NBS TECHNICAL NOTE 1011

U.S. DEPARTMENT OF COMMERCE/National Bureau of Standards

Construction of a Large Transverse Electromagnetic Cell

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CONTENTS

LIST OF FIGURES

CONSTRUCTION OF A LARGE TRANSVERSE ELECTROMAGNETIC CELL

W. F. Decker, M. L. Crawford, and W. A. Wilson

In support of the electromagnetic interference studies underway in the Electromagnetic Fields Division of the National Bureau of Standards, a 2.8 meter transverse electromagnetic (TEM) cell was constructed by the Instrument Shops Division of the NBS Boulder Laboratories.

The cell requirements, design concepts, and fabrication procedures were developed through the coordination of both the Electromagnetic Fields Division personnel and the Instrument Shops Division personnel. This paper provides the sequential procedure used to fabricate this cell, in conjunction with a complete set of detail and assembly drawings used to illustrate the complete fabrication process. The purpose of this publication is to provide documented information sufficient for any outside vendor, with the proper facilities, to construct a similar TEM cell.

Key Words: Electromagnetic susceptibility testing; structural design and fabrication procedures; transverse electromagnetic (TEM) cell.

1. INTRODUCTION

This instruction provides information and procedures necessary to fabricate a large transverse electromagnetic (TEM) cell to be used for experimental "electromagnetic interference" (EMI) evaluation studies (figs. 1 and 2).

The cell is basically an enlarged, 50-ohm, rectangular, coaxial transmission line, designed so that equipment to be EMI tested can be placed inside it. It is constructed with transitions at each end to convert from stripline transmission line (flat center plate) to square coaxial transmission line and then to circular coaxial transmission line having standard connectors.

Susceptibility test fields are established inside the cell by connecting an rf generator to the cell's input port and coupling rf energy through the cell to a 50-ohm termination connected to the cell's output port. For radiated emissions testing, the cell is used as a transducer to couple energy emitted by the equipment under test, placed inside the cell, to detectors connected to the cell's input and/or output ports. Details of how the cell is used for each type (EM susceptibility and emissions) of measurement is contained in reference [1].

The assembly and details of this cell are shown on Drawing No. EN (10 kHz -10kHz-108 MHz) -1/355D, Sheets 1 to 32, which form a part of this paper. The normal cell size of 2.8 meters refers to an effective center section 2800 mm in height, width, and length, and an overall effective length of 5600 mm as shown on Sheet 2 of the above referenced drawings. The cell is shown in figures 1 and 2.

The cell is fabricated from aluminum except for the small components of transition "C," which are fabricated from brass and electroformed copper. The cell is purposely built to provide mechanical stability and to withstand both handling and experimental operations. In addition, it is important that the cell maintain electrical integrity during operation to provide electromagnetic isolation for the evaluation of experimental components. Thus, provision is made to insure uniform and complete electrical conductance through the inner and outer conductors of the cell. All supporting members within the cell, which are not a part of the effective cell conductance, are fabricated from material with the lowest possible dielectric constant to minimize the effects of these members on the characteristic impedance of the cell.

Figure 2. Side view with "A" transitions clamped in place.

2. MATERIALS

Reference Sheet No. 1. (Optional Items - Reference Sheet No. 2).

3. FABRICATION PROCEDURE

It is suggested that the supporting frame structures be constructed in three parts, i.e., main section (center) and transition "A"-2 each, and that they should be assembled after completion.

It is futher suggested that the main section (center) be constructed in two halves and then bolted together appropriately (1/2-13 UNC), particularly if the work area is restricted in size (fig. 3).

Note that all structural members on the main section are channel members (CM), angles on top and bottom corners excepted.

Subassembly fabrication should be scheduled ahead so that parts will be ready when needed.

It is imperative that all internal weldments be continuous and that they be absolutely free of voids and porosity.

4. SUBASSEMBLIES

	Description	Sheet No.
a.	Access doors	17
b.	Access door frames	16
c.	Access door hardware	1
d.	Muffin fan box and tube (smoke detector)	2
e.	Bulkhead panel frame	18
f.	Bulkhead mount plate	18
g.	Bulkhead box	19
h.	Power outlet receptacle frame	20
i.	Power outlet receptacle box	20
j.	Access door switches	1
k.	Top side delrin[1] rod holders and caps	14
l.	Bottom delrin rod holders	14
m.	Horizontal transition delrin and caps	14
n.	Horizontal rod holder and caps	15
o.	Transition "B" access plates	24

[1]Certain commercial equipment, instruments, or materials are identified in this paper in order to adequately specify the cell construction. In no case does such identification imply recommendation or endorsement by the National Bureau of Standards, nor does it imply that the material or equipment identified is necessarily the best available for the purpose.

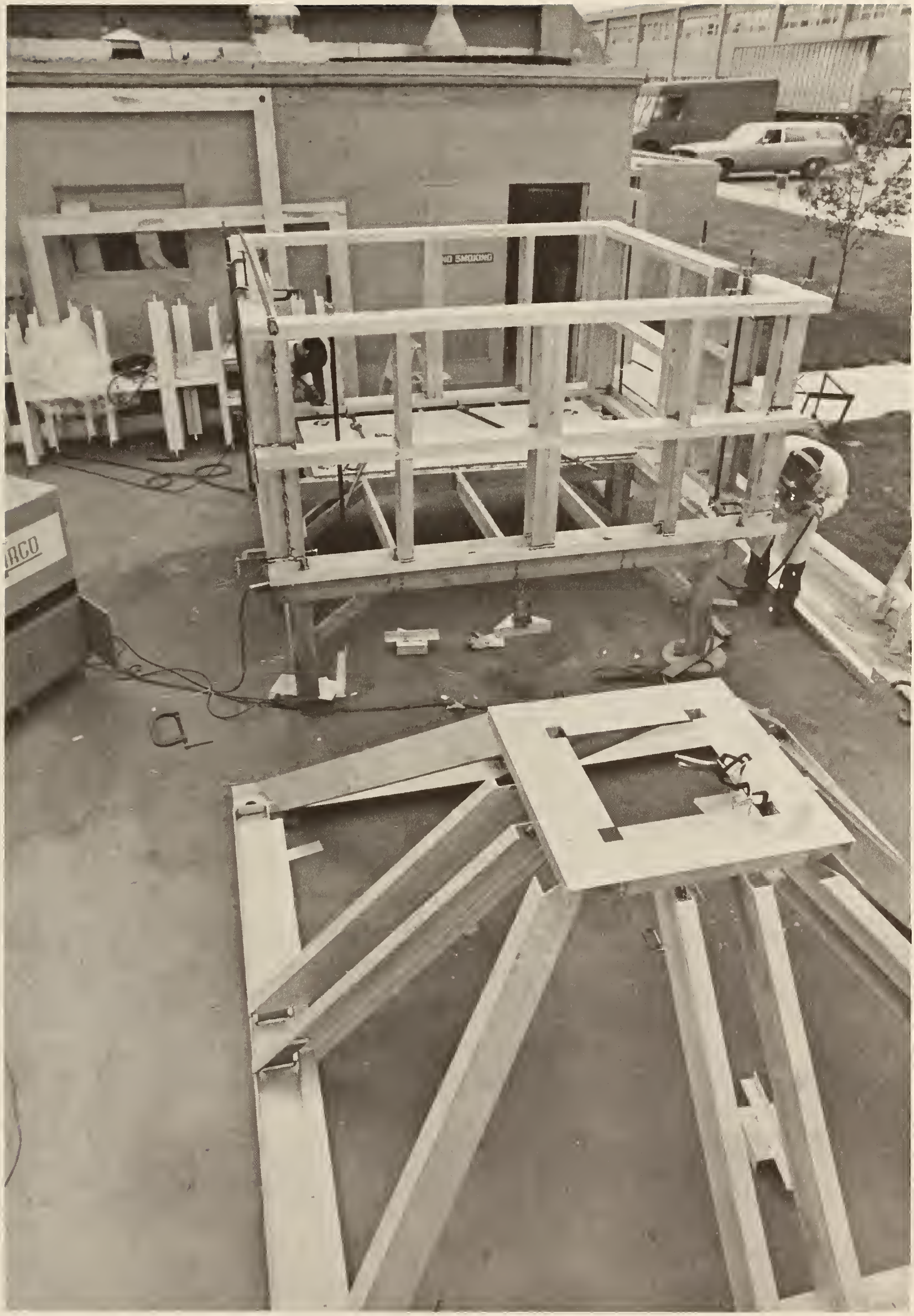


Figure 3. One half of main section is resting on wood frame, welding in progress

p. Transition "B" access plate frames — 23

q. Vertical center conductor support rods — 15

r. Horizontal center conductor support rods — 15

s. Sugar pine — 15

t. Flanges for transitions "A", "B", and "C" — 8, 22, 26

u. Dielectric adjustable elevation table (optional) — 28, 29, 30, 31

Finger stock and rf gasketing must be inserted between all removable metal-to-metal surfaces as required.

5. FABRICATION SEQUENCE, MAIN SECTION (CENTER)

(Reference Sheet No. 3)

Step 1 - All members should be precut precisely and identified.

Step 2 - The large holes should be bored in the top and bottom channel members (CM's) of the large end frames before welding. These holes should later align with similar holes on the large end frame of transition "A."

Step 3 - It should be noted that the two large frames to be bolted together in the center of the main section are not the same as the end frames because the large holes are omitted and that the sides of the frames are separated by 12" on both sides.

Step 4 - The half-sections can now be welded with all welds being located on the inside of CM's and on the side of the channel later to become the external surface of frame. The internal surface of frame should not be welded because it will later receive the plate (skin) (fig. 3).

Step 5 - The two half-sections can now be bolted together forming a structural cube (main section). Extreme care at this juncture should be taken to be well within specified tolerances (Reference Sheet No. 2).

Step 6 - All gussets and reinforcing plates may be added later or at the discretion of the fabricator.

Step 7 - The main section is now ready to accept internal plates (skin); however, care must be taken to have holes punched or milled in the appropriate places and plates for access doors, view ports, smoke detectors, etc., before putting plates in place. Proceed to bolt (10-24x3/8" nickel-plated brass flat-head screws) 1/8" thick plates in place (drill, tap, and countersink from the internal plate surface using conductive liquid adhesive on screws) taking care when plates butt to leave at least a 5/32" gap for a weldment.

Step 8 - Proceed to the external surface and apply intermittent welds, plates to channel at the discretion of welders.

Step 9 - Proceed to the internal surface of the main section and apply longitudinal fillet welds at the four corners and then complete welding of the main section with the four longitudinal butt welds. It is important that only small intermittent tack welds be made at the open ends of the cube to temporarily hold the plate to the smooth surface of the channel. A continuous weld will later be required when the transition "A" is permanently affixed.

Step 10 - All internal weldments at this point can be ground smooth, and all plate surfaces must be surface sanded to remove all mill scale. This will provide an acceptable surface to accommodate the microwave absorber material which will be glued to the internal surface of the cell after the fabrication is complete.

6. FABRICATION SEQUENCE, TRANSITION "A" (2 ea.)

(Reference Sheet No. 7)

Step 11 - Precisely cut CM's for both large and small channel frames. Cut center channel braces (16 required for both "A" transitions).

Step 12 - Bore hole at each end of the longer channel members of large channel frame.

Step 13 - Weld frames. Assure that adjacent channel members in each respective frame are perpendicular (square) to one another. Check using diagonal dimensions in each frame. (Frame is square if diagonal dimensions are identical (figs. 2 and 3).

Step 14 - Bolt (3/8-16 UNC) and weld angle members in proper position inside both frames (Reference Sheet No. 7).

Step 15 - Using suggested fixture (Reference Sheet No. 7) to hold center channel parallel, tack-weld respective pairs of center channel braces to the small channel frame in proper position (with smooth side of small channel frame facing down).

Step 16 - After tacking all four pairs of center channel braces, invert this work, place on top of the large channel frame (with the smooth side of large channel frame facing down), align as necessary, and tack-weld in proper place (fig. 3).

Step 17 - Check elevation of work at this point. It is important that the elevation be 45.250 (+ 0.125, - 0.00) inches from smooth surface of small channel frame to smooth surface of large channel frame.

Step 18 - Weld gussets in place and complete welding of present structures.

Step 19 - Layout, shear, and brake internal corner plates and center plates (Reference Sheet Nos. 11 and 12). Care should be taken to bore or punch access holes for bulkhead panel, power outlet receptacle, etc., in appropriate plates before braking; however, the holes in the center plates for the subassemblies (center conductor horizontal delrin support holders) should be omitted and positioned at a later time (see Step 44).

Step 20 - Bolt (10-24x3/8" UNC nickel plated brass flat-head screws) appropriate 1/8" thick corner plates in place (drill, tap, and countersink from inside, using conductive liquid adhesive from inside) to center channel braces.

Step 21 - Bolt 1/4-20 UNC) flange to flange of 1/8" thick corner plate.

Step 22 - Precisely cut corner channel members (left and right hands) (Reference Sheet No. 11).

Step 23 - Position corner channel braces against bolted flanges of 1/8" thick corner plates and weld these corner channel braces in place.

Step 24 - Bolt (10-24 UNC nickel-plated brass flat-head screw, 3/8" long) 1/8" thick corner plates (drill, tap, and countersink from inside; use conductive liquid adhesive) to newly installed corner channel braces.

Step 25 - All corner plates can now accept an external intermittent weld, channels to plates, at discretion of welders, but again, care should be taken to simply apply small temporary tack welds where the plate edges are held to the large channel frames. A continuous weld will follow when transition is affixed to the center or main section.

Step 26 - Cut and weld in place all intersecting channel braces and apply intermittent weld on these braces where plates and braces touch on the external side.

Step 27 - Center plates can now be positioned, and all longitudinal fillet weldments can be executed, not only on the corners but now on the center plates.

Step 28 - All weldment must now be ground, and all internal plate surfaces must be surface sanded (fig. 4).

Step 29 - One "A" transition can now be positioned and clamped in place at one end of main section and when properly aligned (1/2-13 UNC), the transition can be bolted to the main section, channel-to-channel (figs. 5,6,7).

Step 30 - After properly bolted, the plates of transition "A" and the plates of the main section may now accept an internal continuous weld, vertical and horizontal. This weld must be ground smooth.

Step 31 - Position the remaining transition "A" into proper position and clamp into place. Do not weld or bolt this transition yet (figs. 8 and 9).

Step 32 - It is suggested that the flanges for both "A" transitions (Reference Sheet No. 8) can now be bolted in place. At this time it is pertinent to make precise measurements (center section, cross sectional height, width, and length; transition "A" on axis lengths, and assembly's overall length from transition "B" mating flange surface to opposing transition "B" mating flange surface). These dimensions will be used to make corrections, if required, in size of center conductor (septum) prior to cutting the center conductor. NOTE: The channel frame and the machined flange are first bolted together and can be adjusted by double nutting to achieve the proper horizontal and vertical planes.

Step 33 - If the aforementioned calculations are appropriately acceptable, the small flanges for the "A" transitions can now be secured in place with the bolts and the internal seam can be welded. These welds can only be partially ground at this point.

Step 34 - Make identity marks or reference marks from the clamped "A" transition to the main section and then very carefully unclamp and remove the "A" transition, taking care not to disturb the newly attached flange.

7. CENTER CONDUCTOR (SEPTUM)

Step 35 - Proceed to cut out center conductor (Reference Sheet No. 13). When laying out the hole pattern on the center conductor for the delrin support rods to pass through, a template should be made of the same hole pattern to take in the whole of the center area and one tapered end. Aluminum channel 1" x 2" x1/8" will suffice. This template can then be used to tansfer this hole pattern to the top and bottom of the TEM cell.

If dimensional measurements determined in Step 32 differ substanially (more than 2%) from specifications shown on Reference Sheet No. 13, the center conductor can be redesigned using figure 1 of Appendix A to conform to the outer conductor. Details and equations describing calculations are contained in Appendix A. NOTE: If only the overall length of outer assembly exceeds or is less than specifications, simply adjust septum plate length as appropriate.

Step 36 - Using the template referred to in Step 35, lay out or transfer the hole pattern on the floor and the ceiling of the main section. Take care that this hole pattern is centered in both cases using the same point of reference. Bore holes at these points and weld the internal threaded subassemblies for containing the delrin rods in place (Reference Sheet No. 14). These subassemblies are designed for external welds only.

Step 37 - A wooden frame should be constructed and placed inside the main section to temporarily support the center conductor. The center conductor weighs approximately 275 pounds. With two men working on the frame, approximately 400

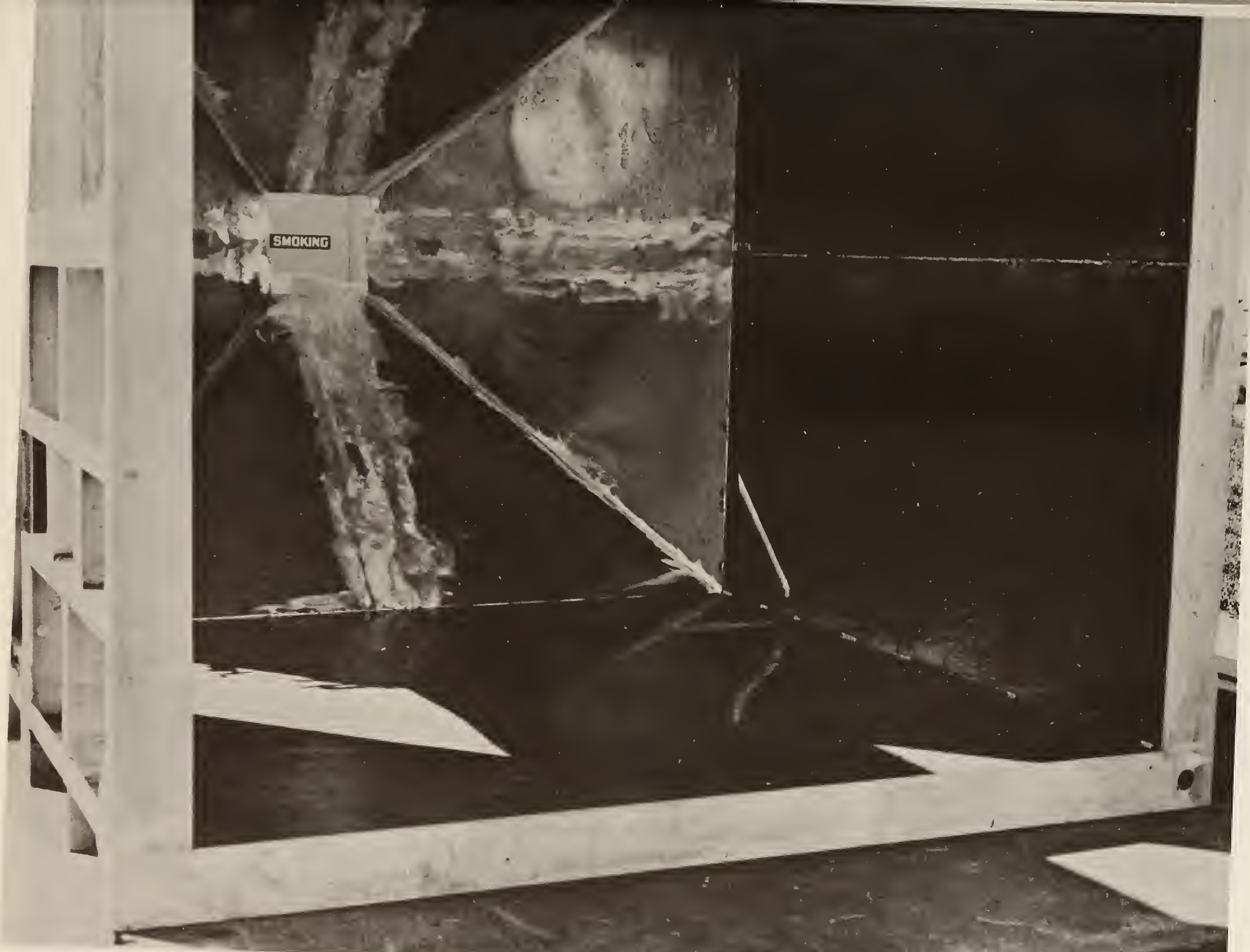
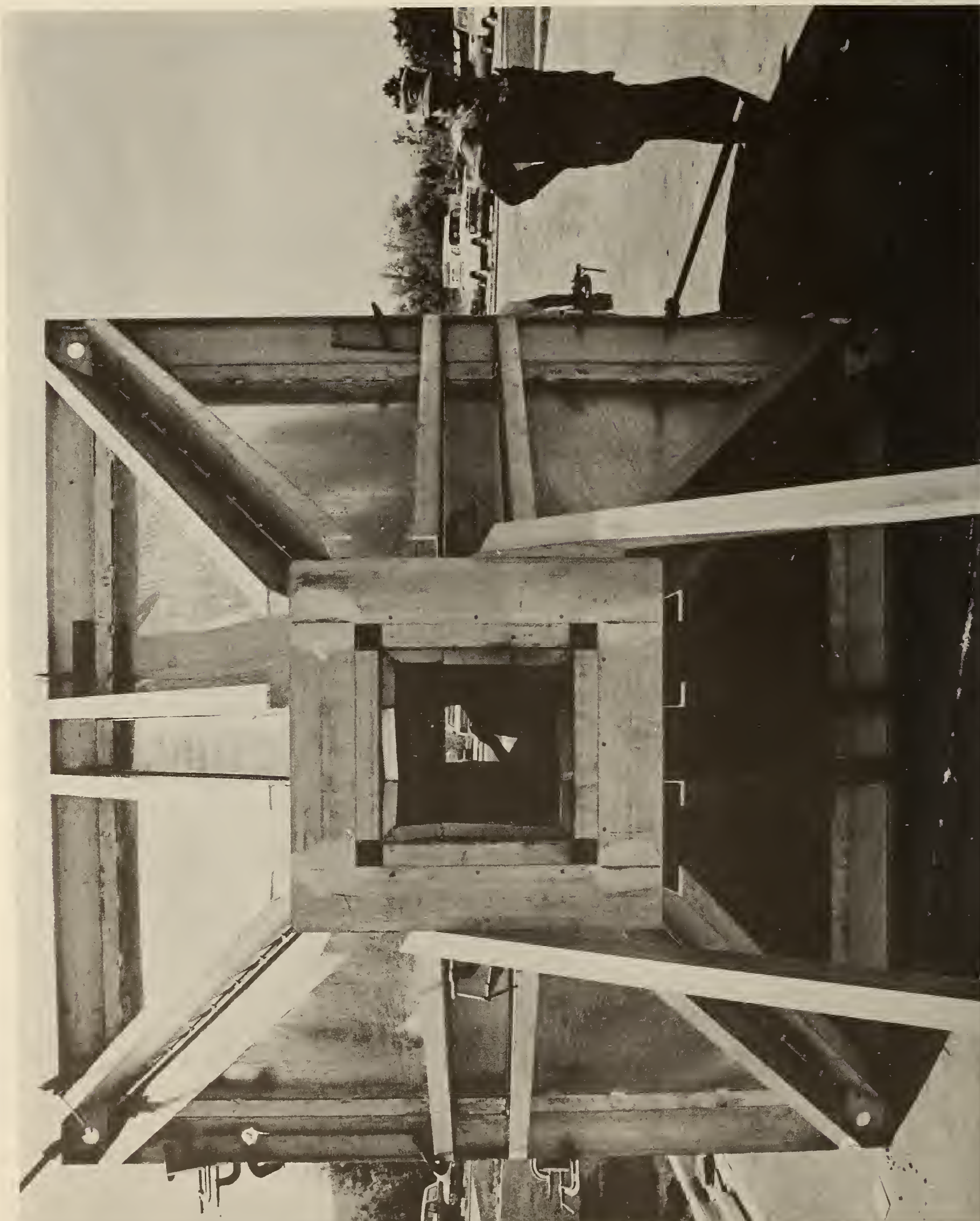


Figure 4. Main section - Transition "A" internal view showing welds ground on transition "A".



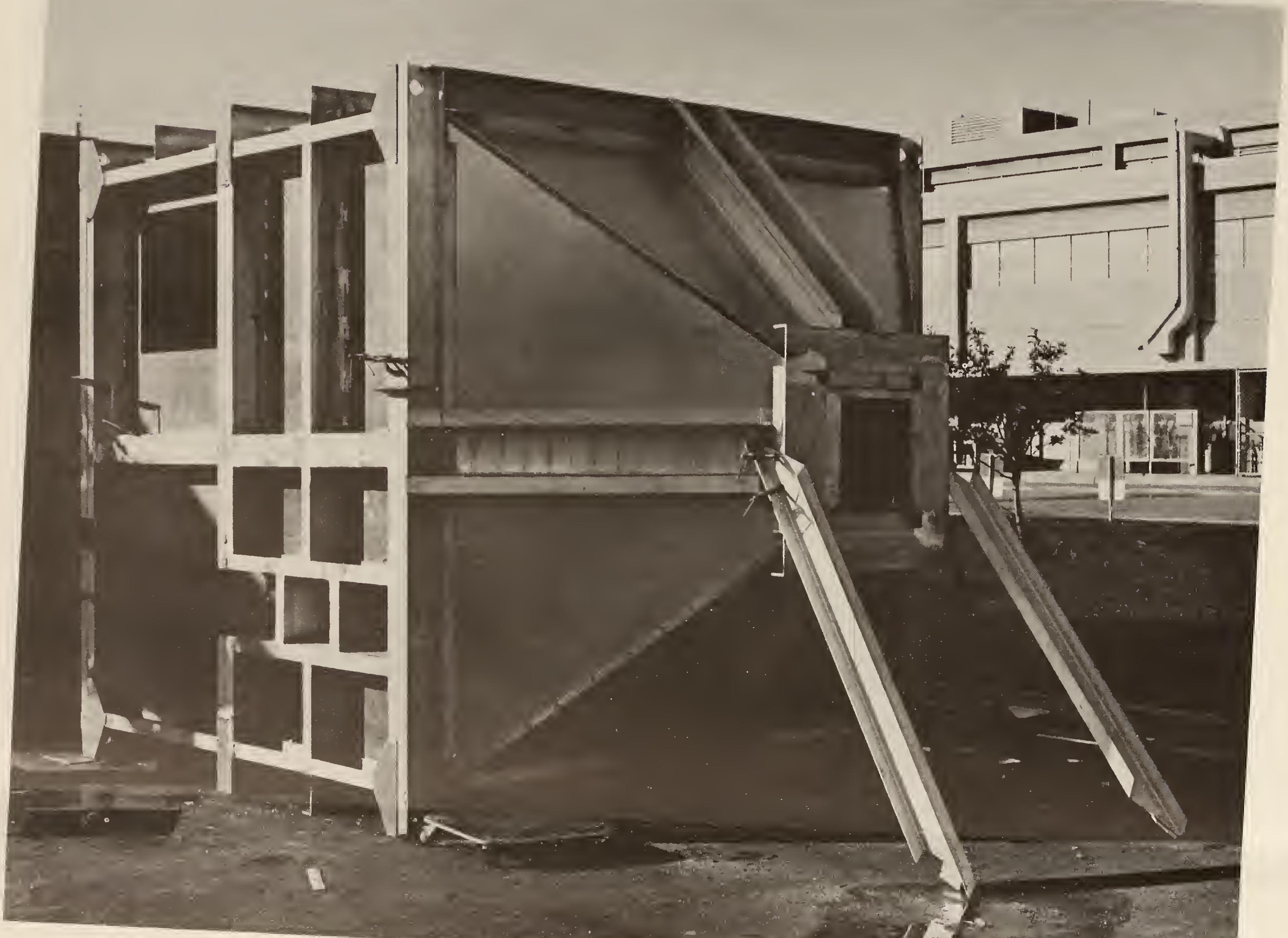


Figure 6. Main section - Transition "A" clamped in place.

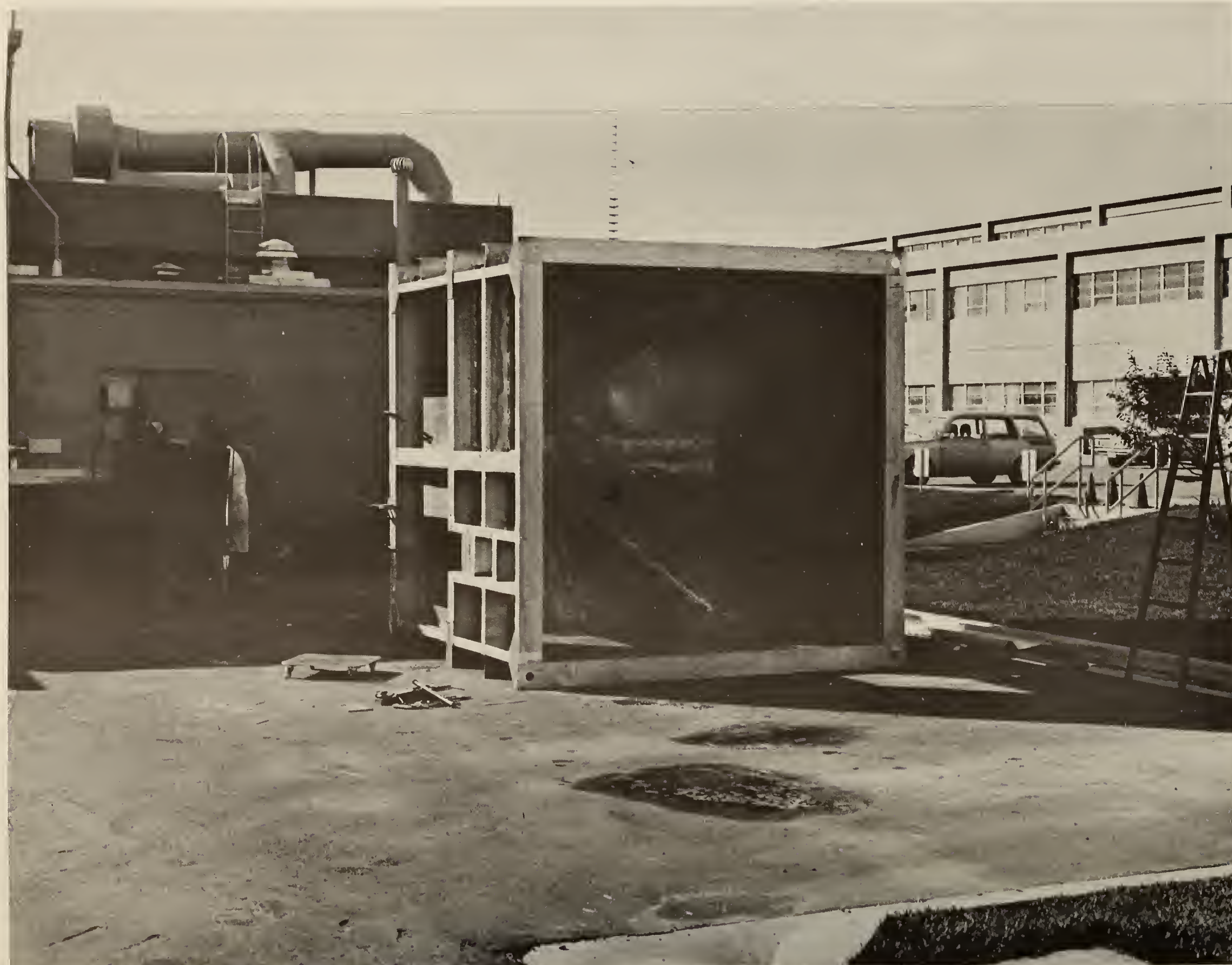


Figure 7. Main section and transition "A" now in position to be joined by an internal weldment.

Figure 8. Transition "A" one Transition "A" in place, one Transition "A" ready to be clamped on for a physical measurement.

Figure 9. Work in progress on fabrication

pounds will be added. The frame should be about 76 inches square and about 46 inches in height.

Step 38 - Place the center conductor in the main section resting on the wooden support frame.

Step 39 - Reposition the remaining "A" transition in place and when properly aligned, bolt (1/2-13 UNC) the transition to the main section, channel to channel (fig. 5).

Step 40 - After sufficiently bolted, the plates of transition "A" and the plates of the main section may now accept an internal continuous weld, vertical and horizontal. This weld must be ground smooth.

Step 41 - Position door frames and clamp in place (Reference Sheet No. 16). Install door frames in the prepared openings on the plates using the heretofore prescribed bolting method. Weld the door frames, by applying a continuous weldment and by clamping on ample heat sinks or back-up bars, to insure minimum warpage.

Step 42 - Accurately position the center conductor. It may be necessary to use throw-away aluminum rods, passing them through the delrin holders on top (ceiling) down through the center conductor and into the delrin holders on the bottom (floor). "

With the center conductor precisely in place, position the hole pattern template (reference Step 35) on top of the TEM cell. With the use of a plumb-bob, locate the hole pattern on the "A" transitions. Once these holes are located and bored, pass the "bob" through these holes and through the holes on the tapered end of the center conductor to locate the holes on the bottom side of the "A" transition. Bore the bottom holes and then externally weld all of the delrin holders in place. Repeat this procedure for the opposite end of the TEM cell.

Step 43 - Install all of the vertical delrin rods.

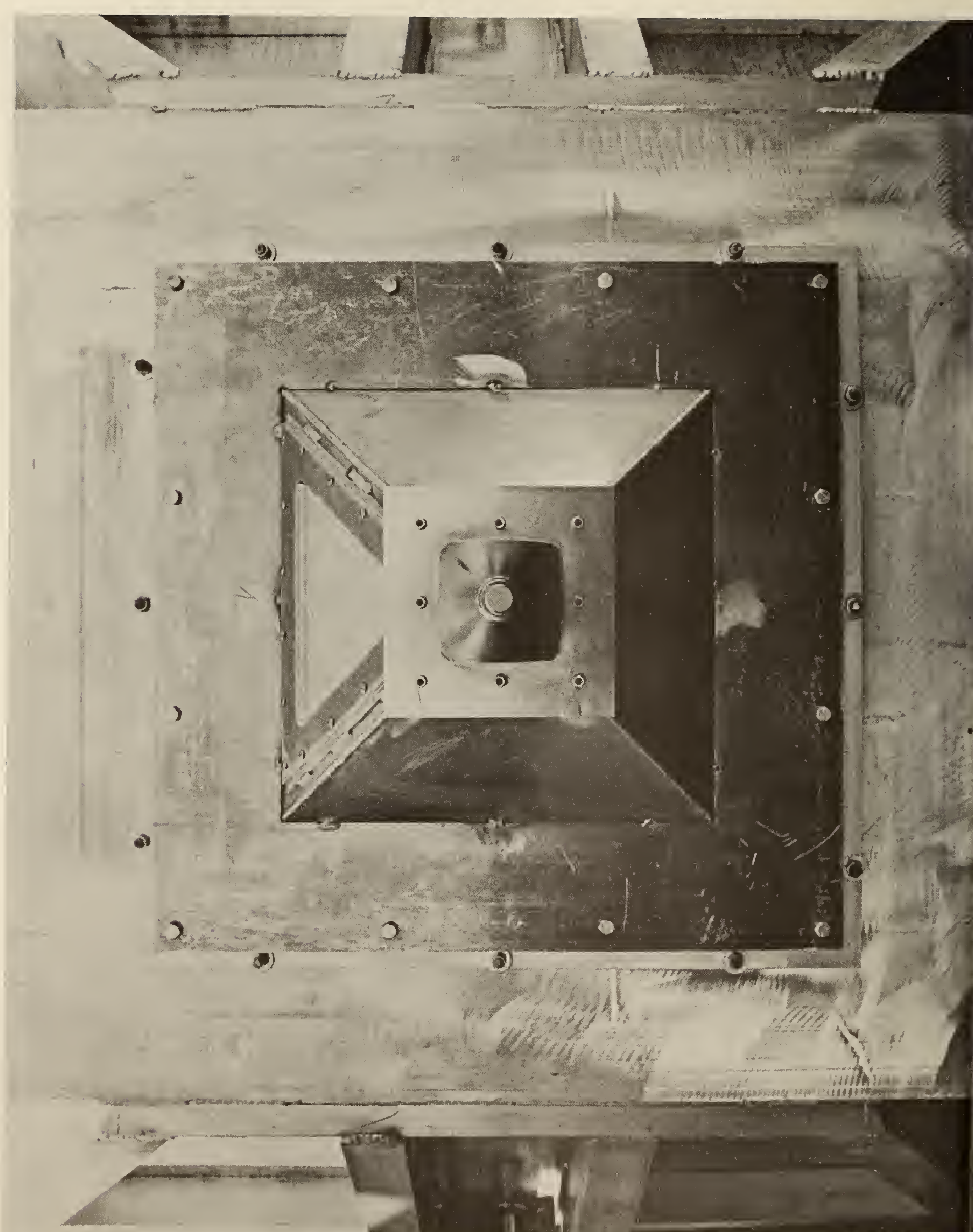
Step 44 - With the center conductor in place it is now possible to locate the holes to be bored into the "A" transition center plates (reference Step 19). These can be located directly opposite the notches on the tapered portion of the center conductor. These holes can now be bored and the horizontal delrin holders welded in place.

8. TRANSITIONS "B" AND "C"

Step 45 - Fabricate transitions "B" and "C" per Reference Sheet Nos. 22 through 27. Experience has shown that it is wise to make the center conductor slightly oversized and then machine it down as required to obtain the desired impedance as measured using a time-domain reflectometer (TDR).

Transitions "B" and "C" can be assembled to each other and then assembled back-to-back (i.e., transition "B" connected to transition "B") to measure their distributed impedance using a TDR prior to their installation on the cell. This allows corrections to be made to the center conductors as suggested above so they conform to their outer conductors as required to obtain a 50-ohm (± 2 ohms) impedance along their length. Once transition "B" and "C" center conductors have been adjusted (if required) so the transition transmission line impedances are 50 ohms (± 2 ohms), they can be installed onto the cell. It should be noted that on the small flanges on both transitions "B" and "C", when the internal surface is ground smooth as required, the strength of the joint is marginal. Therefore, it is recommended that an additional filler rod be applied for strength on the back side of the small flanges (fig. 10).

Step 46 - Install transition "B" outer conductors onto cell. This should be done by first bolting the transitions into position then tack-welding the mating flange of transition on each side. The complete inside seam between "A" and "B" can be welded and ground smooth.



Step 47 - Complete installation of transitions "B" and "C" with their center conductors to the cell. Measure the TDR response of each end of the cell and make additional refinements in the center conductor dimensions by further machining or cutting the center plate if required to obtain 50 ohms (± 2 ohms). If points along the center plate or transition "B" and "C" center conductors are undersized so that the transmission line impedance (measured by the TDR) is over 52 ohms, additional material must be added by soldering, welding, or bolting metal to the center conductor or plate. It should be noted that the outer conductor of transition "C" is fabricated by electroforming copper over an aluminum mandrel (see fig. 4).

Step 48 - Install and wire lights and vent fan for smoke detectors, and install ac power line filter, receptacle (inside fabricated box), and rf filtering (inside fabricated box) over bulkhead as required for EMI measurement applications.

Step 49 - The final step to completing the cell is to attach the microwave absorber to the inside of the cell with the appropriate adhesive to hold it in place, as shown in figure 11.

Step 50 - After installation of absorber, TDR measurements of the cell impedance should be made to insure that its distributed impedance is still within 50 ohms (± 2 ohms). If the addition of absorber lowers the cell impedance below 48 ohms, additional spot trimming of the septum may be required.

THE CELL IS NOW READY FOR OPERATION

9. REFERENCES

[1] Crawford, M. L., and Workman, J. L., Using a TEM cell for EMC measurement of electronic equipment (paper in progress), Nat. Bur. of Stds. (U. S.), Boulder, Colorado.

[2] Decker, W. F., and Lecinski, V., Structural design and fabricating procedures, Nat. Bur. of Stds. (U. S.), Boulder, Colorado.

10. APPENDIX A

Formulation for Design of TEM Cell

A.1 Main (Center) Section

The equation for the characteristic impedance of shielded strip transmission line is given as:

$$Z_o \cong \frac{\eta_o}{4\left[\frac{a}{b} - \frac{2}{\pi} \ln \left(\sinh \frac{\pi g}{2b}\right)\right] - \frac{\Delta C}{\varepsilon_o}} \qquad \text{(a-1)}$$

where a, b, and g are as shown in figure A-1 and η_o is the intrinsic wave impedance of the media (air) inside the cell, (η_o = 376.7 ohms). The term $\Delta C/\varepsilon_o$ relates to the fringing capacitance between the edges of the center plate (septum) and the cell side walls. For large gaps ($w/b \geq 1/2$), used for typical cell designs, this term is negligible. For an exact determination of Z_o, see reference [1]. Curves for designing a cell with arbitrary cross section and impedance are shown in figure A-2. Note: The curve for a square cell (a = b), with a characteristic impedance of 50 ohms, is appropriately indicated.

The length of the septum's main (straight section) region, relative to the cell's outer conductor main region, is shortened so ℓ= 0.94 L; where ℓ and L are as shown in figure A-3.

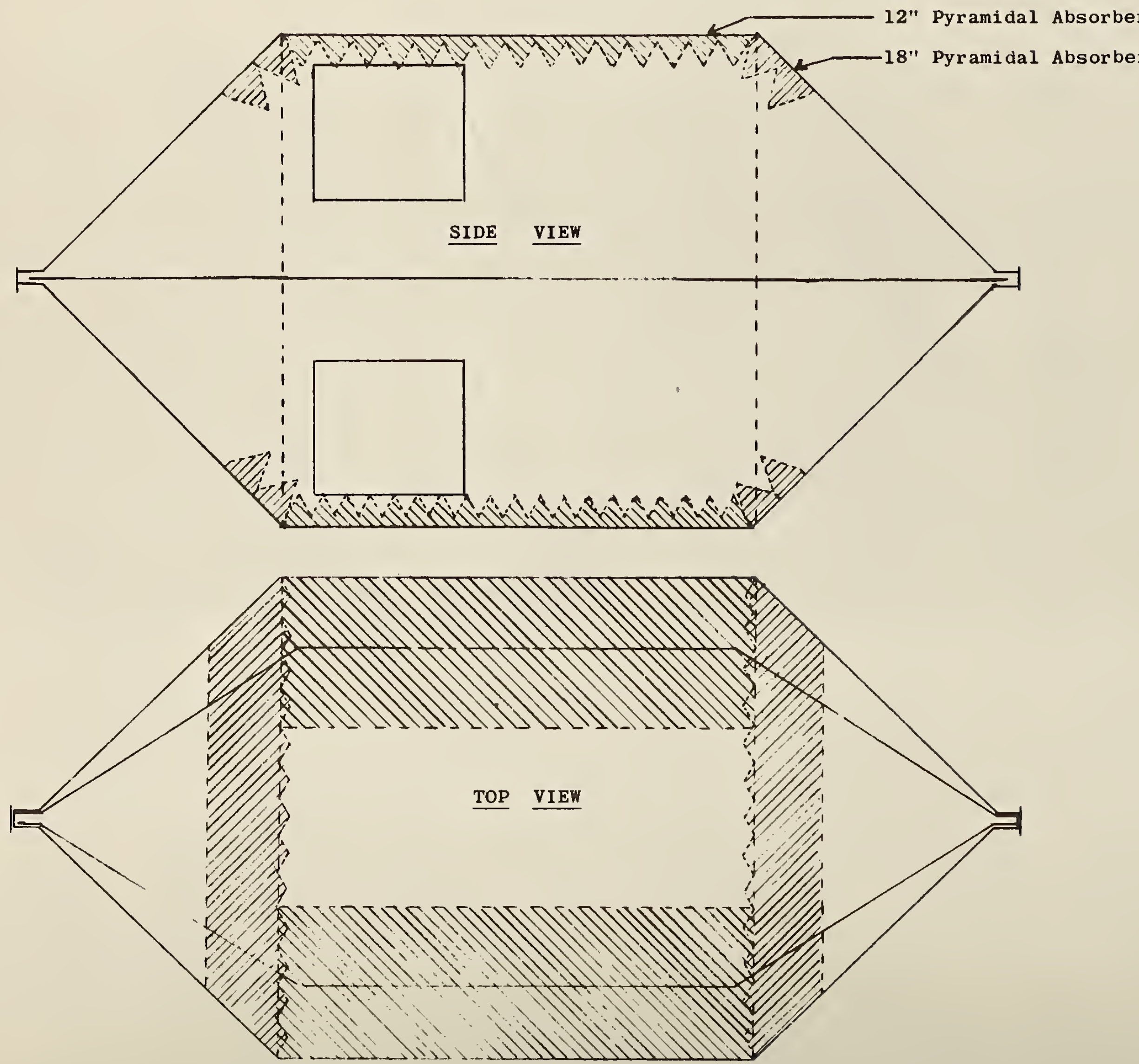


Figure 11. Diagram for absorber loading TEM cell.

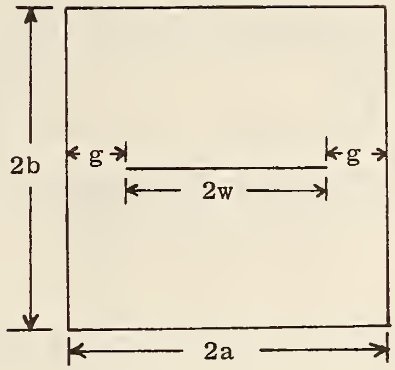


Figure A-1. Cross-section of a TEM cell. (Main section)

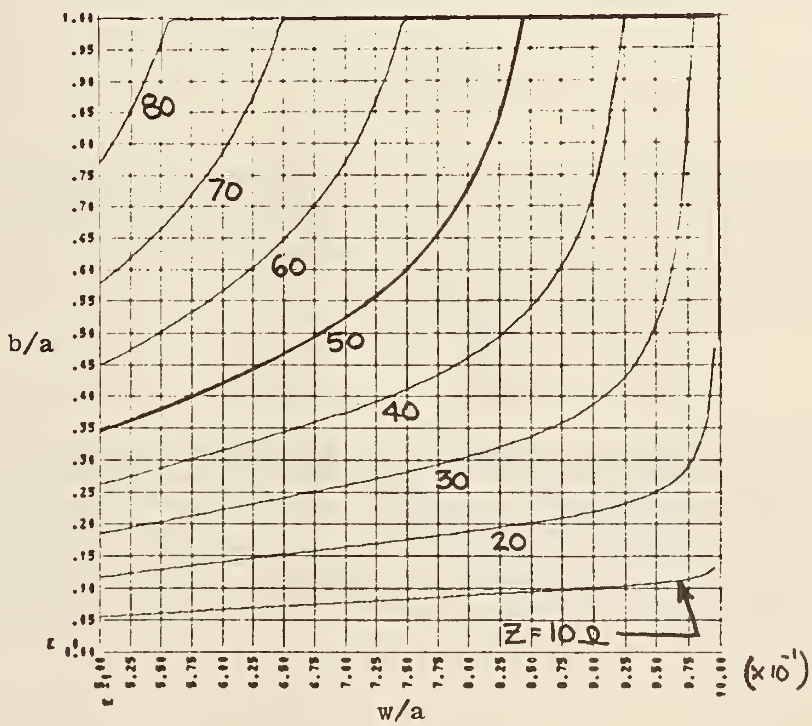


Figure A-2. Design curves for the characteristic impedance of a rectangular coaxial transmission line (TEM cell).

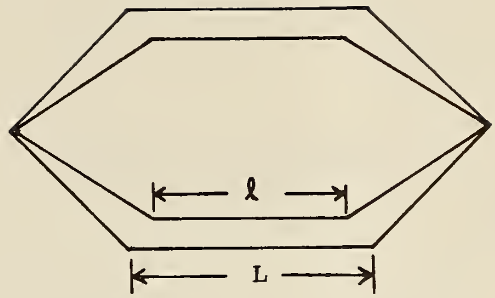


Figure A-3. Top view of a TEM cell.

