.
    MAX ADHESIVE SQUEEZE OUT 100 uM.

[29] STIFFENER MATERIAL: SUS 316L
    OPTION A: STAL 316L-1/2H
    OPTION B: JX NK316L-1/2H-BR(N)
    OPTION C: TOKKIN 316L-1/2H

    STIFFENER THICKNESS: 0.075 ±0.010 mm

    STIFFENER HARDNESS: 200-400 HV. MEASURE AT LOCATION INDICATED.

    STIFFENER FINISH: 1 µm - 5 µm SEMI-BRIGHT NICKEL, PRE-PLATING.

    STIFFENER GLOSS AT 60°: 325 ± 125 GU

    STIFFENER ROUGHNESS: 0.18 ± 0.13 µm Sa

    NO VISIBLE GRAIN DIRECTION. BURR DIRECTION TO FACE AWAY FROM FLEX, 0.03 mm MAX.
    STIFFENERS MUST BE INSPECTED AT SUS STIFFENER OQC AND FLEX IQC ON A LOT BASIS AND APPROVED BY APPLE MQE. COUPON LEVEL TESTING ACCEPTED.
    B2B STIFFENER MUST BE ELECTRICALLY CONNECTED TO GND.

    ALL MATERIALS WITH RECYCLED OR RENEWABLE CONTENT MUST COMPLY WITH THE APPLE RECYCLED & RENEWABLE MATERIAL SPECIFICATION, 099-15583

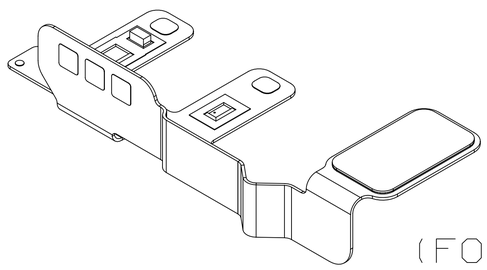
    SUS 316L-80RC 1/2H 80RC AASM 088-06576
    THIS MATERIAL MUST SATISFY THE CERTIFICATION REQUIREMENTS FOR 80% RECYCLED ALLOY BY WEIGHT, PER ISO 14021:2016 SECTION 7.8 (AS ADDITIONALLY DESCRIBED IN 099-15583).
    MATERIAL SHALL BE SOURCED FROM AN APPLE-APPROVED SUPPLIER PER 099-39359.

    ADHESIVE MATERIAL: CONDUCTIVE ADHESIVE, TOYO TSC200
    ADHESIVE THICKNESS: 0.060 ±0.010 mm

[30] BLUE ADHESIVE LINER, PET, 0.030-0.050 mm THICK
    TEST ADHESION BETWEEN LINER AND ADHESIVE PER APLE SPECIFICATION DOCUMENT 080-01313, REPORT LINER TO ADHESIVE PEEL FORCE. 5 PCS FIRST ARTICLE INSPECTION. CPK CAPABILITY NOT REQUIRED. 0.025 MM PROTECTIVE FILM ON BOTTOM SIDE OF HAF LINER

31. ALL MATERIALS MUST COMPLY WITH APPLE INC. SPECIFICATION 062-9728, BE UL RECOGNIZED AND MEET THE FOLLOWING REQUIREMENTS:
    *FLEX & STIFFENER MATERIALS MUST HAVE A MINIMUM FLAMMABILITY RATING OF V-2, VTM-2, VW-1 OR BETTER.
    *PCB & FLEX PCB WITH COMPONENTS MUST HAVE MINIMUM FLAMMABILITY RATING OF V-1, VTM-1 OR BETTER.

[32] FLEX TO SURVIVE CYCLE TESTING ON INDICATED BENDS PER QCP 080-01930.
    USE MANDREL OF DIMENSIONED RADIUS FOR BENDING.
    - ONE CYCLE: BEND TO INDICATED ANGLE AND RETURN PART TO FLATTENED STATE.
    - REPEAT FOR 10 CYCLES.
    - INSPECT FLEX FOR FUNCTIONALITY AND EVIDENCE OF COVERLAY OR TRACE CRACKING.
    - ACCEPT OR REJECT LOT BASED ON 100% PASS.



BENT VIEW
(FOR REFERENCE ONLY)

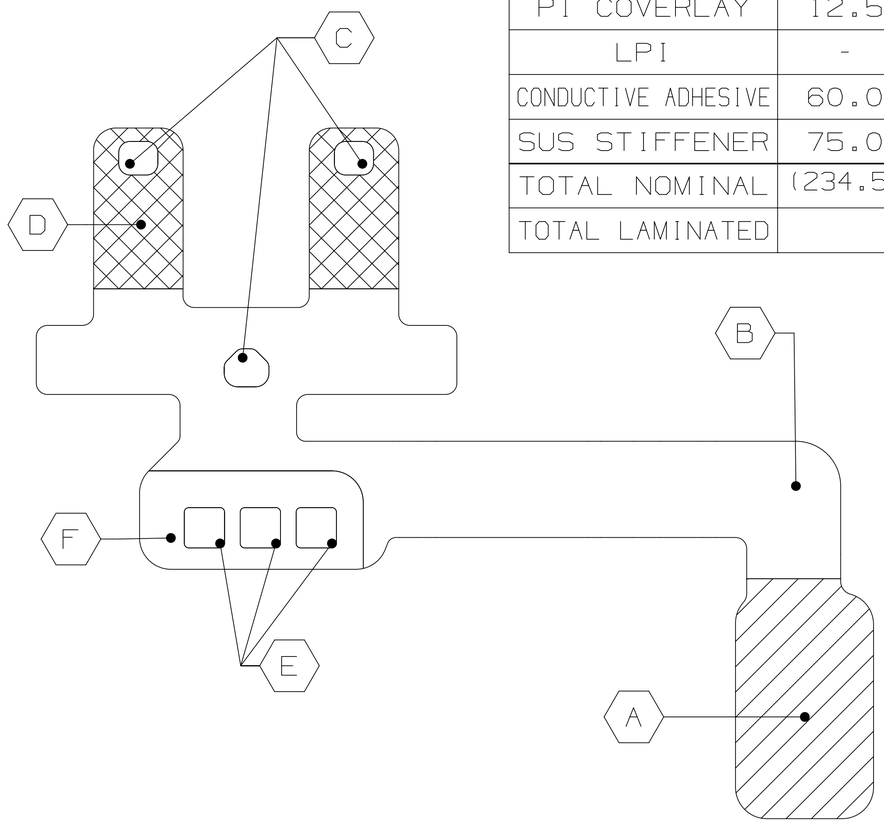
METRIC	Apple Inc.
DRAFTER: APPLE PD — DATE: 06/06/24	NOTICE OF PROPRIETARY PROPERTY: THE INFORMATION CONTAINED HEREIN IS THE PROPRIETARY PROPERTY OF APPLE INC. THE POSSESSOR AGREES TO THE FOLLOWING: (i) TO MAINTAIN THIS DOCUMENT IN CONFIDENCE (ii) NOT TO REPRODUCE OR COPY IT (iii) NOT TO REVEAL OR PUBLISH IT IN WHOLE OR PART (iv) ALL RIGHTS RESERVED
DESIGNER: APPLE PD — DATE: 06/06/24	
DIMENSIONS ARE IN MILLIMETERS TOLERANCES X.X ±0.4 X.XX ±0.20 X.XXX ±0.100 ANGLES ±0.5° DO NOT SCALE DRAWINGS	TITLE: MCO, FLEX, ARC, X3454
	DRAWING NUMBER: 056-20592 — REV.: 14
THIRD ANGLE PROJECTION — SIZE: D	SCALE: NONE — SHT 1 OF 11