This is to compensate for the change in impedance of the cell at the beginning of the tapered regions.

A.2 Transition Adaptors

The transitions for adapting the cell transmission line from shielded strip to rectangular coax and then to 14 mm circular coax (Reference Sheet Nos. 22 through 27) are made in two parts. The first part, transition "B," was designed initially using eq (a-1) to calculate appropriate dimensions at the large end, and the expressions

$$Z_o = \frac{\eta_o}{\frac{4C}{\varepsilon} + \frac{2w}{h} + \frac{2d}{g}} \tag{a-2}$$

to calcualte the dimensions at the small end. The parameters g, d, w and h are shown in figure A-4, with $C/\varepsilon = 0.56$ for a square cross section transmission line.

The second part, transition "C," was designed initially using eq (a-2) to calculate the dimensions at its large end, and the expression

$$Z_o \cong \frac{138}{\sqrt{\varepsilon}} \log \frac{b}{d} \tag{a-3}$$

to calculate the dimensions for circular coax at the transition's small end. Note that the dimensions for the center conductors of transitions "B" and "C" (Reference Sheet Nos. 25 and 27) do not conform precisely with calculated values obtained using eq (a-1), (a-2), and (a-3) and the dimensions shown (Refence Sheet Nos. 22, 23, 24 and 26) for the outer conductors. The final dimensions shown on Reference Sheet Nos. 25 and 27 were obtained empirically using a time-domain reflectometer to measure and adjust the center conductor size to obtain the required distributed impedances along the length of the transitions.

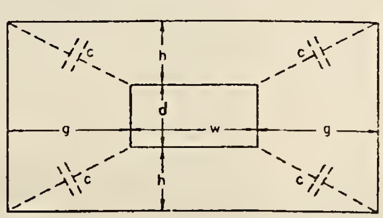


Figure A-4. Cross-section of rectangular coaxial transmission line with thick center conductor.

Figure References

(1) J. C. Tippet, and D. C. Chang, "Radiation characteristics of dipole sources located inside a rectangular, coaxial transmission line," NBSIR 75-829, January 1976.

(2) O. R. Cruzan, and R. V. Garver, "Characteristic impedance of rectangular coaxial transmission lines," IEEE Trans on MTT, September 1964, pp 488-495.

(3) International Telephone and Telegraph Corporation, "Reference Data for Radio Engineers", fourth edition, Copyright 1956, p. 589.

ORIGINAL DATE OF DRAWING	18 AUGUST 1978		
REVISIONS			
NO.	E.C.N.	CHANGE	DATE
1			
2			
3			
4			

) – 20 FT
) – 20 FT
0 LBS) – 16 FT
0 LBS) – 80 FT
– SEE BELOW – INCLUDED IN SUB-ASS'Y "T"
x 14" x 14"
7½" – 2 PLATES
14½ – 2 PLATES
ATE 3/8" x 7½" x 15"
EET #15 – SEE NOTE ABOVE
N SHEET #15 – SEE NOTE ABOVE

COMMERCIAL ITEMS

1). GR-900 BT CONNECTOR —— 2 REQ'D

2). STEEL HEX. HEAD BOLT, ½-13 UNC 1" LONG WITH PLAIN AND LOCK WASHER AND WITH NUT EA. —— 100 REQ'D

3). STEEL HEX. HEAD BOLT, 3/8-16 UNC 2" LONG WITH 2 PLAIN WASHERS AND 3 NUTS EA. —— 50 REQ'D

4). STEEL HEX. HEAD BOLT, 3/8-16 UNC 1½" LONG WITH PLAIN AND LOCK WASHER AND WITH NUT EA. —— 25 REQ'D

5) STEEL HEX. HEAD BOLT, ¼-20 UNC 3/4" LONG WITH PLAIN WASHER EA. —— 150 REQ'D

6) BRASS NICKEL PLATED SCREW #10-24 UNC ½" LONG BINDING HEAD WITH PLAIN WASHER EA. — 100 REQ'D

7) BRASS NICKEL PLATED SCREW #10-24 UNC 3/8" LONG FLAT HEAD —— 1300 REQ'D

8) FINGER CONTACT STRIP FOR SHIELDING INSTRUMENT SPECIALTIES # 97-500 OR EQUIVALENT —— 20 FT REQ'D

9) FINGER CONTACT STRIP FOR SHIELDING INSTRUMENT SPECIALTIES # 97-555 — 10 FT REQ'D OR EQUIVALENT

10) 1" STAINLESS STEEL PIANO HINGE —— 6 FT REQ'D

11) DOOR LATCH SOUTHCO # A2-10-501-21 OR EQUIVALENT —— 12 REQ'D

12) "DELRIN" HEX. HEAD BOLTS ½"-13 UNC —— 32 REQ'D

13) "DELRIN" HEX. NUTS 3/4"-10 UNC —— 32 REQ'D

14) "DELRIN" HEX. HEAD BOLTS 5/16-18 UNC – 2" LONG —— 8 REQ'D

15) "DELRIN" HEX. HEAD BOLTS 5/8-11 UNC, 2½" LONG —— 70 REQ'D

NOTE: SOME ITEMS FABRICATED FROM DELRIN MAY BE NOT AVAILABLE AS COMMERCIAL PRODUCT; MACHINE AS NECESSARY FROM "DELRIN" STOCK LISTED IN SUB-ASS'Y "T"

NATIONAL BUREAU OF STANDARDS
BOULDER, COLORADO, 80303

SCHEDULE OF DRAWINGS

FOR 2.8 m TEM CELL

MODEL 2.8 m	TYPE	SCALE NONE
DIMENSIONS IN INCHES (Unless otherwise specified) TOLERANCES (Unless otherwise specified) DECIMALS ±.000 FRACTIONS ±.010 ANGLES ±½°	DRAFTSMAN Victor Lecinski	CHECKED
	PROJECT ENGR. M.L. CRAWFORD	PROJECT ENGR. J.L. WORKMAN
DO NOT SCALE THIS PRINT	SUBMITTED BY	CHIEF, SEC.
	EXAMINED BY	CHIEF (ENGINEERING)
DIV. SEC. / THIS PRINT ISSUED	APPROVED BY	CHIEF, DIV.
	EN (10 kHz - [illegible]) - V(I[illegible])	

SHEET 1 OF [illegible]

NBS PROJECT 7233570 - 1091

11 AUGUST 1978

2.8m TEM CELL

FOR

ELECTROMAGNETIC INTERFERENCE RESEARCH

SCHEDULE OF DRAWINGS

SHEET #	NOMENCLATURE AND CONTENTS	MATERIALS REQUIRED
1.	TITLE PAGE (LIST OF DRAWINGS, MATERIALS)	
2.	ASSEMBLY 2.8m TEM CELL (OVERALL DIMENSIONS, SUB ASSEMBLIES: MAIN SECTION, TRANSITIONS "A", "B" AND "C")	
3.	ILLUSTRATIVE VIEW (SUGGESTED ORDER OF FABRICATION OF MAIN SECTION)	
4.	DETAIL - MAIN SECTION (STRUCTURAL FRAMEWORK - ONE HALF WITH ACCESS DOORS)	ALUMINUM 6061-T6 CHANNEL 7"[3.205 lbs (2¼" FLANGE) - 220 FT ANGLE ¼" × 2½" × 2½" (1.40 lbs) - 20 FT
5.	DETAIL - MAIN SECTION (STRUCTURAL FRAMEWORK - ONE HALF WITH WINDOWS)	ALUMINUM 6061-T6 CHANNEL 7"[3.205 lbs (2¼" FLANGE) - 220 FT ANGLE ¼" × 2½" × 2½ (1.40 lbs) 20 FT
6.	DETAIL - PLATES FOR MAIN SECTION	ALUMINUM 6061-T6 PLATE ⅛" × 60" × 120" — 8 PLATES
7.	ILLUSTRATIVE VIEW (SUGGESTED ORDER OF FABRICATION OF TRANSITION "A")	
8.	DETAIL - TRANSITION "A" (END FLANGE)	ALUMINUM 6061-T6 PLATE ½" × 28" × 28" — 2 PLATES
9.	DETAIL - TRANSITION "A" (SMALL CHANNEL FRAME)	ALUMINUM 6061-T6 CHANNEL 7"[3.205 lbs (2¼" FLANGE) - 24 FT ANGLE ¼ × 2½" × 2½" (1.40 lbs) - 16 FT
10.	DETAIL - TRANSITION "A" (LARGE CHANNEL FRAME)	ALUMINUM 6061-T6 CHANNEL 7"[3.205 lbs (2¼ FLANGE) - 80 FT ANGLE ¼" × 2½" × 2½" (1.40 lbs) - 80 FT
11.	DETAIL - TRANSITION "A" (CENTER, CORNER AND INTERSECTING CHANNEL BRACES, GUSSETS)	ALUMINUM 6061-T6 CHANNEL 7"[3.205 lbs (2¼ FLANGE) 120 FT PLATE ¼" × 5" - 10 FT
12.	DETAIL - PLATES FOR TRANSITION "A"	ALUMINUM 6061-T6 PLATE ⅛" × 60" × 120" — 8 PLATES
13.	MAIN CENTER CONDUCTOR	ALUMINUM 5456-H116 PLATE 3/16" × 56" × 240"
14.	SHIELDED LOCKNUTS FOR SUSPENSION RODS	ALUMINUM 6061-T6 ROUND BAR 2½" DIA - 13 FT PLATE ¾" × 5" - 10 FT
15.	GIRDERS AND SUSPENSION RODS	ALUMINUM 6061-T6 ROUND BAR 2½" DIA - 3 FT NOTE "DELRIN" AND WOOD SEE BELOW [illegible] "T"
16.	DOOR FRAME	ALUMINUM 6061-T6 PLATE ¾" × 36" × 42" — 2 PLATES
17.	ACCESS DOOR	ALUMINUM 6061-T6 PLATE 1" × 32" × 42" — 2 PLATES
18.	CONNECTOR BULKHEAD FRAME AND CONNECTOR MOUNT	ALUMINUM 6061-T6 PLATE ¾" × 14" × 16" — 2 PLATES
19.	COVER FOR CONNECTOR BULKHEAD	ALUMINUM 6061-T6 PLATE 3/16" × 24" × 32" PLATE ⅛" × 14" × 16"
20.	REMOTE CONNECTOR BULKHEAD AND AC POWER BOX	ALUMINUM 6061-T6 PLATE 3/16" × 10" × 12" PLATE ⅛" × 7" × 9" PLATE ¼" × 14" × 14"
21.	OBSERVATION WINDOW	SUPPLIED BY VENDOR — SPECIAL ORDER 3 WINDOWS
22.	TRANSITION "B" (END FLANGES)	ALUMINUM 6061-T6 PLATE ½" × 26½" × 26½" - 2 PLATES PLATE ½" × 7½" × 7½" - 2 PLATES
23.	TRANSITION "B" (SIDE PLATES, COVER FRAME)	ALUMINUM 6061-T6 PLATE ⅛" × 11" × 17" — 4 PLATES PLATE ¼" × 8½ × 14½ - 2 PLATES
24.	TRANSITION "B" (COVER PLATE)	ALUMINUM 6061-T6 PLATE ¼" × 8" × 14" — 2 PLATES
25.	TRANSITION "B" CENTER CONDUCTOR	FREE CUTTING BRASS PLATE 1/4" × 8½" × 13½" — 4 PLATES
26	TRANSITION "C" (MANDREL FOR ELECTROFORMING OUTER CONDUCTOR, END FLANGE)	ALUMINUM 6061-T6 SQUARE BAR 4" × 4" × 19" FREE CUTTING BRASS PLATE ¼" × 7½" × 15"
27.	TRANSITION "C" CENTER CONDUCTOR	FREE CUTTING BRASS ROUND BAR 2" DIA × 17"
28.	SUB-ASSEMBLY "T" (ADJUSTABLE HEIGHT TABLE - ASS'Y)	"DELRIN" 3/4" DIA ROD - 130 FT 1¼" DIA ROD - 12 FT NOTE: FOR ITEMS ON SHEET #15 - SEE VIEW ABOVE
29	ELEVATION MANUAL DRIVE COMPONENTS	"DELRIN" 6" DIA ROUND BAR - 3 FT
30.	BASE OF TABLE	"DELRIN" 2" DIA ROUND BAR - 6 FT 1/4" DIA ROUND BAR — 6 FT
31.	FRAME FOR TABLE TOP	"DELRIN" PLATE 1" × 12" × 12" PLATE ¾" × 16" × 16"
32.	TABLE TOP	SUGAR PINE 2" × 6" × 150 BOARD FEET (NO KNOTS) NOTE: INCLUDING ITEMS ON SHEET #15 SEE [illegible]

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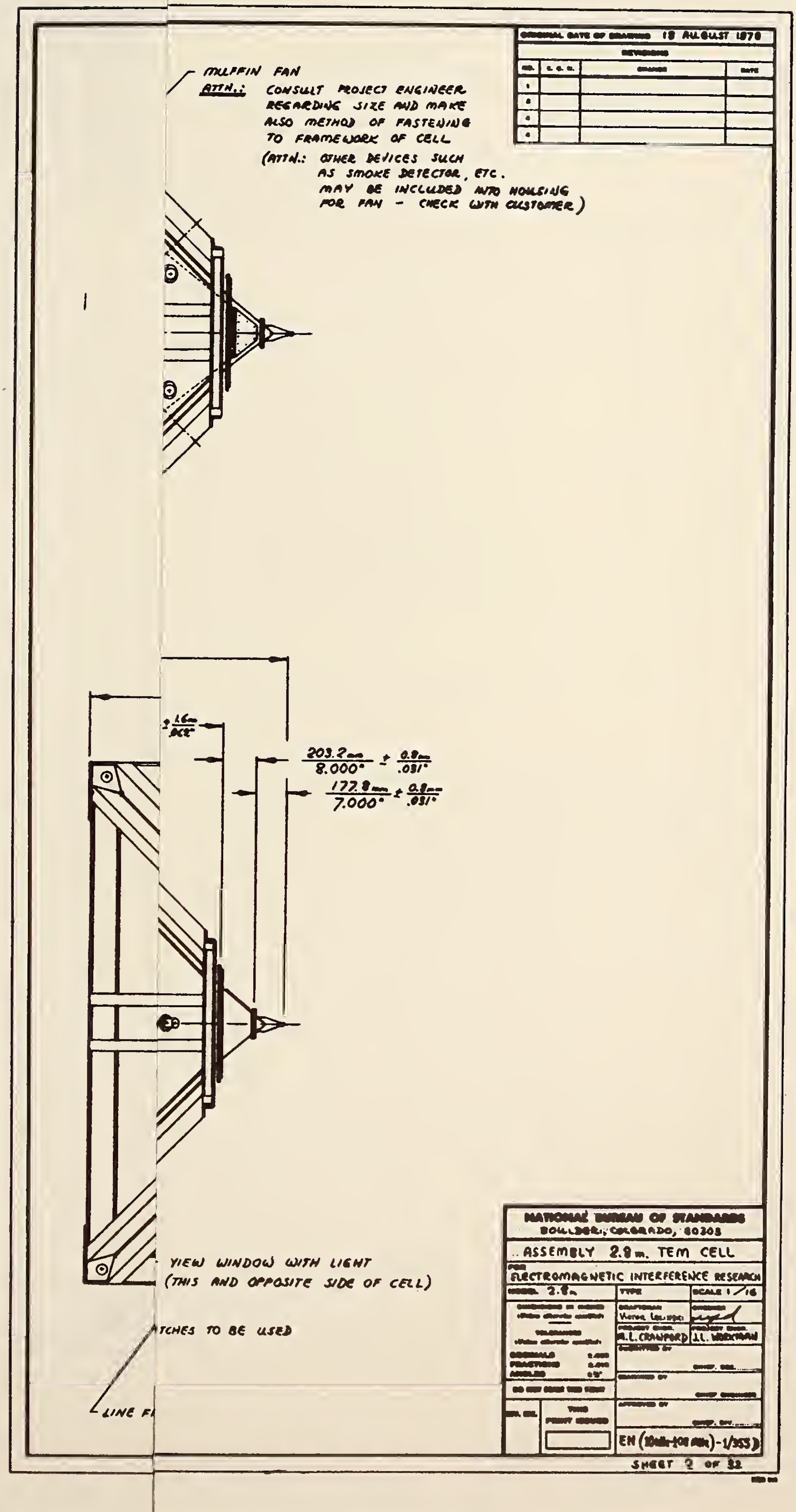
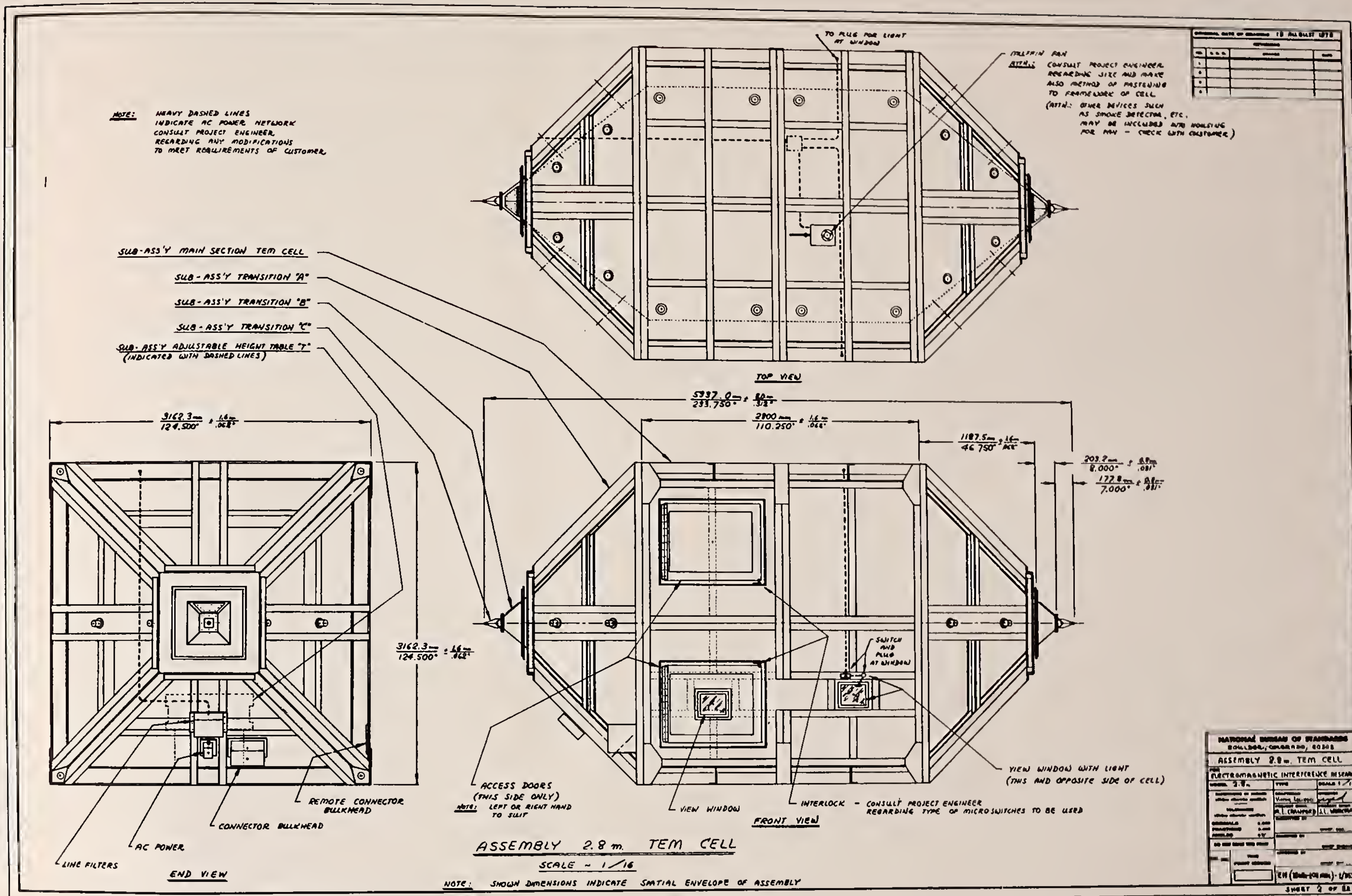
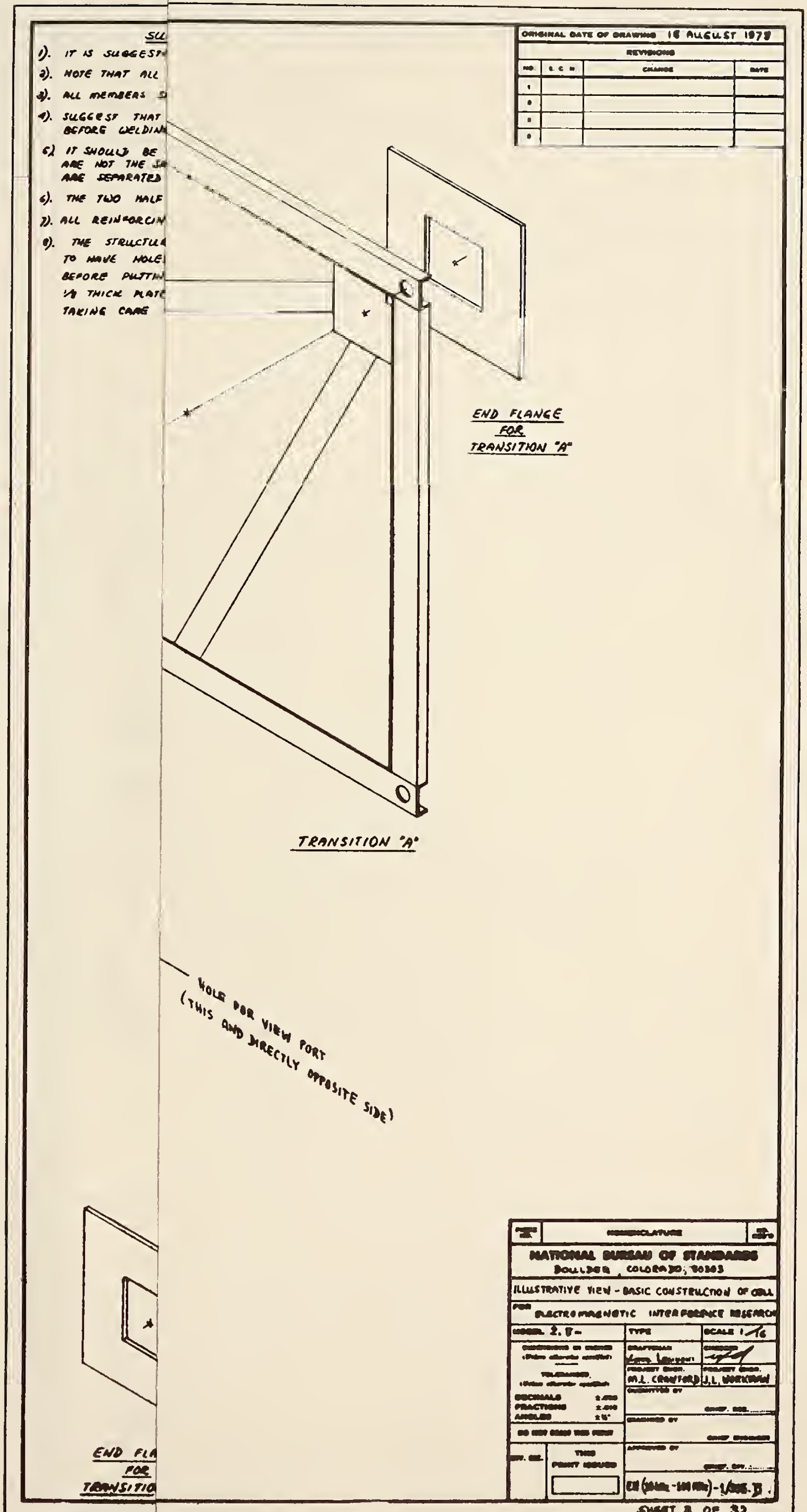
BOULDER, COLORADO

SCHEDULE OF DRAWINGS

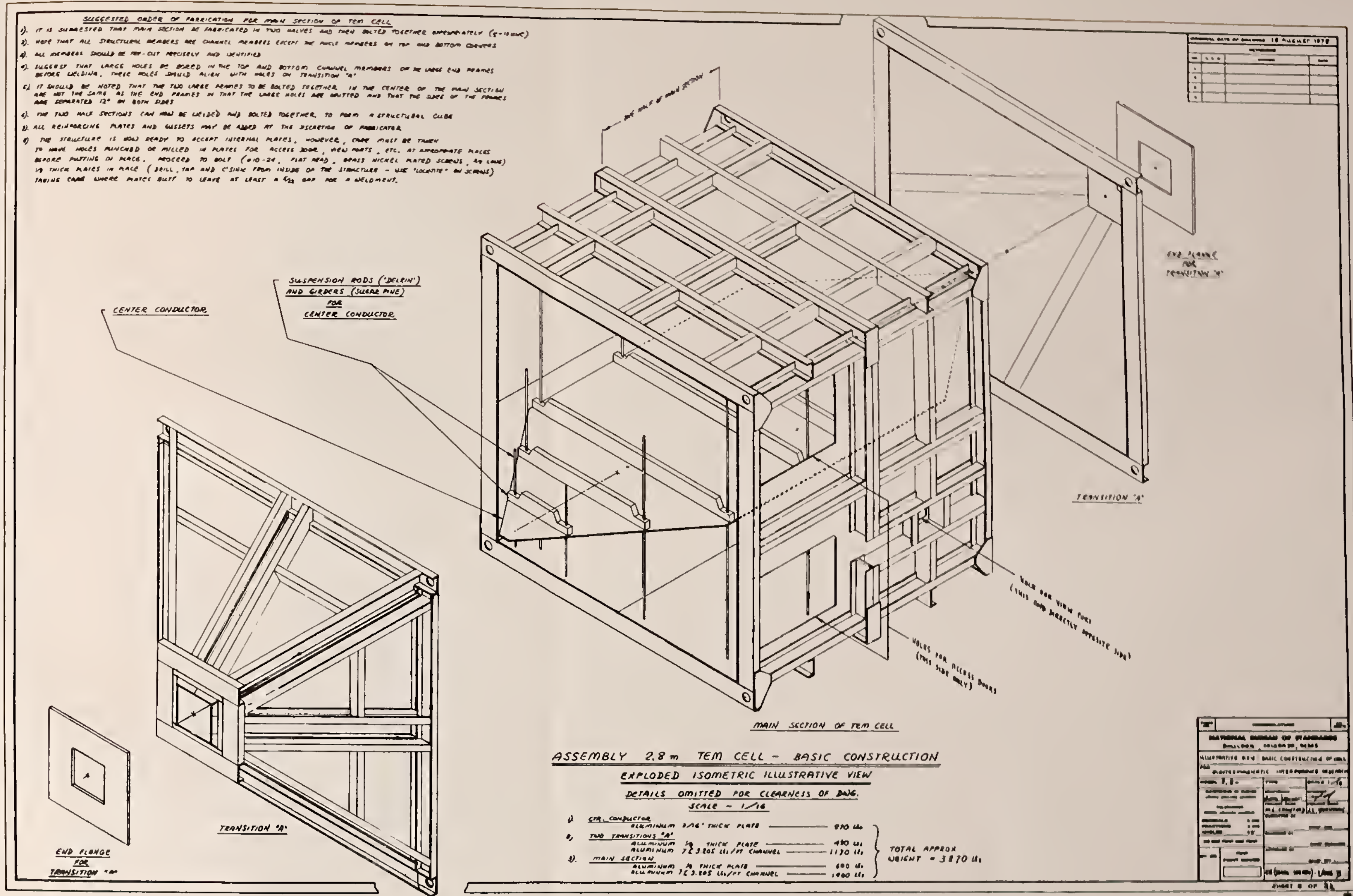
2.8m TEM CELL

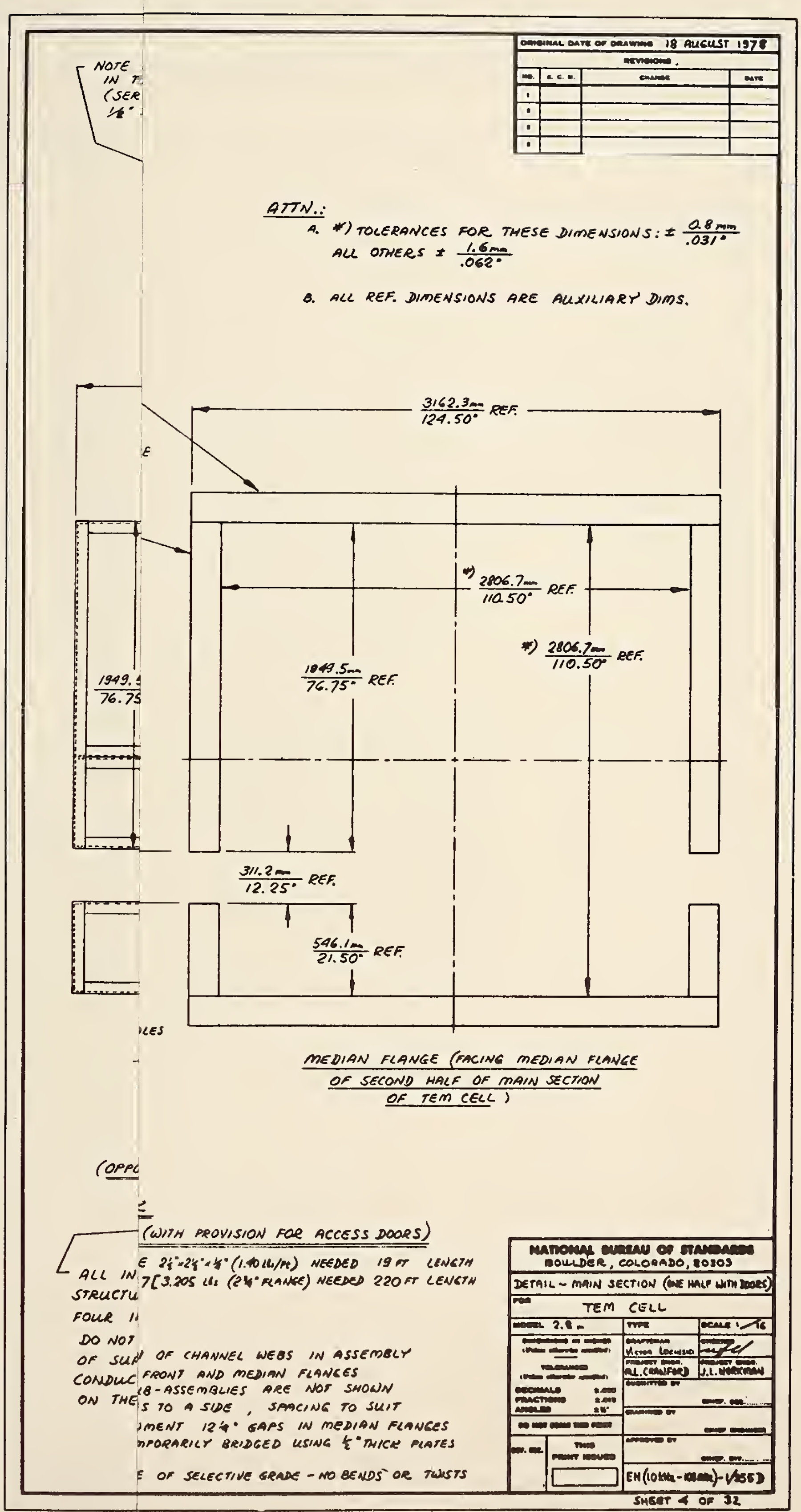

MUFFIN FAN
ATTN.: CONSULT PROJECT ENGINEER REGARDING SIZE AND MAKE ALSO METHOD OF FASTENING TO FRAMEWORK OF CELL
(ATTN.: OTHER DEVICES SUCH AS SMOKE DETECTOR, ETC. MAY BE INCLUDED INTO HOUSING FOR FAN - CHECK WITH CUSTOMER)
203.2mm / 8.000" ± 0.8mm / .031"
177.8mm / 7.000" ± 0.8mm / .031"
VIEW WINDOW WITH LIGHT (THIS AND OPPOSITE SIDE OF CELL)
TCHES TO BE USED
LINE F
REVISIONS
NATIONAL BUREAU OF STANDARDS
BOULDER, COLORADO, 80303
ASSEMBLY 2.9m. TEM CELL
ELECTROMAGNETIC INTERFERENCE RESEARCH
SCALE 1/16
M.L. CRAWFORD
SHEET 2 OF 32


NOTE: HEAVY DASHED LINES INDICATE AC POWER NETWORK CONSULT PROJECT ENGINEER REGARDING ANY MODIFICATIONS TO MEET REQUIREMENTS OF CUSTOMER
TO PLUG FOR LIGHT AT WINDOW
MUFFIN FAN
ATTN.: CONSULT PROJECT ENGINEER REGARDING SIZE AND MAKE ALSO METHOD OF FASTENING TO FRAMEWORK OF CELL
(ATTN.: OTHER DEVICES SUCH AS SMOKE DETECTOR, ETC. MAY BE INCLUDED INTO HOUSING FOR FAN - CHECK WITH CUSTOMER)
SUB-ASS'Y MAIN SECTION TEM CELL
SUB-ASS'Y TRANSITION "A"
SUB-ASS'Y TRANSITION "B"
SUB-ASS'Y TRANSITION "C"
SUB-ASS'Y ADJUSTABLE HEIGHT TABLE "T" (INDICATED WITH DASHED LINES)
TOP VIEW
5937.0 mm / 233.750"
2800 mm / 110.250"
1187.5 mm / 46.750"
203.2 mm / 8.000"
177.8 mm / 7.000"
3162.3 mm / 124.500"
3162.3 mm / 124.500"
SWITCH AND PLUG AT WINDOW
VIEW WINDOW WITH LIGHT (THIS AND OPPOSITE SIDE OF CELL)
ACCESS DOORS (THIS SIDE ONLY)
NOTE: LEFT OR RIGHT HAND TO SUIT
VIEW WINDOW
INTERLOCK - CONSULT PROJECT ENGINEER REGARDING TYPE OF MICROSWITCHES TO BE USED
FRONT VIEW
REMOTE CONNECTOR BULKHEAD
CONNECTOR BULKHEAD
AC POWER
LINE FILTERS
END VIEW
ASSEMBLY 2.8 m. TEM CELL
SCALE ~ 1/16
NOTE: SHOWN DIMENSIONS INDICATE SPATIAL ENVELOPE OF ASSEMBLY
NATIONAL BUREAU OF STANDARDS
BOULDER, COLORADO, 80303
ASSEMBLY 2.8 m. TEM CELL
ELECTROMAGNETIC INTERFERENCE RESEARCH
SCALE 1/16
SHEET 2 OF 11

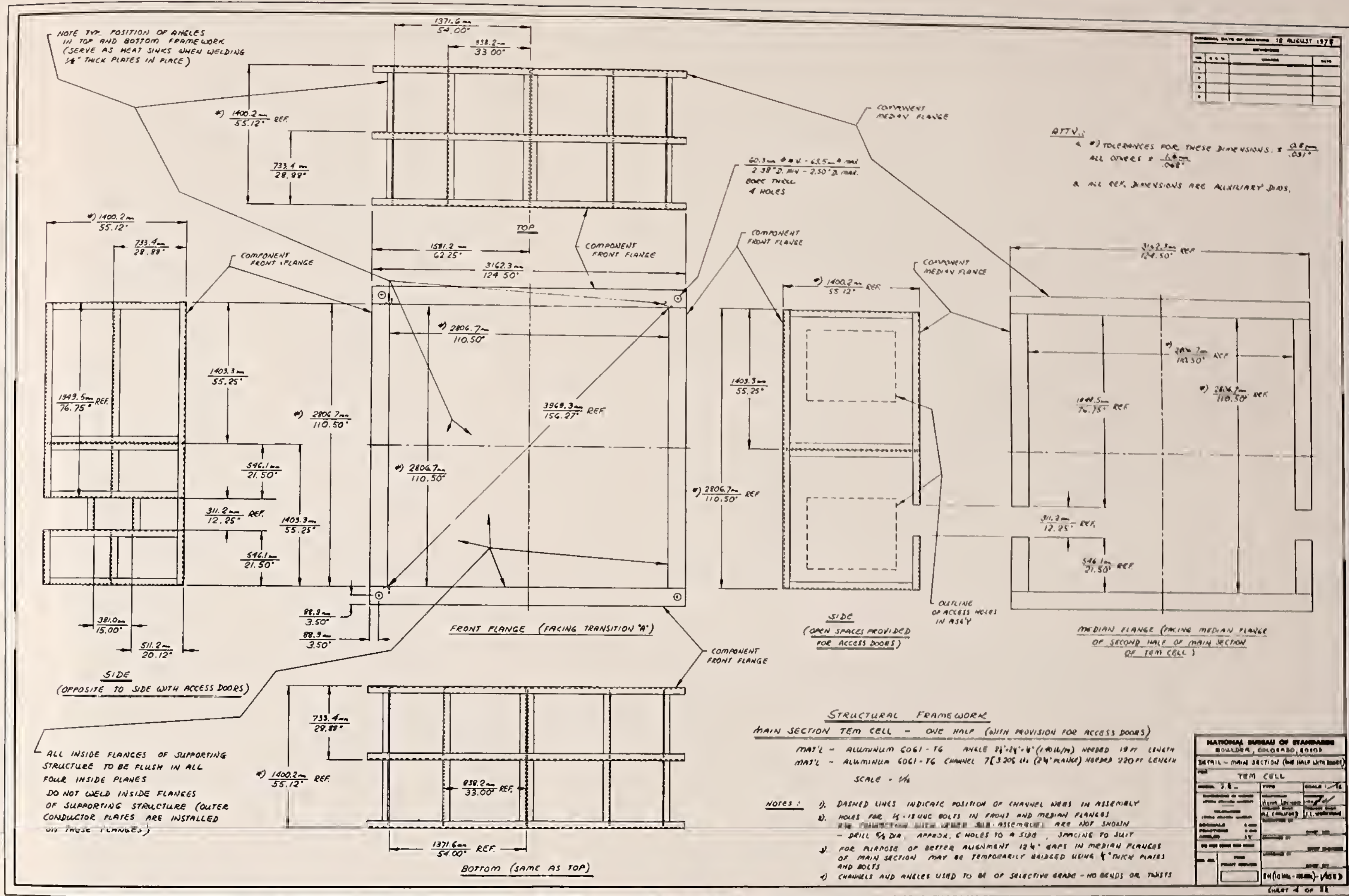


ORIGINAL DATE OF DRAWING 18 AUGUST 1978
REVISIONS
END FLANGE
FOR
TRANSITION "A"
TRANSITION "A"
HOLE FOR VIEW PORT
(THIS AND DIRECTLY OPPOSITE SIDE)
NATIONAL BUREAU OF STANDARDS
BOULDER, COLORADO, 80303
ILLUSTRATIVE VIEW - BASIC CONSTRUCTION OF CELL
ELECTROMAGNETIC INTERFERENCE RESEARCH
M.L. CRAWFORD
J.L. WORKMAN
SHEET 8 OF 32

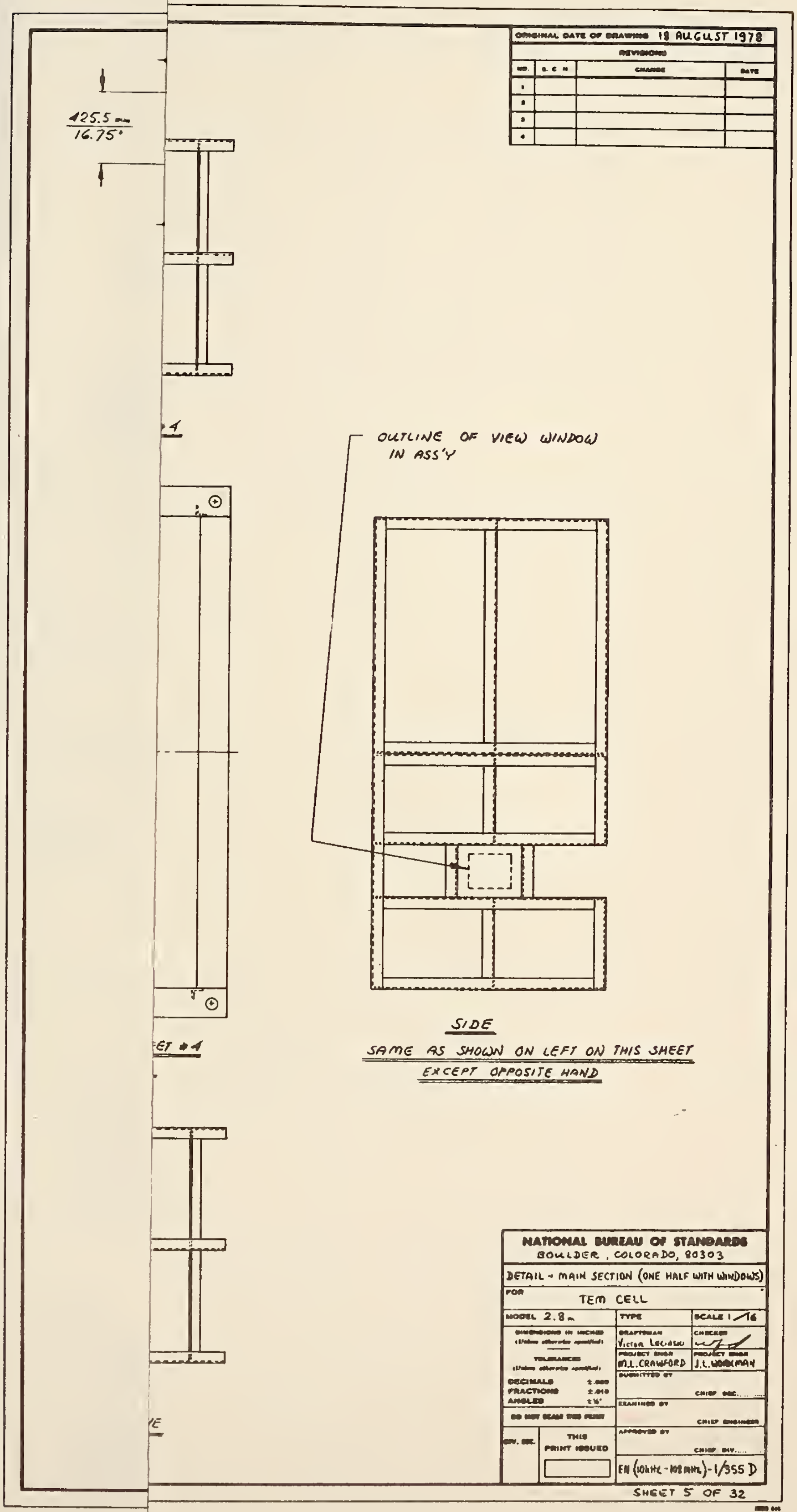

SUGGESTED ORDER OF FABRICATION FOR MAIN SECTION OF TEM CELL
1). IT IS SUGGESTED THAT MAIN SECTION BE FABRICATED IN TWO HALVES AND THEN BOLTED TOGETHER APPROPRIATELY
2). NOTE THAT ALL STRUCTURAL MEMBERS ARE CHANNEL MEMBERS EXCEPT THE ANGLE MEMBERS ON TOP AND BOTTOM CORNERS
3). ALL MEMBERS SHOULD BE PRE-CUT PRECISELY AND IDENTIFIED
4). SUGGEST THAT LARGE HOLES BE BORED IN THE TOP AND BOTTOM CHANNEL MEMBERS OF THE LARGE END FRAMES BEFORE WELDING. THESE HOLES SHOULD ALIGN WITH HOLES ON TRANSITION "A"
5). IT SHOULD BE NOTED THAT THE TWO LARGE FRAMES TO BE BOLTED TOGETHER IN THE CENTER OF THE MAIN SECTION ARE NOT THE SAME AS THE END FRAMES IN THAT THE LARGE HOLES ARE OMITTED AND THAT THE SIDES OF THE FRAMES ARE SEPARATED 12" ON BOTH SIDES
6). THE TWO HALF SECTIONS CAN NOW BE WELDED AND BOLTED TOGETHER TO FORM A STRUCTURAL CUBE
7). ALL REINFORCING PLATES AND GUSSETS MAY BE ADDED AT THE DISCRETION OF FABRICATOR
8) THE STRUCTURE IS NOW READY TO ACCEPT INTERNAL PLATES, HOWEVER, CARE MUST BE TAKEN TO HAVE HOLES PUNCHED OR MILLED IN PLATES FOR ACCESS DOOR, VIEW PORTS, ETC. AT APPROPRIATE PLACES BEFORE PUTTING IN PLACE. PROCEED TO BOLT (#10-24, FLAT HEAD, BRASS NICKEL PLATED SCREWS) 1/8 THICK PLATES IN PLACE (DRILL, TAP AND C'SINK FROM INSIDE OF THE STRUCTURE - USE "LOCTITE" ON SCREWS) TAKING CARE WHERE PLATES BUTT TO LEAVE AT LEAST A 1/32 GAP FOR A WELDMENT.
ONE HALF OF MAIN SECTION
END FLANGE FOR TRANSITION "A"
TRANSITION "A"
SUSPENSION RODS ("DELRIN") AND GIRDERS (SUGAR PINE) FOR CENTER CONDUCTOR
CENTER CONDUCTOR
HOLE FOR VIEW PORT (THIS AND DIRECTLY OPPOSITE SIDE)
HOLES FOR ACCESS DOORS (THIS SIDE ONLY)
MAIN SECTION OF TEM CELL
TRANSITION "A"
END FLANGE FOR TRANSITION "A"
ASSEMBLY 2.8 m TEM CELL - BASIC CONSTRUCTION
EXPLODED ISOMETRIC ILLUSTRATIVE VIEW
DETAILS OMITTED FOR CLEARNESS OF DWG.
SCALE ~ 1/16
1) CTR. CONDUCTOR
ALUMINUM 3/16" THICK PLATE — 870 lbs
2) TWO TRANSITIONS "A"
ALUMINUM 1/8 THICK PLATE — 490 lbs
ALUMINUM 7 [3.205 lbs/ft CHANNEL — 1170 lbs
3). MAIN SECTION
ALUMINUM 1/8 THICK PLATE — 600 lbs
ALUMINUM 7 [3.205 lbs/ft CHANNEL — 1400 lbs
TOTAL APPROX WEIGHT = 3870 lbs
18 AUGUST 1978
NATIONAL BUREAU OF STANDARDS
BOULDER, COLORADO