NX GENERATED

STACKUP REGIONS
(VIEWED FROM TOP SIDE)

14

REGION	A		B		C		D		E		F	
DESCRIPTION	2-LYR		2-LYR		2-LYR		2-LYR		2-LYR		2-LYR	
	PRE	POST	PRE	POST	PRE	POST	PRE	POST	PRE	POST	PRE	POST
LPI	20.0	20.0	-	-	-	-	20.0	20.0	-	-	-	-
PI COVERLAY	-	-	12.5	12.5	-	-	-	-	12.5	12.5	12.5	12.5
ADHESIVE	-	-	20.0	16.0	-	-	-	-	20.0	16.0	20.0	16.0
ENIG	-	-	-	-	4.0	4.0	-	-	-	-	-	-
COPPER	17.5	16.0	17.5	16.0	17.5	16.0	17.5	16.0	17.5	16.0	17.5	16.0
PI BASE	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0
COPPER	17.5	16.0	17.5	16.0	17.5	16.0	17.5	16.0	17.5	16.0	17.5	16.0
ENIG	-	-	-	-	-	-	-	-	4.0	4.0	-	-
ADHESIVE	20.0	16.0	20.0	16.0	20.0	16.0	20.0	16.0	-	-	-	-
PI COVERLAY	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	-	-	-	-
LPI	-	-	-	-	-	-	-	-	-	-	20.0	20.0
CONDUCTIVE ADHESIVE	60.0	45.0	-	-	-	-	-	-	-	-	-	-
SUS STIFFENER	75.0	75.0	-	-	-	-	-	-	-	-	-	-
TOTAL NOMINAL	(234.5)		(112.0)		(83.5)		(99.5)		(83.5)		(99.5)	
TOTAL LAMINATED		212.5±20		101±20		76.5±20		92.5±20		76.5±20		92.5±20
		FAI 1 SPC A		FAI 2 SPC B		FAI 3 SPC C		FAI 87 SPC BF		FAI 88 SPC BG		FAI 89 SPC BH



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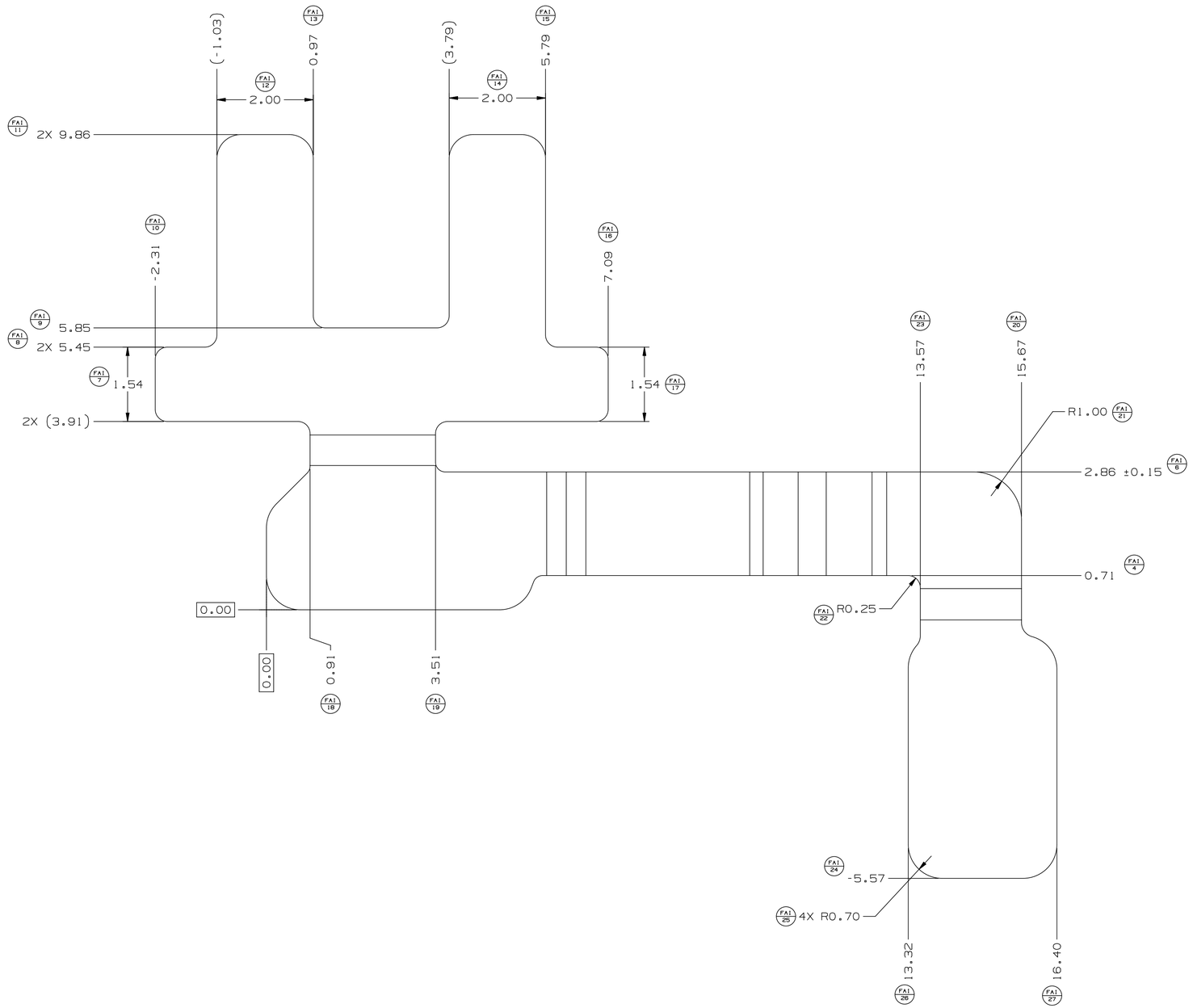
SIZE	DRAWING NUMBER	REV.
D	056-20592	14

SCALE: NONE SHT 2 OF 11

NX GENERATED

FLEX OUTLINE
(VIEWED FROM TOP SIDE)