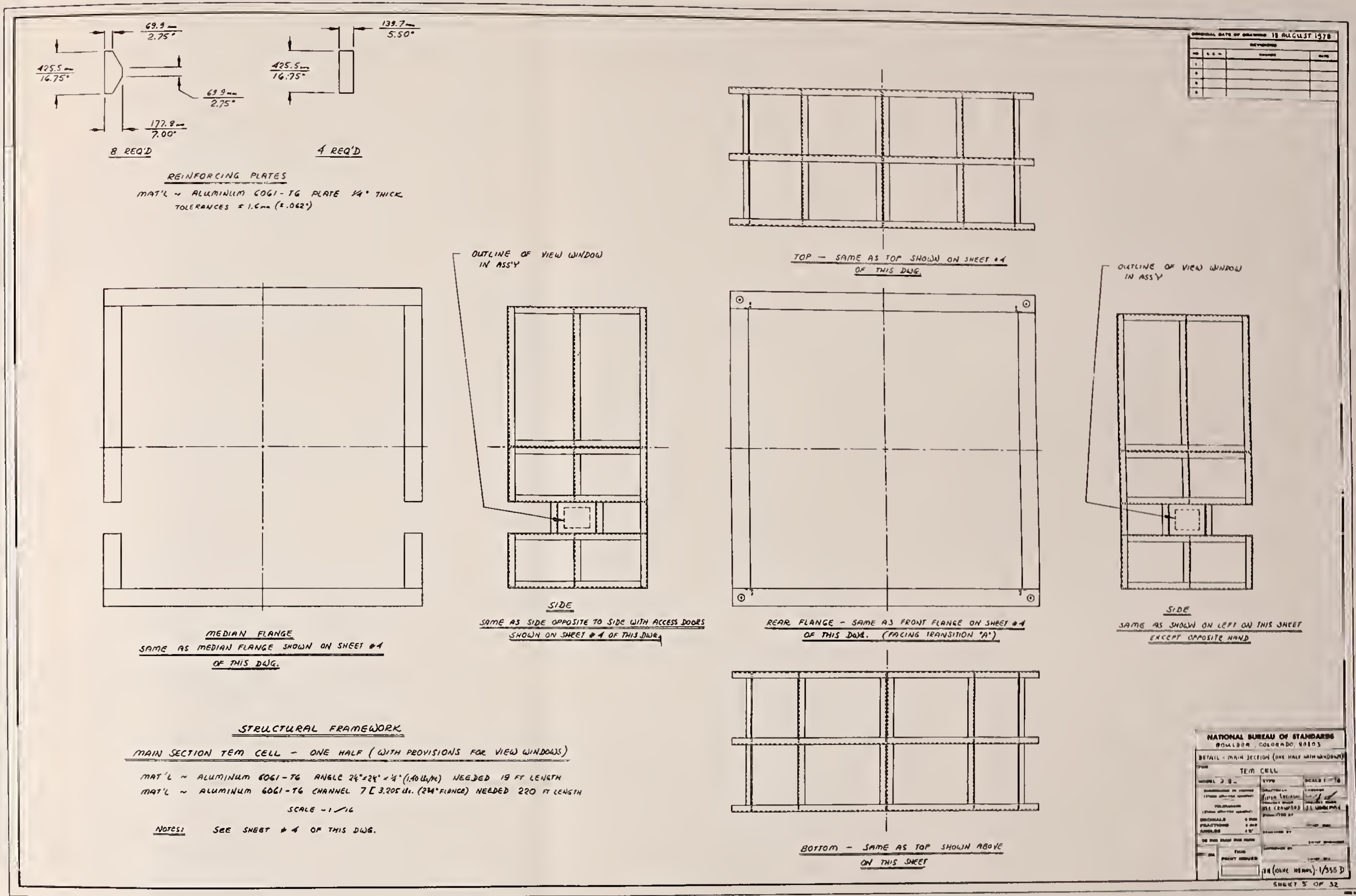


ORIGINAL DATE OF DRAWING 18 AUGUST 1978
REVISIONS
NO.
E. C. N.
CHANGE
DATE
ATTN.:
A. *) TOLERANCES FOR THESE DIMENSIONS: ± 0.8 mm / .031"
ALL OTHERS ± 1.6 mm / .062"
B. ALL REF. DIMENSIONS ARE AUXILIARY DIMS.
3162.3mm / 124.50" REF.
*) 2806.7mm / 110.50" REF.
*) 2806.7mm / 110.50" REF.
1949.5mm / 76.75" REF.
311.2mm / 12.25" REF.
546.1mm / 21.50" REF.
MEDIAN FLANGE (FACING MEDIAN FLANGE OF SECOND HALF OF MAIN SECTION OF TEM CELL)
(WITH PROVISION FOR ACCESS DOORS)
E 2¼"×2¼"×⅛" (1.90 lb/ft) NEEDED 19 FT LENGTH
7[3.205 lbs (2¼" FLANGE) NEEDED 220 FT LENGTH
OF CHANNEL WEBS IN ASSEMBLY
FRONT AND MEDIAN FLANGES
B-ASSEMBLIES ARE NOT SHOWN
S TO A SIDE, SPACING TO SUIT
MENT 12¼" GAPS IN MEDIAN FLANGES
MPORARILY BRIDGED USING ⅛" THICK PLATES
E OF SELECTIVE GRADE - NO BENDS OR TWISTS
NATIONAL BUREAU OF STANDARDS
BOULDER, COLORADO, 80303
DETAIL ~ MAIN SECTION (ONE HALF WITH DOORS)
FOR TEM CELL
MODEL 2.8 m
SCALE 1/16
DRAFTSMAN Victor Lorenzo
PROJECT ENGR. M.L. CRAWFORD
PROJECT ENGR. J.L. WORKMAN
EN (10kHz-100MHz)-V(35D)
SHEET 4 OF 32

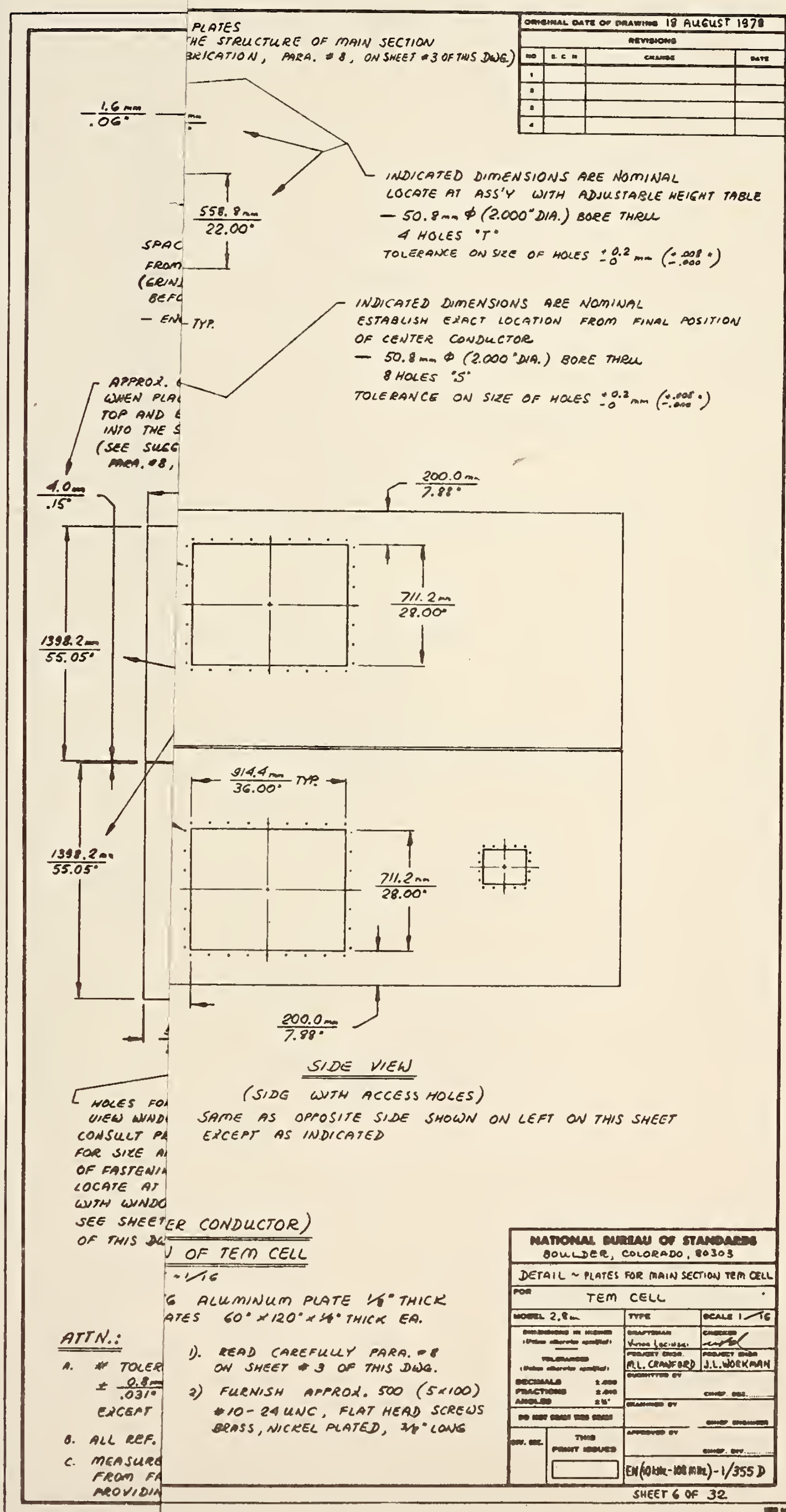


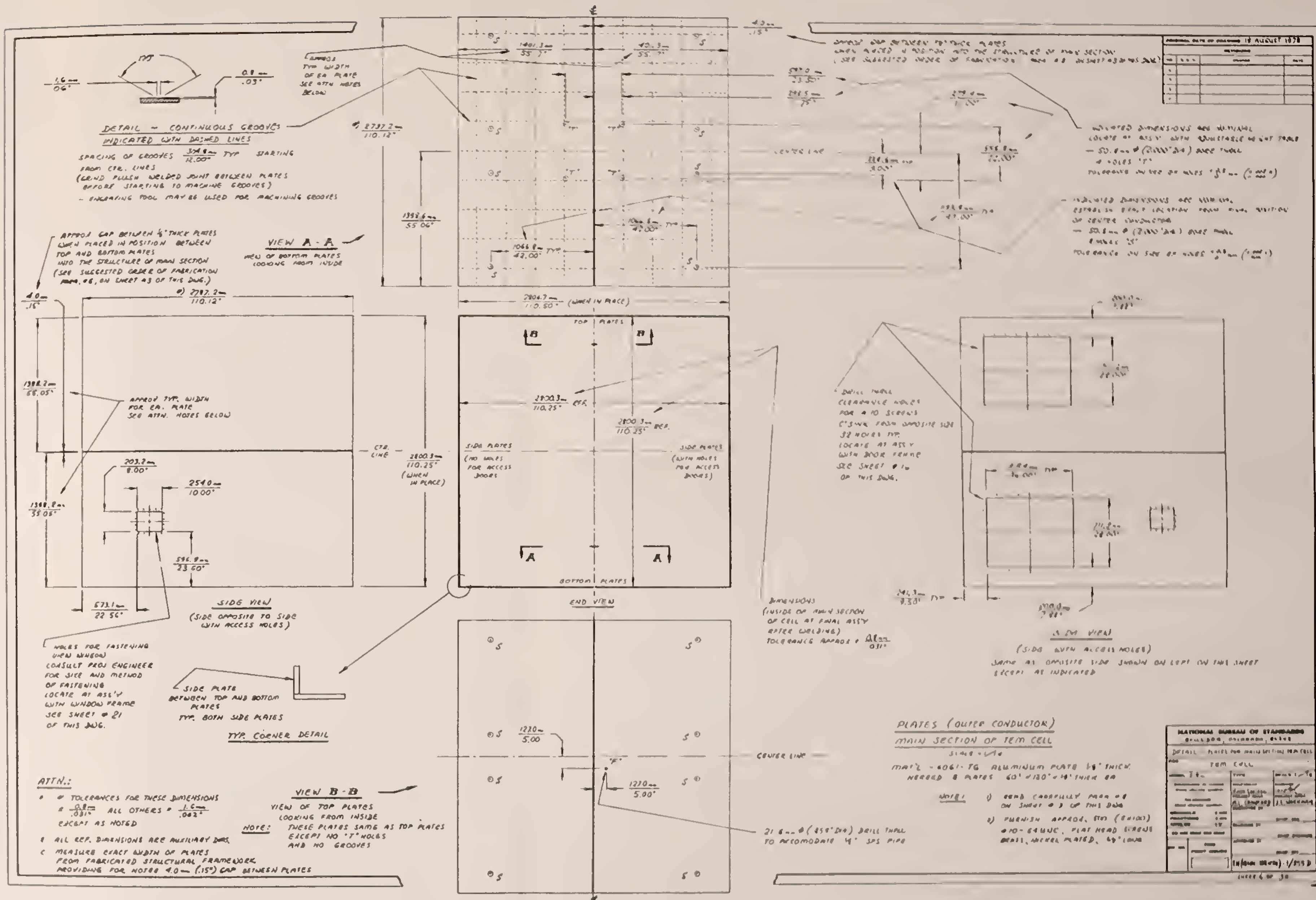
STRUCTURAL FRAMEWORK
MAIN SECTION TEM CELL - ONE HALF (WITH PROVISION FOR ACCESS DOORS)
NATIONAL BUREAU OF STANDARDS
BOULDER, COLORADO
TEM CELL
18 AUGUST 1978
TOP
BOTTOM (SAME AS TOP)
FRONT FLANGE (FACING TRANSITION "A")
SIDE (OPPOSITE TO SIDE WITH ACCESS DOORS)
SIDE (OPEN SPACES PROVIDED FOR ACCESS DOORS)
MEDIAN FLANGE (FACING MEDIAN FLANGE OF SECOND HALF OF MAIN SECTION OF TEM CELL)
COMPONENT FRONT FLANGE
COMPONENT MEDIAN FLANGE
OUTLINE OF ACCESS HOLES IN ASS'Y
NOTE TYP. POSITION OF ANGLES IN TOP AND BOTTOM FRAMEWORK (SERVE AS HEAT SINKS WHEN WELDING 1/4" THICK PLATES IN PLACE)
ALL INSIDE FLANGES OF SUPPORTING STRUCTURE TO BE FLUSH IN ALL FOUR INSIDE PLANES
DO NOT WELD INSIDE FLANGES OF SUPPORTING STRUCTURE (OUTER CONDUCTOR PLATES ARE INSTALLED ON THESE FLANGES)
SCALE - 1/16
NOTES:
1). DASHED LINES INDICATE POSITION OF CHANNEL WEBS IN ASSEMBLY
4) CHANNELS AND ANGLES USED TO BE OF SELECTIVE GRADE - NO BENDS OR TWISTS
ATTN.:
ALL REF. DIMENSIONS ARE AUXILIARY DIMS.
SHEET 4 OF 11

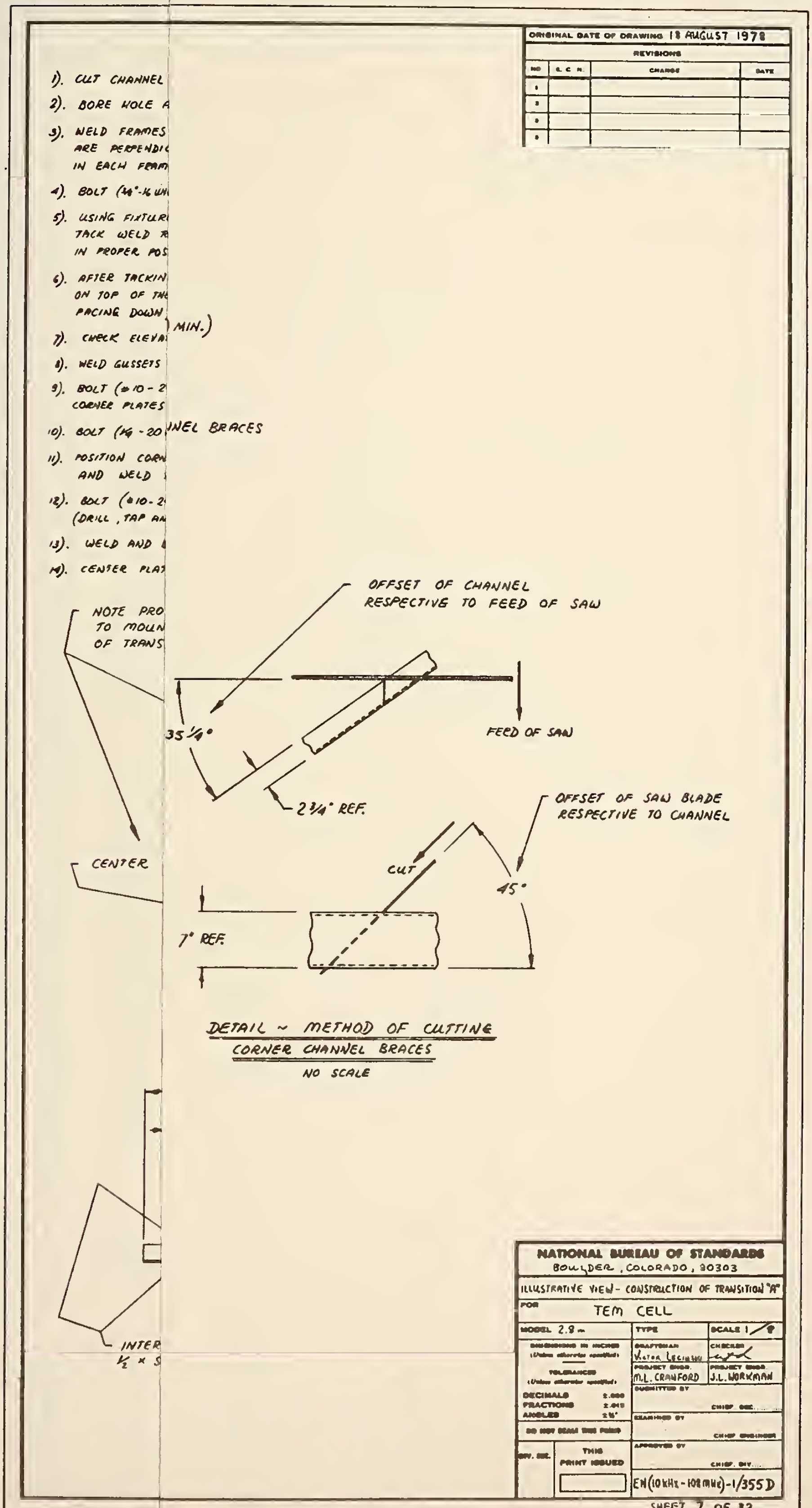

ORIGINAL DATE OF DRAWING 18 AUGUST 1978
REVISIONS
425.5 mm
16.75"
OUTLINE OF VIEW WINDOW
IN ASS'Y
SIDE
SAME AS SHOWN ON LEFT ON THIS SHEET
EXCEPT OPPOSITE HAND
NATIONAL BUREAU OF STANDARDS
BOULDER, COLORADO, 80303
DETAIL - MAIN SECTION (ONE HALF WITH WINDOWS)
FOR
TEM CELL
MODEL 2.8 m
TYPE
SCALE 1/16
CRAFTSMAN
Victor Lecasio
CHECKER
PROJECT ENGR
M.L. CRAWFORD
PROJECT ENGR
J.L. WORKMAN
SUBMITTED BY
EXAMINED BY
APPROVED BY
THIS
PRINT ISSUED
EN (10kHz - 100MHz) - 1/355 D
SHEET 5 OF 32

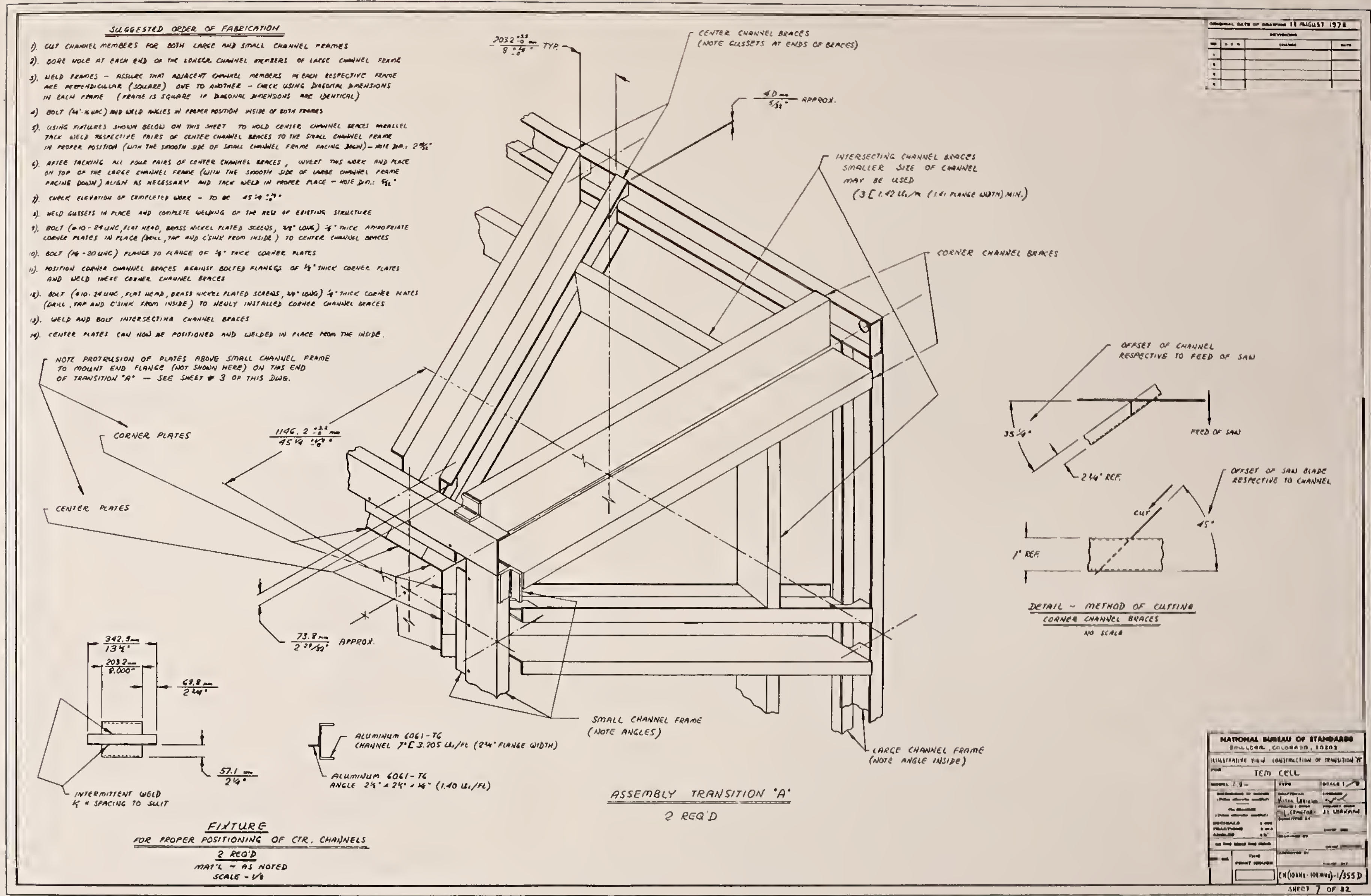


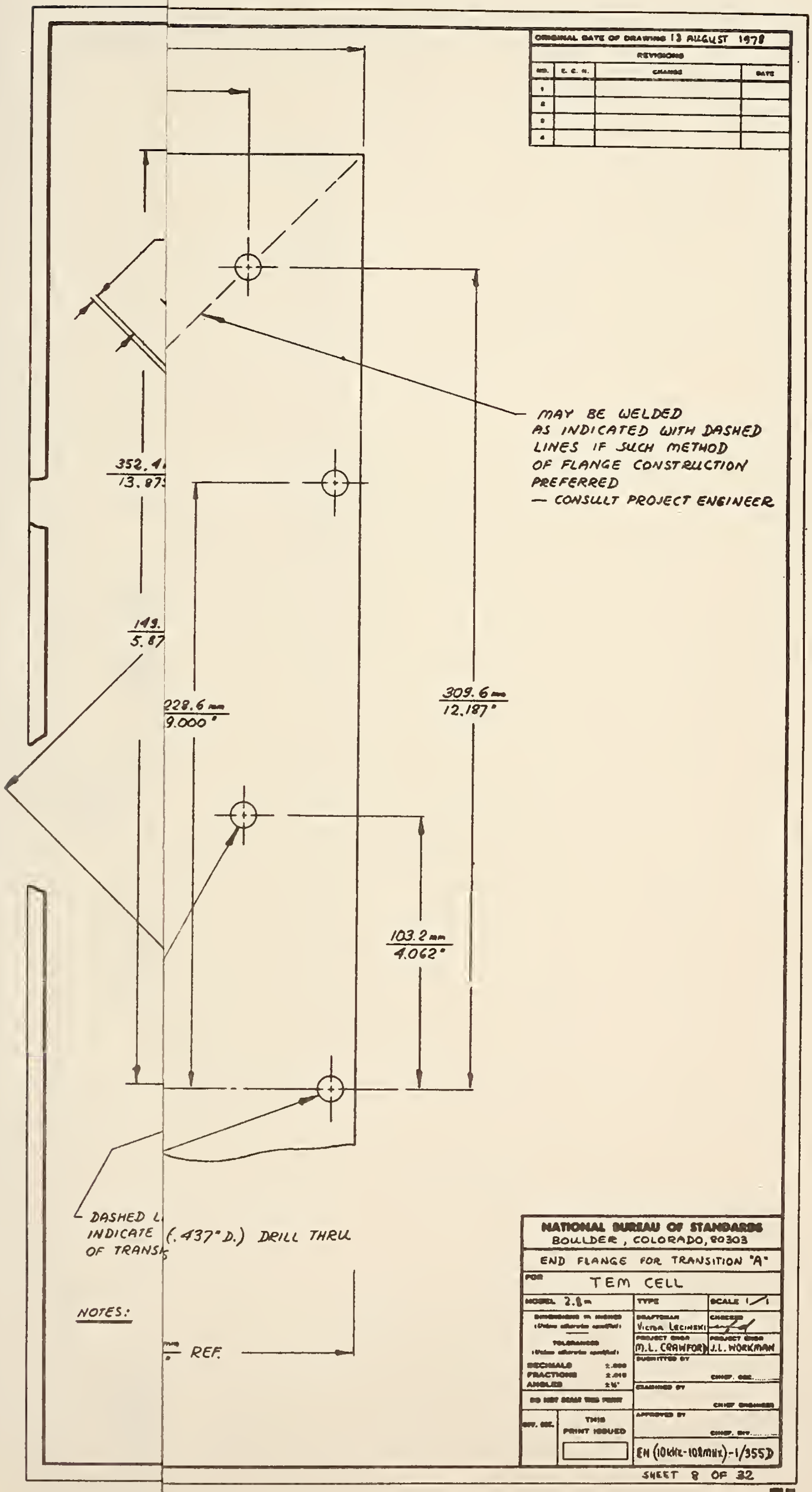
69.9 mm
2.75"
425.5 mm
16.75"
69.9 mm
2.75"
177.8 mm
7.00"
8 REQ'D
139.7 mm
5.50"
425.5 mm
16.75"
4 REQ'D
REINFORCING PLATES
MAT'L ~ ALUMINUM 6061-T6 PLATE 1/4" THICK
TOLERANCES ± 1.6 mm (±.062")
ORIGINAL DATE OF DRAWING 18 AUGUST 1978
TOP — SAME AS TOP SHOWN ON SHEET #4 OF THIS DWG.
OUTLINE OF VIEW WINDOW IN ASS'Y
OUTLINE OF VIEW WINDOW IN ASS'Y
MEDIAN FLANGE
SAME AS MEDIAN FLANGE SHOWN ON SHEET #4 OF THIS DWG.
SIDE
SAME AS SIDE OPPOSITE TO SIDE WITH ACCESS DOORS SHOWN ON SHEET #4 OF THIS DWG.
REAR FLANGE – SAME AS FRONT FLANGE ON SHEET #4 OF THIS DWG. (FACING TRANSITION "A")
SIDE
SAME AS SHOWN ON LEFT ON THIS SHEET EXCEPT OPPOSITE HAND
STRUCTURAL FRAMEWORK
MAIN SECTION TEM CELL – ONE HALF (WITH PROVISIONS FOR VIEW WINDOWS)
MAT'L ~ ALUMINUM 6061-T6 ANGLE 2¼"×2¼"×¼" (1.40 lb/ft) NEEDED 19 FT LENGTH
MAT'L ~ ALUMINUM 6061-T6 CHANNEL 7 [3.205 lbs. (2¼" FLANGE) NEEDED 220 FT LENGTH
SCALE ~ 1/16
NOTES: SEE SHEET #4 OF THIS DWG.
BOTTOM – SAME AS TOP SHOWN ABOVE ON THIS SHEET
NATIONAL BUREAU OF STANDARDS
BOULDER, COLORADO, 80303
DETAIL - MAIN SECTION (ONE HALF WITH WINDOWS)
TEM CELL
SCALE 1/16
SHEET 5 OF 32

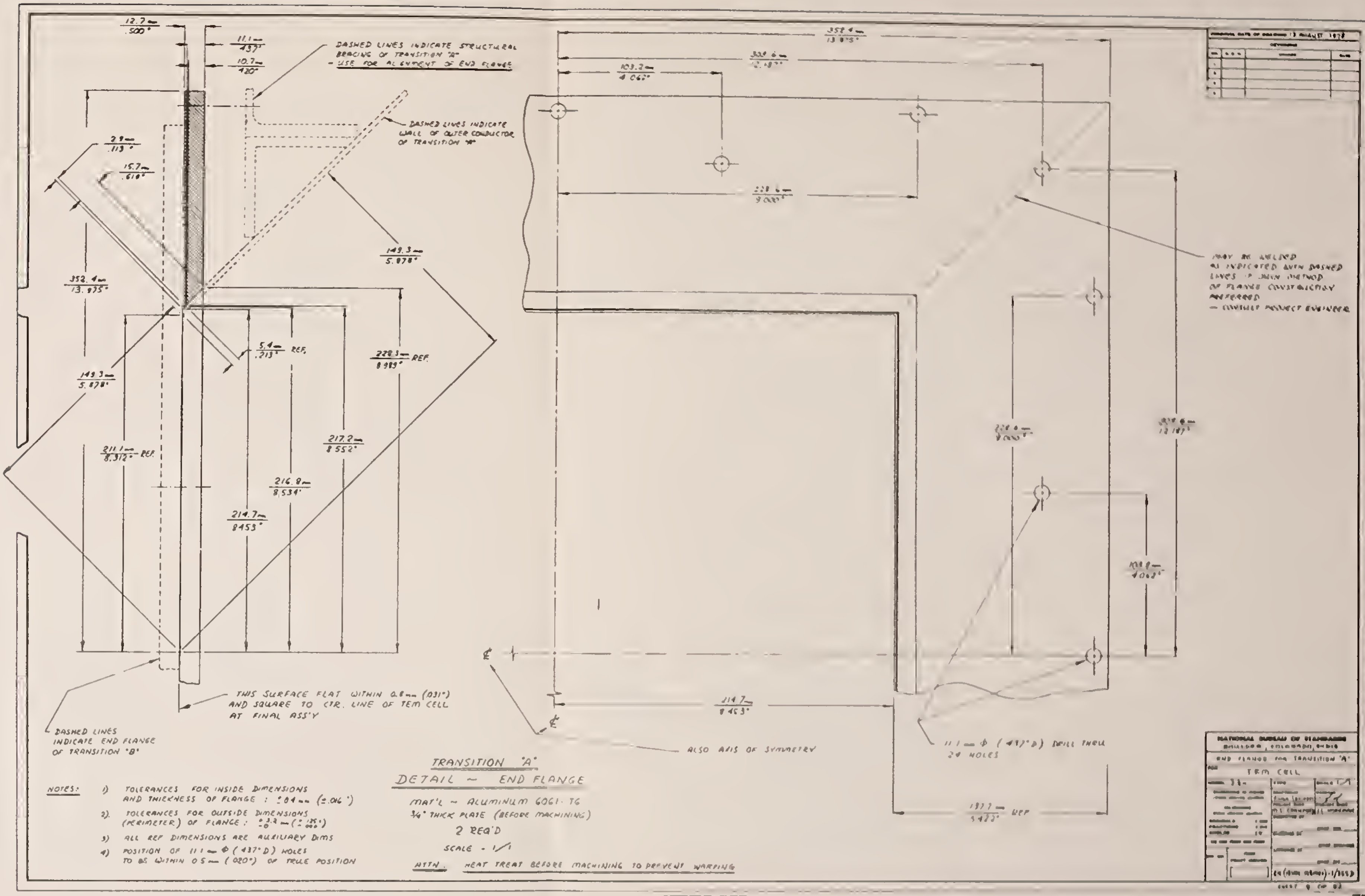

ORIGINAL DATE OF DRAWING 18 AUGUST 1978
REVISIONS
PLATES
THE STRUCTURE OF MAIN SECTION
BRICATION, PARA. #8, ON SHEET #3 OF THIS DWG.)
1.6 mm / .06"
558.8 mm / 22.00"
INDICATED DIMENSIONS ARE NOMINAL
LOCATE AT ASS'Y WITH ADJUSTABLE HEIGHT TABLE
— 50.8 mm Φ (2.000" DIA.) BORE THRU
4 HOLES "T"
TOLERANCE ON SIZE OF HOLES +0.2 -0 mm
INDICATED DIMENSIONS ARE NOMINAL
ESTABLISH EXACT LOCATION FROM FINAL POSITION
OF CENTER CONDUCTOR
— 50.8 mm Φ (2.000" DIA.) BORE THRU
8 HOLES "S"
TOLERANCE ON SIZE OF HOLES +0.2 -0 mm
TYP.
4.0 mm / .15"
200.0 mm / 7.88"
711.2 mm / 28.00"
1398.2 mm / 55.05"
914.4 mm / 36.00" TYP.
SIDE VIEW
(SIDE WITH ACCESS HOLES)
SAME AS OPPOSITE SIDE SHOWN ON LEFT ON THIS SHEET
EXCEPT AS INDICATED
ER CONDUCTOR)
OF TEM CELL
ALUMINUM PLATE 1/4" THICK
ATES 60" × 120" × 1/4" THICK EA.
ATTN.:
1). READ CAREFULLY PARA. #8
ON SHEET #3 OF THIS DWG.
2) FURNISH APPROX. 500 (5×100)
#10-24 UNC, FLAT HEAD SCREWS
BRASS, NICKEL PLATED, 3/4" LONG
NATIONAL BUREAU OF STANDARDS
BOULDER, COLORADO, 80303
DETAIL ~ PLATES FOR MAIN SECTION TEM CELL
TEM CELL
SCALE 1/16
R.L. CRAWFORD
J.L. WORKMAN
EN(10 kHz-100 MHz)-1/355 D
SHEET 6 OF 32


DETAIL ~ CONTINUOUS GROOVES
INDICATED WITH DASHED LINES
VIEW A-A
VIEW OF BOTTOM PLATES
LOOKING FROM INSIDE
SIDE VIEW
(SIDE OPPOSITE TO SIDE
WITH ACCESS HOLES)
END VIEW
TOP PLATES
BOTTOM PLATES
SIDE PLATES
CENTER LINE
TYP. CORNER DETAIL
SIDE PLATE
BETWEEN TOP AND BOTTOM
PLATES
TYP. BOTH SIDE PLATES
VIEW B-B
VIEW OF TOP PLATES
LOOKING FROM INSIDE
NOTE: THESE PLATES SAME AS TOP PLATES
EXCEPT NO "T" HOLES
AND NO GROOVES
ATTN.:
ALL REF. DIMENSIONS ARE AUXILIARY DIMS.
MEASURE EXACT WIDTH OF PLATES
FROM FABRICATED STRUCTURAL FRAMEWORK
PROVIDING FOR NOTED 4.0mm (.15") GAP BETWEEN PLATES
PLATES (OUTER CONDUCTOR)
MAIN SECTION OF TEM CELL
NATIONAL BUREAU OF STANDARDS
TEM CELL

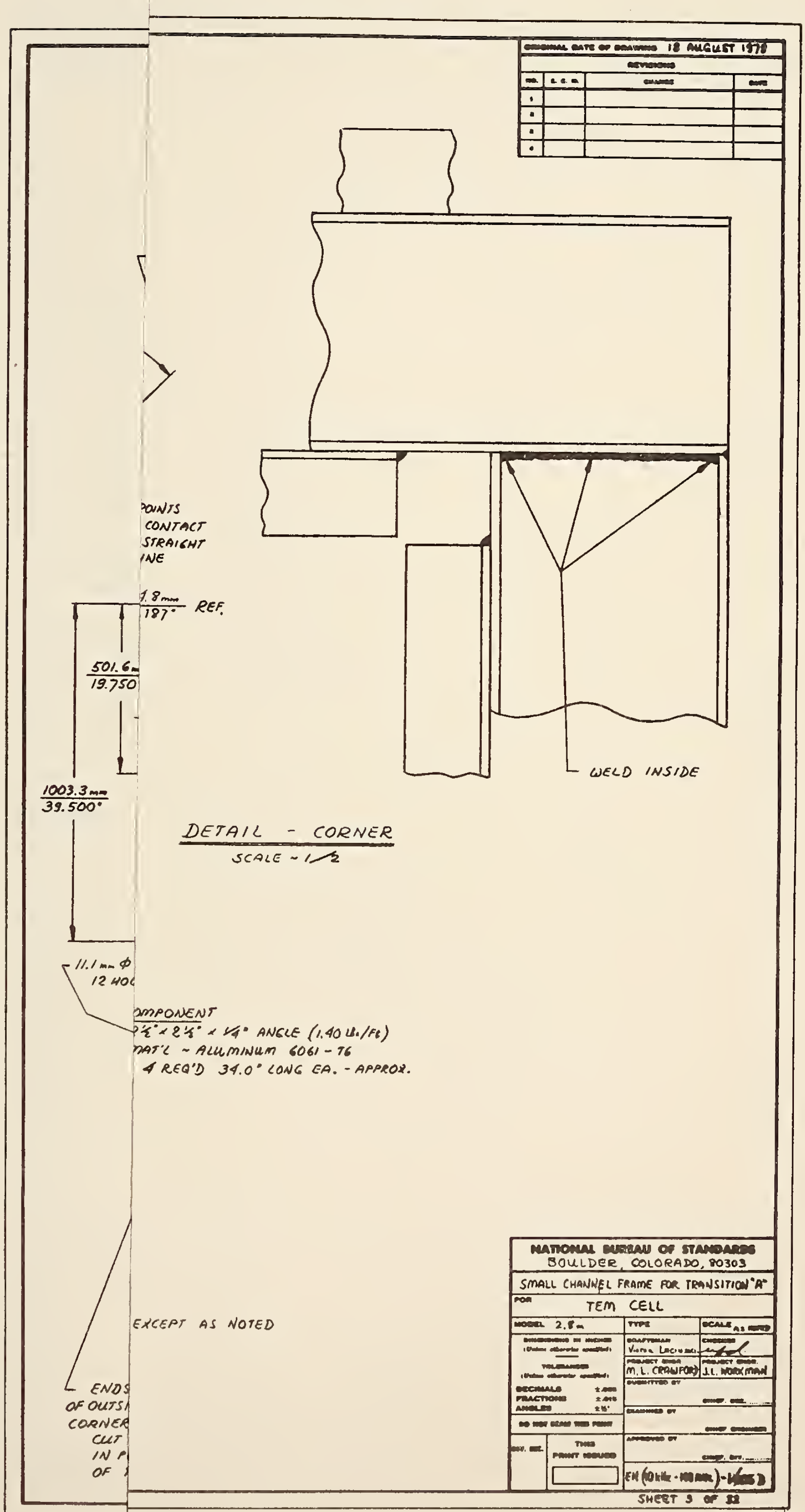

ORIGINAL DATE OF DRAWING 18 AUGUST 1978
REVISIONS
NO. | E.C.N. | CHANGE | DATE
1). CUT CHANNEL
2). BORE HOLE A
3). WELD FRAMES
ARE PERPENDIC
IN EACH FRAM
4). BOLT (1/4"-16 UN
5). USING FIXTUR
TACK WELD
IN PROPER POS
6). AFTER TACKIN
ON TOP OF TH
FACING DOWN
) MIN.)
7). CHECK ELEVA
8). WELD GUSSETS
9). BOLT (#10 - 2
CORNER PLATES
10). BOLT (1/4 - 20
NEL BRACES
11). POSITION CORN
AND WELD
12). BOLT (#10-2
(DRILL, TAP AN
13). WELD AND
14). CENTER PLAT
NOTE PRO
TO MOUN
OF TRANS
OFFSET OF CHANNEL
RESPECTIVE TO FEED OF SAW
35 1/4°
FEED OF SAW
2 3/4" REF.
OFFSET OF SAW BLADE
RESPECTIVE TO CHANNEL
CENTER
CUT
45°
7" REF.
DETAIL ~ METHOD OF CUTTING
CORNER CHANNEL BRACES
NO SCALE
INTER
1/2 x S
NATIONAL BUREAU OF STANDARDS
BOULDER, COLORADO, 80303
ILLUSTRATIVE VIEW - CONSTRUCTION OF TRANSITION "A"
FOR TEM CELL
MODEL 2.9 m
TYPE
SCALE 1/8
DIMENSIONS IN INCHES (Unless otherwise specified)
TOLERANCES (Unless otherwise specified)
DECIMALS ±.000
FRACTIONS ±.015
ANGLES ±1/2°
DO NOT SCALE THIS PRINT
DRAFTSMAN Victor Lecinski
CHECKER
PROJECT ENGR. M.L. CRAWFORD
PROJECT ENGR. J.L. WORKMAN
SUBMITTED BY
CHIEF SEC.
EXAMINED BY
CHIEF ENGINEER
APPROVED BY
CHIEF, DIV.
THIS PRINT ISSUED
EN(10kHz-100MHz)-1/355D
SHEET 7 OF 32

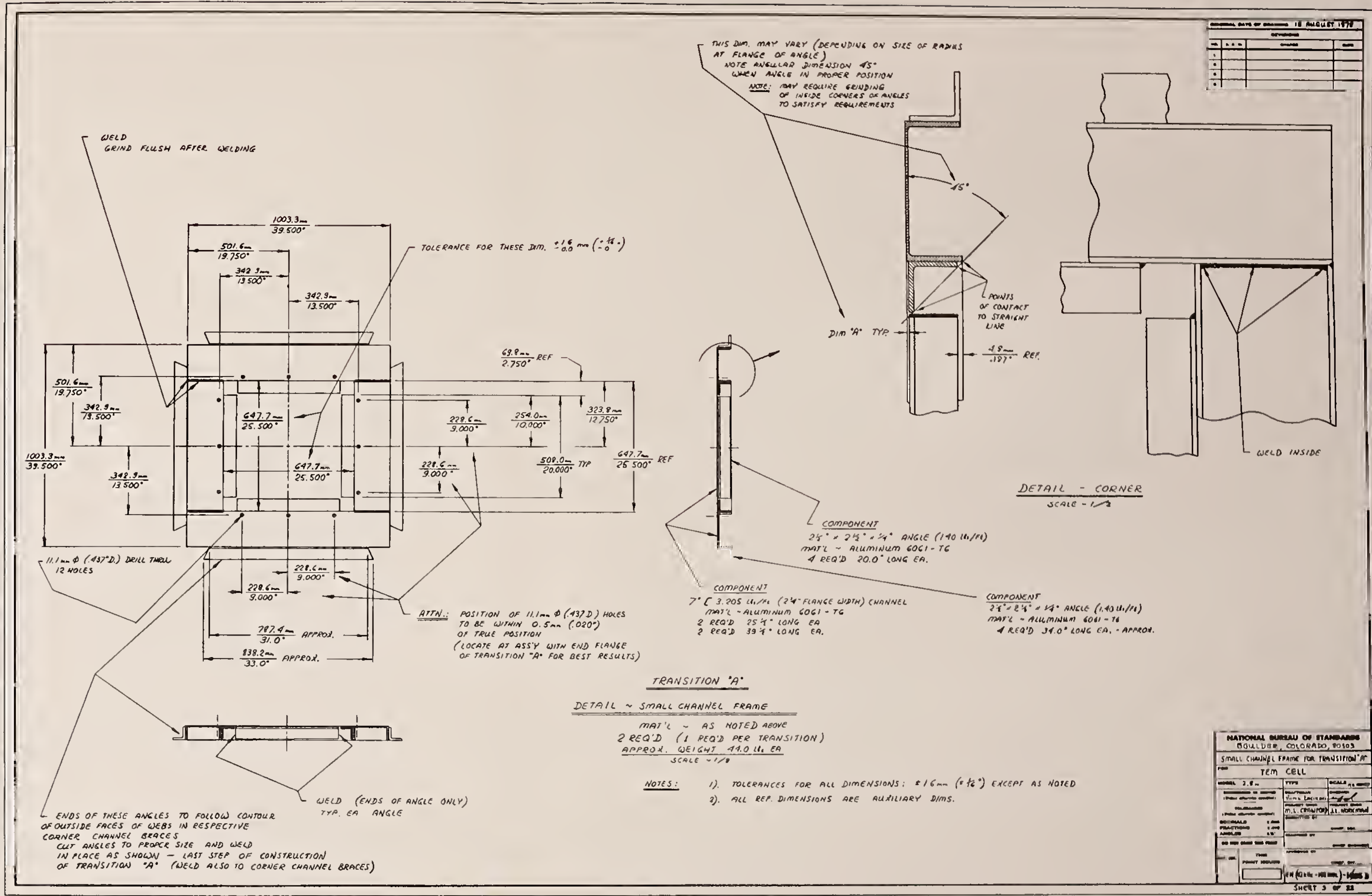

SUGGESTED ORDER OF FABRICATION
1). CUT CHANNEL MEMBERS FOR BOTH LARGE AND SMALL CHANNEL FRAMES
2). BORE HOLE AT EACH END OF THE LONGER CHANNEL MEMBERS OF LARGE CHANNEL FRAME
3). WELD FRAMES – ASSURE THAT ADJACENT CHANNEL MEMBERS IN EACH RESPECTIVE FRAME ARE PERPENDICULAR (SQUARE) ONE TO ANOTHER – CHECK USING DIAGONAL DIMENSIONS IN EACH FRAME (FRAME IS SQUARE IF DIAGONAL DIMENSIONS ARE IDENTICAL)
4) BOLT (1/4"-16 UNC) AND WELD ANGLES IN PROPER POSITION INSIDE OF BOTH FRAMES
5). USING FIXTURES SHOWN BELOW ON THIS SHEET TO HOLD CENTER CHANNEL BRACES PARALLEL TACK WELD RESPECTIVE PAIRS OF CENTER CHANNEL BRACES TO THE SMALL CHANNEL FRAME IN PROPER POSITION (WITH THE SMOOTH SIDE OF SMALL CHANNEL FRAME FACING DOWN) – HOLE DIA.: 2 9/32"
6). AFTER TACKING ALL FOUR PAIRS OF CENTER CHANNEL BRACES, INVERT THIS WORK AND PLACE ON TOP OF THE LARGE CHANNEL FRAME (WITH THE SMOOTH SIDE OF LARGE CHANNEL FRAME FACING DOWN) ALIGN AS NECESSARY AND TACK WELD IN PROPER PLACE – HOLE DIA.: 5/32"
7). CHECK ELEVATION OF COMPLETED WORK – TO BE 45 1/4 +1/4 -0"
8). WELD GUSSETS IN PLACE AND COMPLETE WELDING OF THE REST OF EXISTING STRUCTURE
9). BOLT (#10-24 UNC, FLAT HEAD, BRASS NICKEL PLATED SCREWS, 3/8" LONG) 1/4" THICK APPROPRIATE CORNER PLATES IN PLACE (DRILL, TAP AND C'SINK FROM INSIDE) TO CENTER CHANNEL BRACES
10). BOLT (1/4-20 UNC) FLANGE TO FLANGE OF 1/4" THICK CORNER PLATES
11). POSITION CORNER CHANNEL BRACES AGAINST BOLTED FLANGES OF 1/4" THICK CORNER PLATES AND WELD THESE CORNER CHANNEL BRACES
12). BOLT (#10-24 UNC, FLAT HEAD, BRASS NICKEL PLATED SCREWS, 3/8" LONG) 1/4" THICK CORNER PLATES (DRILL, TAP AND C'SINK FROM INSIDE) TO NEWLY INSTALLED CORNER CHANNEL BRACES
13). WELD AND BOLT INTERSECTING CHANNEL BRACES
14). CENTER PLATES CAN NOW BE POSITIONED AND WELDED IN PLACE FROM THE INSIDE.
NOTE PROTRUSION OF PLATES ABOVE SMALL CHANNEL FRAME TO MOUNT END FLANGE (NOT SHOWN HERE) ON THIS END OF TRANSITION "A" — SEE SHEET # 3 OF THIS DWG.
CORNER PLATES
CENTER PLATES
1146.2 mm
45 1/4"
203.2 mm
8"
TYP.
CENTER CHANNEL BRACES
(NOTE GUSSETS AT ENDS OF BRACES)
4.0 mm
5/32"
APPROX.
INTERSECTING CHANNEL BRACES
SMALLER SIZE OF CHANNEL MAY BE USED
(3 [1.42 lb/ft (1.41 FLANGE WIDTH) MIN.)
CORNER CHANNEL BRACES
73.8 mm
2 29/32"
APPROX.
SMALL CHANNEL FRAME
(NOTE ANGLES)
LARGE CHANNEL FRAME
(NOTE ANGLE INSIDE)
OFFSET OF CHANNEL RESPECTIVE TO FEED OF SAW
35 1/4"
FEED OF SAW
2 1/4" REF.
OFFSET OF SAW BLADE RESPECTIVE TO CHANNEL
CUT
45°
1" REF.
DETAIL ~ METHOD OF CUTTING CORNER CHANNEL BRACES
NO SCALE
342.9 mm
13 1/2"
203.2 mm
8.000"
69.8 mm
2 3/4"
57.1 mm
2 1/4"
INTERMITTENT WELD
SPACING TO SUIT
FIXTURE
FOR PROPER POSITIONING OF CTR. CHANNELS
2 REQ'D
MAT'L ~ AS NOTED
SCALE - 1/8
ALUMINUM 6061-T6
CHANNEL 7" [3.205 lb/ft (2 1/4" FLANGE WIDTH)
ALUMINUM 6061-T6
ANGLE 2 1/2" x 2 1/2" x 1/4" (1.40 lb/ft)
ASSEMBLY TRANSITION "A"
2 REQ'D
ORIGINAL DATE OF DRAWING 18 AUGUST 1978
REVISIONS
NATIONAL BUREAU OF STANDARDS
BOULDER, COLORADO, 80303
ILLUSTRATIVE VIEW CONSTRUCTION OF TRANSITION "A"
TEM CELL
SCALE 1/8
EN(10kHz-100MHz)-1/355D
SHEET 7 OF 32


ORIGINAL DATE OF DRAWING 13 AUGUST 1978
REVISIONS
MAY BE WELDED AS INDICATED WITH DASHED LINES IF SUCH METHOD OF FLANGE CONSTRUCTION PREFERRED — CONSULT PROJECT ENGINEER
352.4
13.87
149.
5.87
228.6 mm
9.000"
309.6 mm
12.187"
103.2 mm
4.062"
DASHED L
INDICATE
OF TRANS
(.437" D.) DRILL THRU
NOTES:
REF.
NATIONAL BUREAU OF STANDARDS
BOULDER, COLORADO, 80303
END FLANGE FOR TRANSITION "A"
TEM CELL
MODEL 2.8 m
SCALE 1/1
DRAFTSMAN VICTOR LECINSKI
PROJECT ENGR M.L. CRAWFORD
PROJECT ENGR J.L. WORKMAN
EN (10kHz-100MHz)-1/355D
SHEET 8 OF 32

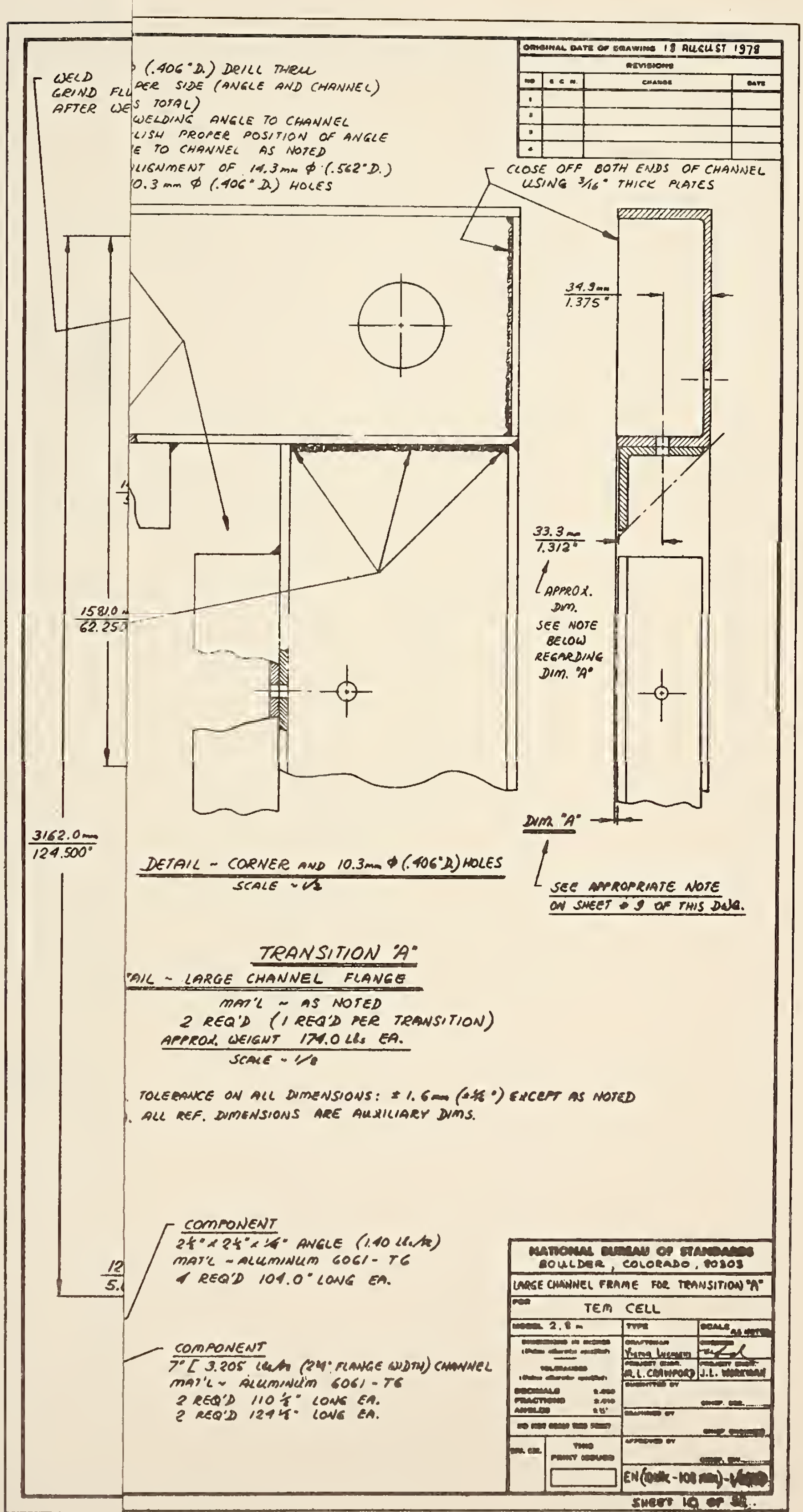


DASHED LINES INDICATE STRUCTURAL BRACING OF TRANSITION "A" - USE FOR AL EXTENT OF END FLANGE
DASHED LINES INDICATE WALL OF OUTER CONDUCTOR OF TRANSITION "A"
12.7 mm .500"
11.1 mm .437"
10.7 mm .420"
2.9 mm .113"
15.7 mm .618"
352.4 mm 13.875"
149.3 mm 5.878"
5.4 mm .213" REF.
228.3 mm 8.989" REF.
211.1 mm 8.312" REF.
217.2 mm 8.552"
216.8 mm 8.534"
214.7 mm 8453"
THIS SURFACE FLAT WITHIN 0.8 mm (.031") AND SQUARE TO CTR. LINE OF TEM CELL AT FINAL ASS'Y
DASHED LINES INDICATE END FLANGE OF TRANSITION "B"
103.2 mm 4.062"
214.7 mm 8.453"
ALSO AXIS OF SYMMETRY
11.1 mm Φ (.437" D) DRILL THRU 24 HOLES
137.7 mm 5.422" REF
103.2 mm 4.062"
NOTES:
1) TOLERANCES FOR INSIDE DIMENSIONS AND THICKNESS OF FLANGE : ±.04 mm (±.016")
2) TOLERANCES FOR OUTSIDE DIMENSIONS (PERIMETER) OF FLANGE : +3.2/-0 mm (+.125/-.000")
3) ALL REF DIMENSIONS ARE AUXILIARY DIMS
4) POSITION OF 11.1 mm Φ (.437" D) HOLES TO BE WITHIN 0.5 mm (.020") OF TRUE POSITION
TRANSITION "A"
DETAIL ~ END FLANGE
MAT'L ~ ALUMINUM 6061-T6
3/4" THICK PLATE (BEFORE MACHINING)
2 REQ'D
SCALE - 1/1
ATTN. HEAT TREAT BEFORE MACHINING TO PREVENT WARPING
NATIONAL BUREAU OF STANDARDS
BOULDER, COLORADO
END FLANGE FOR TRANSITION "A"
TEM CELL

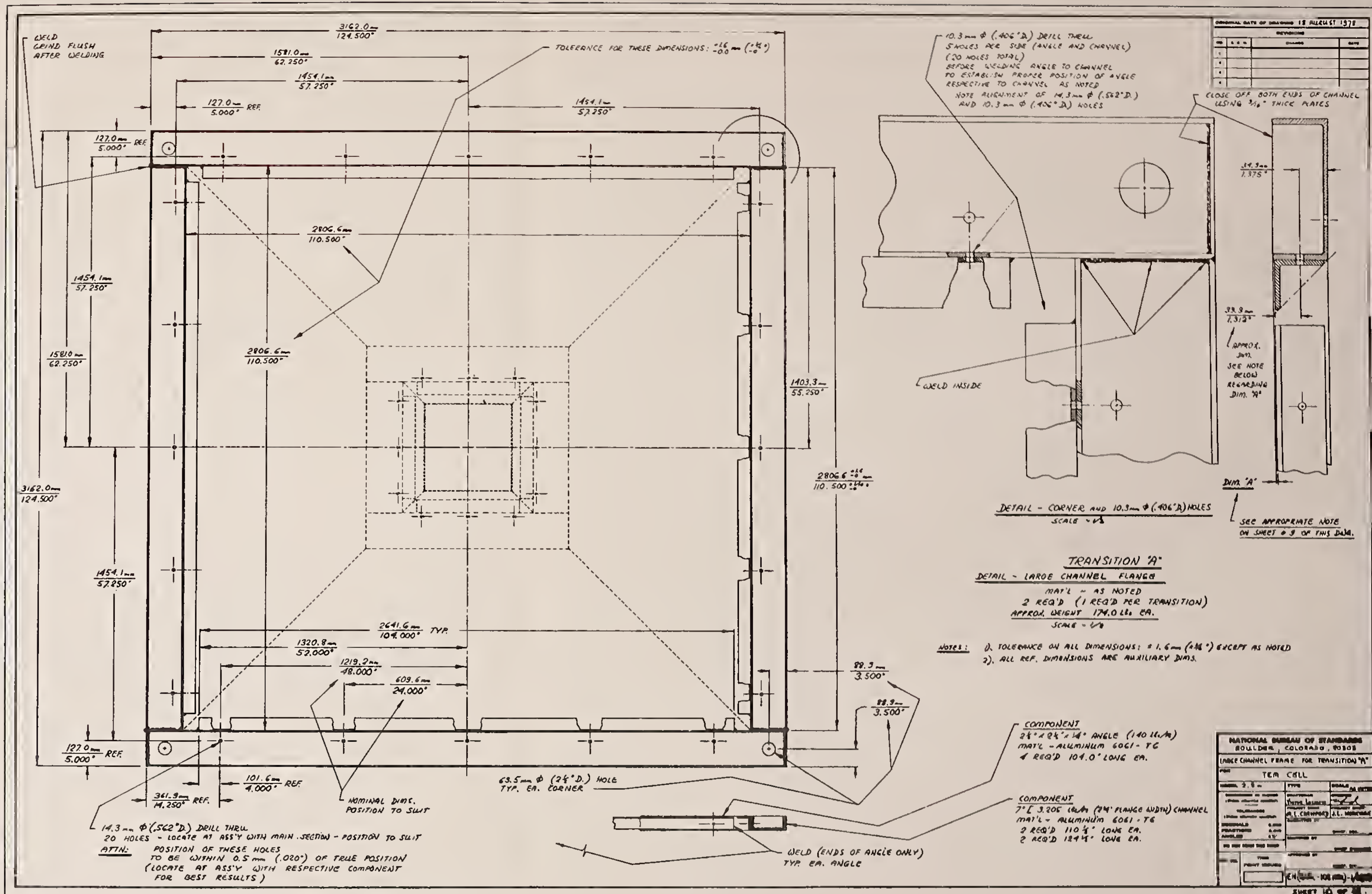

18 AUGUST 1978
REVISIONS
WELD INSIDE
DETAIL - CORNER
SCALE ~ 1/2
REF.
501.6
19.750
1003.3 mm
39.500"
MPONENT
2½" × 2½" × ¼" ANGLE (1.40 lb./Ft)
MAT'L ~ ALUMINUM 6061 - T6
4 REQ'D 34.0" LONG EA. - APPROX.
EXCEPT AS NOTED
NATIONAL BUREAU OF STANDARDS
BOULDER, COLORADO, 80303
SMALL CHANNEL FRAME FOR TRANSITION "A"
TEM CELL
MODEL 2.8 m
M. L. CRAWFORD
J. L. WORKMAN
SHEET 3 OF 32



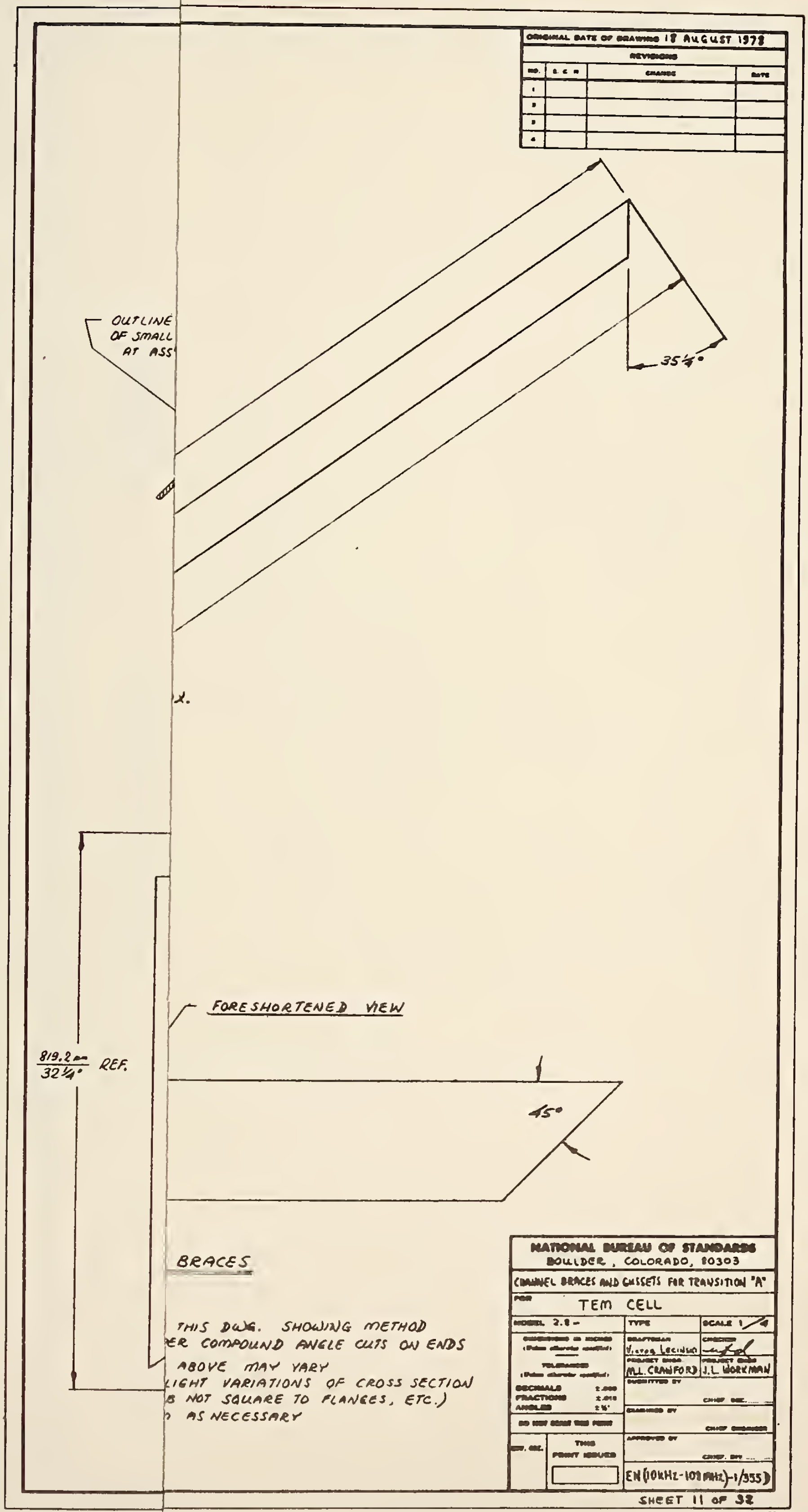
WELD
GRIND FLUSH AFTER WELDING
TOLERANCE FOR THESE DIM.
THIS DIM. MAY VARY (DEPENDING ON SIZE OF RADIUS AT FLANGE OF ANGLE)
NOTE ANGULAR DIMENSION 45° WHEN ANGLE IN PROPER POSITION
NOTE: MAY REQUIRE GRINDING OF INSIDE CORNERS OF ANGLES TO SATISFY REQUIREMENTS
1003.3mm 39.500"
501.6mm 19.750"
342.9mm 13.500"
647.7mm 25.500"
228.6mm 9.000"
254.0mm 10.000"
323.9mm 12.750"
508.0mm 20.000" TYP
647.7mm 25.500" REF
69.9mm 2.750" REF
POINTS OF CONTACT TO STRAIGHT LINE
DIM "A" TYP.
4.8mm .187" REF.
WELD INSIDE
DETAIL - CORNER
11.1mm ϕ (.437"D.) DRILL THRU 12 HOLES
787.4mm 31.0" APPROX.
838.2mm 33.0" APPROX.
ATTN.: POSITION OF 11.1mm ϕ (.437 D.) HOLES TO BE WITHIN 0.5mm (.020") OF TRUE POSITION (LOCATE AT ASS'Y WITH END FLANGE OF TRANSITION "A" FOR BEST RESULTS)
COMPONENT
2½" × 2½" × ¼" ANGLE (1.40 lb/ft)
MAT'L ~ ALUMINUM 6061-T6
4 REQ'D 20.0" LONG EA.
COMPONENT
7" [3.205 lb/ft (2¼" FLANGE WIDTH) CHANNEL
MAT'L ~ ALUMINUM 6061-T6
2 REQ'D 25¼" LONG EA
2 REQ'D 39¼" LONG EA.
COMPONENT
2½" × 2½" × ¼" ANGLE (1.40 lb/ft)
MAT'L ~ ALUMINUM 6061-T6
4 REQ'D 34.0" LONG EA. - APPROX.
TRANSITION "A"
DETAIL ~ SMALL CHANNEL FRAME
MAT'L ~ AS NOTED ABOVE
2 REQ'D (1 REQ'D PER TRANSITION)
APPROX. WEIGHT 44.0 lb EA
NOTES: 1). TOLERANCES FOR ALL DIMENSIONS: ±1.6mm (±1/16") EXCEPT AS NOTED
2). ALL REF. DIMENSIONS ARE AUXILIARY DIMS.
WELD (ENDS OF ANGLE ONLY) TYP. EA ANGLE
ENDS OF THESE ANGLES TO FOLLOW CONTOUR OF OUTSIDE FACES OF WEBS IN RESPECTIVE CORNER CHANNEL BRACES
CUT ANGLES TO PROPER SIZE AND WELD IN PLACE AS SHOWN — LAST STEP OF CONSTRUCTION OF TRANSITION "A" (WELD ALSO TO CORNER CHANNEL BRACES)
18 AUGUST 1978
NATIONAL BUREAU OF STANDARDS
BOULDER, COLORADO, 80303
SMALL CHANNEL FRAME FOR TRANSITION "A"
TEM CELL
M. L. CRAWFORD
SHEET 3 OF 22

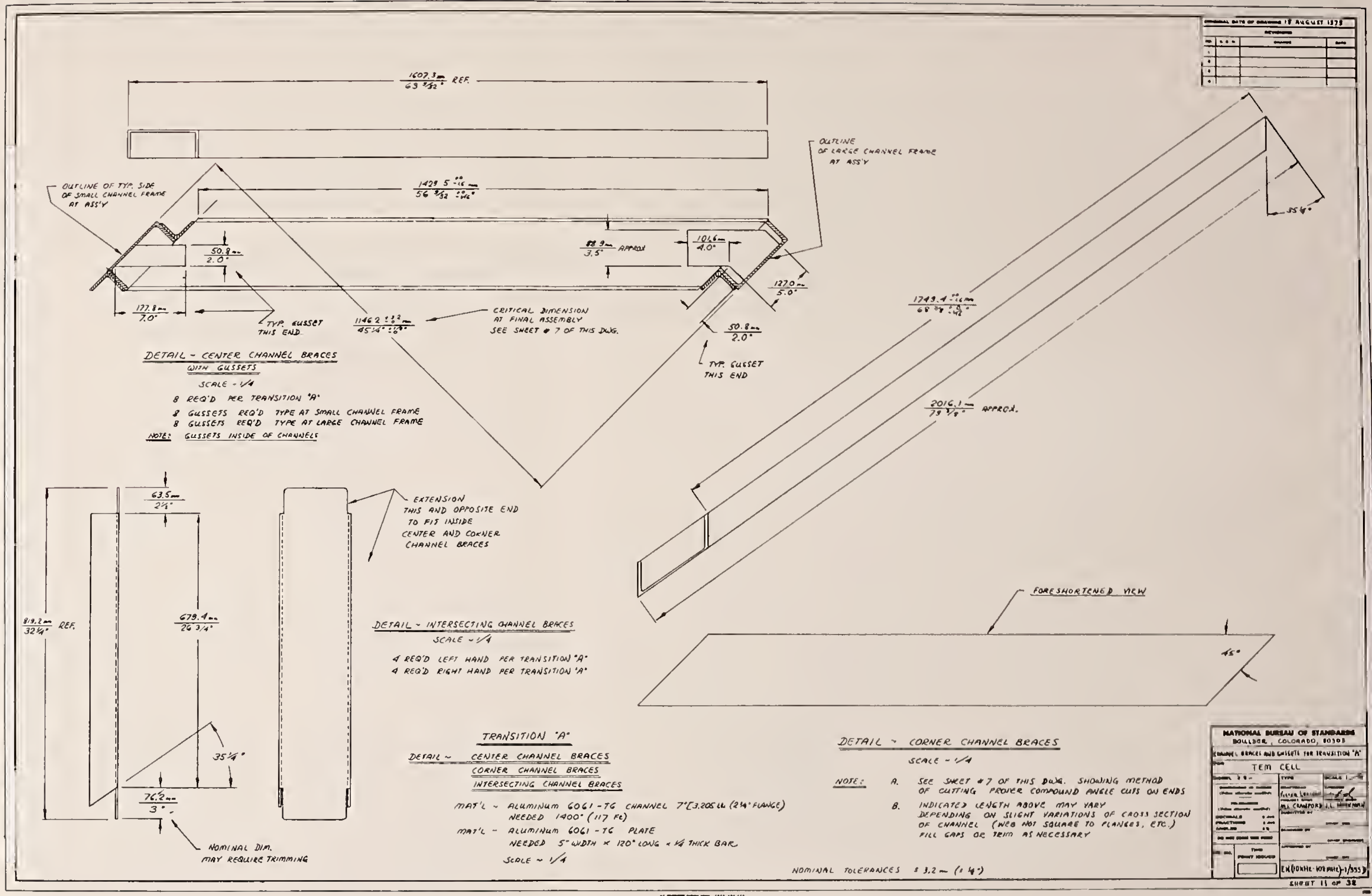


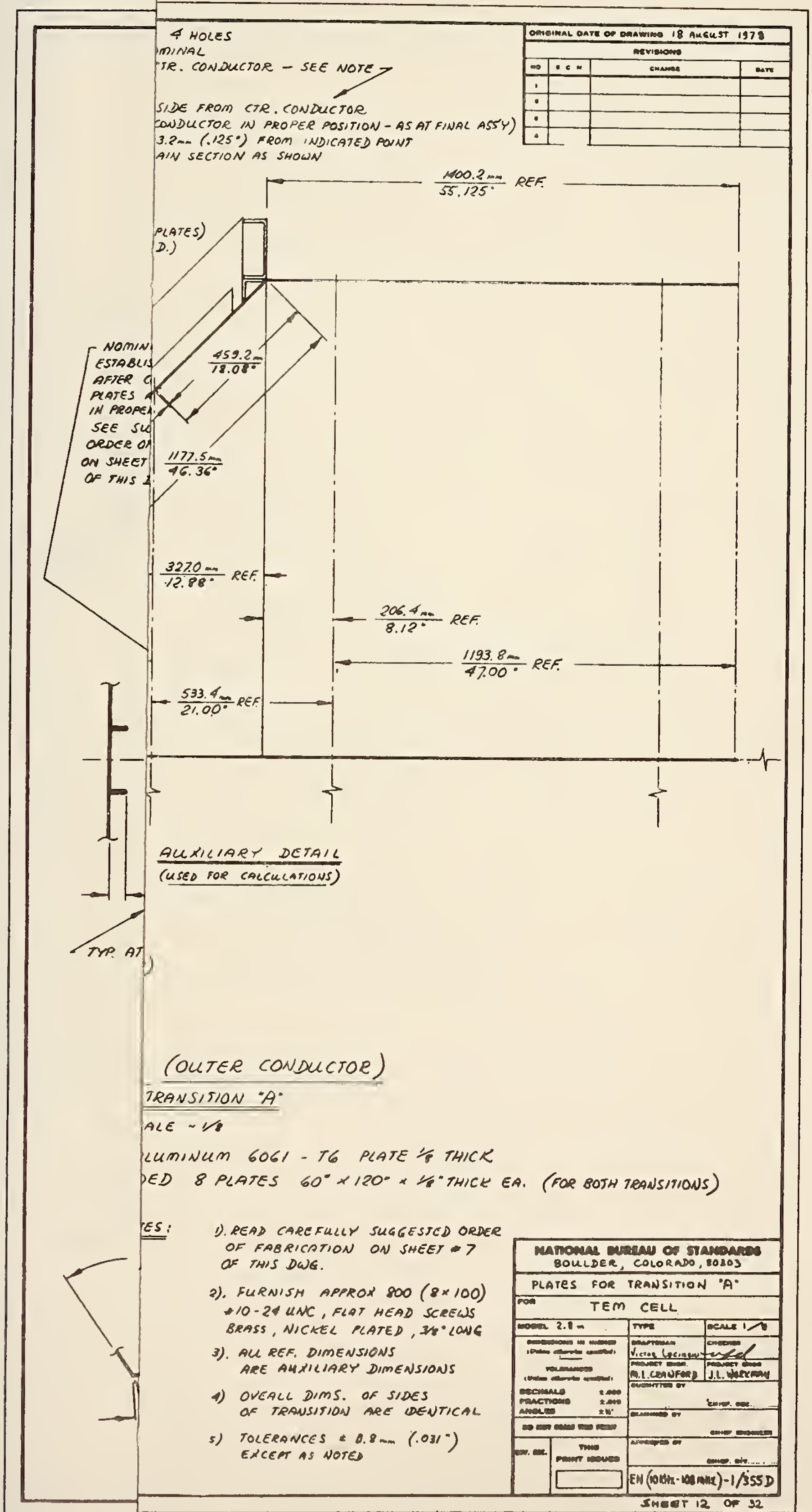
ORIGINAL DATE OF DRAWING 18 AUGUST 1978
REVISIONS
WELD
GRIND FL
AFTER WE
(.406" D.) DRILL THRU
PER SIDE (ANGLE AND CHANNEL)
S TOTAL)
WELDING ANGLE TO CHANNEL
LISH PROPER POSITION OF ANGLE
E TO CHANNEL AS NOTED
LIGNMENT OF 14.3mm ϕ (.562" D.)
0.3 mm ϕ (.406" D.) HOLES
CLOSE OFF BOTH ENDS OF CHANNEL USING 3/16" THICK PLATES
34.9mm 1.375"
33.3mm 1.312"
APPROX. DIM. SEE NOTE BELOW REGARDING DIM. "A"
1581.0 62.250
3162.0mm 124.500"
DIM. "A"
DETAIL ~ CORNER AND 10.3mm ϕ (.406" D.) HOLES
SCALE ~ 1/2
SEE APPROPRIATE NOTE ON SHEET # 9 OF THIS DWG.
TRANSITION "A"
AIL ~ LARGE CHANNEL FLANGE
MAT'L ~ AS NOTED
2 REQ'D (1 REQ'D PER TRANSITION)
APPROX. WEIGHT 174.0 Lbs EA.
SCALE ~ 1/8
. TOLERANCE ON ALL DIMENSIONS: ± 1.6mm (±1/16") EXCEPT AS NOTED
. ALL REF. DIMENSIONS ARE AUXILIARY DIMS.
COMPONENT
2½" x 2½" x ¼" ANGLE (1.40 Lb/ft)
MAT'L ~ ALUMINUM 6061 - T6
4 REQ'D 104.0" LONG EA.
COMPONENT
7" [3.205 Lb/ft (2¼" FLANGE WIDTH) CHANNEL
MAT'L ~ ALUMINUM 6061 - T6
2 REQ'D 110 ½" LONG EA.
2 REQ'D 124 ½" LONG EA.
NATIONAL BUREAU OF STANDARDS
BOULDER, COLORADO, 80303
LARGE CHANNEL FRAME FOR TRANSITION "A"
TEM CELL
MODEL 2.1 m
AS NOTED
R. L. CRAWFORD
J. L. WORKMAN
SHEET 10 OF



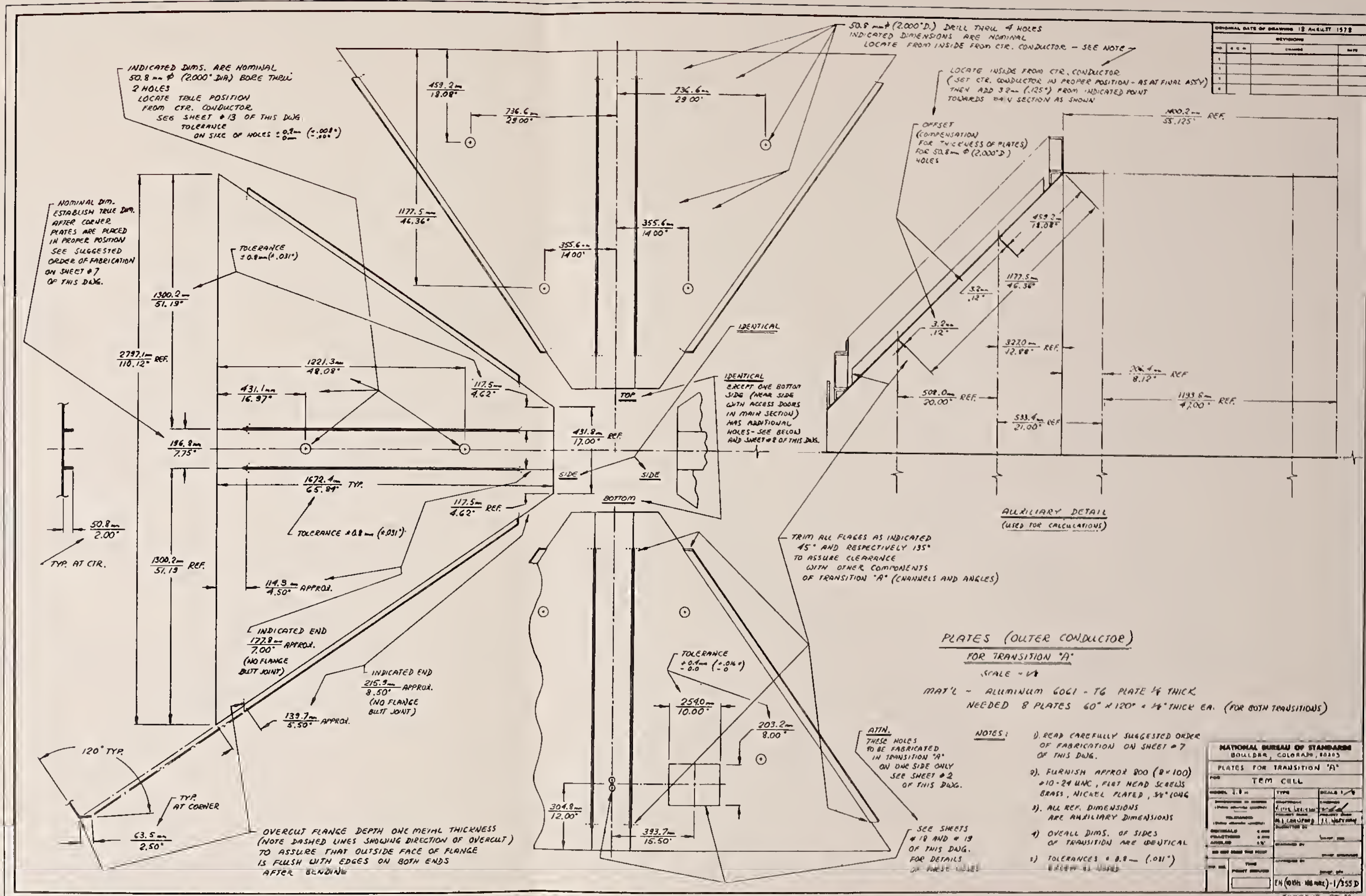
WELD GRIND FLUSH AFTER WELDING
TOLERANCE FOR THESE DIMENSIONS
3162.0mm 124.500"
1581.0mm 62.250"
1454.1mm 57.250"
127.0mm 5.000" REF.
2806.6mm 110.500"
1403.3mm 55.250"
2641.6mm 104.000" TYP.
1320.8mm 52.000"
1219.2mm 48.000"
609.6mm 24.000"
88.9mm 3.500"
101.6mm 4.000" REF.
361.9mm 14.250" REF.
NOMINAL DIMS. POSITION TO SUIT
63.5mm ϕ (2½"D.) HOLE TYP. EA. CORNER
14.3mm ϕ (.562"D.) DRILL THRU 20 HOLES - LOCATE AT ASS'Y WITH MAIN SECTION - POSITION TO SUIT
ATTN: POSITION OF THESE HOLES TO BE WITHIN 0.5mm (.020") OF TRUE POSITION (LOCATE AT ASS'Y WITH RESPECTIVE COMPONENT FOR BEST RESULTS)
WELD (ENDS OF ANGLE ONLY) TYP. EA. ANGLE
10.3mm ϕ (.406"D.) DRILL THRU 5 HOLES PER SIDE (ANGLE AND CHANNEL) (20 HOLES TOTAL) BEFORE WELDING ANGLE TO CHANNEL TO ESTABLISH PROPER POSITION OF ANGLE RESPECTIVE TO CHANNEL AS NOTED
NOTE ALIGNMENT OF 14.3mm ϕ (.562"D.) AND 10.3mm ϕ (.406"D.) HOLES
CLOSE OFF BOTH ENDS OF CHANNEL USING 3/16" THICK PLATES
WELD INSIDE
APPROX. DIM. SEE NOTE BELOW REGARDING DIM. "A"
DIM. "A"
SEE APPROPRIATE NOTE ON SHEET # 9 OF THIS DWG.
DETAIL - CORNER AND 10.3mm ϕ (.406"D.) HOLES
TRANSITION "A"
DETAIL - LARGE CHANNEL FLANGE
MAT'L - AS NOTED
2 REQ'D (1 REQ'D PER TRANSITION)
APPROX. WEIGHT 174.0 LB. EA.
NOTES: 1). TOLERANCE ON ALL DIMENSIONS: ± 1.6mm (±1/16") EXCEPT AS NOTED
2). ALL REF. DIMENSIONS ARE AUXILIARY DIMS.
COMPONENT 2½" x 2½" x ¼" ANGLE (1.40 lb/ft) MAT'L - ALUMINUM 6061 - T6 4 REQ'D 104.0" LONG EA.
COMPONENT 7" [3.205 lb/ft (2¾" FLANGE WIDTH) CHANNEL MAT'L - ALUMINUM 6061 - T6 2 REQ'D 110⅛" LONG EA. 2 REQ'D 124⅝" LONG EA.
NATIONAL BUREAU OF STANDARDS BOULDER, COLORADO, 80303
LARGE CHANNEL FRAME FOR TRANSITION "A"
TEM CELL


ORIGINAL DATE OF DRAWING 18 AUGUST 1978
REVISIONS
OUTLINE
OF SMALL
AT ASS
35¼°
FORESHORTENED VIEW
819.2 mm
32¼"
REF.
45°
BRACES
THIS DWG. SHOWING METHOD
ER COMPOUND ANGLE CUTS ON ENDS
ABOVE MAY VARY
LIGHT VARIATIONS OF CROSS SECTION
S NOT SQUARE TO FLANGES, ETC.)
AS NECESSARY
NATIONAL BUREAU OF STANDARDS
BOULDER, COLORADO, 80303
CHANNEL BRACES AND GUSSETS FOR TRANSITION "A"
TEM CELL
MODEL 2.8 -
SCALE 1/4
DRAFTSMAN Victor Lecinski
PROJECT ENGR. M.L. CRAWFORD
PROJECT ENGR. J.L. WORKMAN
EN(10kHz-108MHz)-1/355)
SHEET 11 OF 32

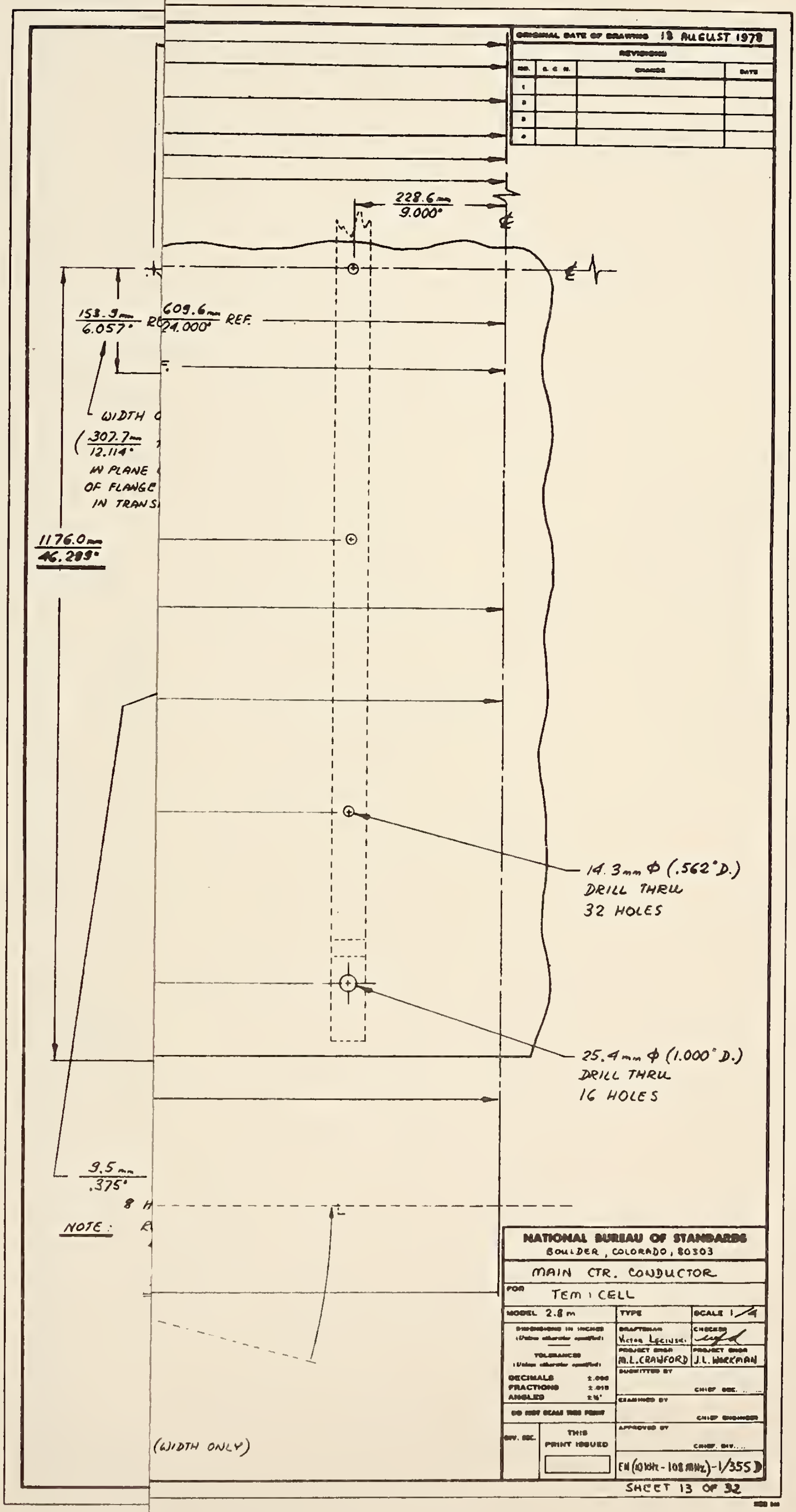

ORIGINAL DATE OF DRAWING 19 AUGUST 1979
OUTLINE OF TYP. SIDE OF SMALL CHANNEL FRAME AT ASS'Y
OUTLINE OF LARGE CHANNEL FRAME AT ASS'Y
1607.3mm / 63 9/32" REF.
TYP. GUSSET THIS END
CRITICAL DIMENSION AT FINAL ASSEMBLY SEE SHEET # 7 OF THIS DWG.
DETAIL ~ CENTER CHANNEL BRACES WITH GUSSETS
SCALE - 1/4
8 REQ'D PER TRANSITION "A"
8 GUSSETS REQ'D TYPE AT SMALL CHANNEL FRAME
8 GUSSETS REQ'D TYPE AT LARGE CHANNEL FRAME
NOTE: GUSSETS INSIDE OF CHANNELS
EXTENSION THIS AND OPPOSITE END TO FIT INSIDE CENTER AND CORNER CHANNEL BRACES
NOMINAL DIM. MAY REQUIRE TRIMMING
DETAIL ~ INTERSECTING CHANNEL BRACES
SCALE ~ 1/4
4 REQ'D LEFT HAND PER TRANSITION "A"
4 REQ'D RIGHT HAND PER TRANSITION "A"
FORESHORTENED VIEW
2016.1mm / 79 3/8" APPROX.
TRANSITION "A"
DETAIL ~ CENTER CHANNEL BRACES
CORNER CHANNEL BRACES
INTERSECTING CHANNEL BRACES
MAT'L ~ ALUMINUM 6061-T6 CHANNEL 7" [3.205 LL (2¼" FLANGE)
NEEDED 1400" (117 Ft)
MAT'L ~ ALUMINUM 6061-T6 PLATE
NEEDED 5" WIDTH × 120" LONG × ¼ THICK BAR
SCALE ~ 1/4
DETAIL ~ CORNER CHANNEL BRACES
SCALE ~ 1/4
NOTE: A. SEE SHEET #7 OF THIS DWG. SHOWING METHOD OF CUTTING PROPER COMPOUND ANGLE CUTS ON ENDS
B. INDICATED LENGTH ABOVE MAY VARY DEPENDING ON SLIGHT VARIATIONS OF CROSS SECTION OF CHANNEL (WEB NOT SQUARE TO FLANGES, ETC.) FILL GAPS OR TRIM AS NECESSARY
NOMINAL TOLERANCES ± 3.2mm (⅛")
NATIONAL BUREAU OF STANDARDS
BOULDER, COLORADO, 80303
CHANNEL BRACES AND GUSSETS FOR TRANSITION "A"
TEM CELL
M.L. CRAWFORD
SHEET 11 OF 38