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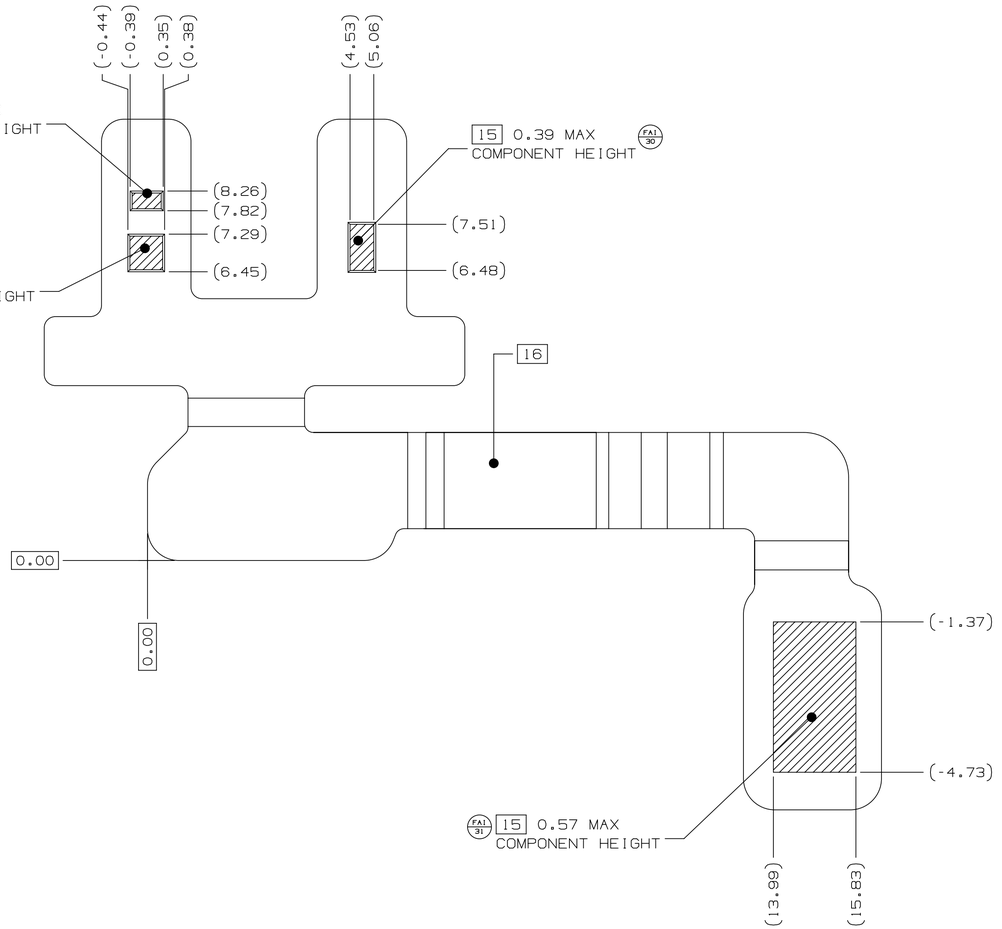
SIZE	DRAWING NUMBER	REV.
D	056-20592	14
SCALE: NONE	SHT 3 OF 11	

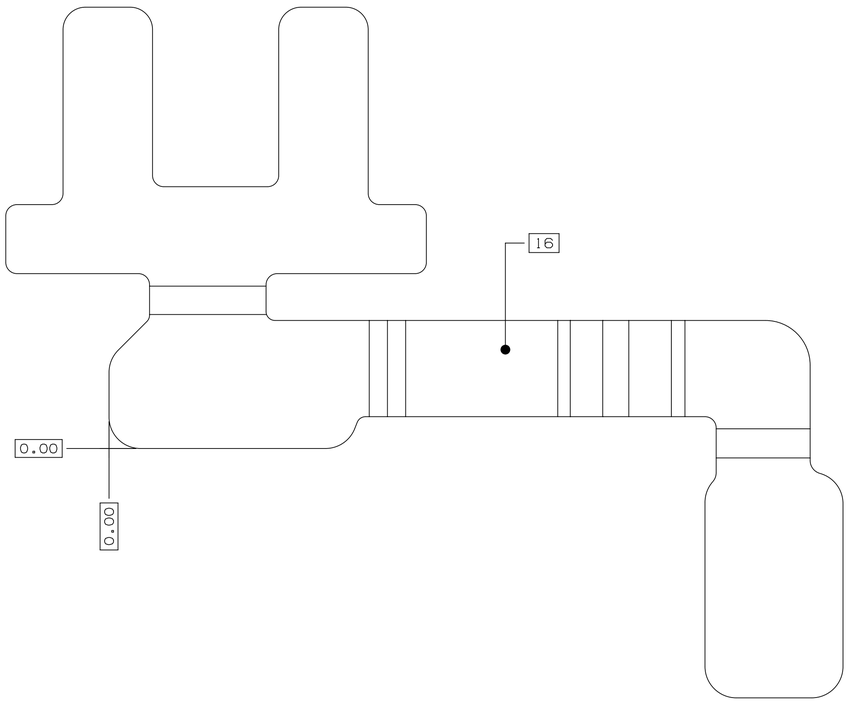
NX GENERATED

COMPONENT KEEP-IN
(VIEWED FROM TOP SIDE)

TOP SIDE



BOTTOM SIDE



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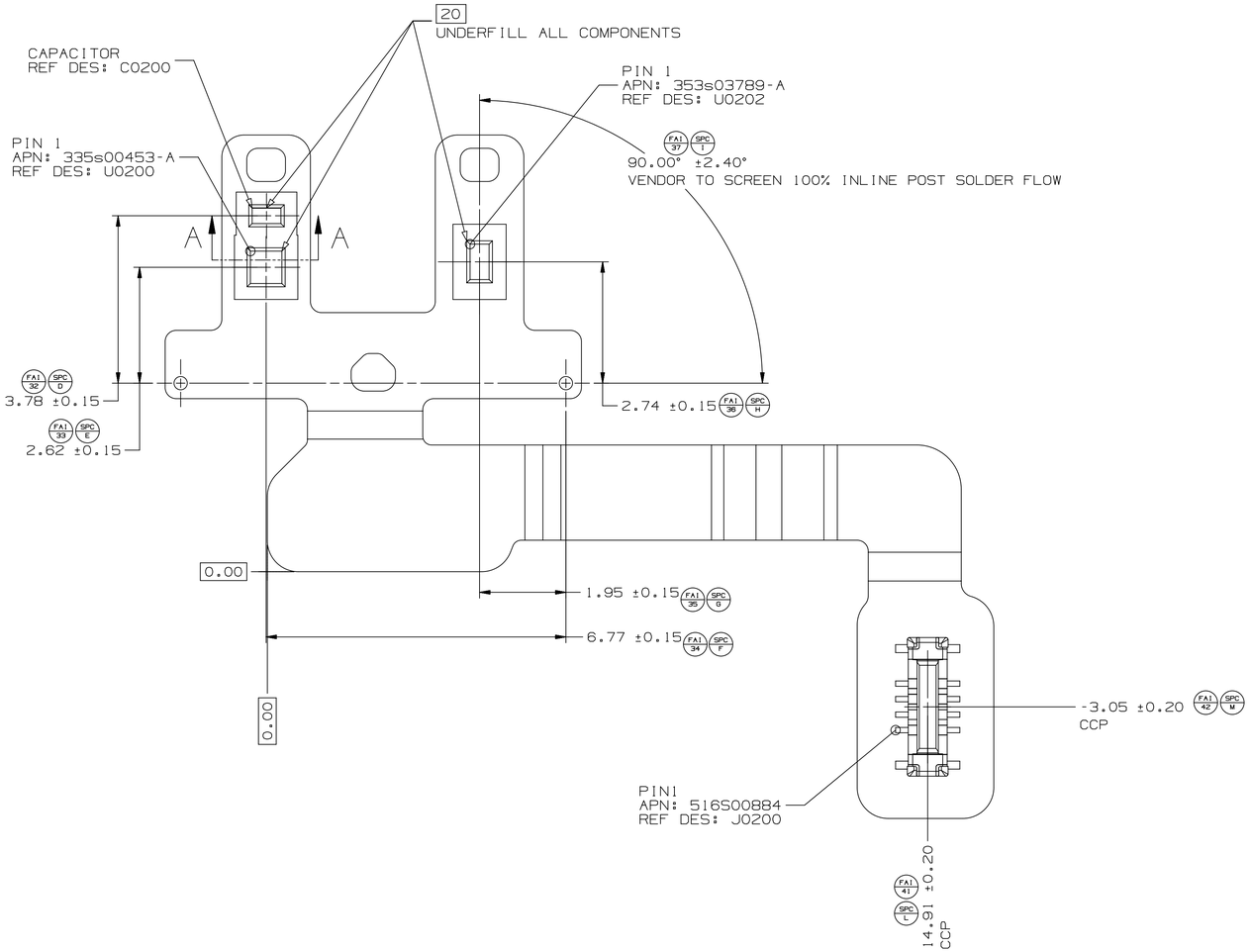
SIZE	DRAWING NUMBER	REV.
D	056-20592	14