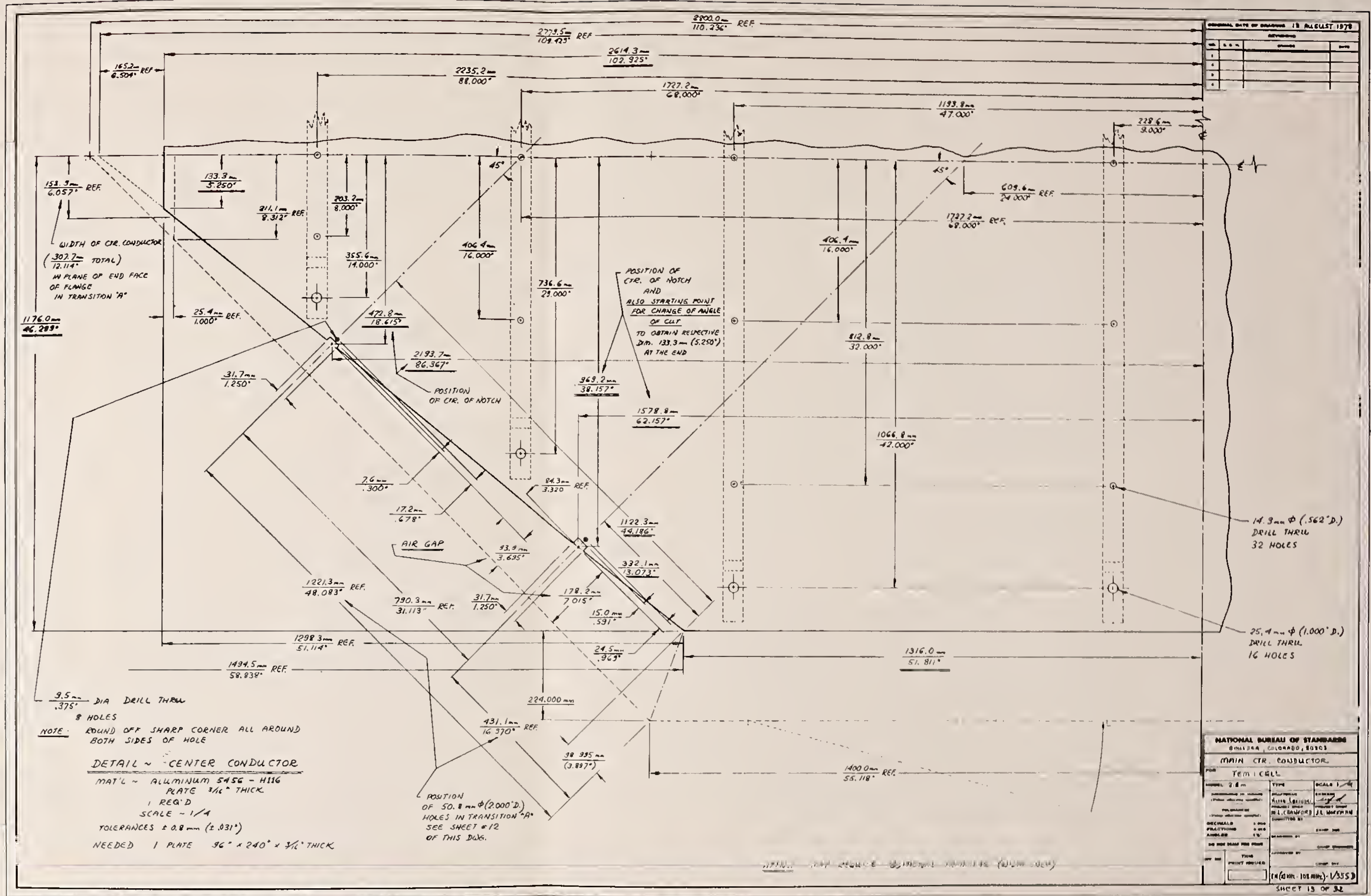
ORIGINAL DATE OF DRAWING 18 AUGUST 1978
REVISIONS
NO
E C N
CHANGE
DATE
4 HOLES
MINAL
TR. CONDUCTOR – SEE NOTE
SIDE FROM CTR. CONDUCTOR
CONDUCTOR IN PROPER POSITION – AS AT FINAL ASS'Y)
3.2mm (.125") FROM INDICATED POINT
AIN SECTION AS SHOWN
1400.2 mm / 55.125" REF.
PLATES)
D.)
NOMIN
ESTABLIS
AFTER C
PLATES A
IN PROPE
SEE SU
ORDER OF
ON SHEET
OF THIS
459.2 mm / 18.08"
1177.5 mm / 46.36"
327.0 mm / 12.88" REF.
206.4 mm / 8.12" REF.
1193.8 mm / 47.00" REF.
533.4 mm / 21.00" REF.
AUXILIARY DETAIL
(USED FOR CALCULATIONS)
TYP. AT
(OUTER CONDUCTOR)
TRANSITION "A"
ALE ~ 1/8
LUMINUM 6061 - T6 PLATE 1/8 THICK
DED 8 PLATES 60" × 120" × 1/8" THICK EA. (FOR BOTH TRANSITIONS)
ES:
1). READ CAREFULLY SUGGESTED ORDER OF FABRICATION ON SHEET # 7 OF THIS DWG.
2). FURNISH APPROX 800 (8 × 100) #10-24 UNC, FLAT HEAD SCREWS BRASS, NICKEL PLATED, 3/8" LONG
3). ALL REF. DIMENSIONS ARE AUXILIARY DIMENSIONS
4) OVERALL DIMS. OF SIDES OF TRANSITION ARE IDENTICAL
5) TOLERANCES ± 0.8 mm (.031") EXCEPT AS NOTED
NATIONAL BUREAU OF STANDARDS
BOULDER, COLORADO, 80303
PLATES FOR TRANSITION "A"
FOR TEM CELL
MODEL 2.8 m
TYPE
SCALE 1/8
DRAFTSMAN Victor Lacinauski
PROJECT ENGR. M.L. CRAWFORD
PROJECT ENGR J.L. WORKMAN
DECIMALS
FRACTIONS
ANGLES
THIS PRINT ISSUED
EN (10 kHz-100 MHz)-1/355D
SHEET 12 OF 32



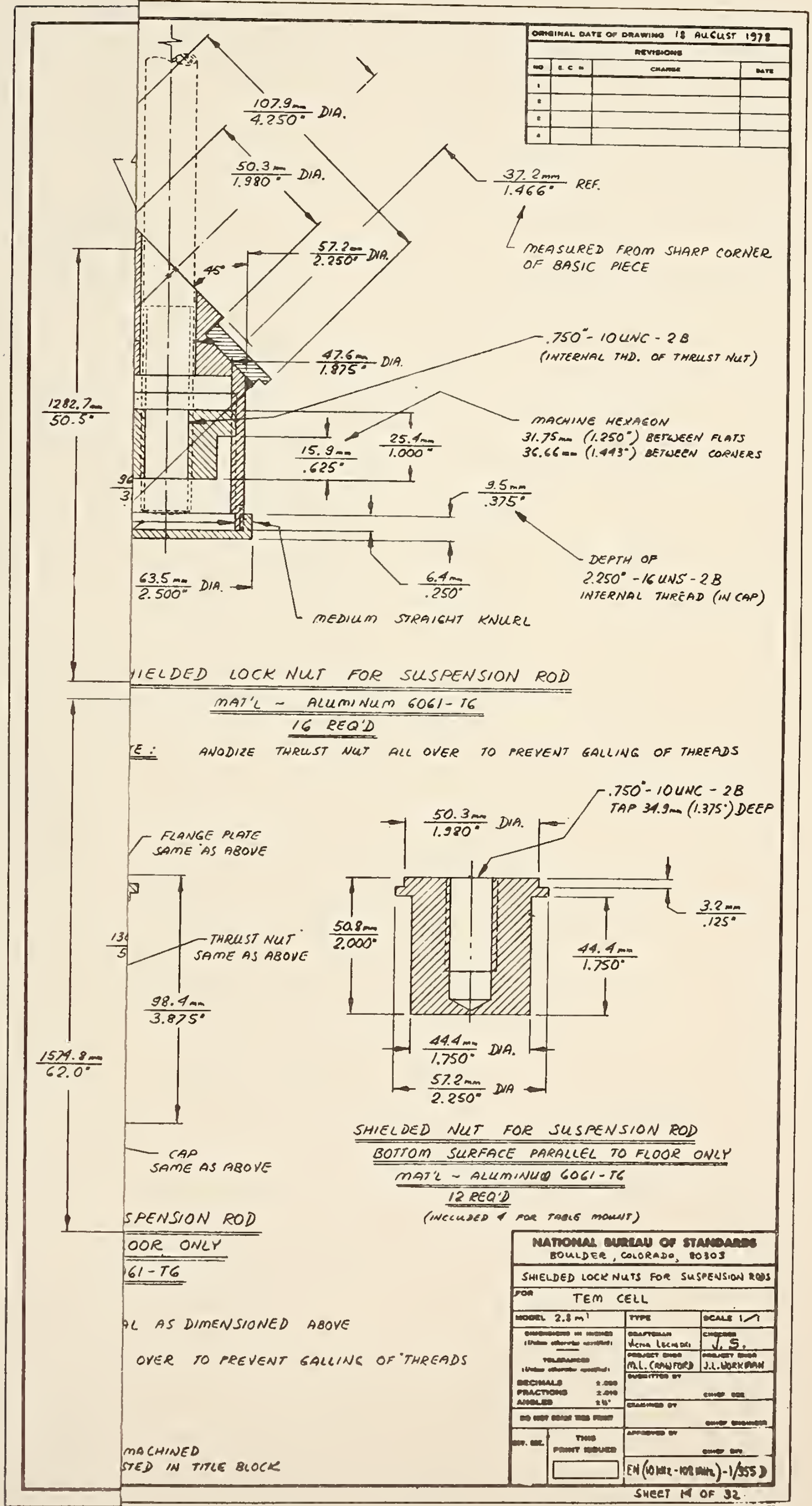
50.8 mm ⌀ (2.000" D.) DRILL THRU 4 HOLES
INDICATED DIMENSIONS ARE NOMINAL
LOCATE FROM INSIDE FROM CTR. CONDUCTOR – SEE NOTE
INDICATED DIMS. ARE NOMINAL
50.8 mm ⌀ (2.000" DIA) BORE THRU 2 HOLES
LOCATE TRUE POSITION FROM CTR. CONDUCTOR
SEE SHEET # 13 OF THIS DWG
TOLERANCE ON SIZE OF HOLES
LOCATE INSIDE FROM CTR. CONDUCTOR
(SET CTR. CONDUCTOR IN PROPER POSITION – AS AT FINAL ASS'Y)
THEN ADD 3.2 mm (.125") FROM INDICATED POINT
TOWARDS MAIN SECTION AS SHOWN
OFFSET (COMPENSATION) FOR THICKNESS OF PLATES) FOR 50.8 mm ⌀ (2.000" D) HOLES
NOMINAL DIM. ESTABLISH TRUE DIM. AFTER CORNER PLATES ARE PLACED IN PROPER POSITION
SEE SUGGESTED ORDER OF FABRICATION ON SHEET #7 OF THIS DWG.
TOLERANCE ±0.8 mm (±.031")
IDENTICAL
IDENTICAL EXCEPT ONE BOTTOM SIDE (NEAR SIDE WITH ACCESS DOORS IN MAIN SECTION) HAS ADDITIONAL HOLES – SEE BELOW AND SHEET #2 OF THIS DWG.
TOP
SIDE
SIDE
BOTTOM
TYP. AT CTR.
TOLERANCE ±0.8 mm (±.031")
INDICATED END 177.8 mm 7.00" APPROX. (NO FLANGE BUTT JOINT)
INDICATED END 215.9 mm 8.50" APPROX. (NO FLANGE BUTT JOINT)
120° TYP.
TYP. AT CORNER
OVERCUT FLANGE DEPTH ONE METAL THICKNESS (NOTE DASHED LINES SHOWING DIRECTION OF OVERCUT) TO ASSURE THAT OUTSIDE FACE OF FLANGE IS FLUSH WITH EDGES ON BOTH ENDS AFTER BENDING
TRIM ALL FLAGES AS INDICATED 45° AND RESPECTIVELY 135° TO ASSURE CLEARANCE WITH OTHER COMPONENTS OF TRANSITION "A" (CHANNELS AND ANGLES)
AUXILIARY DETAIL (USED FOR CALCULATIONS)
ATTN. THESE HOLES TO BE FABRICATED IN TRANSITION "A" ON ONE SIDE ONLY SEE SHEET #2 OF THIS DWG.
SEE SHEETS #18 AND #19 OF THIS DWG. FOR DETAILS OF THESE HOLES
PLATES (OUTER CONDUCTOR)
FOR TRANSITION "A"
SCALE ~ 1/4
MAT'L ~ ALUMINUM 6061 - T6 PLATE 1/4 THICK
NEEDED 8 PLATES 60" × 120" × 1/4" THICK EA. (FOR BOTH TRANSITIONS)
NOTES:
1) READ CAREFULLY SUGGESTED ORDER OF FABRICATION ON SHEET #7 OF THIS DWG.
2). FURNISH APPROX 800 (8×100) #10-24 UNC, FLAT HEAD SCREWS BRASS, NICKEL PLATED, 3/4" LONG
3). ALL REF. DIMENSIONS ARE AUXILIARY DIMENSIONS
4) OVERALL DIMS. OF SIDES OF TRANSITION ARE IDENTICAL
5) TOLERANCES ± 0.8 mm (.031") EXCEPT AS NOTED
NATIONAL BUREAU OF STANDARDS
BOULDER, COLORADO, 80303
PLATES FOR TRANSITION "A"
TEM CELL
SHEET 12 OF 32
ORIGINAL DATE OF DRAWING 18 AUGUST 1978



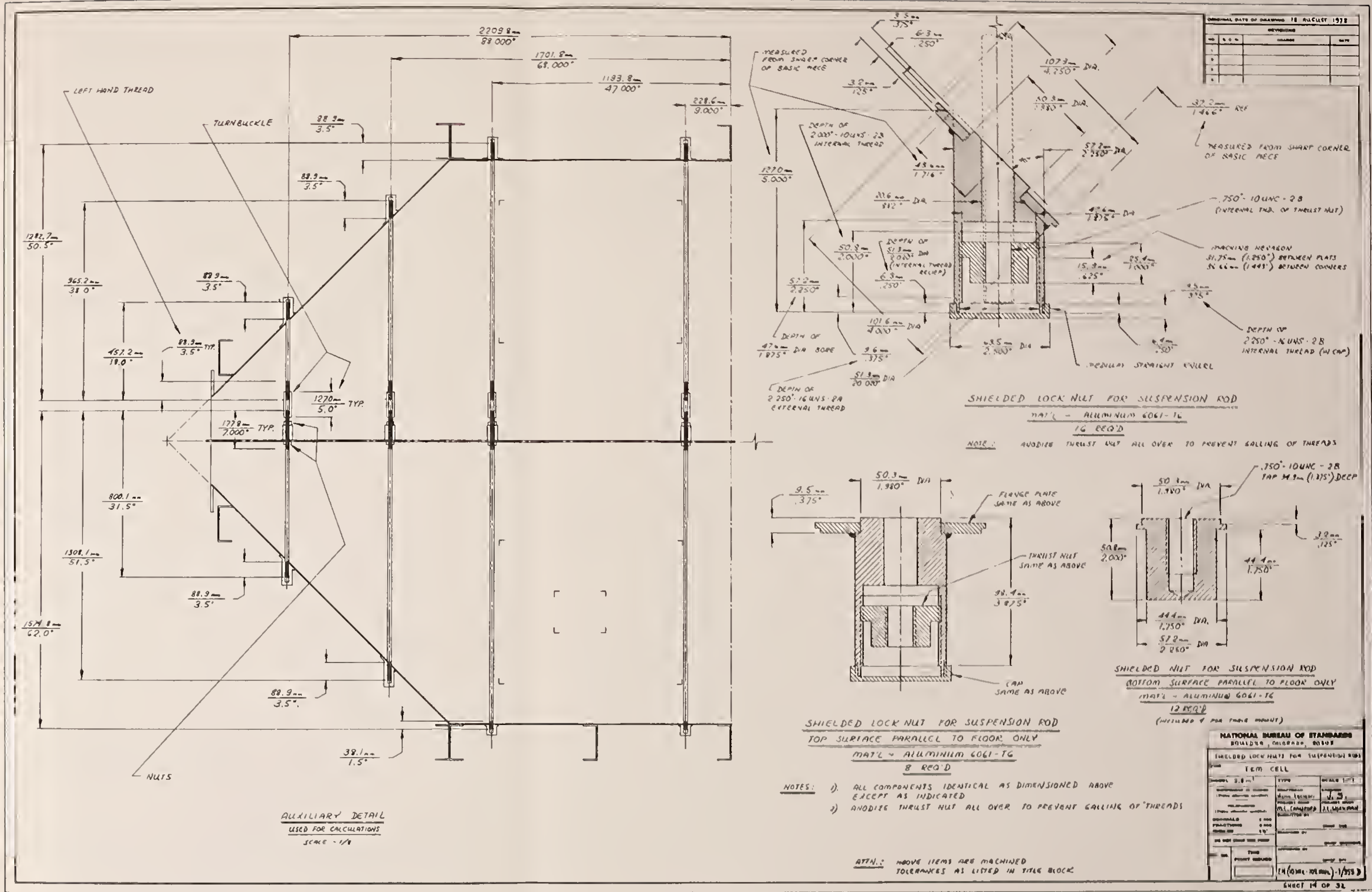
ORIGINAL DATE OF DRAWING 13 AUGUST 1978
REVISIONS
228.6mm 9.000"
158.9mm 6.057"
609.6mm 24.000" REF.
WIDTH
307.7mm 12.114"
IN PLANE
OF FLANGE
IN TRANS
1176.0mm 46.289"
14.3mm ϕ (.562" D.) DRILL THRU 32 HOLES
25.4mm ϕ (1.000" D.) DRILL THRU 16 HOLES
9.5mm .375"
NOTE:
(WIDTH ONLY)
NATIONAL BUREAU OF STANDARDS
BOULDER, COLORADO, 80303
MAIN CTR. CONDUCTOR
FOR TEM CELL
MODEL 2.8 m
SCALE 1/4
Victor Lecinski
M.L. CRAWFORD
J.L. WORKMAN
EM (10 kHz - 108 MHz)-1/355 D
SHEET 13 OF 32



ORIGINAL DATE OF DRAWING 13 AUGUST 1979
2800.0 mm / 110.236" REF.
2779.5 mm / 109.429" REF.
2614.3 mm / 102.925"
2235.2 mm / 88.000"
1727.2 mm / 68.000"
1193.8 mm / 47.000"
228.6 mm / 9.000"
165.2 mm / 6.504" REF
153.9 mm / 6.057" REF.
133.3 mm / 5.250"
211.1 mm / 8.312" REF.
203.2 mm / 8.000"
355.6 mm / 14.000"
406.4 mm / 16.000"
736.6 mm / 29.000"
609.6 mm / 24.000" REF.
1727.2 mm / 68.000" REF.
45°
WIDTH OF CTR. CONDUCTOR
(307.7 mm / 12.114" TOTAL)
IN PLANE OF END FACE
OF FLANGE
IN TRANSITION "A"
1176.0 mm / 46.299"
25.4 mm / 1.000" REF.
472.8 mm / 18.615"
2193.7 mm / 86.367"
POSITION OF CTR. OF NOTCH
31.7 mm / 1.250"
POSITION OF
CTR. OF NOTCH
AND
ALSO STARTING POINT
FOR CHANGE OF ANGLE
OF CUT
TO OBTAIN RESPECTIVE
DIM. 133.3 mm (5.250")
AT THE END
969.2 mm / 38.157"
1578.8 mm / 62.157"
812.8 mm / 32.000"
1066.8 mm / 42.000"
7.6 mm / .300"
17.2 mm / .678"
84.3 mm / 3.320 REF.
1122.3 mm / 44.186"
AIR GAP
93.9 mm / 3.695"
332.1 mm / 13.073"
178.2 mm / 7.015"
15.0 mm / .591"
1221.3 mm / 48.083" REF.
790.3 mm / 31.113" REF.
31.7 mm / 1.250"
1298.3 mm / 51.114" REF.
24.5 mm / .965"
1316.0 mm / 51.811"
1494.5 mm / 58.838" REF.
224.000 mm
431.1 mm / 16.970" REF.
98.995 mm / (3.897")
1400.0 mm / 55.118" REF.
14.3 mm ϕ (.562" D.)
DRILL THRU
32 HOLES
25.4 mm ϕ (1.000" D.)
DRILL THRU
16 HOLES
9.5 mm / .375" DIA DRILL THRU
8 HOLES
NOTE: ROUND OFF SHARP CORNER ALL AROUND
BOTH SIDES OF HOLE
DETAIL ~ CENTER CONDUCTOR
MAT'L ~ ALUMINUM 5456 - H116
PLATE 3/16" THICK
1 REQ'D
SCALE ~ 1/4
TOLERANCES ± 0.8 mm (± .031")
NEEDED 1 PLATE 96" × 240" × 3/16" THICK
POSITION
OF 50.8 mm ϕ (2.000" D.)
HOLES IN TRANSITION "A"
SEE SHEET # 12
OF THIS DWG.
NATIONAL BUREAU OF STANDARDS
BOULDER, COLORADO, 80303
MAIN CTR. CONDUCTOR
FOR TEM CELL
MODEL 3.6 m
SCALE 1/4
M. L. CRAWFORD
J. L. WORKMAN
TH (10 kHz - 108 MHz) - 1/355
SHEET 13 OF 32



ORIGINAL DATE OF DRAWING 18 AUGUST 1978
REVISIONS
NO | E.C.N. | CHANGE | DATE
107.9mm / 4.250" DIA.
50.3mm / 1.980" DIA.
37.2mm / 1.466" REF.
MEASURED FROM SHARP CORNER OF BASIC PIECE
57.2mm / 2.250" DIA.
45°
47.6mm / 1.875" DIA.
.750"-10UNC-2B (INTERNAL THD. OF THRUST NUT)
1282.7mm / 50.5"
MACHINE HEXAGON
31.75mm (1.250") BETWEEN FLATS
36.66mm (1.443") BETWEEN CORNERS
15.9mm / .625"
25.4mm / 1.000"
9.5mm / .375"
DEPTH OF 2.250"-16UNS-2B INTERNAL THREAD (IN CAP)
63.5mm / 2.500" DIA.
6.4mm / .250"
MEDIUM STRAIGHT KNURL
IELDED LOCK NUT FOR SUSPENSION ROD
MAT'L ~ ALUMINUM 6061-T6
16 REQ'D
E: ANODIZE THRUST NUT ALL OVER TO PREVENT GALLING OF THREADS
.750"-10UNC-2B TAP 34.9mm (1.375") DEEP
50.3mm / 1.980" DIA.
FLANGE PLATE SAME AS ABOVE
3.2mm / .125"
50.8mm / 2.000"
THRUST NUT SAME AS ABOVE
44.4mm / 1.750"
98.4mm / 3.875"
1574.8mm / 62.0"
44.4mm / 1.750" DIA.
57.2mm / 2.250" DIA
SHIELDED NUT FOR SUSPENSION ROD
BOTTOM SURFACE PARALLEL TO FLOOR ONLY
MAT'L ~ ALUMINUM 6061-T6
12 REQ'D
(INCLUDED 4 FOR TABLE MOUNT)
CAP SAME AS ABOVE
SPENSION ROD
OOR ONLY
61-T6
AL AS DIMENSIONED ABOVE
OVER TO PREVENT GALLING OF THREADS
MACHINED
STED IN TITLE BLOCK
NATIONAL BUREAU OF STANDARDS
BOULDER, COLORADO, 80303
SHIELDED LOCK NUTS FOR SUSPENSION RODS
FOR TEM CELL
MODEL 2.8 m³
SCALE 1/1
DECIMALS ±.005
FRACTIONS ±.010
ANGLES ±½°
DO NOT SCALE THIS PRINT
Vern Lecmski
J. S.
M.L. CRAWFORD
J.L. WORKMAN
EN (10 kHz-100 MHz)-1/355 D
SHEET 14 OF 32



AUXILIARY DETAIL
USED FOR CALCULATIONS
SCALE - 1/8

SHIELDED LOCK NUT FOR SUSPENSION ROD
MAT'L - ALUMINUM 6061-T6
16 REQ'D

NOTE: ANODIZE THRUST NUT ALL OVER TO PREVENT GALLING OF THREADS

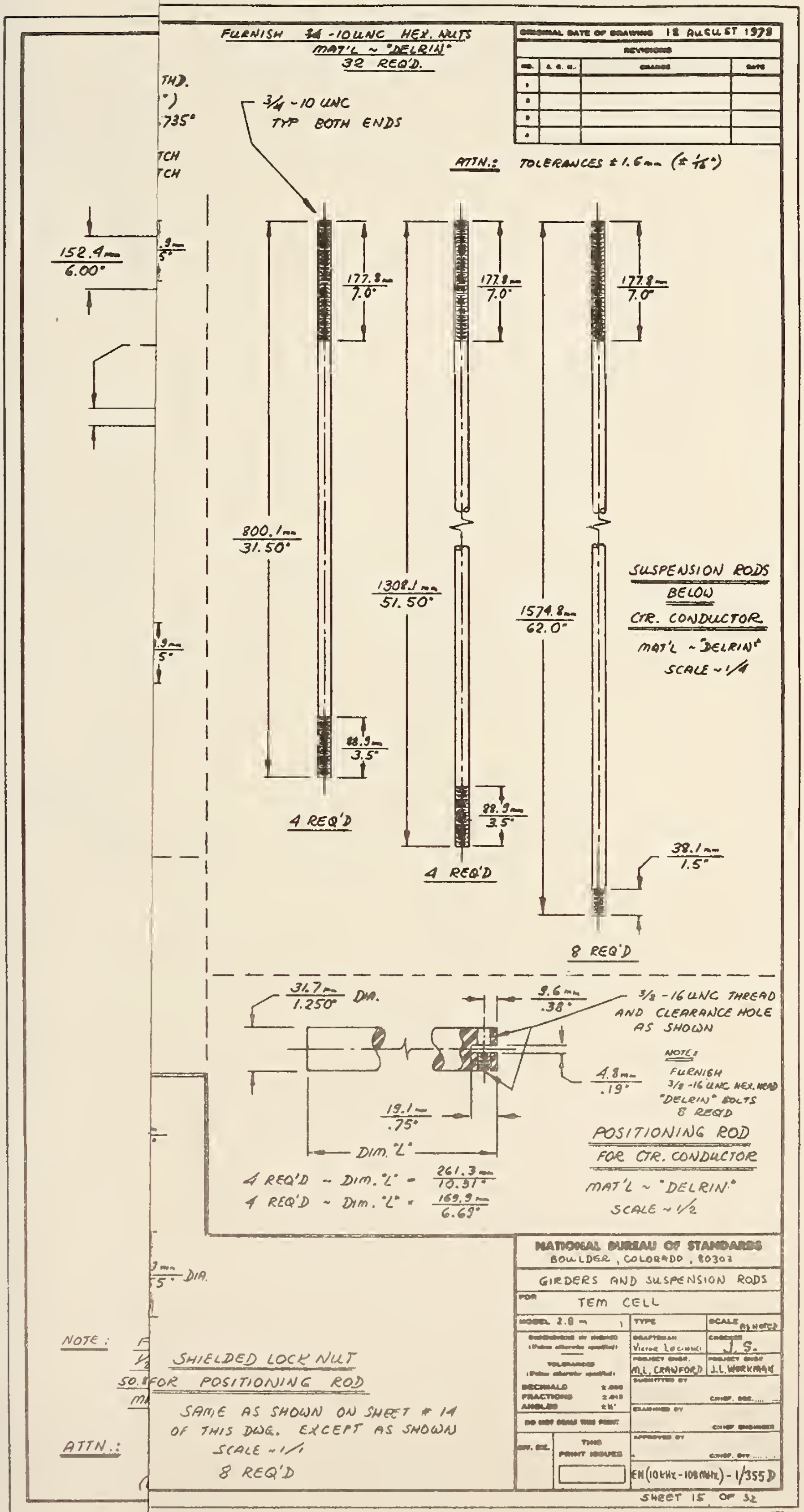
SHIELDED LOCK NUT FOR SUSPENSION ROD
TOP SURFACE PARALLEL TO FLOOR ONLY
MAT'L - ALUMINUM 6061-T6
8 REQ'D

SHIELDED NUT FOR SUSPENSION ROD
BOTTOM SURFACE PARALLEL TO FLOOR ONLY
MAT'L - ALUMINUM 6061-T6
12 REQ'D
(INCLUDES 4 FOR TRAVEL MOUNT)

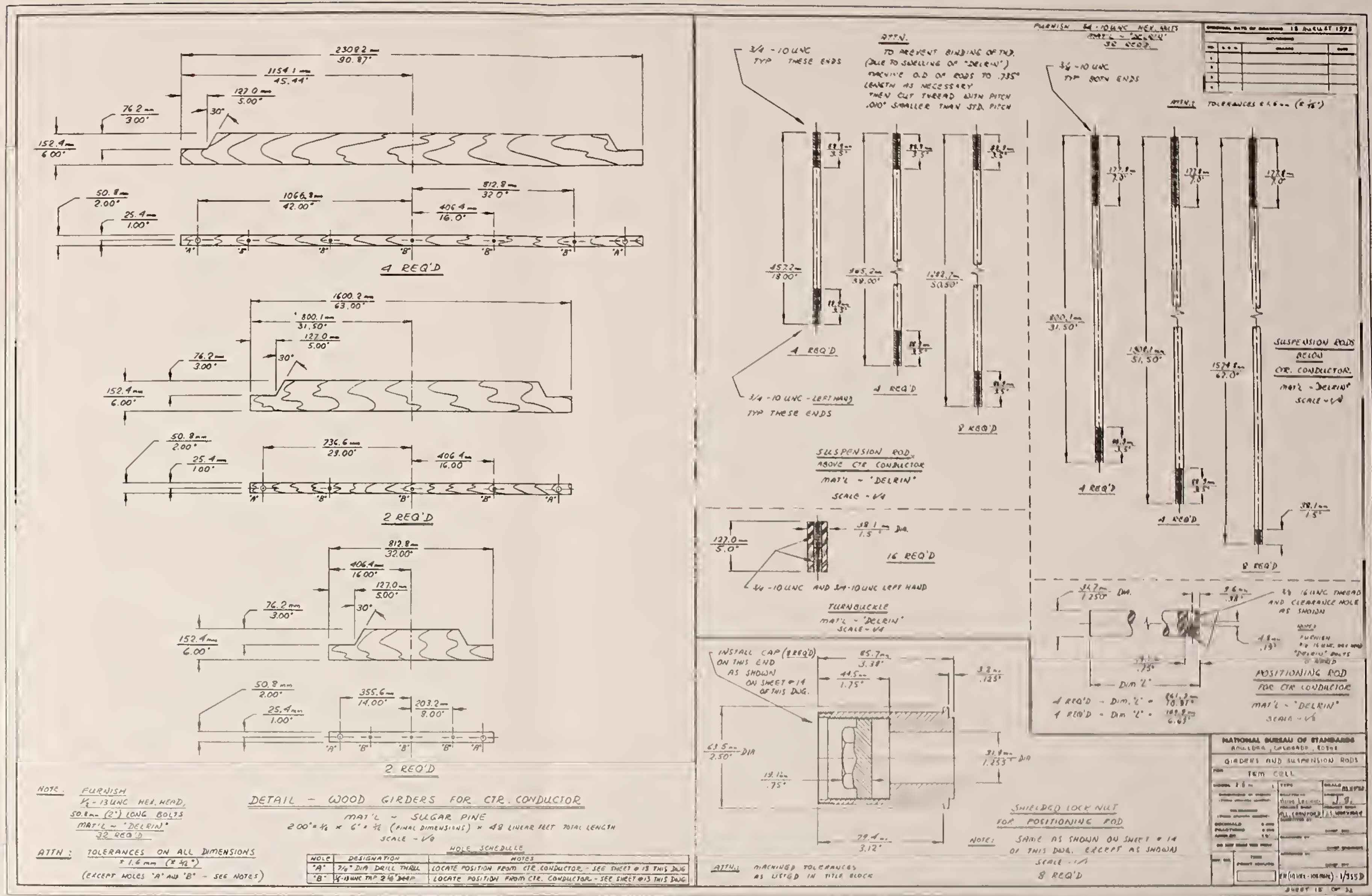
NOTES: 1). ALL COMPONENTS IDENTICAL AS DIMENSIONED ABOVE EXCEPT AS INDICATED
2) ANODIZE THRUST NUT ALL OVER TO PREVENT GALLING OF THREADS

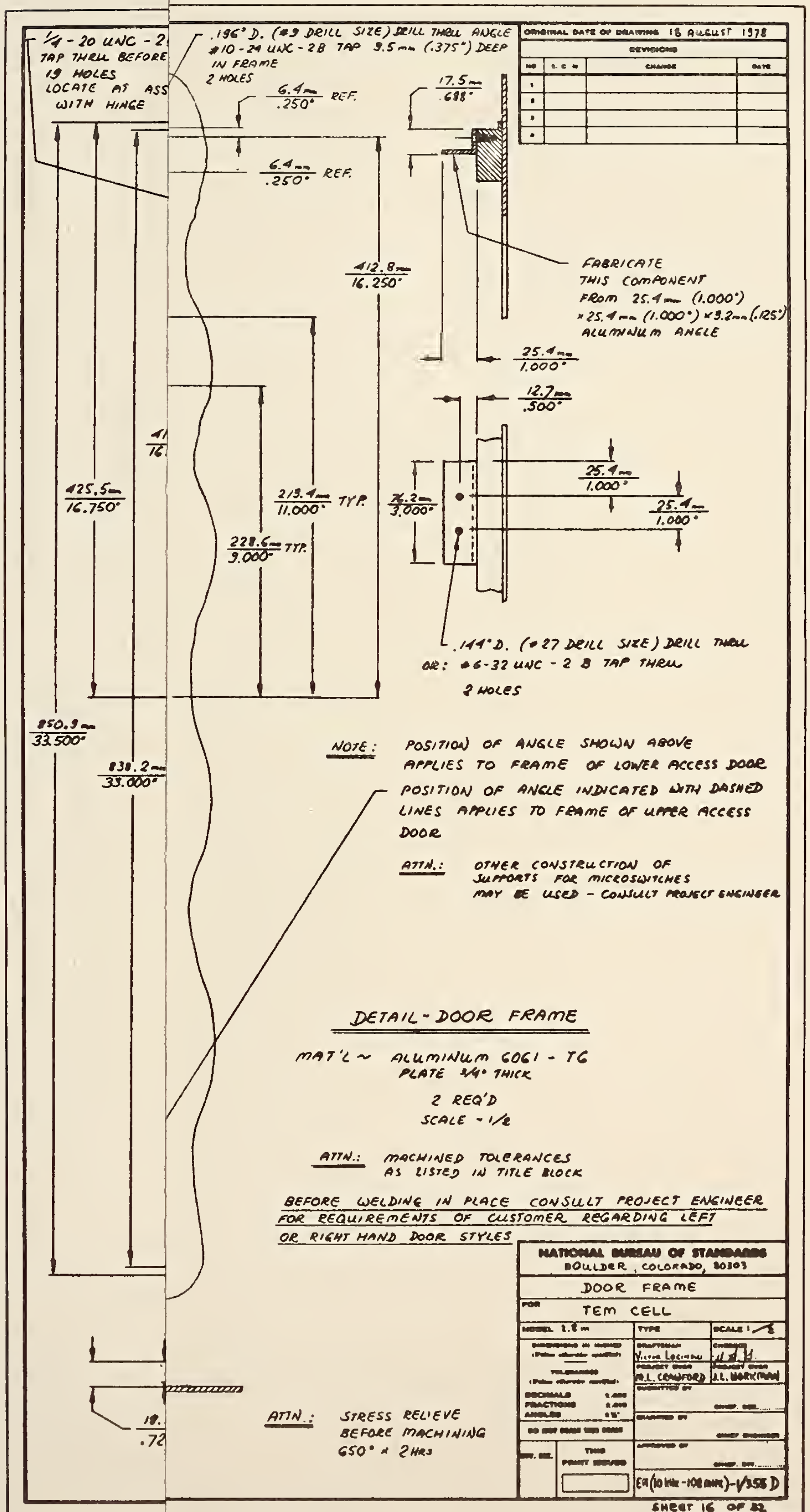
ATTN.: ABOVE ITEMS ARE MACHINED TOLERANCES AS LISTED IN TITLE BLOCK

NATIONAL BUREAU OF STANDARDS
BOULDER, COLORADO, 80303
SHIELDED LOCK NUTS FOR SUSPENSION RODS
TEM CELL
SHEET 14 OF 32

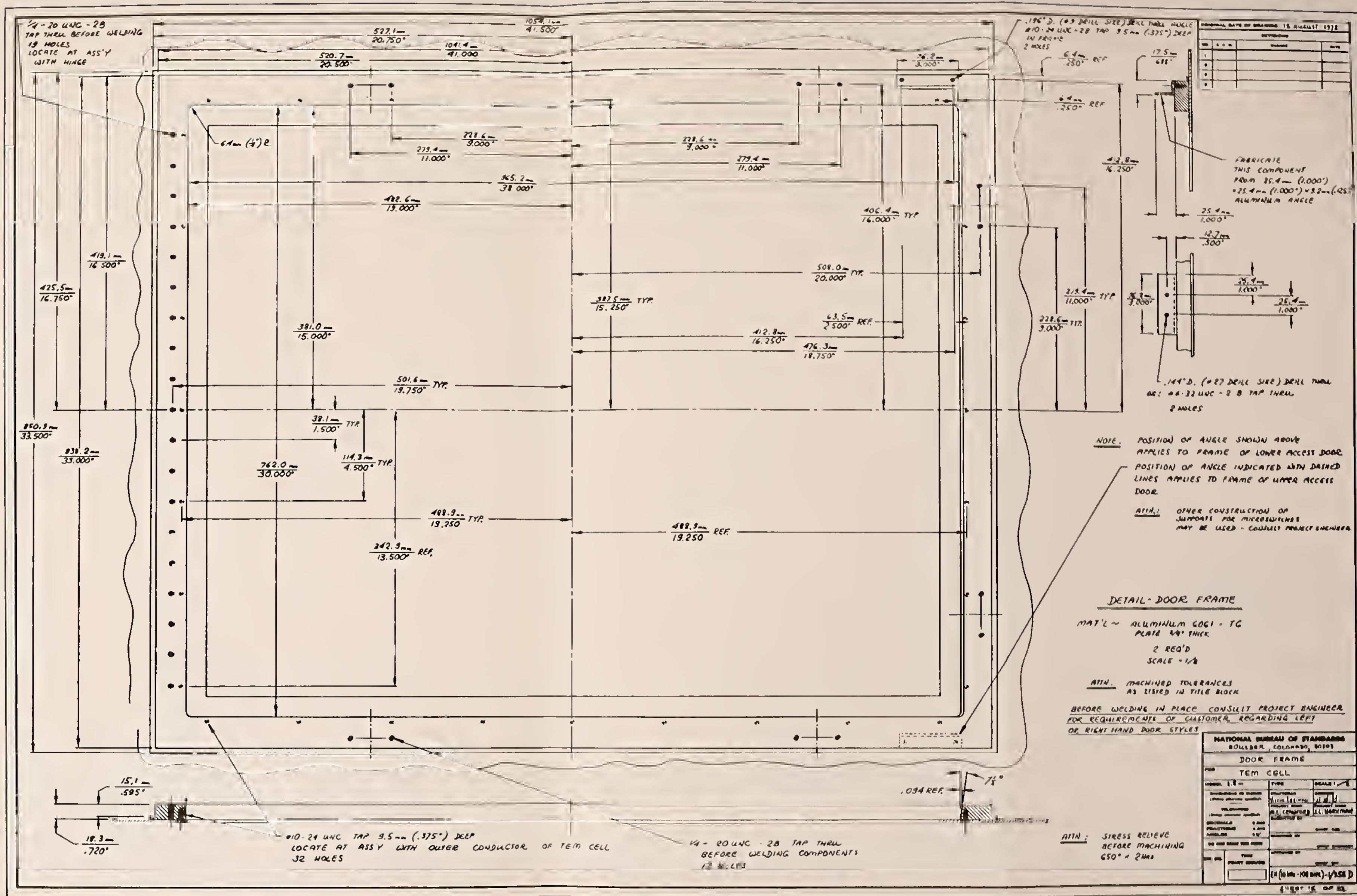


FURNISH 3/4-10UNC HEX. NUTS
MAT'L ~ "DELRIN"
32 REQ'D.
3/4-10 UNC
TYP BOTH ENDS
ATTN.: TOLERANCES ± 1.6mm (± 1/16")
ORIGINAL DATE OF DRAWING 18 AUGUST 1978
REVISIONS
177.8mm
7.0"
800.1mm
31.50"
1308.1mm
51.50"
1574.8mm
62.0"
88.9mm
3.5"
38.1mm
1.5"
4 REQ'D
4 REQ'D
8 REQ'D
SUSPENSION RODS
BELOW
CTR. CONDUCTOR
MAT'L ~ "DELRIN"
SCALE ~ 1/4
31.7mm
1.250" DIA.
9.6mm
.38"
3/8-16 UNC THREAD
AND CLEARANCE HOLE
AS SHOWN
4.8mm
.19"
NOTE:
FURNISH
3/8-16 UNC HEX. HEAD
"DELRIN" BOLTS
8 REQ'D
19.1mm
.75"
DIM. "L"
4 REQ'D ~ DIM. "L" = 261.3mm / 10.31"
4 REQ'D ~ DIM. "L" = 169.9mm / 6.69"
POSITIONING ROD
FOR CTR. CONDUCTOR
MAT'L ~ "DELRIN"
SCALE ~ 1/2
SHIELDED LOCK NUT
FOR POSITIONING ROD
SAME AS SHOWN ON SHEET # 14
OF THIS DWG. EXCEPT AS SHOWN
SCALE ~ 1/1
8 REQ'D
NATIONAL BUREAU OF STANDARDS
BOULDER, COLORADO, 80303
GIRDERS AND SUSPENSION RODS
FOR TEM CELL
MODEL 3.0 m
SCALE AS NOTED
DRAFTSMAN Victor Lecinski
CHECKER J. S.
PROJECT ENGR. M.L. CRAWFORD
PROJECT ENGR. J.L. WORKMAN
EN(10kHz-100MHz)-1/355 D
SHEET 15 OF 32
152.4mm
6.00"
NOTE:
ATTN.:

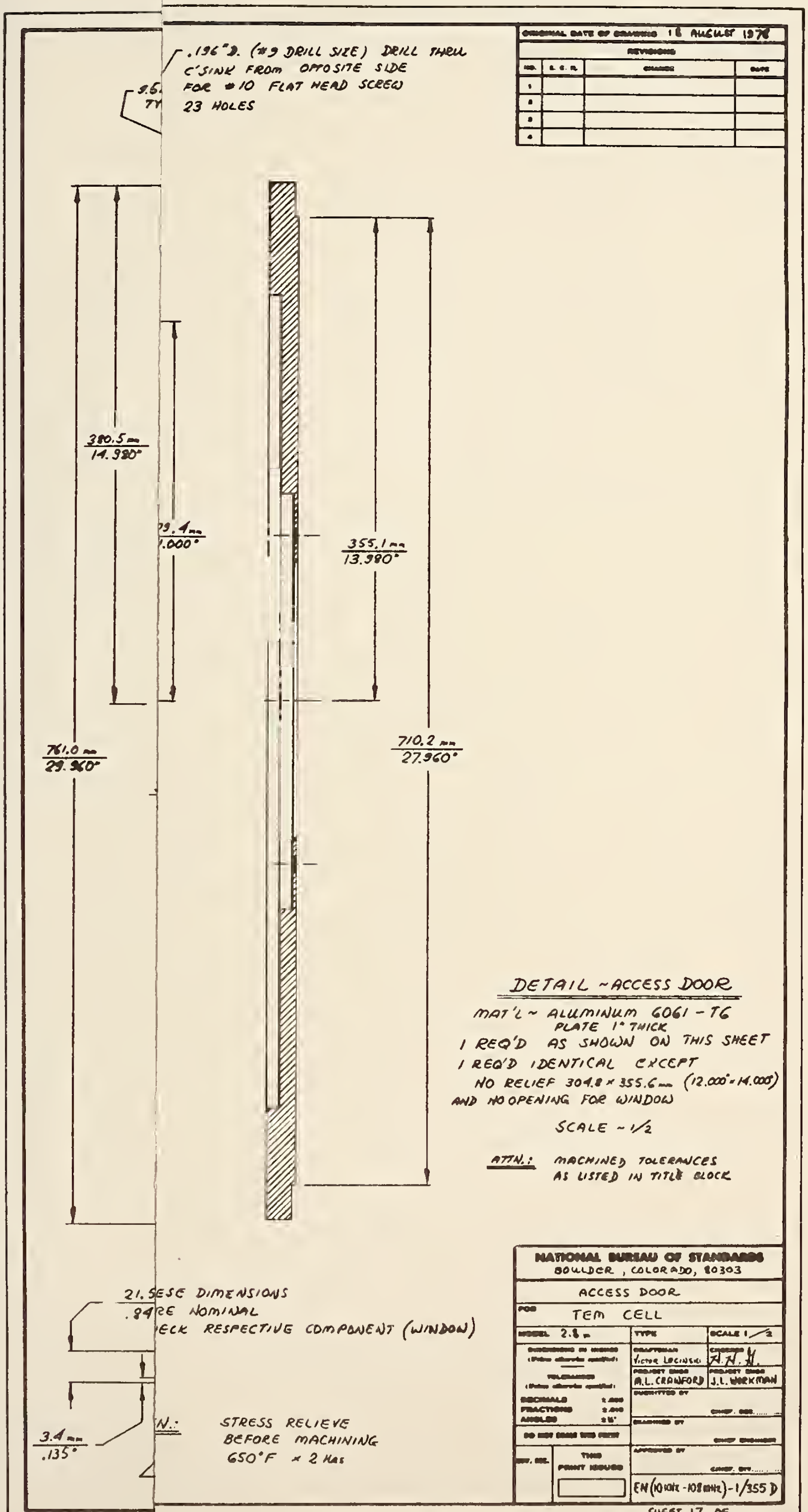

4 REQ'D
2 REQ'D
2 REQ'D
NOTE: FURNISH 1/2-13UNC HEX. HEAD, 50.8mm (2") LONG BOLTS MAT'L ~ 'DELRIN' 32 REQ'D
ATTN: TOLERANCES ON ALL DIMENSIONS ± 1.6 mm (± 1/16") (EXCEPT HOLES "A" AND "B" - SEE NOTES)
DETAIL - WOOD GIRDERS FOR CTR. CONDUCTOR
MAT'L ~ SUGAR PINE
SCALE - 1/8
HOLE SCHEDULE
SUSPENSION ROD ABOVE CTR CONDUCTOR
MAT'L ~ 'DELRIN'
SCALE - 1/4
SUSPENSION RODS BELOW CTR. CONDUCTOR
16 REQ'D
TURNBUCKLE
MAT'L ~ 'DELRIN'
SCALE - 1/4
POSITIONING ROD FOR CTR CONDUCTOR
MAT'L ~ 'DELRIN'
SHIELDED LOCK NUT FOR POSITIONING ROD
8 REQ'D
NATIONAL BUREAU OF STANDARDS
GIRDERS AND SUSPENSION RODS
TEM CELL

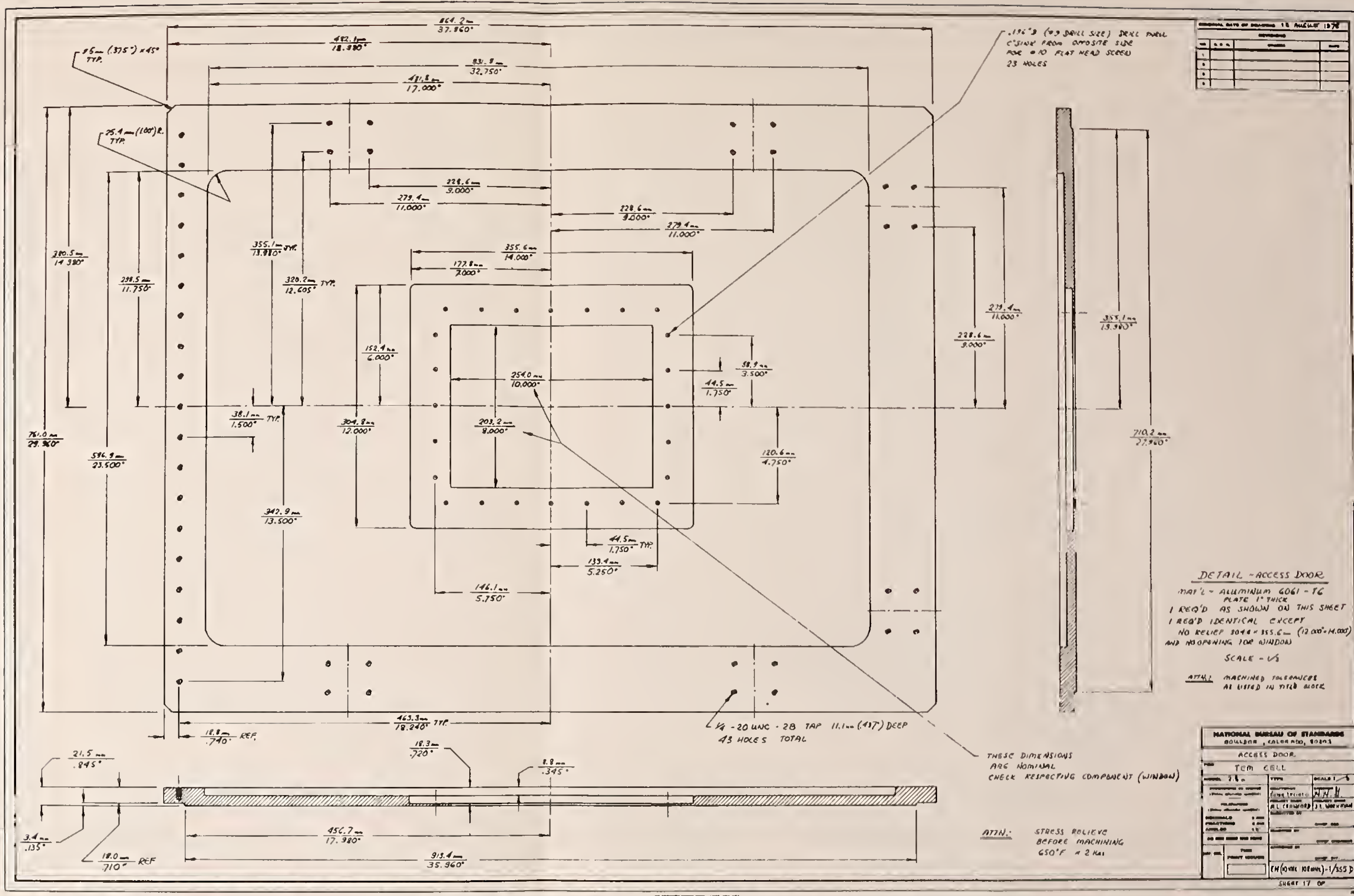


1/4 - 20 UNC - 2
TAP THRU BEFORE
19 HOLES
LOCATE AT ASS
WITH HINGE
.196" D. (#9 DRILL SIZE) DRILL THRU ANGLE
#10-24 UNC-2B TAP 9.5mm (.375") DEEP
IN FRAME
2 HOLES
6.4mm .250" REF.
6.4mm .250" REF.
17.5mm .688"
ORIGINAL DATE OF DRAWING 18 AUGUST 1978
REVISIONS
FABRICATE
THIS COMPONENT
FROM 25.4mm (1.000")
× 25.4mm (1.000") × 3.2mm (.125")
ALUMINUM ANGLE
412.8mm 16.250"
25.4mm 1.000"
12.7mm .500"
425.5mm 16.750"
219.4mm 11.000" TYP.
228.6mm 9.000" TYP.
76.2mm 3.000"
25.4mm 1.000"
25.4mm 1.000"
.144" D. (#27 DRILL SIZE) DRILL THRU
OR: #6-32 UNC - 2 B TAP THRU
2 HOLES
850.9mm 33.500"
838.2mm 33.000"
NOTE: POSITION OF ANGLE SHOWN ABOVE
APPLIES TO FRAME OF LOWER ACCESS DOOR
POSITION OF ANGLE INDICATED WITH DASHED
LINES APPLIES TO FRAME OF UPPER ACCESS
DOOR
ATTN.: OTHER CONSTRUCTION OF
SUPPORTS FOR MICROSWITCHES
MAY BE USED - CONSULT PROJECT ENGINEER
DETAIL - DOOR FRAME
MAT'L ~ ALUMINUM 6061 - T6
PLATE 3/4" THICK
2 REQ'D
SCALE ~ 1/2
ATTN.: MACHINED TOLERANCES
AS LISTED IN TITLE BLOCK
BEFORE WELDING IN PLACE CONSULT PROJECT ENGINEER
FOR REQUIREMENTS OF CUSTOMER REGARDING LEFT
OR RIGHT HAND DOOR STYLES
ATTN.: STRESS RELIEVE
BEFORE MACHINING
650° × 2 HRS
NATIONAL BUREAU OF STANDARDS
BOULDER, COLORADO, 80303
DOOR FRAME
TEM CELL
M.L. CRAWFORD
J.L. WORKMAN
SHEET 16 OF 32

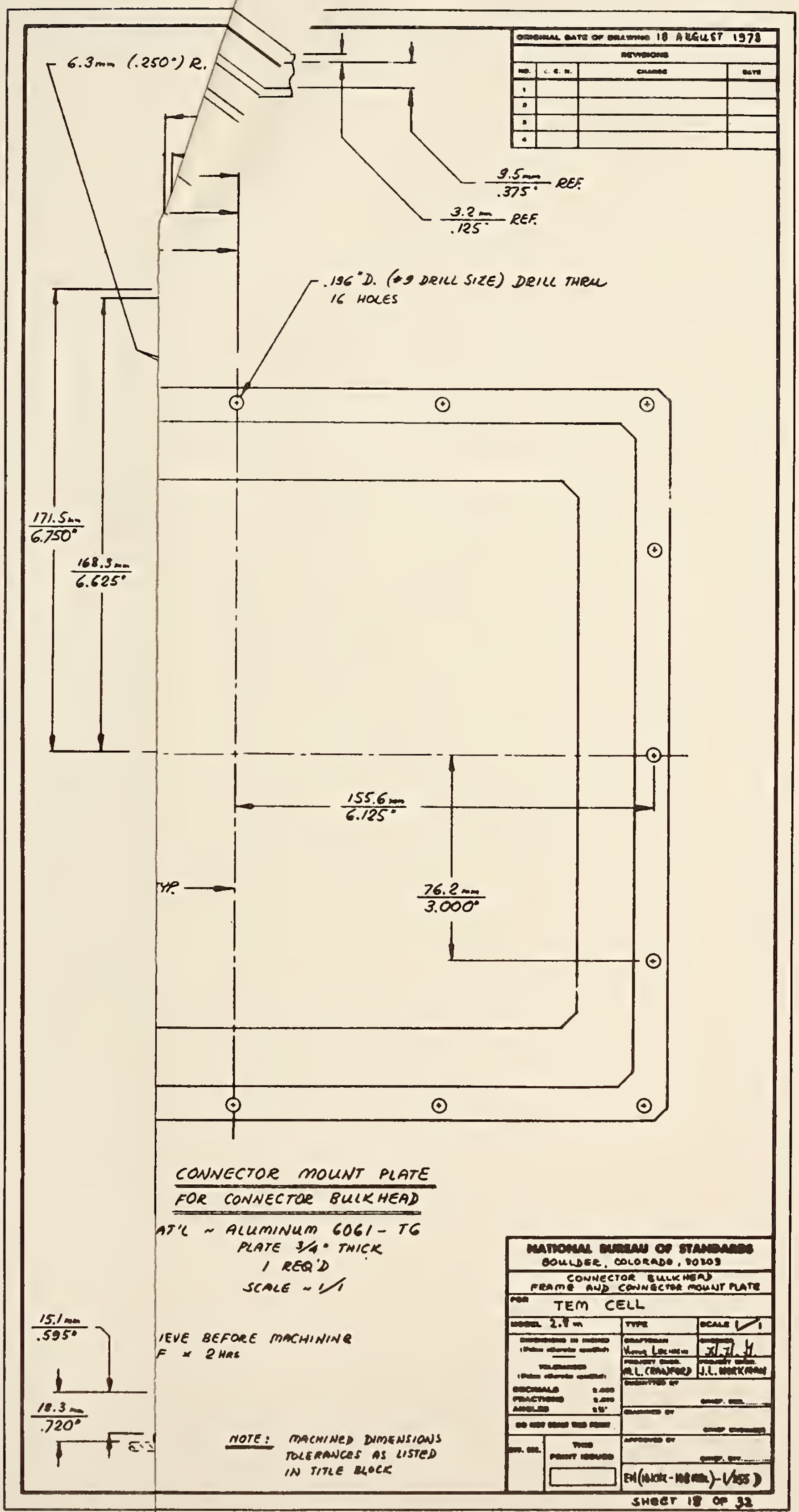


1/4 - 20 UNC - 2B TAP THRU BEFORE WELDING 19 HOLES LOCATE AT ASS'Y WITH HINGE
6.4 mm (1/4") R.
NOTE. POSITION OF ANGLE SHOWN ABOVE APPLIES TO FRAME OF LOWER ACCESS DOOR. POSITION OF ANGLE INDICATED WITH DASHED LINES APPLIES TO FRAME OF UPPER ACCESS DOOR.
DETAIL - DOOR FRAME
MAT'L ~ ALUMINUM 6061 - T6 PLATE 1/4" THICK
2 REQ'D
SCALE = 1/4
BEFORE WELDING IN PLACE CONSULT PROJECT ENGINEER FOR REQUIREMENTS OF CUSTOMER REGARDING LEFT OR RIGHT HAND DOOR STYLES
#10 - 24 UNC TAP 9.5 mm (.375") DEEP LOCATE AT ASS'Y WITH OUTER CONDUCTOR OF TEM CELL 32 HOLES
1/4 - 20 UNC - 2B TAP THRU BEFORE WELDING COMPONENTS
ATTN: STRESS RELIEVE BEFORE MACHINING 650° F 2 Hrs
NATIONAL BUREAU OF STANDARDS
BOULDER, COLORADO, 80303
DOOR FRAME
TEM CELL

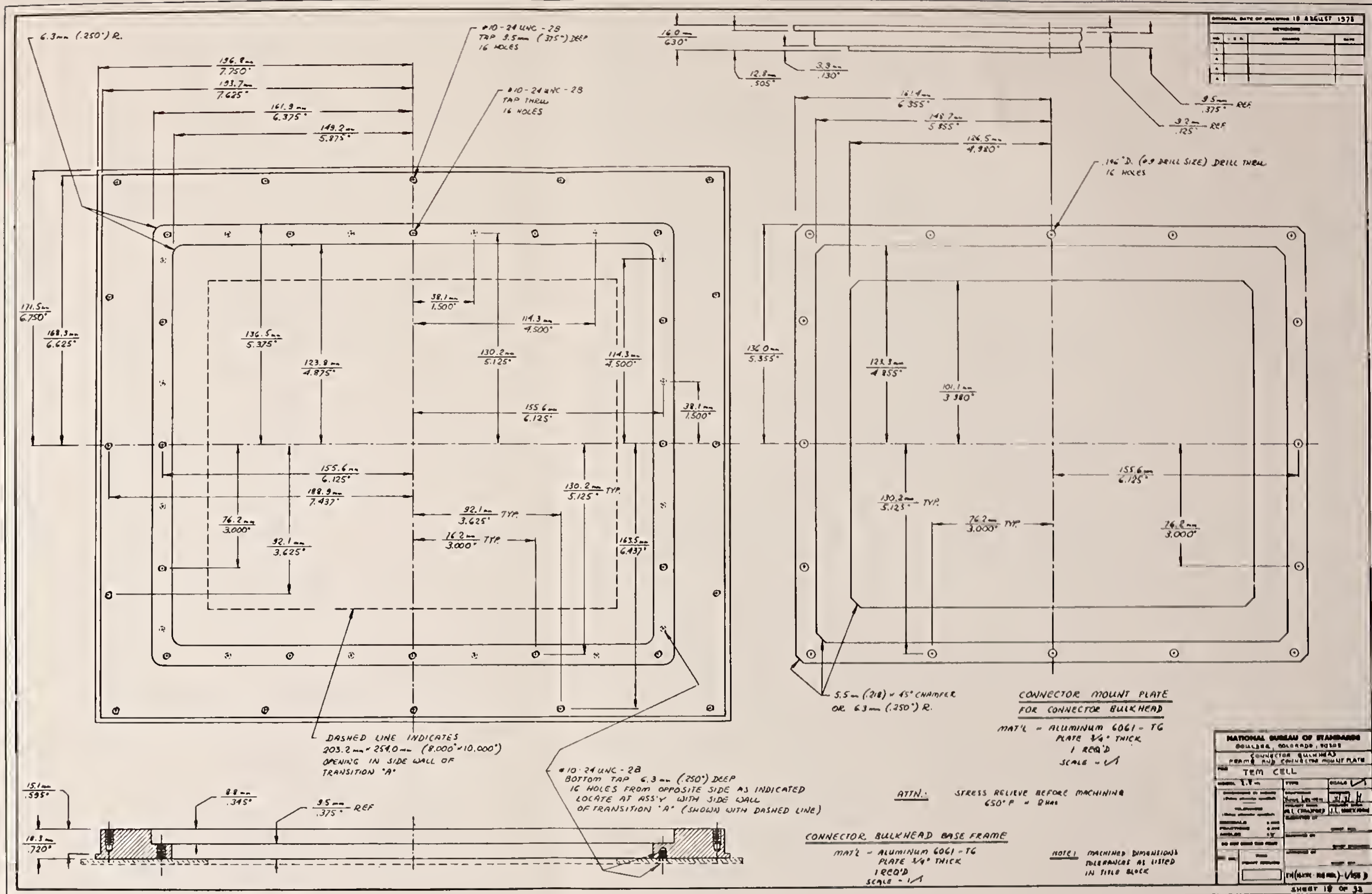

ORIGINAL DATE OF DRAWING 18 AUGUST 1978
REVISIONS
.196" Ø. (#9 DRILL SIZE) DRILL THRU
C'SINK FROM OPPOSITE SIDE
FOR #10 FLAT HEAD SCREW
23 HOLES
380.5 mm / 14.980"
355.1 mm / 13.980"
761.0 mm / 29.960"
710.2 mm / 27.960"
DETAIL ~ ACCESS DOOR
MAT'L ~ ALUMINUM 6061 - T6
PLATE 1" THICK
1 REQ'D AS SHOWN ON THIS SHEET
1 REQ'D IDENTICAL EXCEPT
NO RELIEF 304.8 × 355.6 mm (12.000" × 14.000")
AND NO OPENING FOR WINDOW
SCALE ~ 1/2
ATTN.: MACHINED TOLERANCES
AS LISTED IN TITLE BLOCK
ESE DIMENSIONS
RE NOMINAL
ECK RESPECTIVE COMPONENT (WINDOW)
3.4 mm / .135"
STRESS RELIEVE
BEFORE MACHINING
650°F × 2 HRS
NATIONAL BUREAU OF STANDARDS
BOULDER, COLORADO, 80303
ACCESS DOOR
TEM CELL
2.8 m
SCALE 1/2
VICTOR LOCINSKI
A.L. CRAWFORD
J.L. WORKMAN
EN (10 kHz - 108 MHz) - 1/355 D
SHEET 17 OF



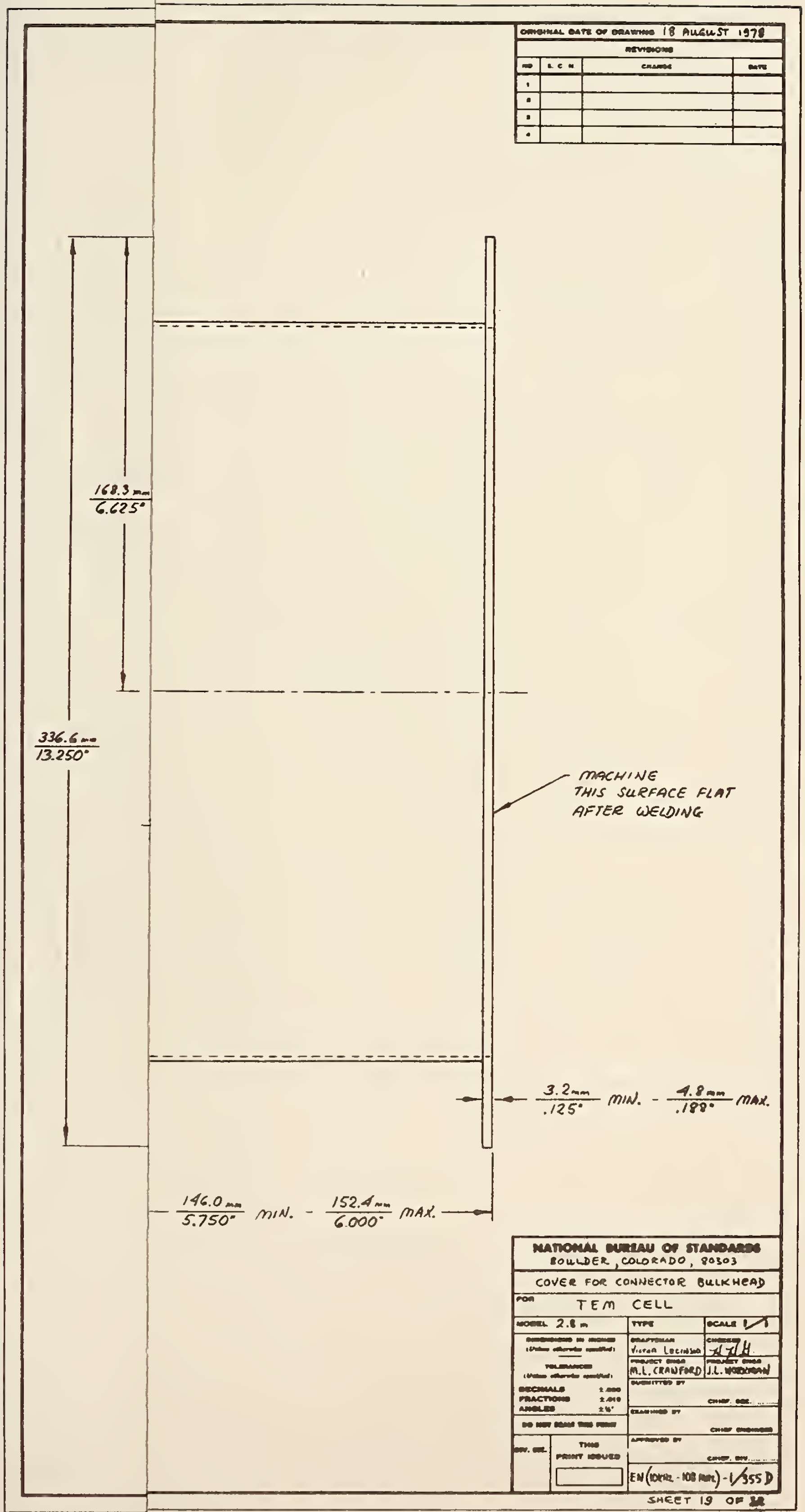
.196" ⌀ (#9 DRILL SIZE) DRILL THRU
C'SINK FROM OPPOSITE SIDE
FOR #10 FLAT HEAD SCREW
23 HOLES
1/4 -20 UNC - 2B TAP 11.1 mm (.437") DEEP
43 HOLES TOTAL
THESE DIMENSIONS
ARE NOMINAL
CHECK RESPECTIVE COMPONENT (WINDOW)
DETAIL - ACCESS DOOR
MAT'L - ALUMINUM 6061 - T6
PLATE 1" THICK
1 REQ'D AS SHOWN ON THIS SHEET
1 REQ'D IDENTICAL EXCEPT
NO RELIEF 304.8 × 355.6 mm (12.000" × 14.000")
AND NO OPENING FOR WINDOW
SCALE - 1/5
ATTN.: MACHINED TOLERANCES
AS LISTED IN TITLE BLOCK
ATTN.: STRESS RELIEVE
BEFORE MACHINING
650°F ± 2 Hrs
NATIONAL BUREAU OF STANDARDS
BOULDER, COLORADO, 80303
ACCESS DOOR
TEM CELL
SHEET 17 OF



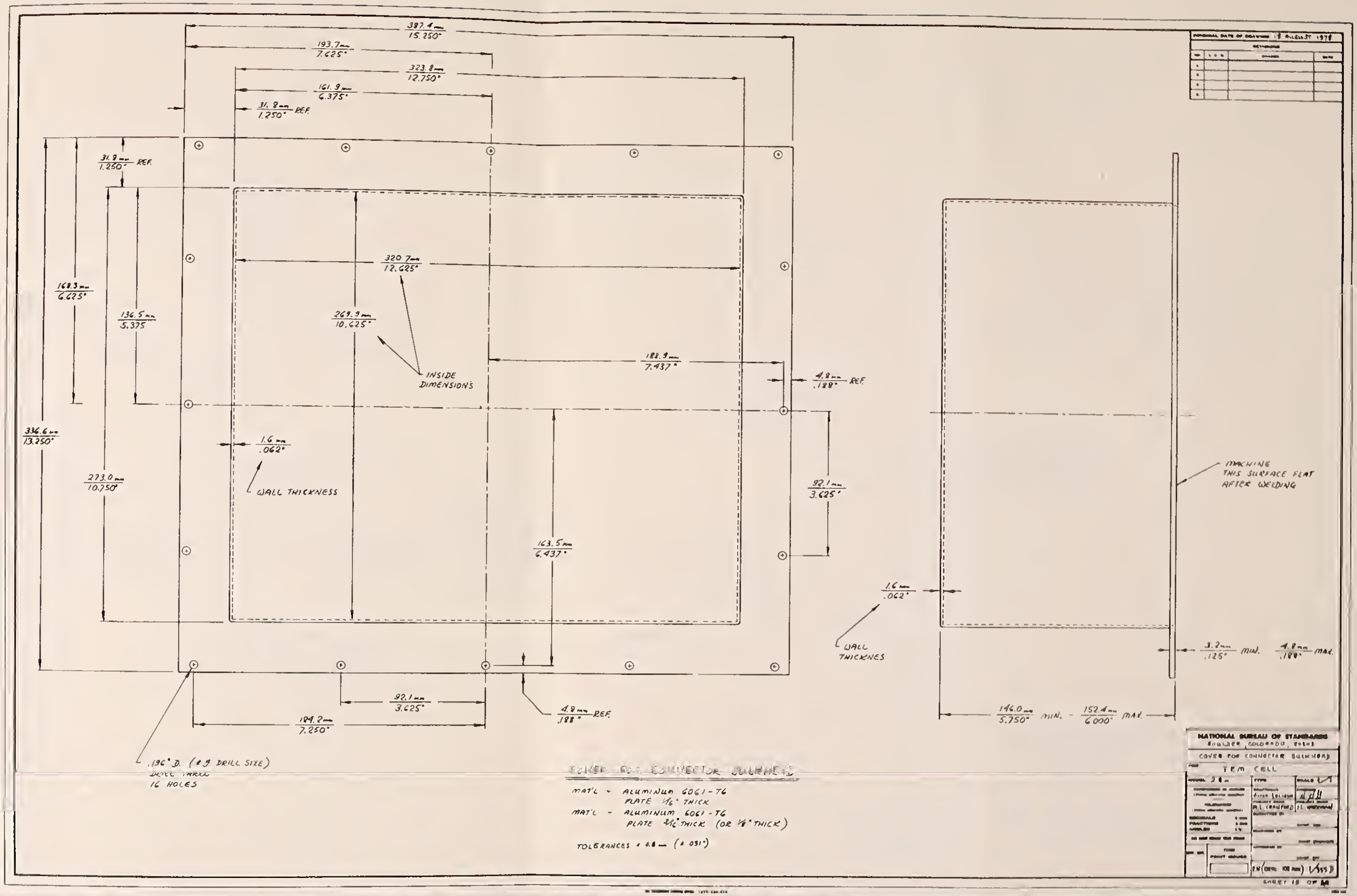
ORIGINAL DATE OF DRAWING 18 AUGUST 1978
REVISIONS
6.3mm (.250") R.
9.5mm .375" REF.
3.2mm .125" REF.
.196" D. (#9 DRILL SIZE) DRILL THRU 16 HOLES
171.5mm 6.750"
168.3mm 6.625"
155.6mm 6.125"
76.2mm 3.000"
YP.
CONNECTOR MOUNT PLATE
FOR CONNECTOR BULKHEAD
AT'L ~ ALUMINUM 6061 - T6
PLATE 3/4" THICK
1 REQ'D
SCALE ~ 1/1
15.1mm .595"
IEVE BEFORE MACHINING
F × 2 HRS
18.3mm .720"
NOTE: MACHINED DIMENSIONS TOLERANCES AS LISTED IN TITLE BLOCK
NATIONAL BUREAU OF STANDARDS
BOULDER, COLORADO, 80303
CONNECTOR BULKHEAD
FRAME AND CONNECTOR MOUNT PLATE
TEM CELL
SCALE 1/1
M.L. CRAWFORD
J.L. WORKMAN
SHEET 18 OF 32

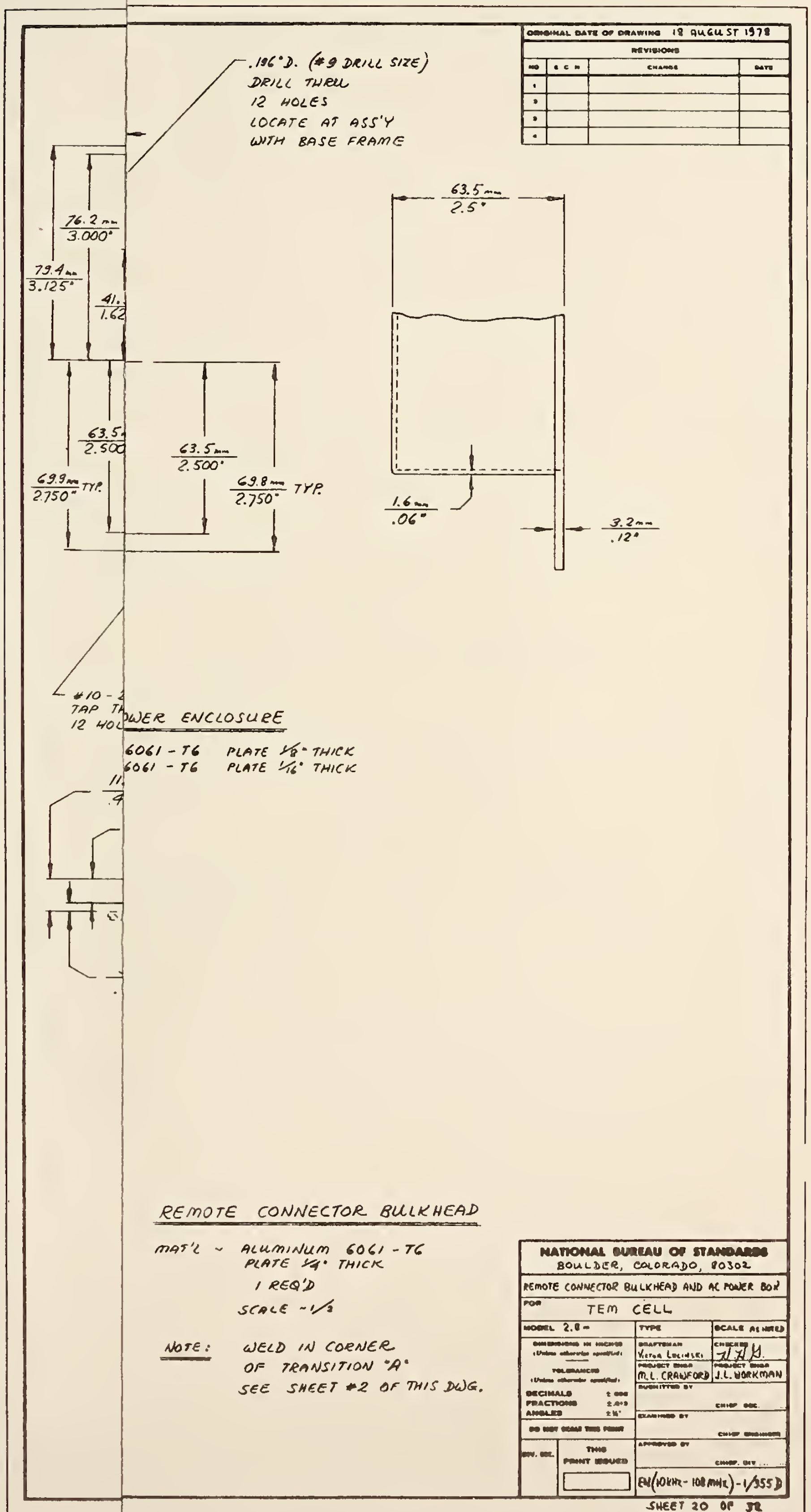


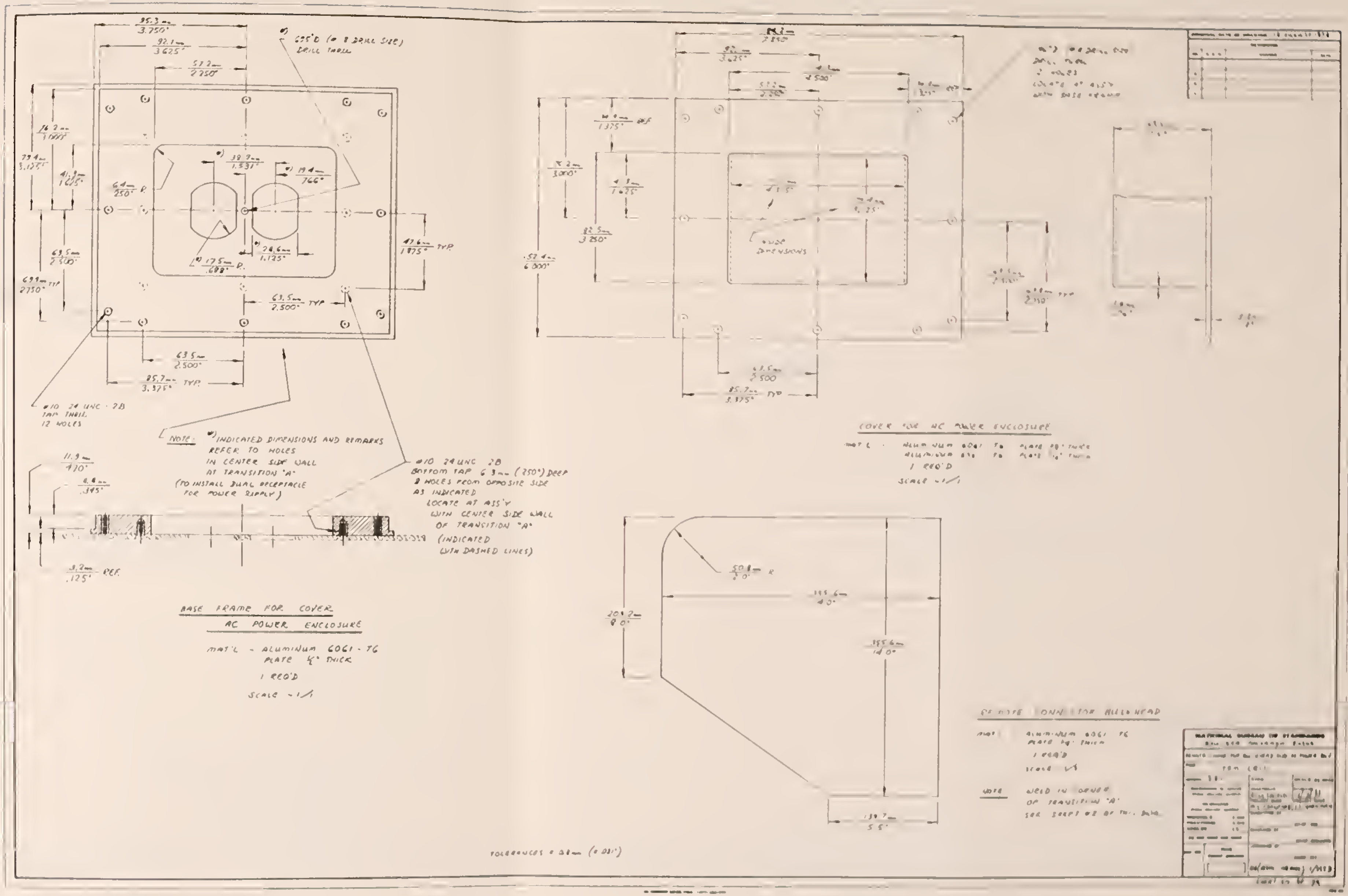
6.3mm (.250") R.
#10-24 UNC-2B TAP 9.5mm (.375") DEEP 16 HOLES
#10-24 UNC-2B TAP THRU 16 HOLES
.196" D. (#9 DRILL SIZE) DRILL THRU 16 HOLES
DASHED LINE INDICATES 203.2mm × 254.0mm (8.000" × 10.000") OPENING IN SIDE WALL OF TRANSITION "A"
5.5mm (.218) × 45° CHAMFER OR 6.3mm (.250") R.
#10-24 UNC-2B BOTTOM TAP 6.3mm (.250") DEEP 16 HOLES FROM OPPOSITE SIDE AS INDICATED LOCATE AT ASS'Y WITH SIDE WALL OF TRANSITION "A" (SHOWN WITH DASHED LINE)
CONNECTOR MOUNT PLATE FOR CONNECTOR BULKHEAD
MAT'L = ALUMINUM 6061-T6 PLATE 1/4" THICK 1 REQ'D SCALE = 1/1
ATTN.: STRESS RELIEVE BEFORE MACHINING 650° F = 8 HRS
CONNECTOR BULKHEAD BASE FRAME
MAT'L = ALUMINUM 6061-T6 PLATE 3/4" THICK 1 REQ'D SCALE = 1/1
NOTE: MACHINED DIMENSIONS TOLERANCES AS LISTED IN TITLE BLOCK
NATIONAL BUREAU OF STANDARDS
BOULDER, COLORADO, 80303
CONNECTOR BULKHEAD FRAME AND CONNECTOR MOUNT PLATE
TEM CELL
SHEET 18 OF 33

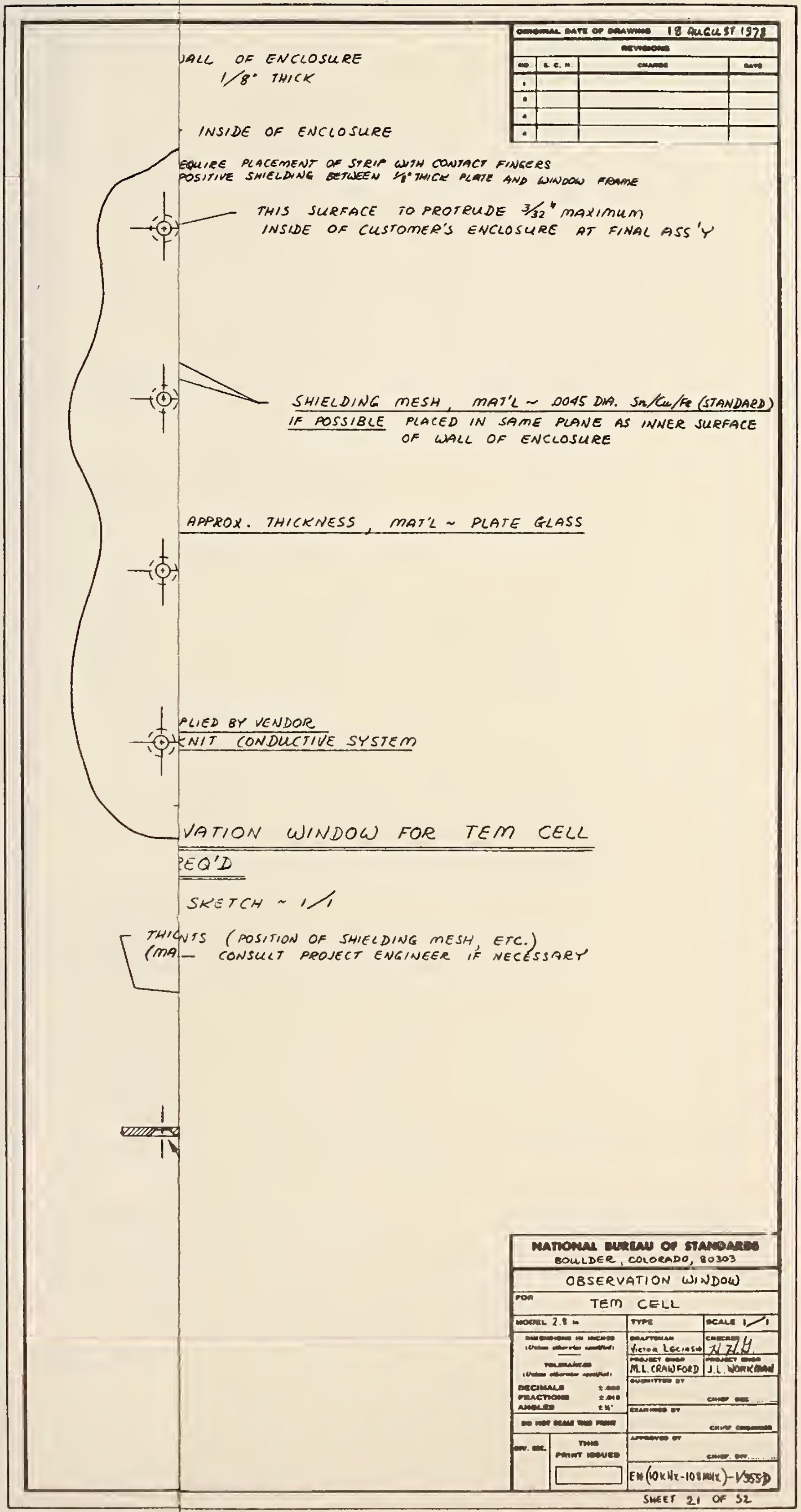


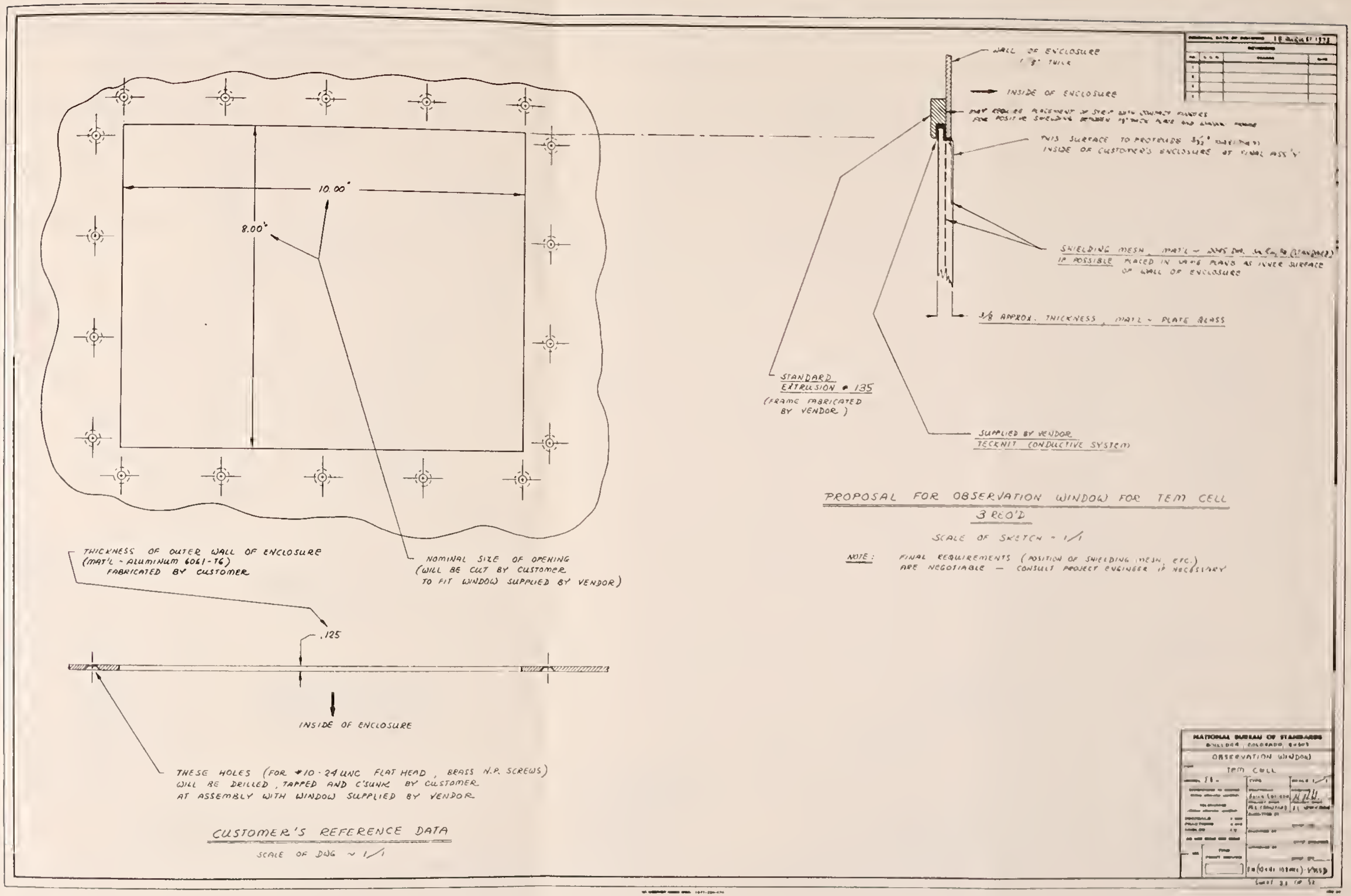
ORIGINAL DATE OF DRAWING 18 AUGUST 1978
REVISIONS
168.3 mm
6.625"
336.6 mm
13.250"
MACHINE THIS SURFACE FLAT AFTER WELDING
3.2 mm
.125" MIN. - 4.8 mm
.188" MAX.
146.0 mm
5.750" MIN. - 152.4 mm
6.000" MAX.
NATIONAL BUREAU OF STANDARDS
BOULDER, COLORADO, 80303
COVER FOR CONNECTOR BULKHEAD
FOR TEM CELL
MODEL 2.8 m
TYPE
SCALE 1/1
DECIMALS
FRACTIONS
ANGLES
Victor Locinski
M.L. CRAWFORD
EN(10kHz - 108 MHz)-1/355 D
SHEET 19 OF


387.4 mm / 15.250"
193.7 mm / 7.625"
323.8 mm / 12.750"
161.9 mm / 6.375"
31.8 mm / 1.250" REF.
31.8 mm / 1.250" REF.
168.3 mm / 6.625"
136.5 mm / 5.375"
320.7 mm / 12.625"
269.9 mm / 10.625"
INSIDE DIMENSIONS
188.9 mm / 7.437"
4.8 mm / .188" REF.
336.6 mm / 13.250"
1.6 mm / .062"
WALL THICKNESS
273.0 mm / 10.750"
92.1 mm / 3.625"
163.5 mm / 6.437"
MACHINE THIS SURFACE FLAT AFTER WELDING
1.6 mm / .062"
WALL THICKNES
3.2 mm / .125" MIN. 4.8 mm / .188" MAX.
92.1 mm / 3.625"
184.2 mm / 7.250"
4.9 mm / .188" REF.
146.0 mm / 5.750" MIN. - 152.4 mm / 6.000" MAX.
.196" D. (#9 DRILL SIZE) DRILL THRU 16 HOLES
COVER FOR CONNECTOR BULKHEAD
MAT'L - ALUMINUM 6061-T6 PLATE 1/16" THICK
MAT'L - ALUMINUM 6061-T6 PLATE 3/16" THICK (OR 1/8" THICK)
NATIONAL BUREAU OF STANDARDS
BOULDER, COLORADO, 80303
COVER FOR CONNECTOR BULKHEAD
TEM CELL
SHEET 19 OF

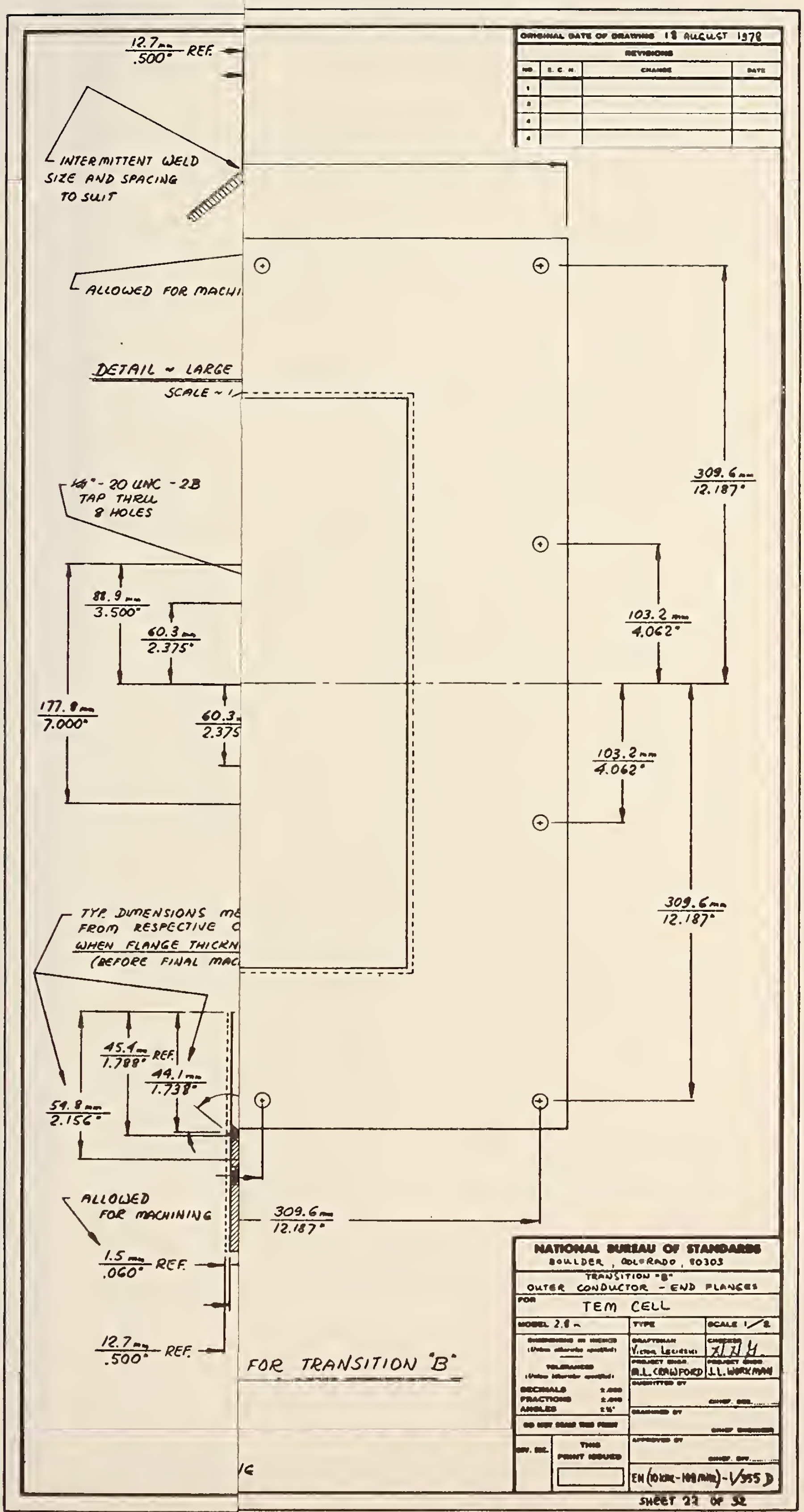

ORIGINAL DATE OF DRAWING 18 AUGUST 1978
REVISIONS
NO
E C N
CHANGE
DATE
.196" D. (#9 DRILL SIZE)
DRILL THRU
12 HOLES
LOCATE AT ASS'Y
WITH BASE FRAME
76.2 mm
3.000"
79.4 mm
3.125"
63.5 mm
2.5"
63.5 mm
2.500"
69.9 mm
2.750" TYP.
69.8 mm
2.750" TYP.
1.6 mm
.06"
3.2 mm
.12"
#10 -
TAP
12 HOL
WER ENCLOSURE
6061 - T6 PLATE 1/8" THICK
6061 - T6 PLATE 1/16" THICK
REMOTE CONNECTOR BULKHEAD
MAT'L ~ ALUMINUM 6061 - T6
PLATE 1/4" THICK
1 REQ'D
SCALE ~ 1/2
NOTE: WELD IN CORNER
OF TRANSITION "A"
SEE SHEET #2 OF THIS DWG.
NATIONAL BUREAU OF STANDARDS
BOULDER, COLORADO, 80302
REMOTE CONNECTOR BULKHEAD AND AC POWER BOX
FOR TEM CELL
MODEL 2.0
TYPE
SCALE AS NOTED
DRAFTSMAN
CHECKED
PROJECT ENGR M.L. CRAWFORD
PROJECT ENGR J.L. WORKMAN
SUBMITTED BY
CHIEF SEC.
EXAMINED BY
CHIEF ENGINEER
APPROVED BY
CHIEF, DIV.
DECIMALS
FRACTIONS
ANGLES
DO NOT SCALE THIS PRINT
THIS PRINT ISSUED
EM(10KHz - 108MHz) - 1/355D
SHEET 20 OF 32