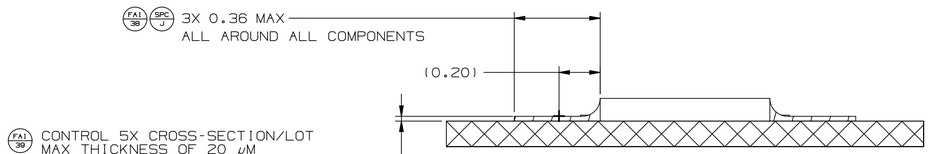
SCALE: NONE SHT 4 OF 11

NX GENERATED

COMPONENT AND STIFFENER PLACEMENT
(VIEWED FROM TOP SIDE)

TOP SIDE

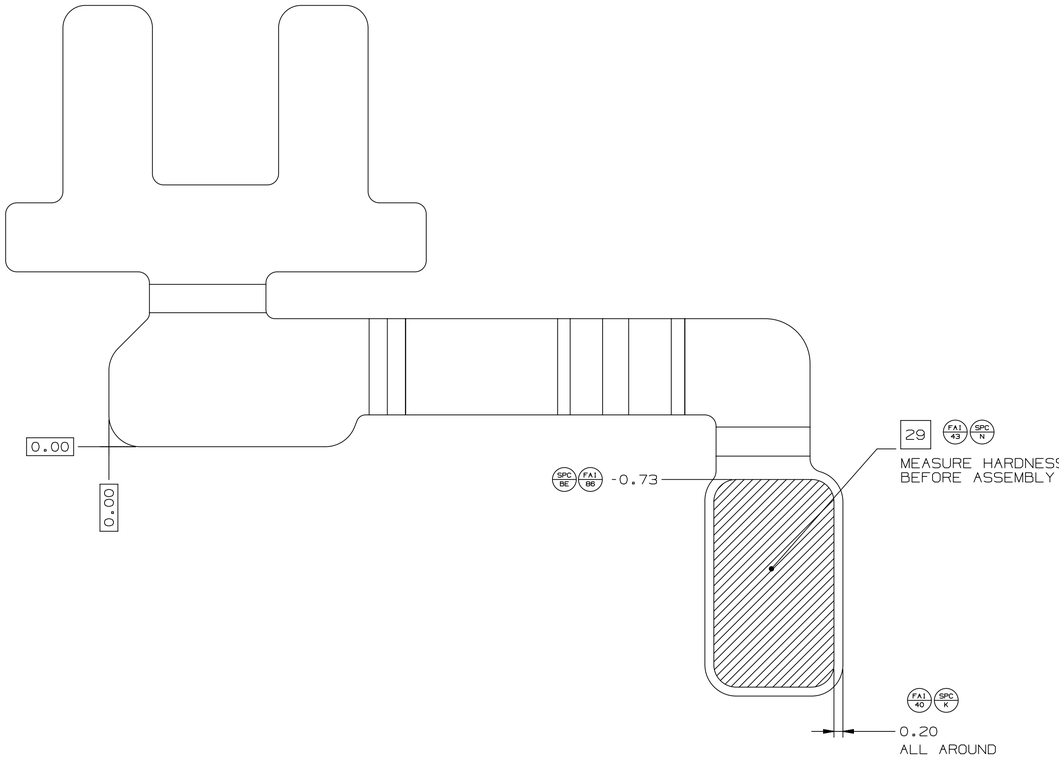




FAI 39 CONTROL 5X CROSS-SECTION/LOT
MAX THICKNESS OF 20 μM
MEASURED 200 μM FROM COMPONENT EDGE
IN X-DIRECTION BOTH SIDES
5 PCS FIRST ARTICLE INSPECTION,
CPK CAPABILITY NOT REQUIRED

SECTION A - A

BOTTOM SIDE



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SIZE	DRAWING NUMBER	REV.
D	056-20592	14
SCALE: NONE	SHT 5 OF 11	