.625" D (# 8 DRILL SIZE) DRILL THRU
#10 24 UNC - 2B TAP THRU. 12 HOLES
NOTE: *) INDICATED DIMENSIONS AND REMARKS REFER TO HOLES IN CENTER SIDE WALL AT TRANSITION "A" (TO INSTALL DUAL RECEPTACLE FOR POWER SUPPLY)
#10 24 UNC 2B BOTTOM TAP 6.3mm (.250") DEEP 8 HOLES FROM OPPOSITE SIDE AS INDICATED LOCATE AT ASS'Y WITH CENTER SIDE WALL OF TRANSITION "A" (INDICATED WITH DASHED LINES)
BASE FRAME FOR COVER AC POWER ENCLOSURE
MAT'L - ALUMINUM 6061 - T6 PLATE 1/4" THICK
1 REQ'D
SCALE ~1/1
COVER FOR AC POWER ENCLOSURE
TOLERANCES ± .38mm (±.015")

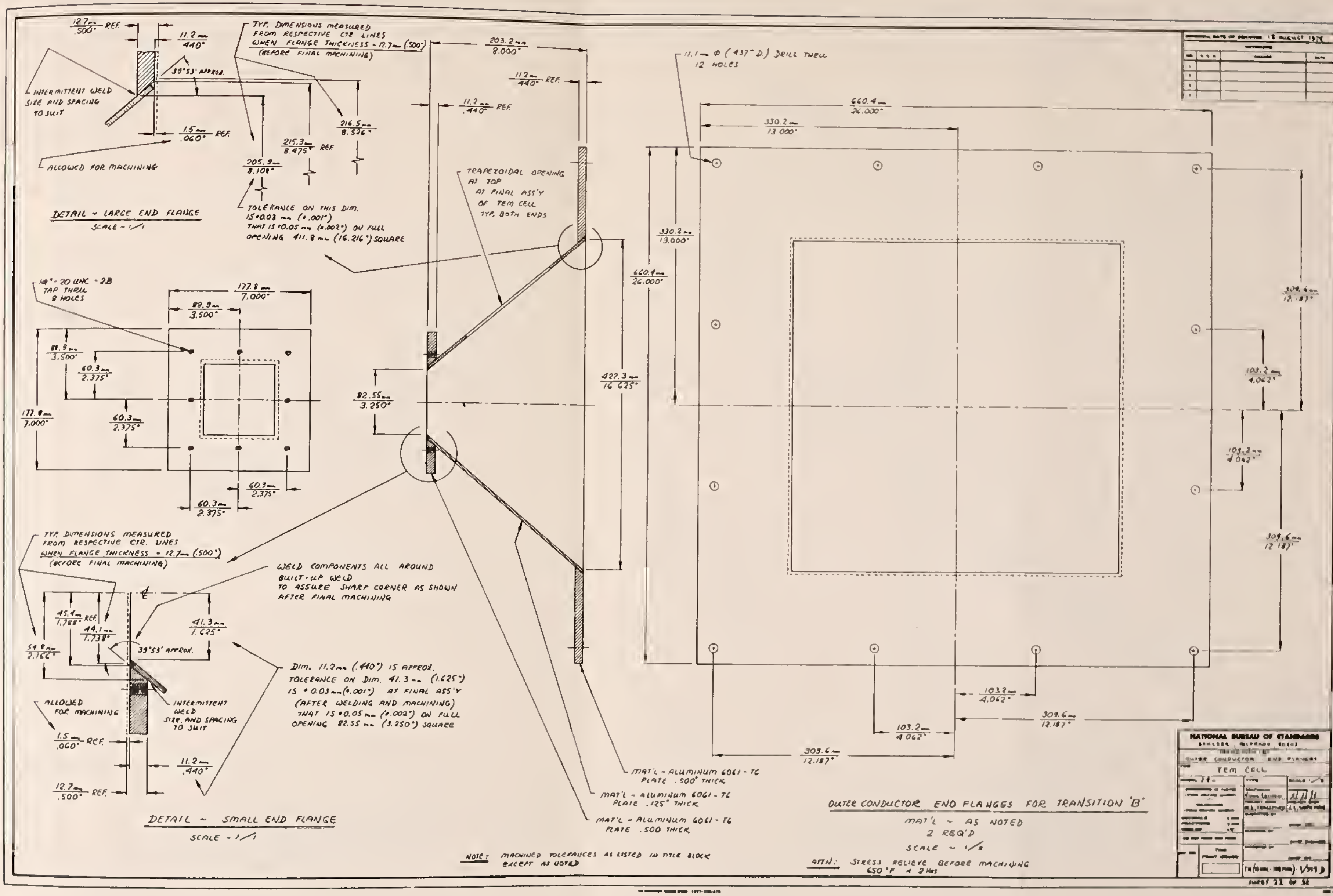

ORIGINAL DATE OF DRAWING 18 AUGUST 1978
REVISIONS
WALL OF ENCLOSURE
1/8" THICK
INSIDE OF ENCLOSURE
EQUIRE PLACEMENT OF STRIP WITH CONTACT FINGERS
POSITIVE SHIELDING BETWEEN 1/8" THICK PLATE AND WINDOW FRAME
THIS SURFACE TO PROTRUDE 3/32" MAXIMUM
INSIDE OF CUSTOMER'S ENCLOSURE AT FINAL ASS'Y
SHIELDING MESH, MAT'L ~ .0045 DIA. Sn/Cu/Fe (STANDARD)
IF POSSIBLE PLACED IN SAME PLANE AS INNER SURFACE
OF WALL OF ENCLOSURE
APPROX. THICKNESS, MAT'L ~ PLATE GLASS
PLIED BY VENDOR
KNIT CONDUCTIVE SYSTEM
VATION WINDOW FOR TEM CELL
REQ'D
SKETCH ~ 1/1
THI NTS (POSITION OF SHIELDING MESH, ETC.)
(MA — CONSULT PROJECT ENGINEER IF NECESSARY
NATIONAL BUREAU OF STANDARDS
BOULDER, COLORADO, 80303
OBSERVATION WINDOW
FOR TEM CELL
MODEL 2.8 m
TYPE
SCALE 1/1
DRAFTSMAN Victor Locicero
CHECKED
PROJECT ENGR M.L. CRAWFORD
PROJECT ENGR J.L. WORKMAN
DECIMALS
FRACTIONS
ANGLES
DO NOT SCALE THIS PRINT
THIS PRINT ISSUED
SUBMITTED BY
EXAMINED BY
APPROVED BY
EM (10kHz-108MHz)-V355D
SHEET 21 OF 52

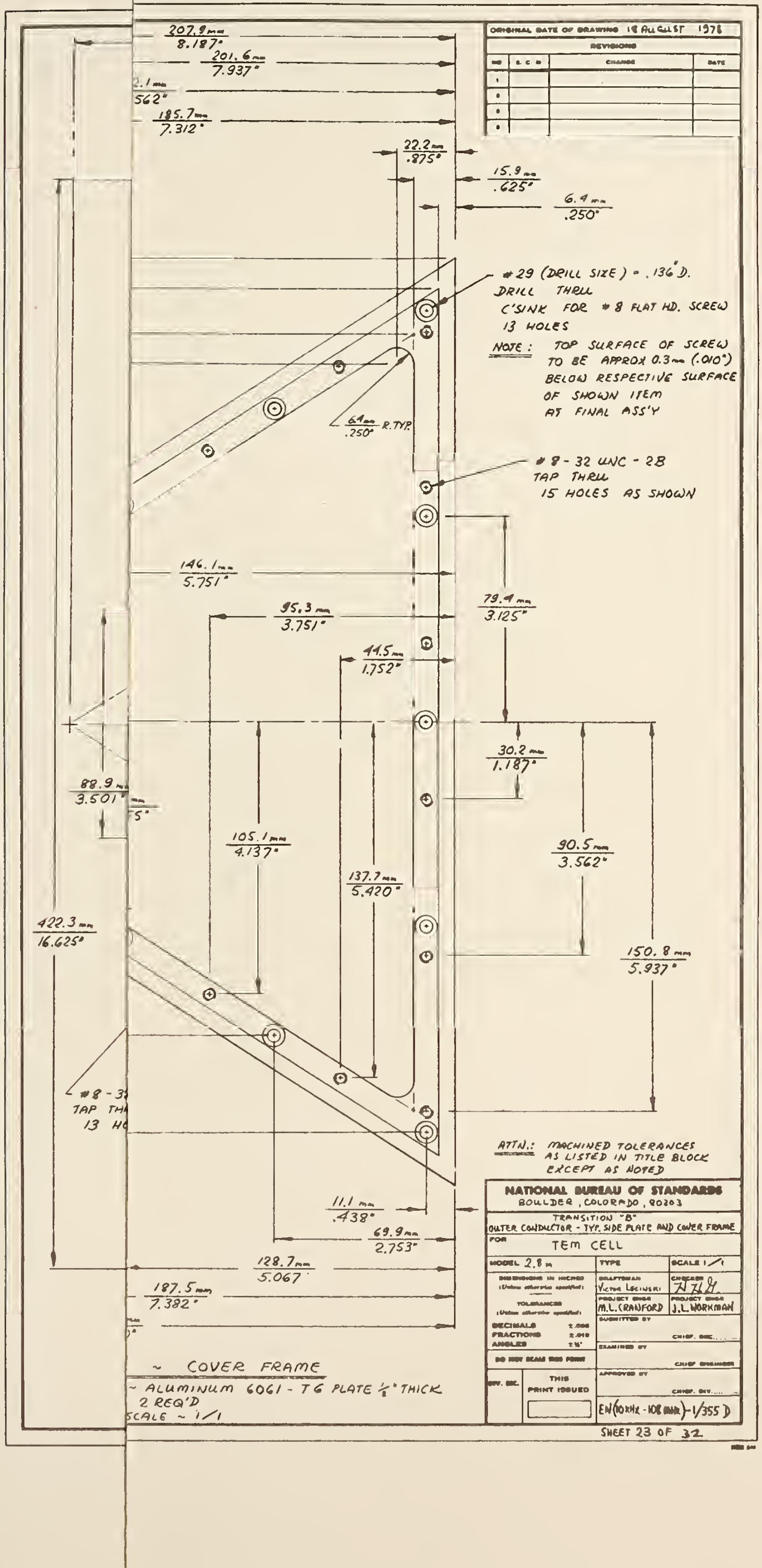


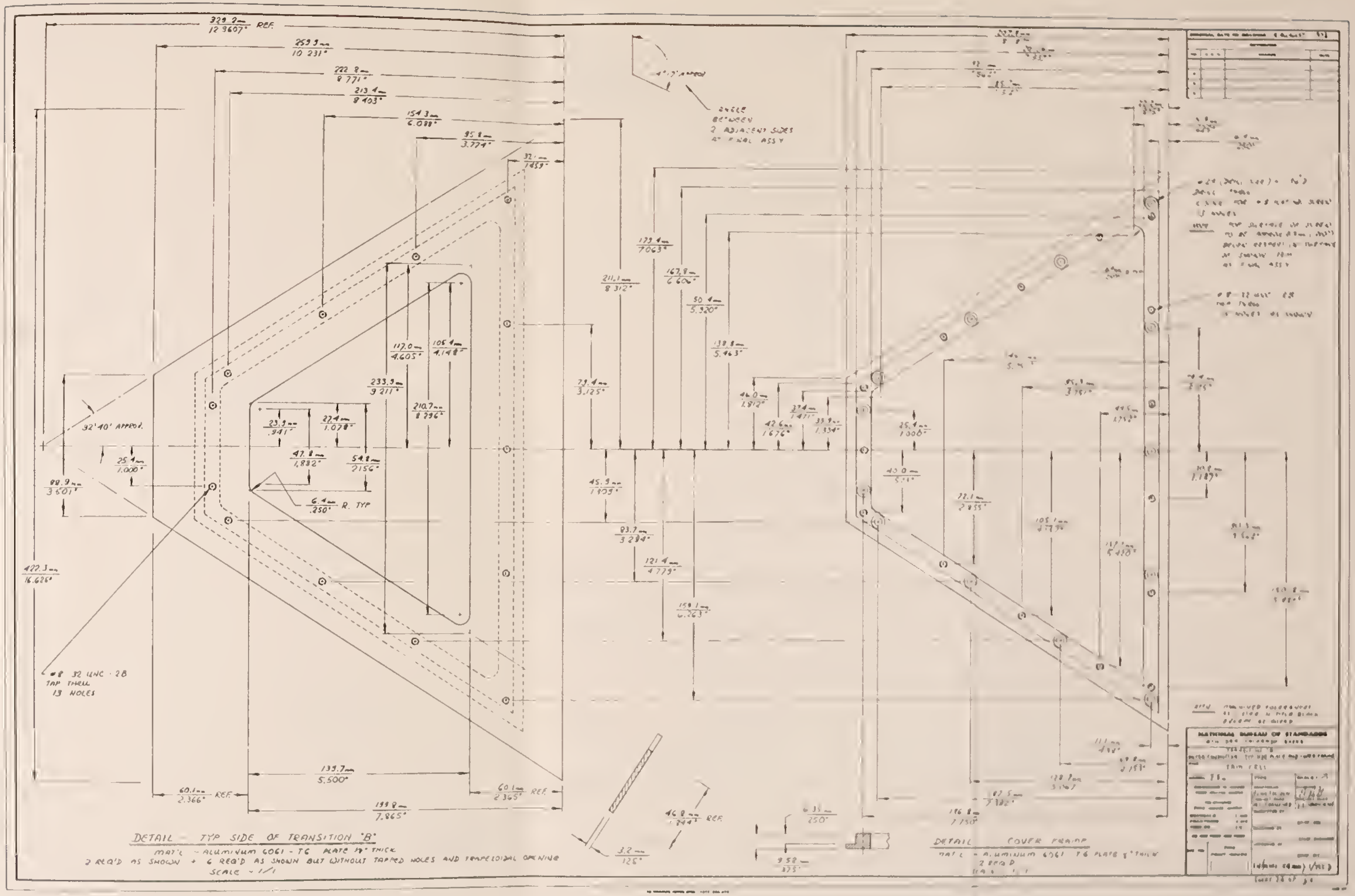
WALL OF ENCLOSURE
INSIDE OF ENCLOSURE
THIS SURFACE TO PROTRUDE
INSIDE OF CUSTOMER'S ENCLOSURE AT FINAL ASS'Y
SHIELDING MESH
IF POSSIBLE PLACED IN SAME PLANE AS INNER SURFACE
OF WALL OF ENCLOSURE
3/8 APPROX. THICKNESS, MAT'L ~ PLATE GLASS
10.00"
8.00"
STANDARD
EXTRUSION # 135
(FRAME FABRICATED
BY VENDOR)
SUPPLIED BY VENDOR
TECKNIT CONDUCTIVE SYSTEM
PROPOSAL FOR OBSERVATION WINDOW FOR TEM CELL
3 REQ'D
SCALE OF SKETCH ~ 1/1
NOTE: FINAL REQUIREMENTS (POSITION OF SHIELDING MESH, ETC.)
ARE NEGOTIABLE — CONSULT PROJECT ENGINEER IF NECESSARY
THICKNESS OF OUTER WALL OF ENCLOSURE
(MAT'L - ALUMINUM 6061-T6)
FABRICATED BY CUSTOMER
NOMINAL SIZE OF OPENING
(WILL BE CUT BY CUSTOMER
TO FIT WINDOW SUPPLIED BY VENDOR)
.125
INSIDE OF ENCLOSURE
THESE HOLES (FOR #10-24 UNC FLAT HEAD, BRASS N.P. SCREWS)
WILL BE DRILLED, TAPPED AND C'SUNK BY CUSTOMER
AT ASSEMBLY WITH WINDOW SUPPLIED BY VENDOR
CUSTOMER'S REFERENCE DATA
SCALE OF DWG ~ 1/1
NATIONAL BUREAU OF STANDARDS
OBSERVATION WINDOW
TEM CELL



ORIGINAL DATE OF DRAWING 18 AUGUST 1978
REVISIONS
12.7 mm .500" REF.
INTERMITTENT WELD SIZE AND SPACING TO SUIT
ALLOWED FOR MACHI
DETAIL ~ LARGE
SCALE ~ 1
1/4" - 20 UNC - 2B TAP THRU 8 HOLES
88.9 mm 3.500"
60.3 mm 2.375"
177.8 mm 7.000"
309.6 mm 12.187"
103.2 mm 4.062"
TYP. DIMENSIONS ME FROM RESPECTIVE C WHEN FLANGE THICKN (BEFORE FINAL MAC
45.4 mm 1.788" REF.
44.1 mm 1.738"
54.8 mm 2.156"
ALLOWED FOR MACHINING
1.5 mm .060" REF.
FOR TRANSITION "B"
NATIONAL BUREAU OF STANDARDS
BOULDER, COLORADO, 80303
TRANSITION "B"
OUTER CONDUCTOR - END FLANGES
TEM CELL
SCALE 1/8
VICTOR LECIEJEWSKI
M.L. CRAWFORD
J.L. WORKMAN
EN (10 kHz-100 MHz)-1/355 D
SHEET 27 OF 32

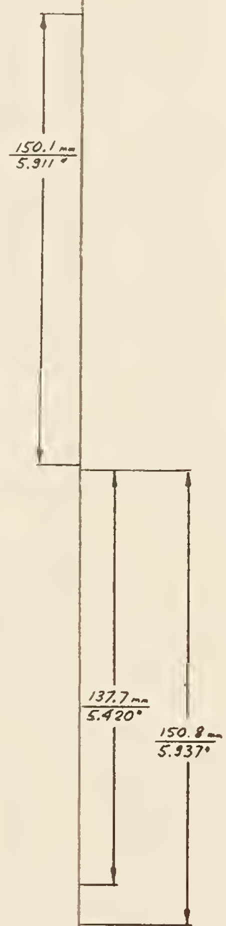

DETAIL ~ LARGE END FLANGE
SCALE ~ 1/1
INTERMITTENT WELD SIZE AND SPACING TO SUIT
ALLOWED FOR MACHINING
TYP. DIMENSIONS MEASURED FROM RESPECTIVE CTR LINES WHEN FLANGE THICKNESS = 12.7mm (.500") (BEFORE FINAL MACHINING)
TOLERANCE ON THIS DIM. IS ±0.03 mm (±.001") THAT IS ±0.05 mm (±.002") ON FULL OPENING 411.8 mm (16.216") SQUARE
TRAPEZOIDAL OPENING AT TOP AT FINAL ASS'Y OF TEM CELL TYP. BOTH ENDS
1/4" - 20 UNC - 2B TAP THRU 8 HOLES
11.1 mm ⌀ (.437" D.) DRILL THRU 12 HOLES
WELD COMPONENTS ALL AROUND BUILT-UP WELD TO ASSURE SHARP CORNER AS SHOWN AFTER FINAL MACHINING
Dim. 11.2mm (.440") IS APPROX. TOLERANCE ON DIM. 41.3 mm (1.625") IS ± 0.03 mm (±.001") AT FINAL ASS'Y (AFTER WELDING AND MACHINING) THAT IS ±0.05 mm (±.002") ON FULL OPENING 82.55 mm (3.250") SQUARE
DETAIL ~ SMALL END FLANGE
SCALE - 1/1
MAT'L - ALUMINUM 6061 - T6 PLATE .500" THICK
MAT'L - ALUMINUM 6061 - T6 PLATE .125" THICK
MAT'L - ALUMINUM 6061 - T6 PLATE .500 THICK
OUTER CONDUCTOR END FLANGES FOR TRANSITION "B"
MAT'L ~ AS NOTED
2 REQ'D
SCALE ~ 1/8
NOTE: MACHINED TOLERANCES AS LISTED IN TITLE BLOCK EXCEPT AS NOTED
ATTN: STRESS RELIEVE BEFORE MACHINING 650 °F 4 2 HRS
NATIONAL BUREAU OF STANDARDS
TEM CELL


ORIGINAL DATE OF DRAWING 18 AUGUST 1978
REVISIONS
#29 (DRILL SIZE) = .136" D.
DRILL THRU
C'SINK FOR #8 FLAT HD. SCREW
13 HOLES
NOTE: TOP SURFACE OF SCREW TO BE APPROX 0.3 mm (.010") BELOW RESPECTIVE SURFACE OF SHOWN ITEM AT FINAL ASS'Y
#8 - 32 UNC - 2B
TAP THRU
15 HOLES AS SHOWN
ATTN.: MACHINED TOLERANCES AS LISTED IN TITLE BLOCK EXCEPT AS NOTED
NATIONAL BUREAU OF STANDARDS
BOULDER, COLORADO, 80303
TRANSITION "B"
OUTER CONDUCTOR - TYP. SIDE PLATE AND COVER FRAME
TEM CELL
MODEL 2.8 m
SCALE 1/1
Victor Lecinski
M.L. CRANFORD
J.L. WORKMAN
EN(10 kHz - 108 MHz)-1/355 D
SHEET 23 OF 32
COVER FRAME
ALUMINUM 6061 - T6 PLATE 1/4" THICK
2 REQ'D
SCALE ~ 1/1


DETAIL - TYP SIDE OF TRANSITION "B"
MAT'L - ALUMINUM 6061 - T6 PLATE 1/8" THICK
2 REQ'D AS SHOWN + 6 REQ'D AS SHOWN BUT WITHOUT TAPPED HOLES AND TRAPEZOIDAL OPENING
SCALE - 1/1
#8 32 UNC - 2B
TAP THRU
13 HOLES
92°40' APPROX.
6.4mm .250" R. TYP
60.1mm 2.366" REF
139.7mm 5.500"
199.8mm 7.865"
329.2mm 12.9607" REF.
427.3mm 16.826"
ANGLE BETWEEN 2 ADJACENT SIDES AT FINAL ASSY
DETAIL COVER FRAME
NATIONAL BUREAU OF STANDARDS

ORIGINAL DATE OF DRAWING 18 AUGUST 1978

REVISIONS			
NO	E. C. N	CHANGE	DATE
1			
2			
3			
4			



COVER FOR TRANSITION "B"

'L ~ ALUMINUM 6061-T6 PLATE 3/4" THICK

2 REQ'D

SCALE ~ 1/1

NED TOLERANCES AS LISTED IN TITLE BLOCK
PT AS NOTED

RESS RELIEVE BEFORE MACHINING
650°F ~ 2 Hrs

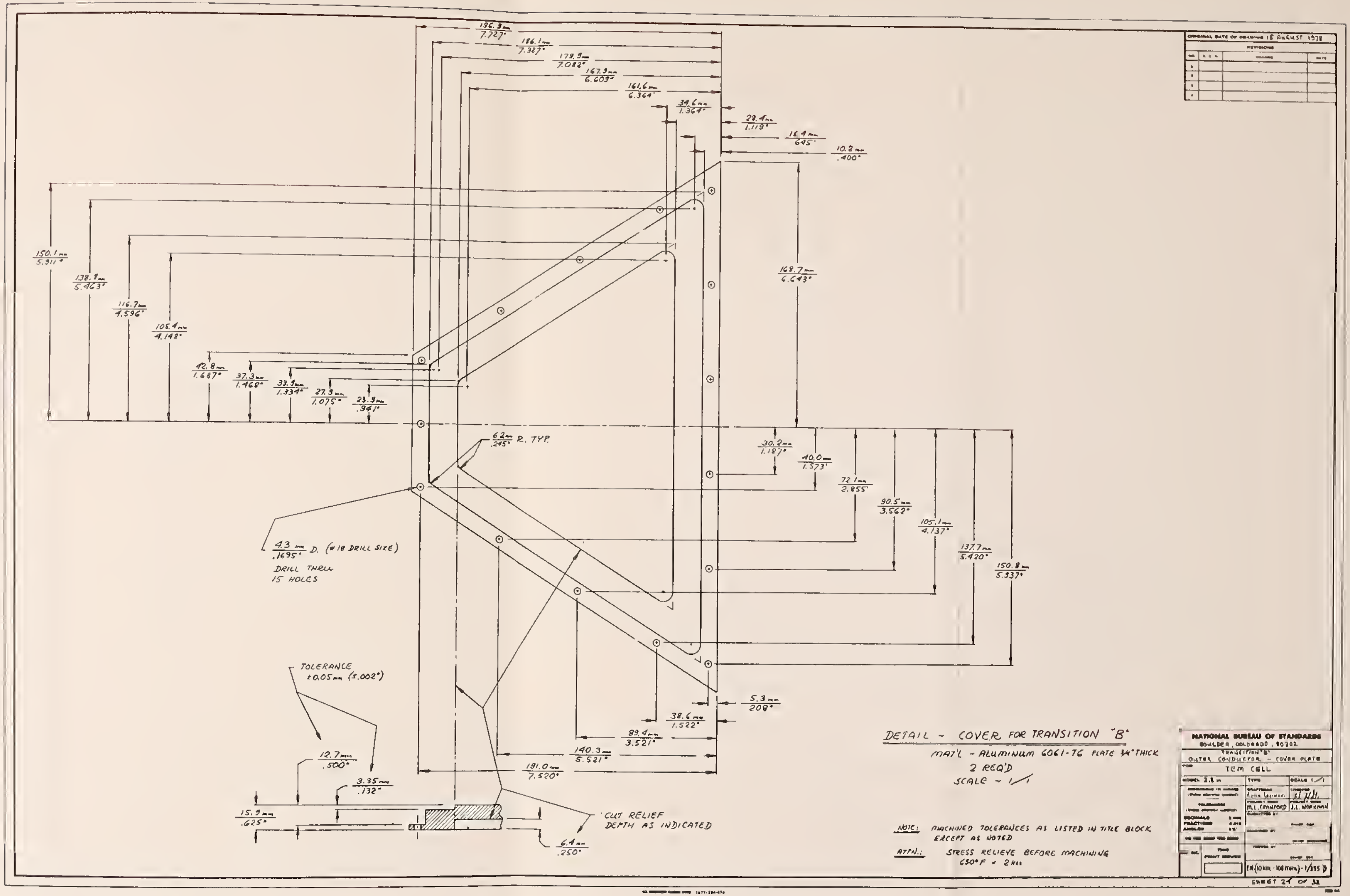
NATIONAL BUREAU OF STANDARDS
BOULDER, COLORADO, 80302

TRANSITION "B"
OUTER CONDUCTOR – COVER PLATE

FOR TEM CELL

MODEL 2.8 m	TYPE	SCALE 1/1
DIMENSIONS IN INCHES (Unless otherwise specified)	DRAFTSMAN Victor Lecinski	CHECKER J. H. H.
TOLERANCES (Unless otherwise specified)	PROJECT ENGR M.L. CRAWFORD	PROJECT ENGR J.L. WORKMAN
DECIMALS / FRACTIONS / ANGLES	SUBMITTED BY ... CHIEF SEC.	
DO NOT SCALE THIS PRINT	EXAMINED BY ... CHIEF ENGINEER	
DIV. SEC. / THIS PRINT ISSUED	APPROVED BY ... CHIEF DIV.	
	EN (10 kHz - 108 MHz) - 1/355 D	

SHEET 24 OF 32


DETAIL ~ COVER FOR TRANSITION "B"
MAT'L ~ ALUMINUM 6061-T6 PLATE 3/4" THICK
2 REQ'D
SCALE ~ 1/1
NOTE: MACHINED TOLERANCES AS LISTED IN TITLE BLOCK EXCEPT AS NOTED
ATTN.: STRESS RELIEVE BEFORE MACHINING 650°F × 2 HRS
4.3 mm .1695" D. (#18 DRILL SIZE) DRILL THRU 15 HOLES
6.2 mm .245" R. TYP.
TOLERANCE ±0.05 mm (±.002")
CUT RELIEF DEPTH AS INDICATED
NATIONAL BUREAU OF STANDARDS
BOULDER, COLORADO, 80302
TRANSITION "B" OUTER CONDUCTOR - COVER PLATE
TEM CELL
ORIGINAL DATE OF DRAWING 18 AUGUST 1978
M.L. CRAWFORD
J.L. WORKMAN
SHEET 24 OF 32

ORIGINAL DATE OF DRAWING 18 AUGUST 1978			
REVISIONS			
NO	E C N	CHANGE	DATE
1			
2			
3			
4			

DETAIL ~ CTR. CONDUCTOR FOR TRANSITION "B"

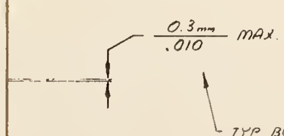
MAT'L ~ FREE CUTTING BRASS
NICKEL PLATE ALL OVER

2 REQ'D

ATTN.: 1) MAY REQUIRE ADDITIONAL TRIMMING TO OBTAIN THE DESIRED IMPEDANCE AS MEASURED USING TDR

2) MACHINED TOLERANCES AS LISTED IN TITLE BLOCK EXCEPT AS NOTED

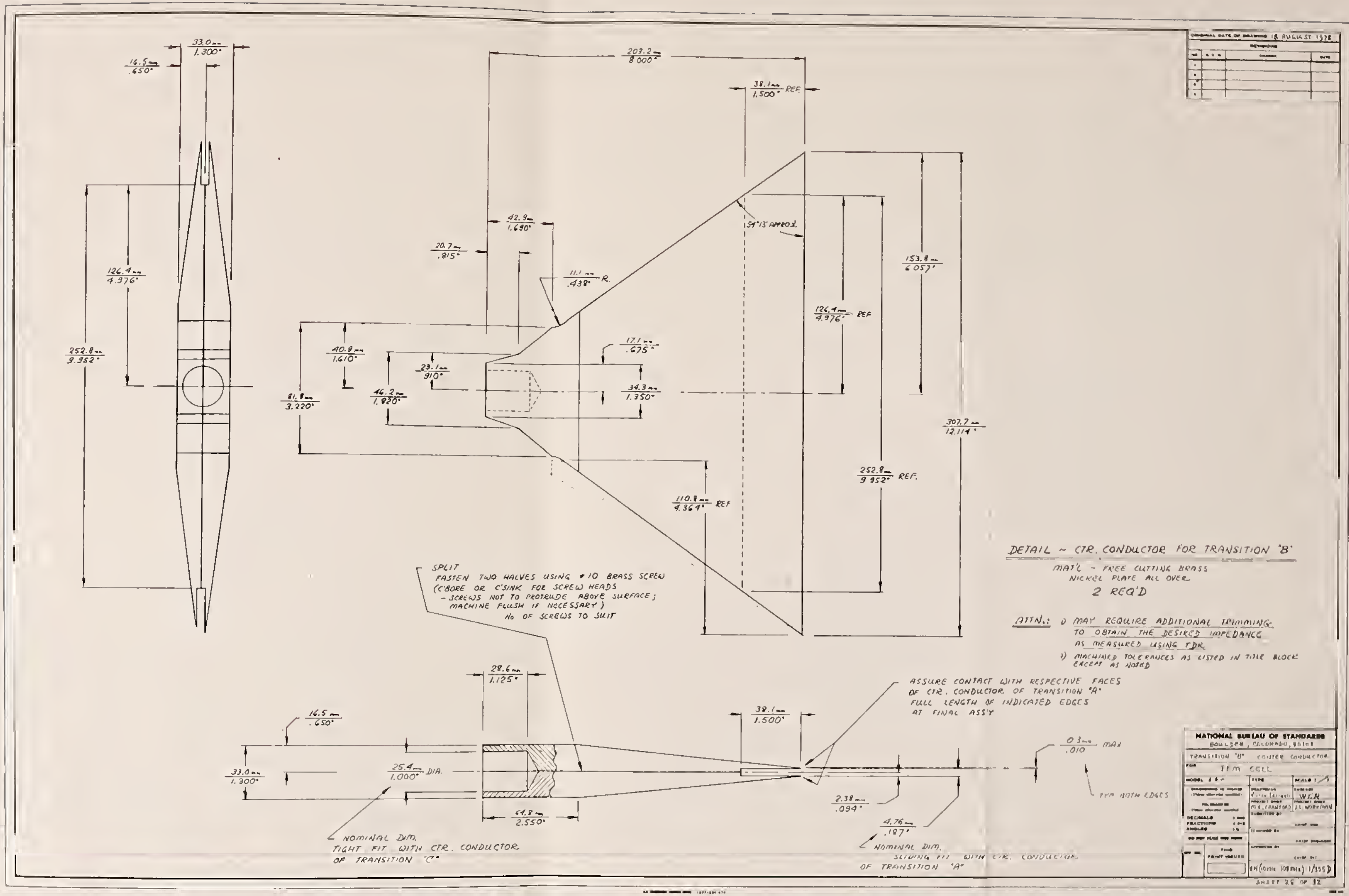
T WITH RESPECTIVE FACES
TOR OF TRANSITION "A"
OF INDICATED EDGES
Y

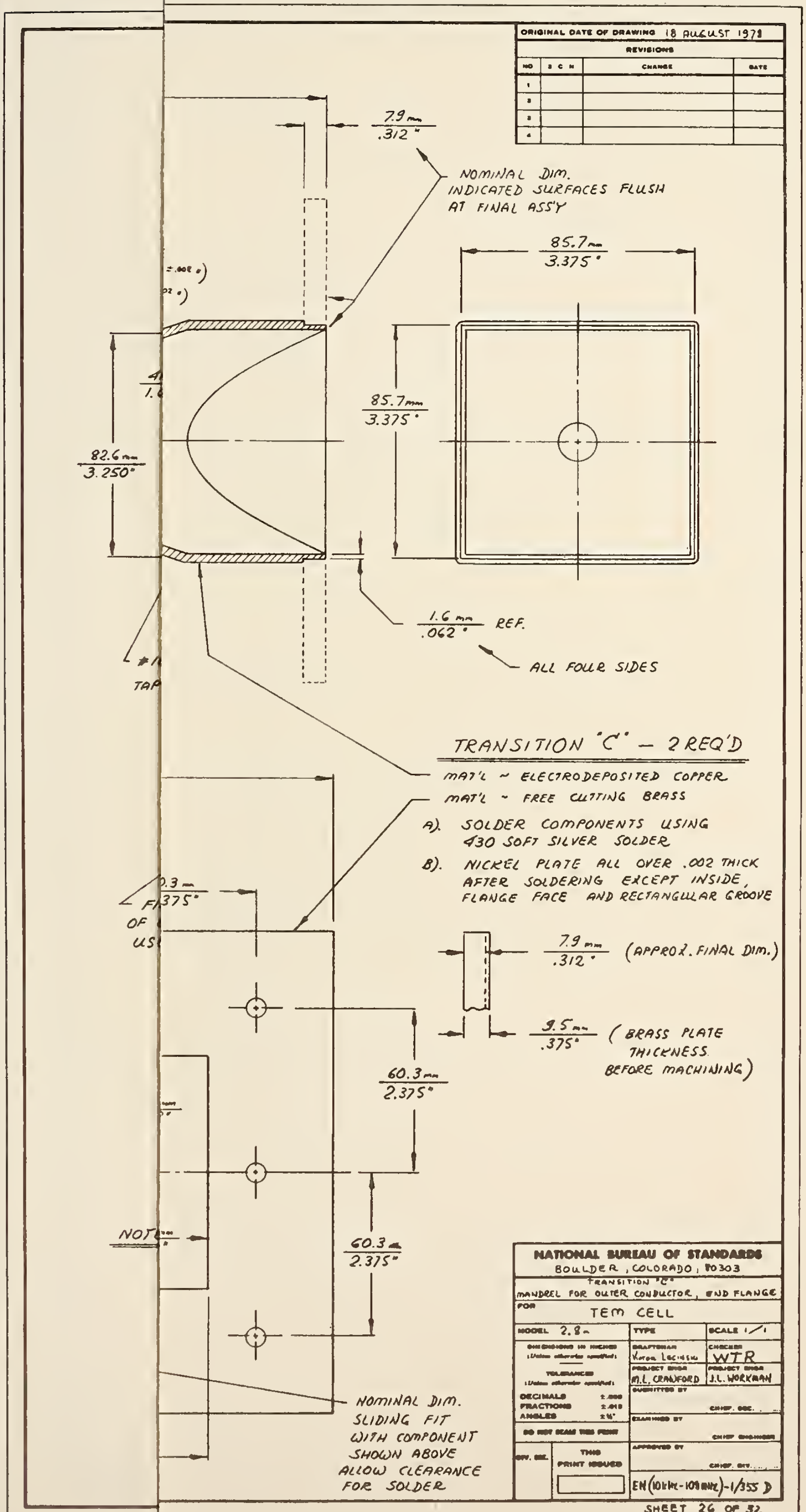


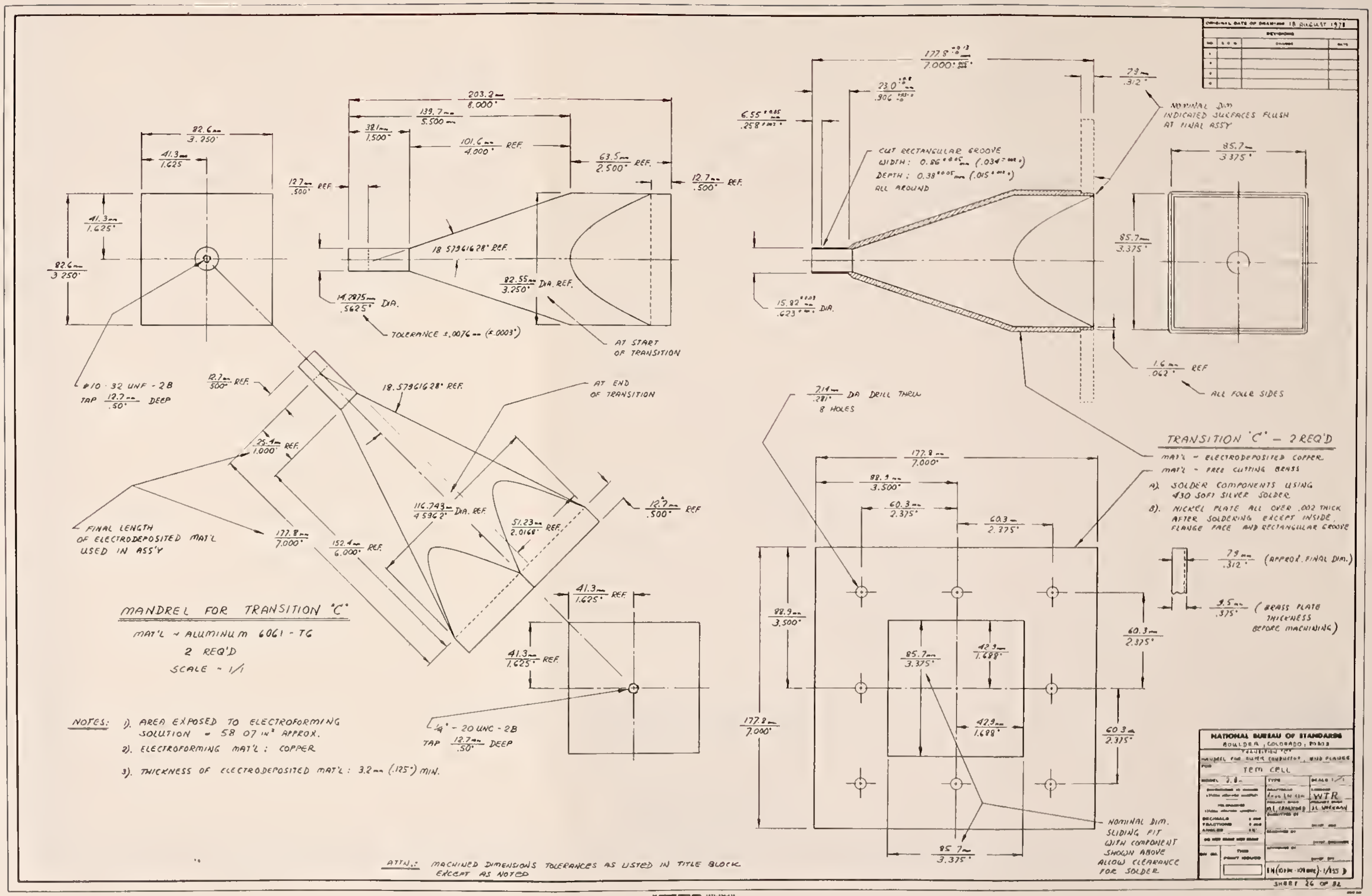
CTR. CONDUCTOR

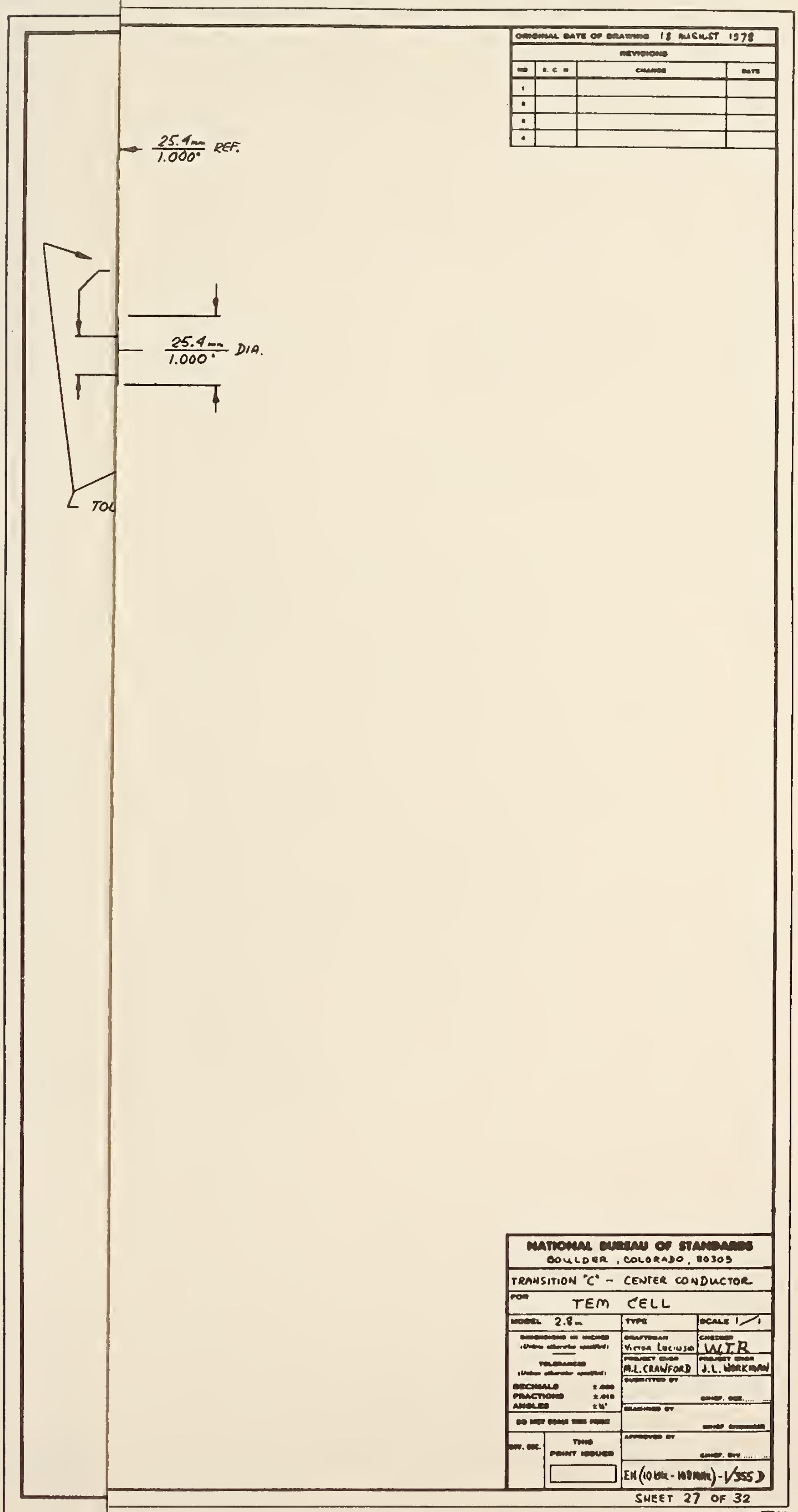
NATIONAL BUREAU OF STANDARDS BOULDER, COLORADO, 80303		
TRANSITION "B" - CENTER CONDUCTOR		
FOR TEM CELL		
MODEL 2.8 m	TYPE	SCALE 1/1
DIMENSIONS IN INCHES (Unless otherwise specified)	DRAFTSMAN Victor Lecinski	CHECKER W.T.R
TOLERANCES (Unless otherwise specified)	PROJECT ENGR M.L. CRAWFORD	PROJECT ENGR J.L. WORKMAN
DECIMALS ±.005 FRACTIONS ±.010 ANGLES ±½°	SUBMITTED BY	CHIEF SEC.
DO NOT SCALE THIS PRINT	EXAMINED BY	CHIEF ENGINEER
DIV. SEC. THIS PRINT ISSUED	APPROVED BY	CHIEF DIV.
	EN (10kHz - 108 MHz) - 1/355D	