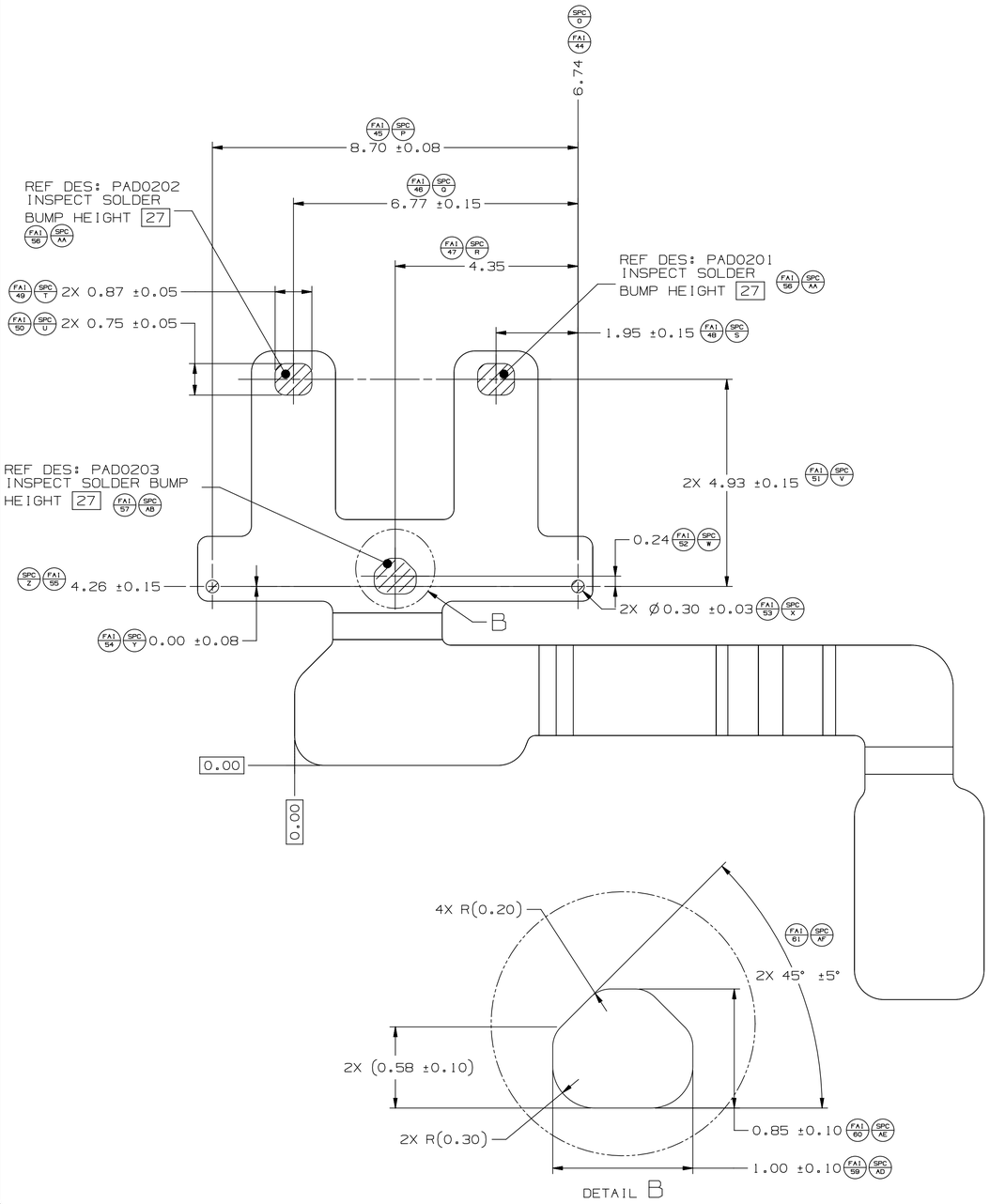
NX GENERATED

EXPOSED COPPER

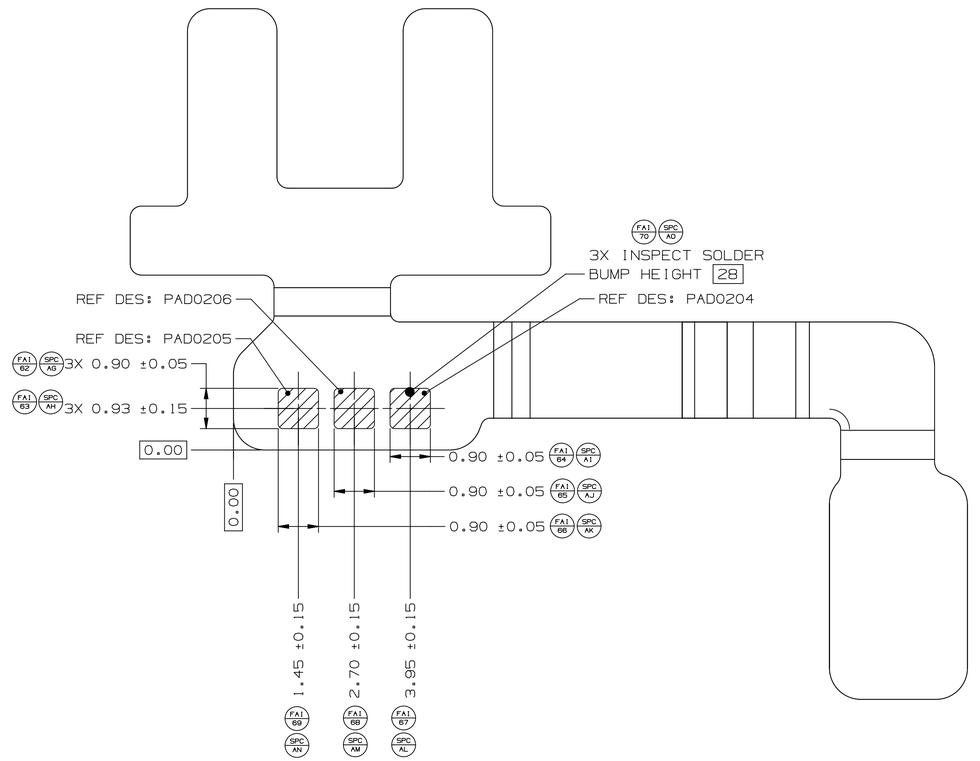
(VIEWED FROM TOP SIDE)

(PAD MEASUREMENTS TAKE FROM COVERLAY OPENING, NOT INCLUDING ADHESIVE SQUEEZE OUT)

TOP SIDE



BOTTOM SIDE



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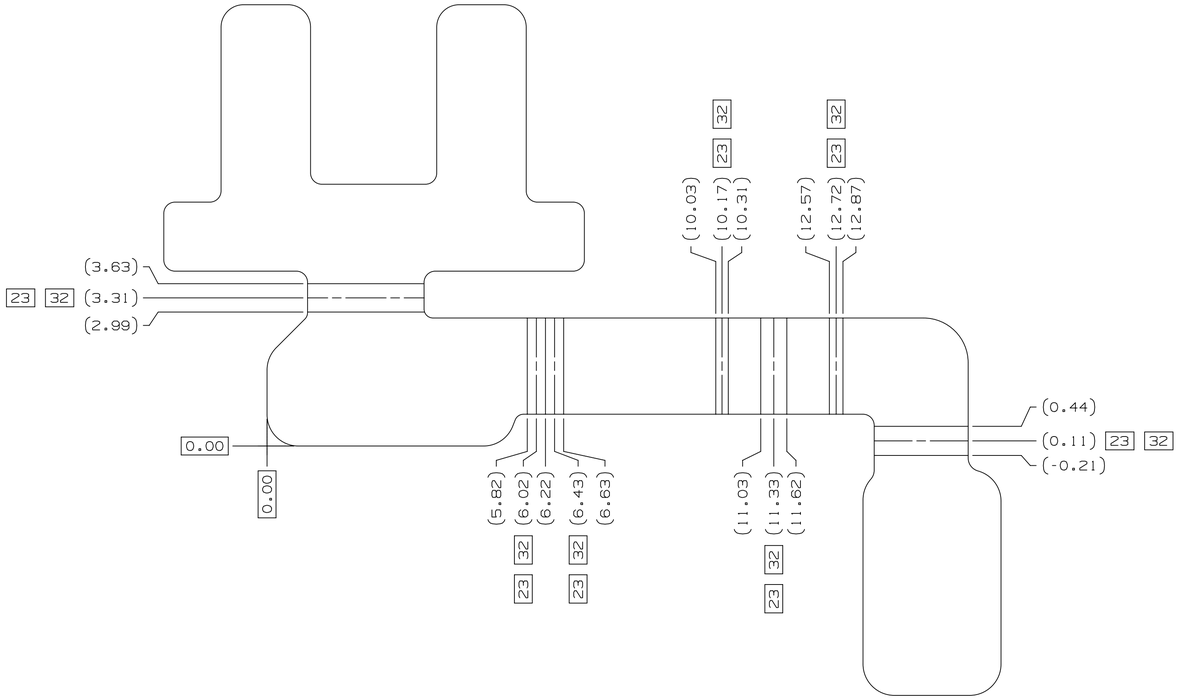
SIZE	DRAWING NUMBER	REV.
D	056-20592	14

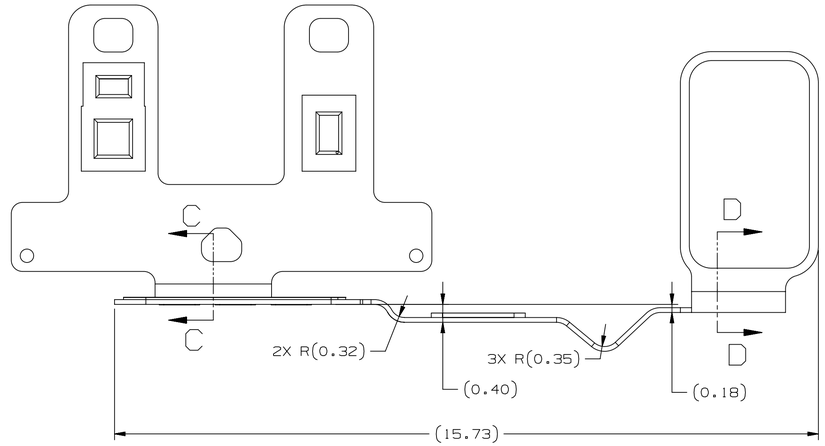
SCALE: NONE SHT 6 OF 11

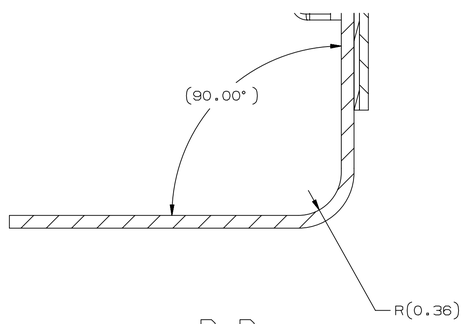
NX GENERATED

BEND DETAILS

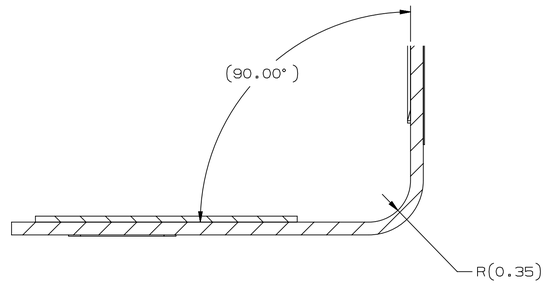
AS VIEWED FROM TOP SIDE







SECTION D - D



SECTION C - C

Apple Inc.

SIZE	DRAWING NUMBER	REV.
D	056-20592	14
SCALE: NONE	SHT 7 OF 11	

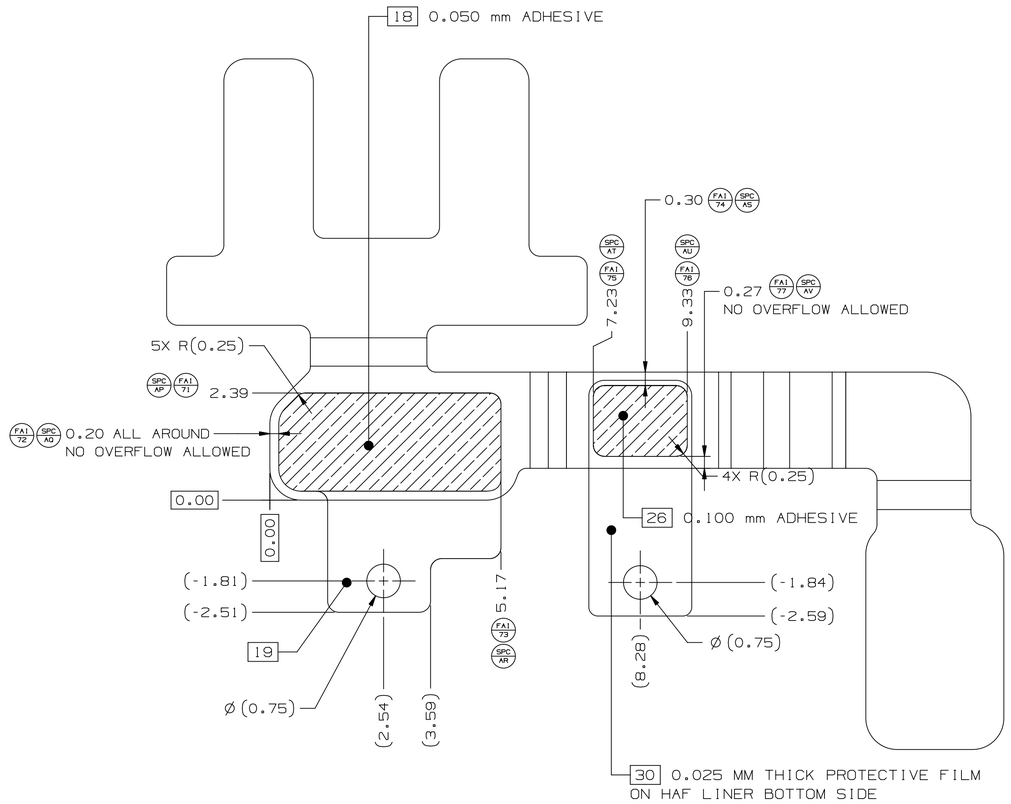
NX GENERATED

ADHESIVES AND LINERS

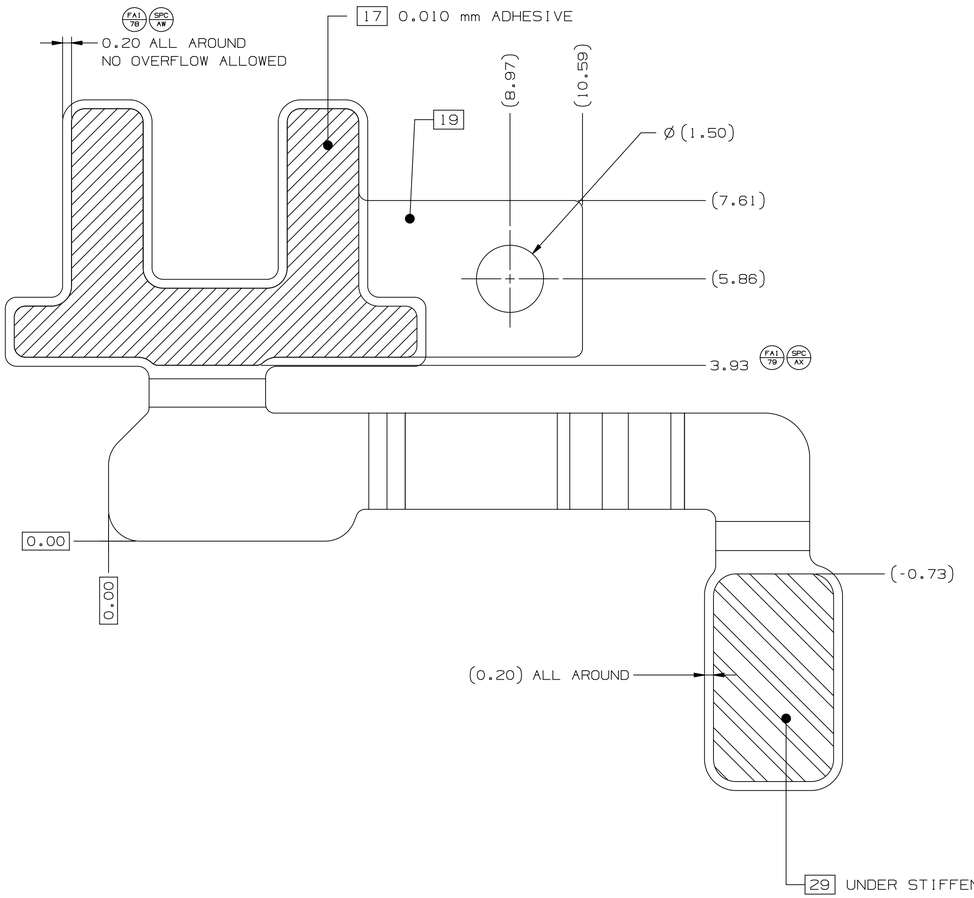
AS VIEWED FROM TOP SIDE

ADHESIVES VIEWED THROUGH LINERS

TOP SIDE



BOTTOM SIDE



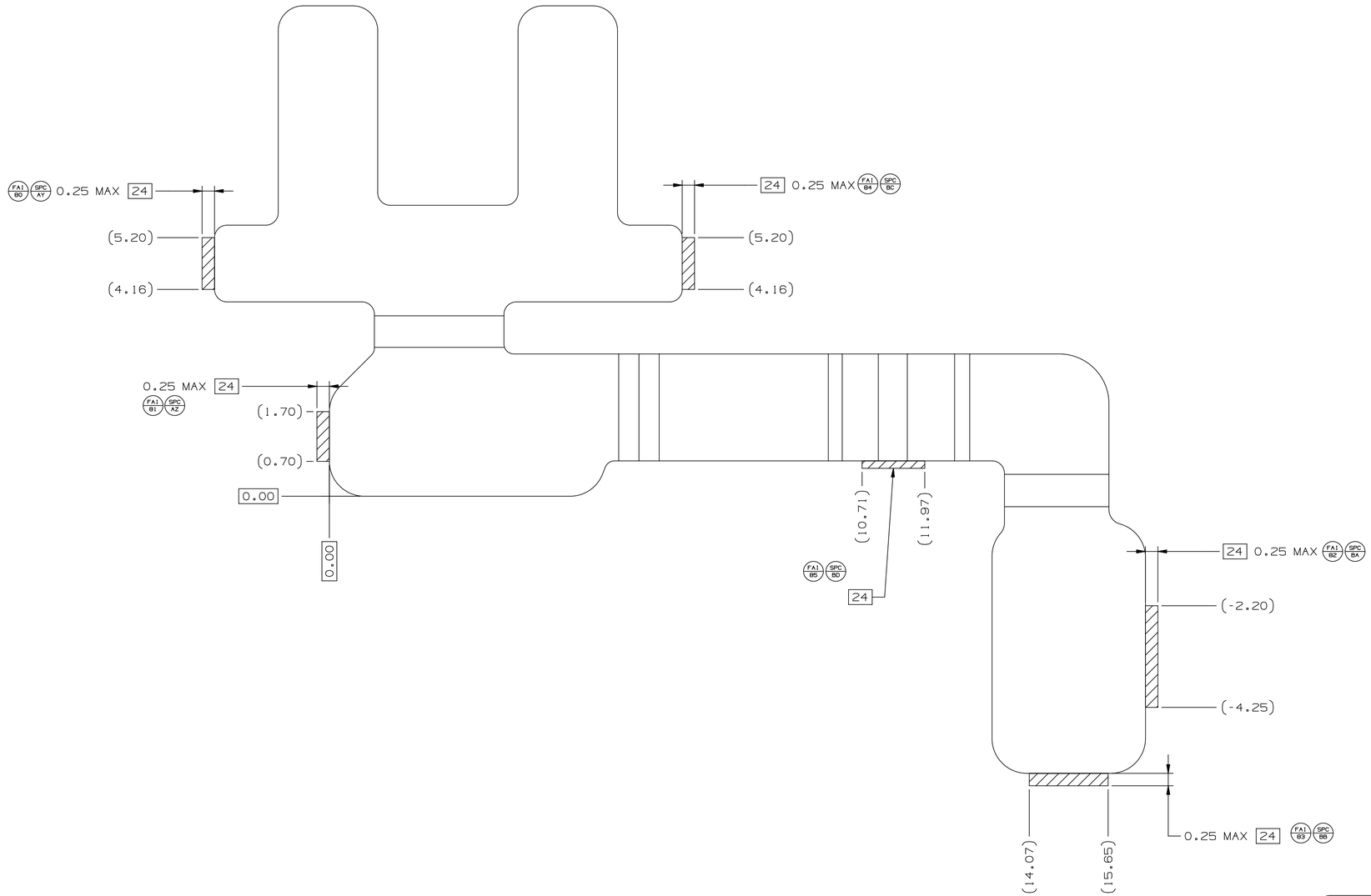
Apple Inc.

SIZE	DRAWING NUMBER	REV.
D	056-20592	14
SCALE: NONE	SHT 8 OF 11	

NX GENERATED

ALLOWABLE VESTIAGE TAB LOCATIONS

(VIEWED FROM TOP SIDE)



Apple Inc.

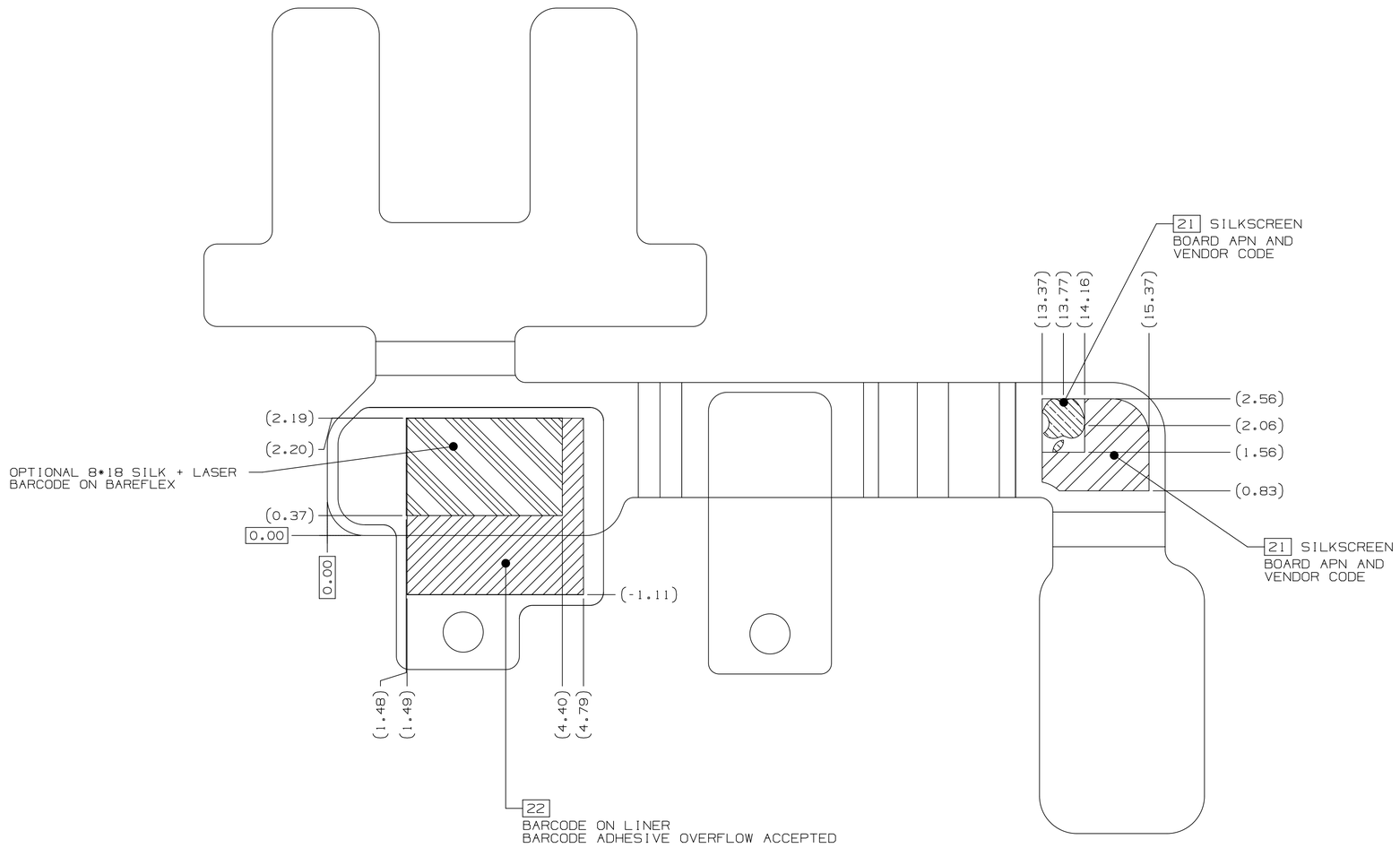
SIZE	DRAWING NUMBER	REV.
D	056-20592	14

SCALE: NONE SHT 9 OF 11

NX GENERATED

BARCODE AND SILKSCREEN

(VIEWED FROM TOP SIDE)



Apple Inc.

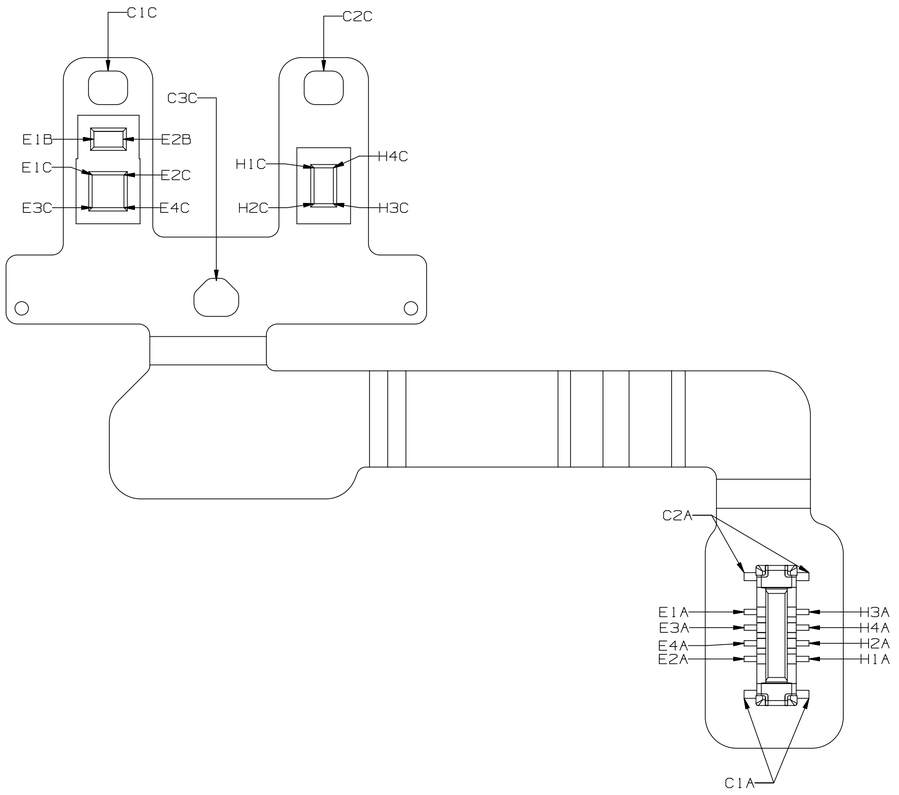
SIZE	DRAWING NUMBER	REV.
D	056-20592	14
SCALE: NONE	SHT 10 OF 11	

NX GENERATED

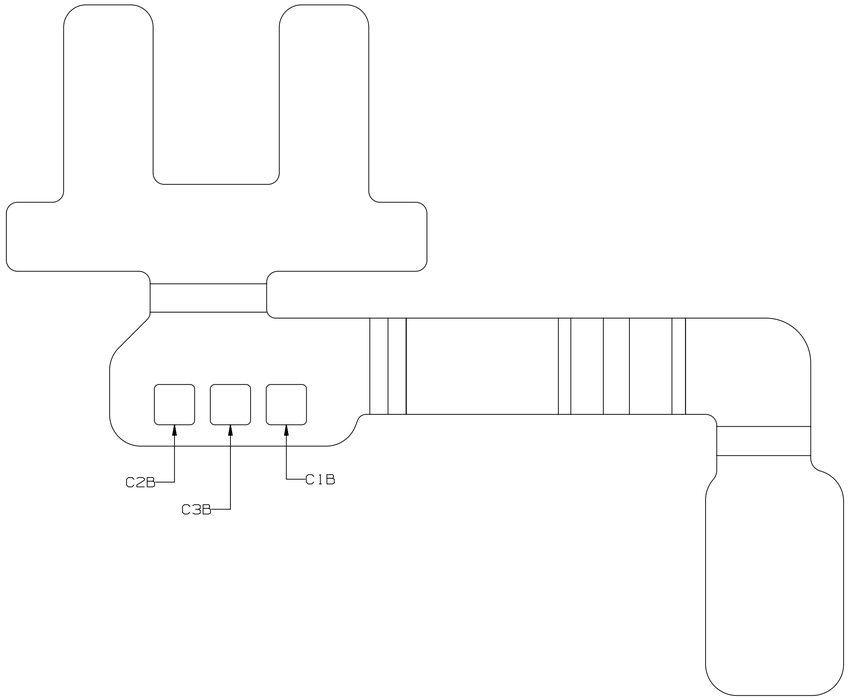
ERS DESIGNATORS CONVENTION

REFER TO ERS 099-19729 FOR TEST REQUIREMENTS

TOP SIDE



BOTTOM SIDE
(VIEWED THROUGH TOP SIDE)



Apple Inc.

SIZE	DRAWING NUMBER	REV.
D	056-20592	14
SCALE: NONE	SHT 11 OF 11	

NX GENERATED