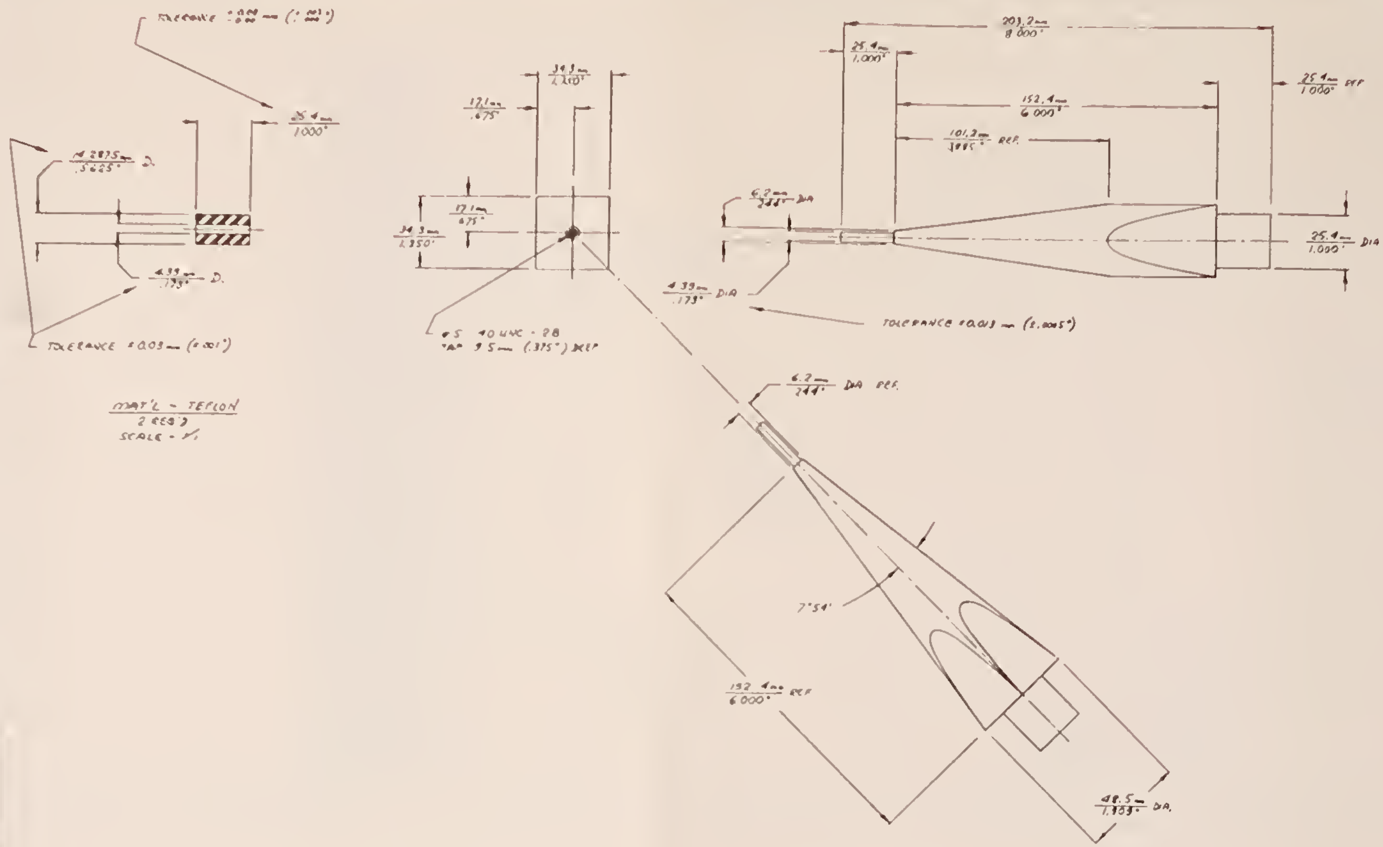
SHEET 25 OF 32


DETAIL ~ CTR. CONDUCTOR FOR TRANSITION "B"
MAT'L - FREE CUTTING BRASS
NICKEL PLATE ALL OVER
2 REQ'D
ATTN.: 1) MAY REQUIRE ADDITIONAL TRIMMING TO OBTAIN THE DESIRED IMPEDANCE AS MEASURED USING TDR.
2) MACHINED TOLERANCES AS LISTED IN TITLE BLOCK EXCEPT AS NOTED
SPLIT
FASTEN TWO HALVES USING #10 BRASS SCREW
(C'BORE OR C'SINK FOR SCREW HEADS
- SCREWS NOT TO PROTRUDE ABOVE SURFACE;
MACHINE FLUSH IF NECESSARY)
No OF SCREWS TO SUIT
ASSURE CONTACT WITH RESPECTIVE FACES
OF CTR. CONDUCTOR OF TRANSITION "A"
FULL LENGTH OF INDICATED EDGES
AT FINAL ASS'Y
NOMINAL DIM.
TIGHT FIT WITH CTR. CONDUCTOR
OF TRANSITION "C"
NOMINAL DIM.
SLIDING FIT WITH CTR. CONDUCTOR
OF TRANSITION "A"
TYP BOTH EDGES
54°13' APPROX.
203.2 mm 8.000"
38.1 mm 1.500" REF
153.8 mm 6.057"
126.4 mm 4.976" REF
307.7 mm 12.114"
252.8 mm 9.952" REF.
110.8 mm 4.364" REF
11.1 mm .438" R.
42.9 mm 1.690"
20.7 mm .815"
17.1 mm .675"
34.3 mm 1.350"
40.9 mm 1.610"
23.1 mm .910"
46.2 mm 1.820"
81.8 mm 3.220"
33.0 mm 1.300"
16.5 mm .650"
126.4 mm 4.976"
252.8 mm 9.952"
28.6 mm 1.125"
38.1 mm 1.500"
25.4 mm 1.000" DIA.
64.8 mm 2.550"
2.38 mm .094"
4.76 mm .187"
0.3 mm .010 MAX
ORIGINAL DATE OF DRAWING 18 AUGUST 1978
REVISIONS
NATIONAL BUREAU OF STANDARDS
BOULDER, COLORADO, 80303
TRANSITION "B" CENTER CONDUCTOR
FOR TEM CELL
SCALE 1/1
W.F.R.
M.L. CRAWFORD
SHEET 26 OF 32


ORIGINAL DATE OF DRAWING 18 AUGUST 1978
REVISIONS
NO
CHANGE
DATE
7.9 mm
.312"
NOMINAL DIM.
INDICATED SURFACES FLUSH
AT FINAL ASS'Y
85.7 mm
3.375"
85.7 mm
3.375"
82.6 mm
3.250"
1.6 mm
.062"
REF.
ALL FOUR SIDES
TRANSITION "C" – 2 REQ'D
MAT'L ~ ELECTRODEPOSITED COPPER
MAT'L ~ FREE CUTTING BRASS
A). SOLDER COMPONENTS USING 430 SOFT SILVER SOLDER
B). NICKEL PLATE ALL OVER .002 THICK AFTER SOLDERING EXCEPT INSIDE, FLANGE FACE AND RECTANGULAR GROOVE
7.9 mm
.312"
(APPROX. FINAL DIM.)
9.5 mm
.375"
(BRASS PLATE THICKNESS BEFORE MACHINING)
60.3 mm
2.375"
60.3 mm
2.375"
NOMINAL DIM.
SLIDING FIT
WITH COMPONENT
SHOWN ABOVE
ALLOW CLEARANCE
FOR SOLDER
NATIONAL BUREAU OF STANDARDS
BOULDER, COLORADO, 80303
TRANSITION "C"
MANDREL FOR OUTER CONDUCTOR, END FLANGE
TEM CELL
MODEL 2.8 m
SCALE 1/1
CHECKER WTR
PROJECT ENGR M.L. CRAWFORD
PROJECT ENGR J.L. WORKMAN
EN(10kHz-100MHz)-1/355 D
SHEET 26 OF 32


MANDREL FOR TRANSITION "C"
MAT'L ~ ALUMINUM 6061 - T6
2 REQ'D
SCALE ~ 1/1
NOTES: 1). AREA EXPOSED TO ELECTROFORMING SOLUTION = 58 07 in² APPROX.
2). ELECTROFORMING MAT'L : COPPER
3). THICKNESS OF ELECTRODEPOSITED MAT'L : 3.2mm (.125") MIN.
FINAL LENGTH OF ELECTRODEPOSITED MAT'L USED IN ASS'Y
AT START OF TRANSITION
AT END OF TRANSITION
TOLERANCE ±.0076mm (±.0003")
#10 - 32 UNF - 2B TAP 12.7mm .50" DEEP
1/4" - 20 UNC - 2B TAP 12.7mm .50" DEEP
CUT RECTANGULAR GROOVE
ALL AROUND
NOMINAL DIM. INDICATED SURFACES FLUSH AT FINAL ASSY
ALL FOUR SIDES
7.14mm .281" DA DRILL THRU 8 HOLES
TRANSITION "C" — 2 REQ'D
MAT'L - ELECTRODEPOSITED COPPER
MAT'L - FREE CUTTING BRASS
A). SOLDER COMPONENTS USING 430 SOFT SILVER SOLDER
B). NICKEL PLATE ALL OVER .002 THICK AFTER SOLDERING EXCEPT INSIDE FLANGE FACE AND RECTANGULAR GROOVE
7.9mm .312" (APPROX. FINAL DIM.)
9.5mm .375" (BRASS PLATE THICKNESS BEFORE MACHINING)
NOMINAL DIM. SLIDING FIT WITH COMPONENT SHOWN ABOVE ALLOW CLEARANCE FOR SOLDER
ATTN.: MACHINED DIMENSIONS TOLERANCES AS LISTED IN TITLE BLOCK EXCEPT AS NOTED
NATIONAL BUREAU OF STANDARDS
BOULDER, COLORADO
TEM CELL
WTR
SHEET 26 OF 32
ORIGINAL DATE OF DRAWING 18 AUGUST 1978
REVISIONS


ORIGINAL DATE OF DRAWING 18 AUGUST 1978
REVISIONS
NO
CHANGE
DATE
1
2
3
4
25.4 mm / 1.000" REF.
25.4 mm / 1.000" DIA.
NATIONAL BUREAU OF STANDARDS
BOULDER, COLORADO, 80303
TRANSITION "C" - CENTER CONDUCTOR
FOR TEM CELL
MODEL 2.8 m
TYPE
SCALE 1/1
DRAFTSMAN Victor Lucinsio
CHECKED W.T.R
PROJECT ENGR M.L. CRAWFORD
PROJECT ENGR J.L. WORKMAN
DECIMALS
FRACTIONS
ANGLES
THIS PRINT ISSUED
EN (10 kHz - 100 MHz) - V355 D
SHEET 27 OF 32



DETAIL ~ CTR CONDUCTOR FOR TRANSITION "C"

MAT'L ~ FREE CUTTING BRASS

2 REQ'D

NOTE: NICKEL PLATE ALL OVER

ATTN.: MAY REQUIRE ADDITIONAL TRIMMING
TO OBTAIN THE DESIRED IMPEDANCE
AS MEASURED USING TDR

MACHINED DIMENSIONAL TOLERANCES SAME AS LISTED IN TITLE BLOCK EXCEPT AS NOTED

NATIONAL BUREAU OF STANDARDS
BOULDER, COLORADO, 80303

TRANSITION "C" – CENTER CONDUCTOR

TEM CELL

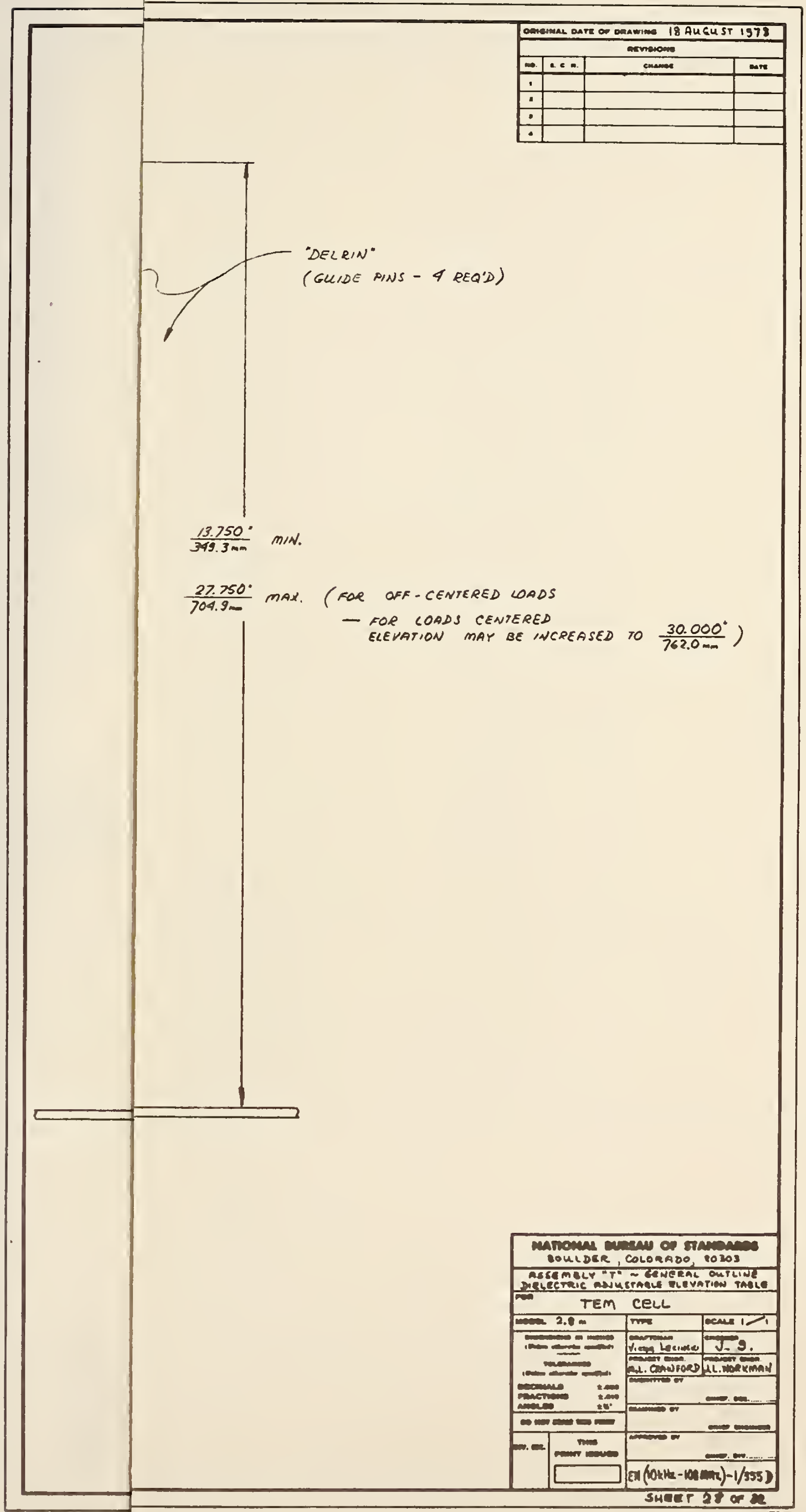
2.5 m

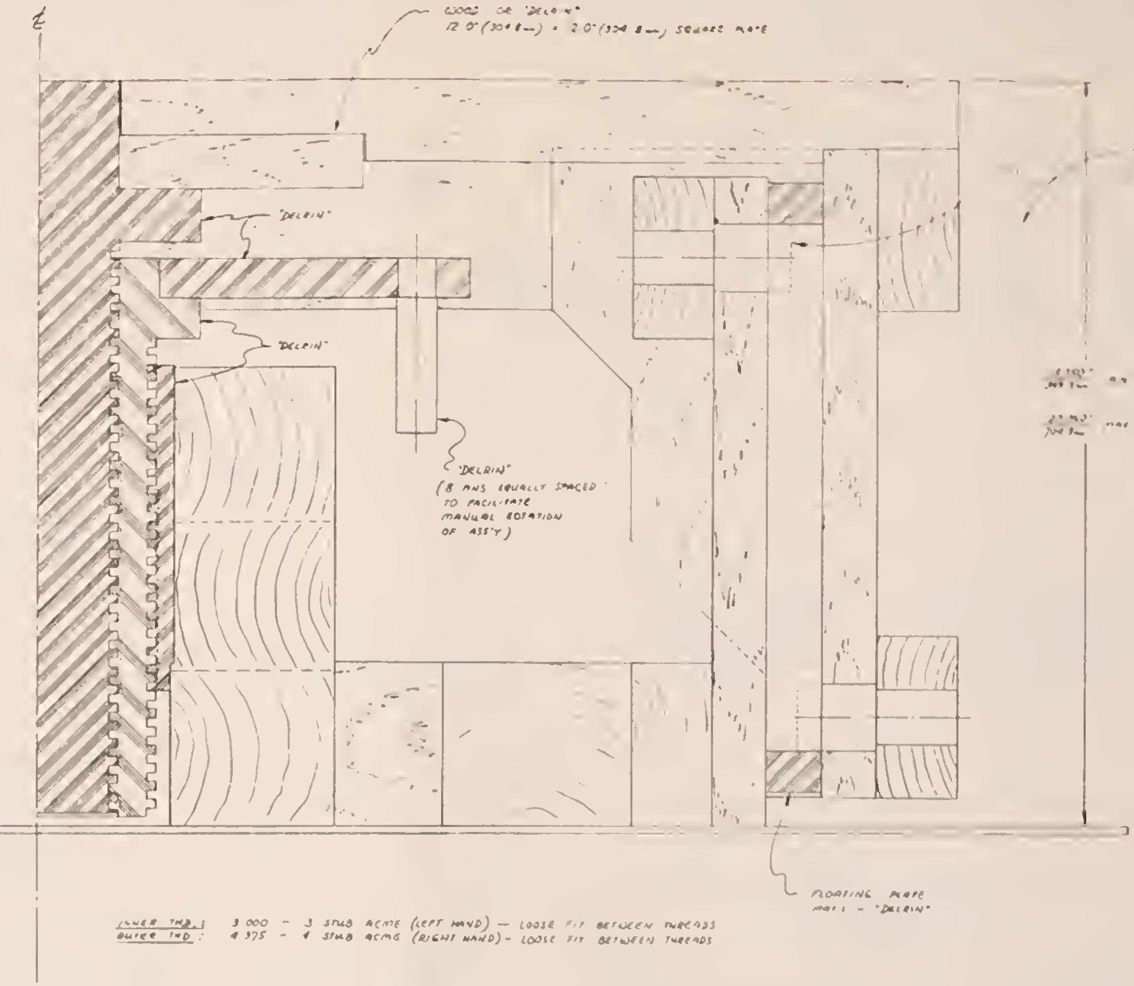
SCALE 1/1

W.T.R.

A.L. CRAWFORD

SHEET 27 OF 32


ORIGINAL DATE OF DRAWING 18 AUGUST 1978
REVISIONS
NO.
CHANGE
DATE
"DELRIN"
(GUIDE PINS - 4 REQ'D)
13.750" / 349.3 mm MIN.
27.750" / 704.9 mm MAX. (FOR OFF-CENTERED LOADS
— FOR LOADS CENTERED
ELEVATION MAY BE INCREASED TO 30.000" / 762.0 mm)
NATIONAL BUREAU OF STANDARDS
BOULDER, COLORADO, 80303
ASSEMBLY "T" ~ GENERAL OUTLINE
DIELECTRIC ADJUSTABLE ELEVATION TABLE
TEM CELL
MODEL 2.0 m
TYPE
SCALE
DECIMALS
FRACTIONS
ANGLES
J. S.
A.L. CRAWFORD
J.L. WORKMAN
EX (10kHz-100MHz)-1/555)
SHEET 28 OF 32



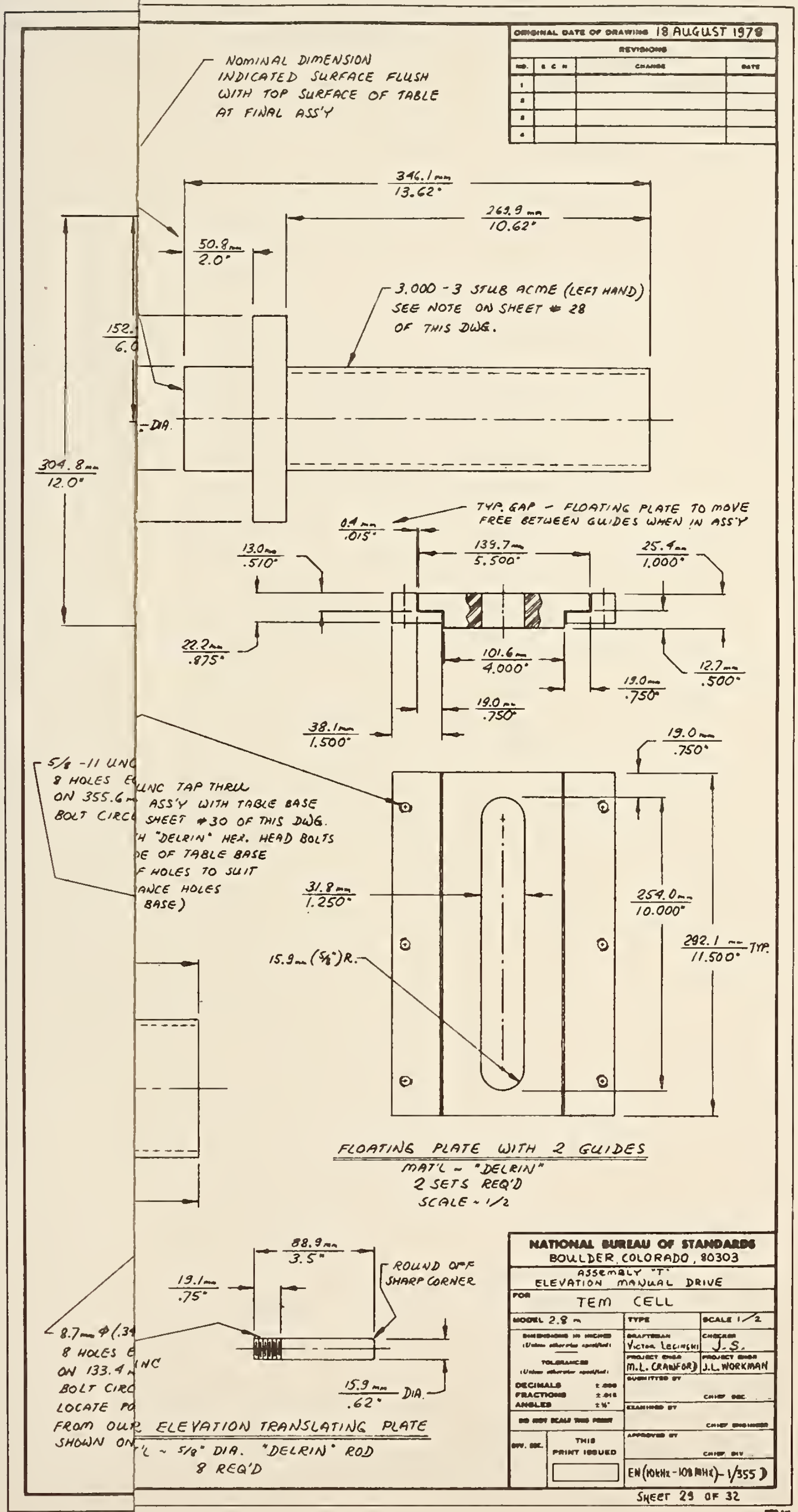
INNER THD.: 3.000 - 3 STUB ACME (LEFT HAND) — LOOSE FIT BETWEEN THREADS
OUTER THD.: 4.375 - 4 STUB ACME (RIGHT HAND) - LOOSE FIT BETWEEN THREADS

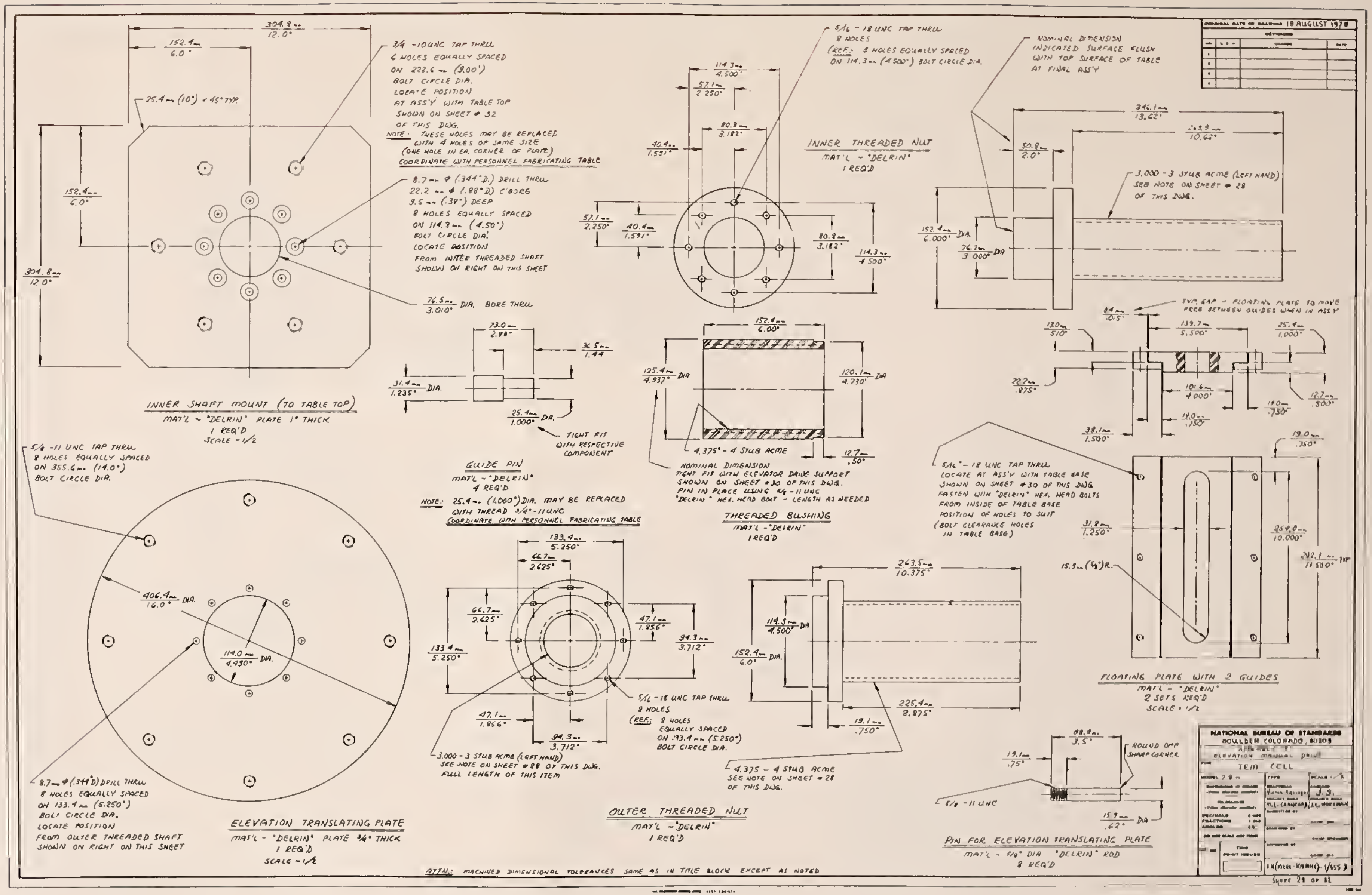
ASSEMBLY 'T' ~ DIELECTRIC ADJUSTABLE ELEVATION TABLE

MAT'L ~ SUGAR PINE AND 'DELRIN'

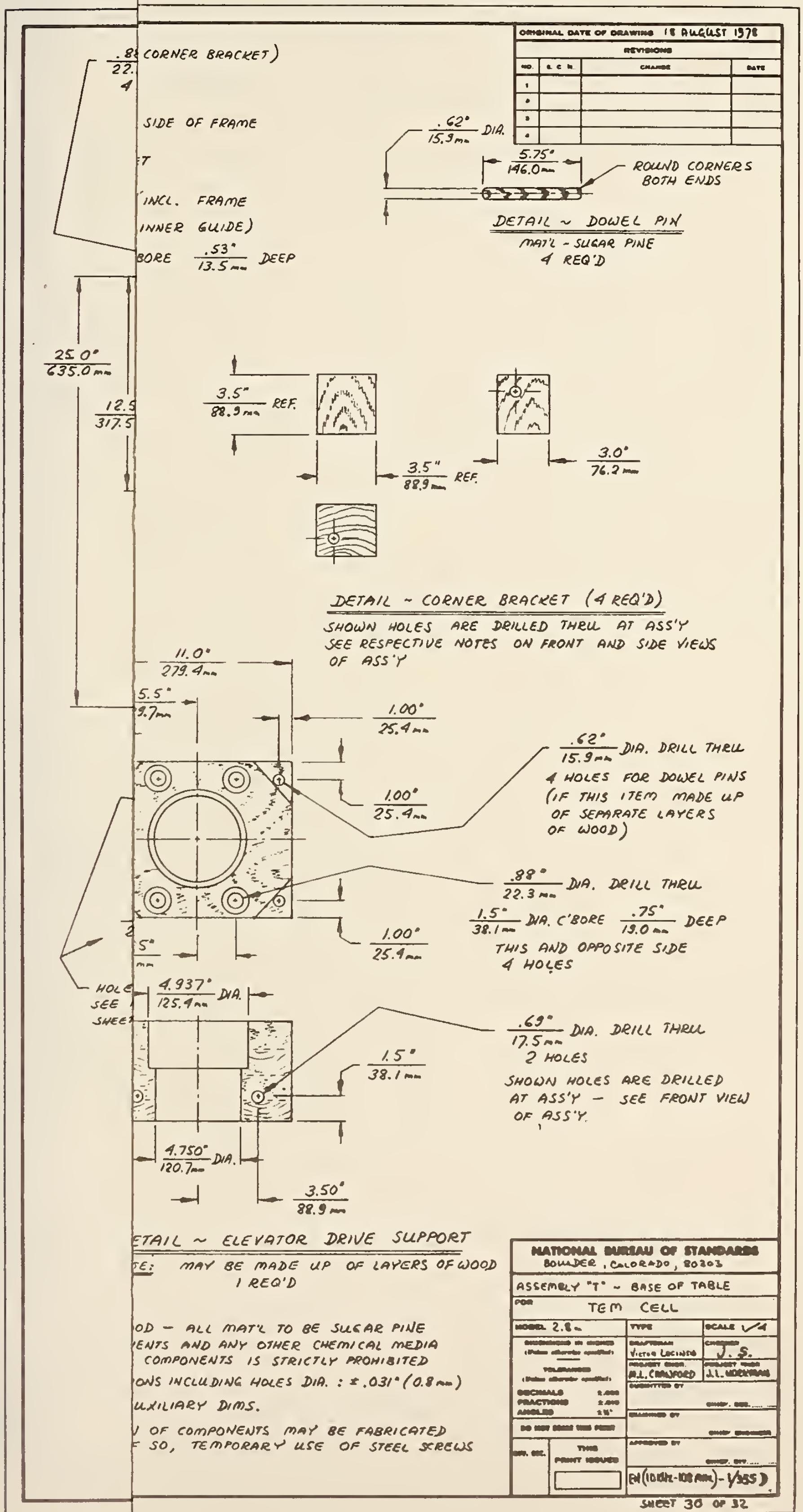
1 REQD

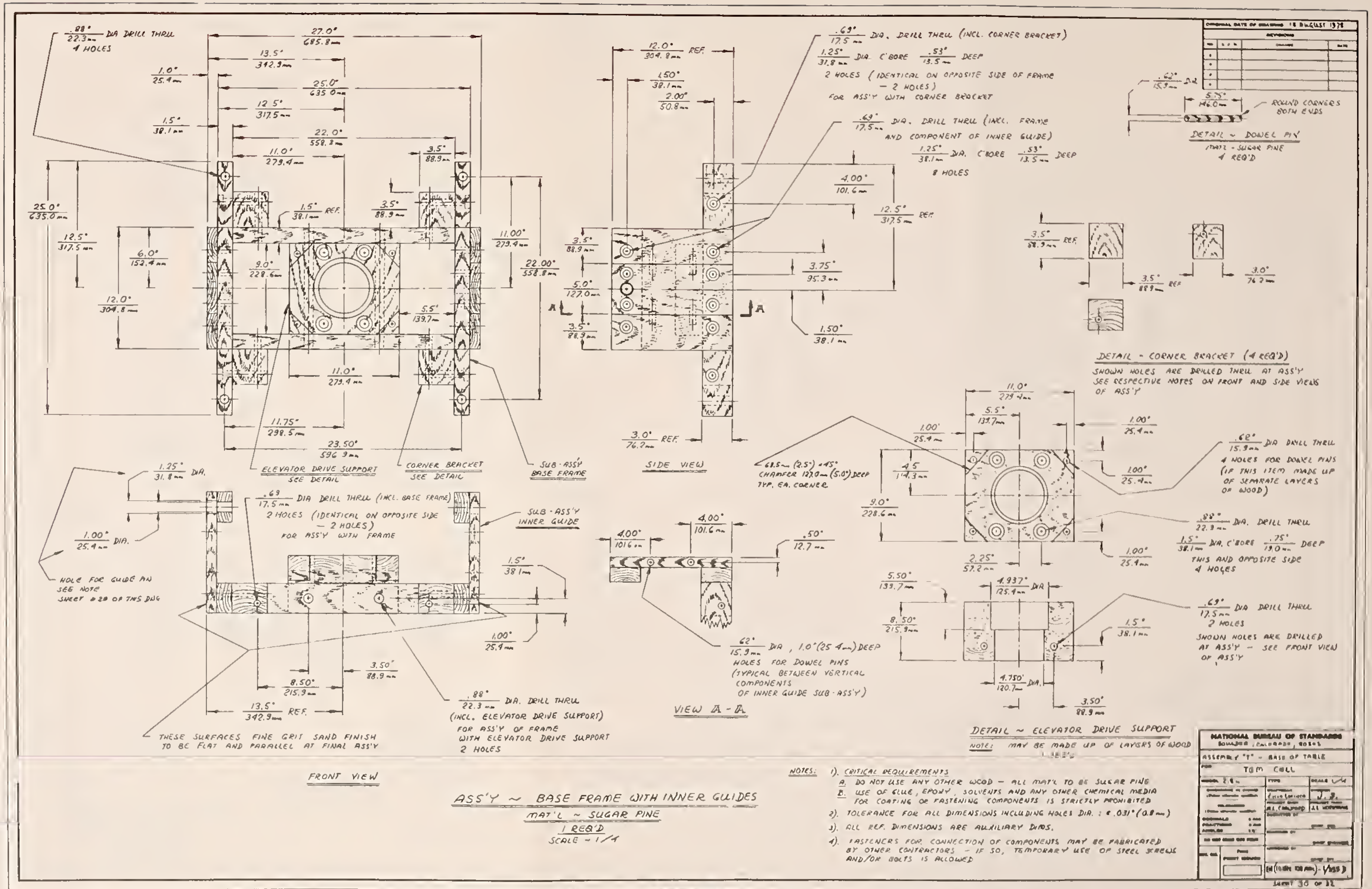
SCALE - 1/1

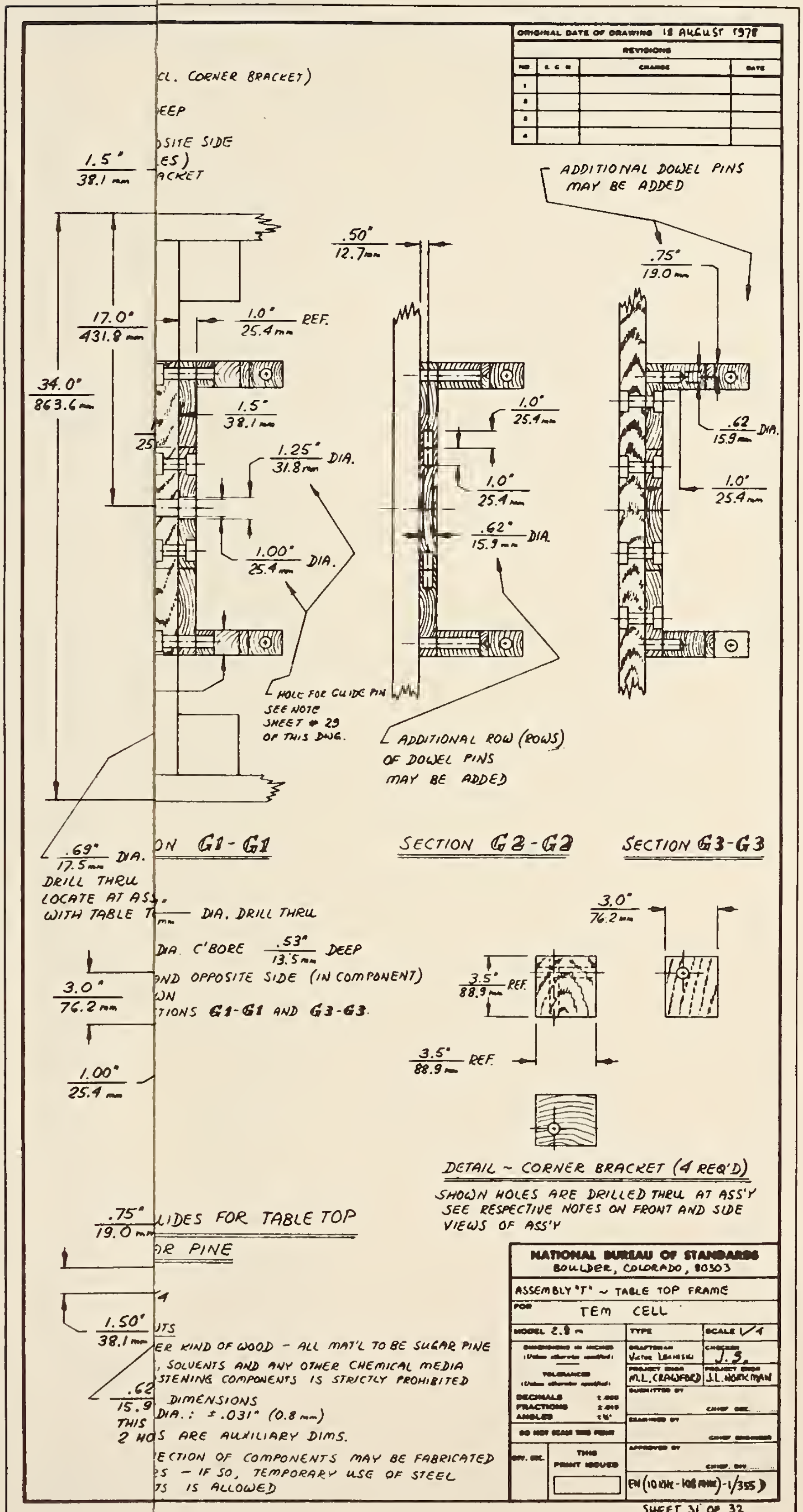

ORIGINAL DATE OF DRAWING 18 AUGUST 1978
REVISIONS
NOMINAL DIMENSION INDICATED SURFACE FLUSH WITH TOP SURFACE OF TABLE AT FINAL ASS'Y
346.1 mm 13.62"
269.9 mm 10.62"
50.8 mm 2.0"
3.000 - 3 STUB ACME (LEFT HAND) SEE NOTE ON SHEET # 28 OF THIS DWG.
304.8 mm 12.0"
DIA.
TYP. GAP - FLOATING PLATE TO MOVE FREE BETWEEN GUIDES WHEN IN ASS'Y
0.4 mm .015"
13.0 mm .510"
139.7 mm 5.500"
25.4 mm 1.000"
22.2 mm .875"
101.6 mm 4.000"
12.7 mm .500"
19.0 mm .750"
38.1 mm 1.500"
5/8 -11 UNC TAP THRU
8 HOLES
ON 355.6 mm
BOLT CIRC
ASS'Y WITH TABLE BASE
SHEET #30 OF THIS DWG.
"DELRIN" HEX. HEAD BOLTS
OF TABLE BASE
HOLES TO SUIT
ANCE HOLES
BASE)
31.8 mm 1.250"
254.0 mm 10.000"
292.1 mm 11.500" TYP.
15.9 mm (5/8")R.
FLOATING PLATE WITH 2 GUIDES
MAT'L ~ "DELRIN"
2 SETS REQ'D
SCALE ~ 1/2
88.9 mm 3.5"
ROUND OFF SHARP CORNER
19.1 mm .75"
8.7 mm
8 HOLES
ON 133.4
UNC
BOLT CIRC
LOCATE
FROM OUR ELEVATION TRANSLATING PLATE
SHOWN ON
15.9 mm .62" DIA.
~ 5/8" DIA. "DELRIN" ROD
8 REQ'D
NATIONAL BUREAU OF STANDARDS
BOULDER, COLORADO, 80303
ASSEMBLY "T" ELEVATION MANUAL DRIVE
FOR TEM CELL
MODEL 2.8 m
SCALE 1/2
DRAFTSMAN Victor Lecinski
CHECKER J.S.
PROJECT ENGR M.L. CRAWFORD
PROJECT ENGR J.L. WORKMAN
EN(10kHz-108MHz)-1/355 D
SHEET 29 OF 32

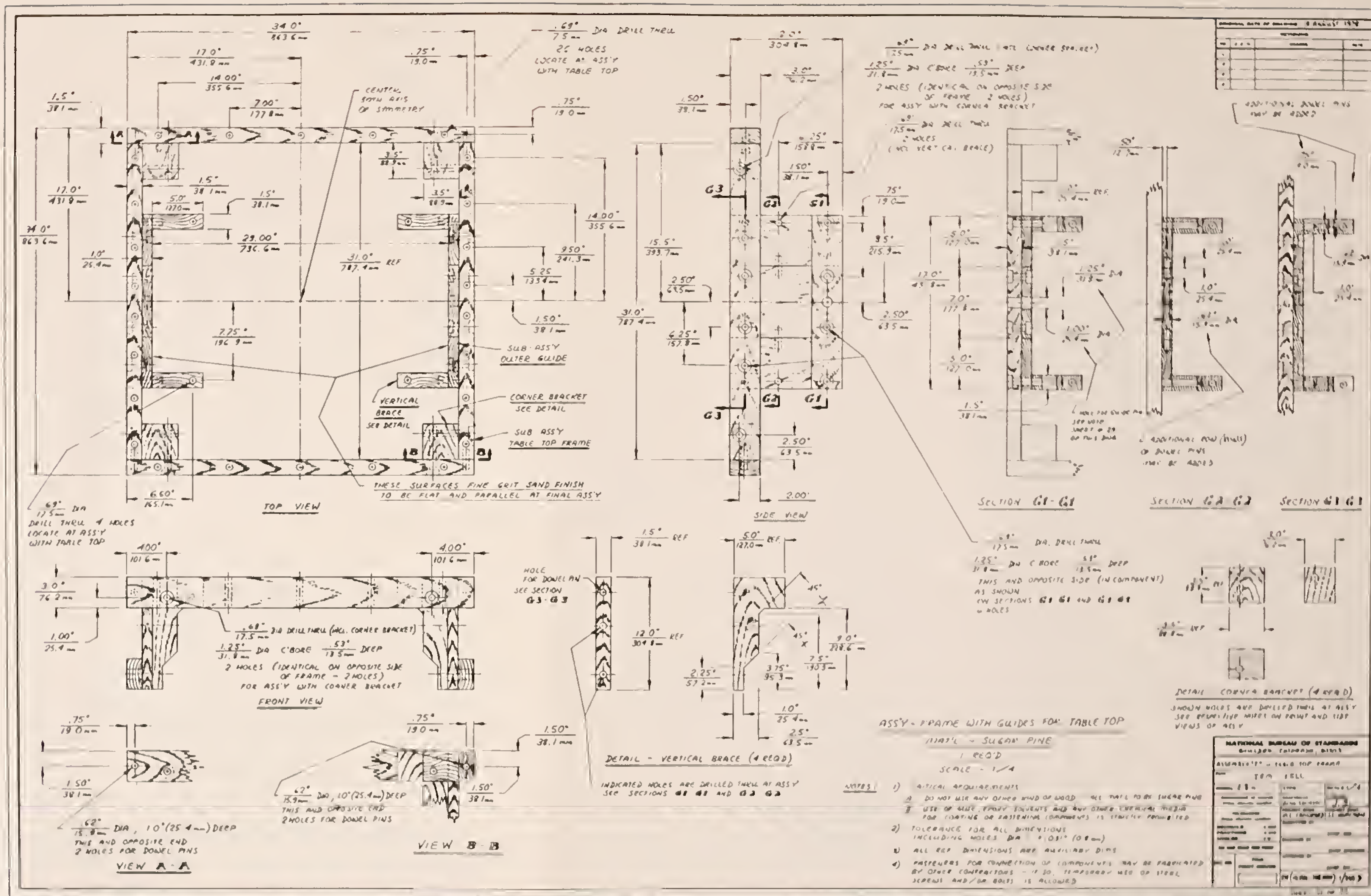


INNER SHAFT MOUNT (TO TABLE TOP)
MAT'L ~ "DELRIN" PLATE 1" THICK
1 REQ'D
SCALE ~ 1/2
3/4 -10UNC TAP THRU
6 HOLES EQUALLY SPACED
ON 228.6 mm (9.00") BOLT CIRCLE DIA.
LOCATE POSITION AT ASS'Y WITH TABLE TOP SHOWN ON SHEET # 32 OF THIS DWG.
NOTE: THESE HOLES MAY BE REPLACED WITH 4 HOLES OF SAME SIZE (ONE HOLE IN EA. CORNER OF PLATE)
COORDINATE WITH PERSONNEL FABRICATING TABLE
8.7 mm ⌀ (.344" D.) DRILL THRU
22.2 mm ⌀ (.88" D) C'BORE
9.5 mm (.38") DEEP
8 HOLES EQUALLY SPACED
ON 114.3 mm (4.50") BOLT CIRCLE DIA.
LOCATE POSITION FROM INNER THREADED SHAFT SHOWN ON RIGHT ON THIS SHEET
76.5 mm / 3.010" DIA. BORE THRU
GUIDE PIN
MAT'L ~ "DELRIN"
4 REQ'D
TIGHT FIT WITH RESPECTIVE COMPONENT
NOTE: 25.4 mm (1.000") DIA. MAY BE REPLACED WITH THREAD 3/4"-11UNC
COORDINATE WITH PERSONNEL FABRICATING TABLE
INNER THREADED NUT
MAT'L ~ "DELRIN"
1 REQ'D
5/16 - 18 UNC TAP THRU
8 HOLES
(REF.: 8 HOLES EQUALLY SPACED ON 114.3 mm (4.500") BOLT CIRCLE DIA.
THREADED BUSHING
MAT'L - "DELRIN"
1 REQ'D
4.375" - 4 STUB ACME
NOMINAL DIMENSION
TIGHT FIT WITH ELEVATOR DRIVE SUPPORT SHOWN ON SHEET #30 OF THIS DWG.
PIN IN PLACE USING 5/8 - 11 UNC "DELRIN" HEX. HEAD BOLT - LENGTH AS NEEDED
NOMINAL DIMENSION INDICATED SURFACE FLUSH WITH TOP SURFACE OF TABLE AT FINAL ASS'Y
3.000 - 3 STUB ACME (LEFT HAND)
SEE NOTE ON SHEET # 28 OF THIS DWG.
TYP. GAP - FLOATING PLATE TO MOVE FREE BETWEEN GUIDES WHEN IN ASS'Y
5/16" - 18 UNC TAP THRU
LOCATE AT ASS'Y WITH TABLE BASE SHOWN ON SHEET #30 OF THIS DWG
FASTEN WITH "DELRIN" HEX. HEAD BOLTS FROM INSIDE OF TABLE BASE
POSITION OF HOLES TO SUIT
(BOLT CLEARANCE HOLES IN TABLE BASE)
FLOATING PLATE WITH 2 GUIDES
MAT'L - "DELRIN"
2 SETS REQ'D
SCALE - 1/2
5/8 -11 UNC TAP THRU
8 HOLES EQUALLY SPACED
ON 355.6 mm (14.0") BOLT CIRCLE DIA.
8.7 mm ⌀ (.344" D) DRILL THRU
8 HOLES EQUALLY SPACED
ON 133.4 mm (5.250") BOLT CIRCLE DIA.
LOCATE POSITION FROM OUTER THREADED SHAFT SHOWN ON RIGHT ON THIS SHEET
ELEVATION TRANSLATING PLATE
MAT'L - "DELRIN" PLATE 3/4" THICK
1 REQ'D
SCALE ~ 1/2
5/16 - 18 UNC TAP THRU
8 HOLES
(REF.: 8 HOLES EQUALLY SPACED ON 133.4 mm (5.250") BOLT CIRCLE DIA.
3.000 - 3 STUB ACME (LEFT HAND)
SEE NOTE ON SHEET # 28 OF THIS DWG.
FULL LENGTH OF THIS ITEM
OUTER THREADED NUT
MAT'L ~ "DELRIN"
1 REQ'D
4.375 ~ 4 STUB ACME
SEE NOTE ON SHEET # 28 OF THIS DWG.
ROUND OFF SHARP CORNER
5/8 -11 UNC
PIN FOR ELEVATION TRANSLATING PLATE
MAT'L ~ 5/8" DIA "DELRIN" ROD
8 REQ'D
ATTN: MACHINED DIMENSIONAL TOLERANCES SAME AS IN TITLE BLOCK EXCEPT AS NOTED
18 AUGUST 1978
NATIONAL BUREAU OF STANDARDS
BOULDER, COLORADO, 80303
TEM CELL
SHEET 29 OF 32

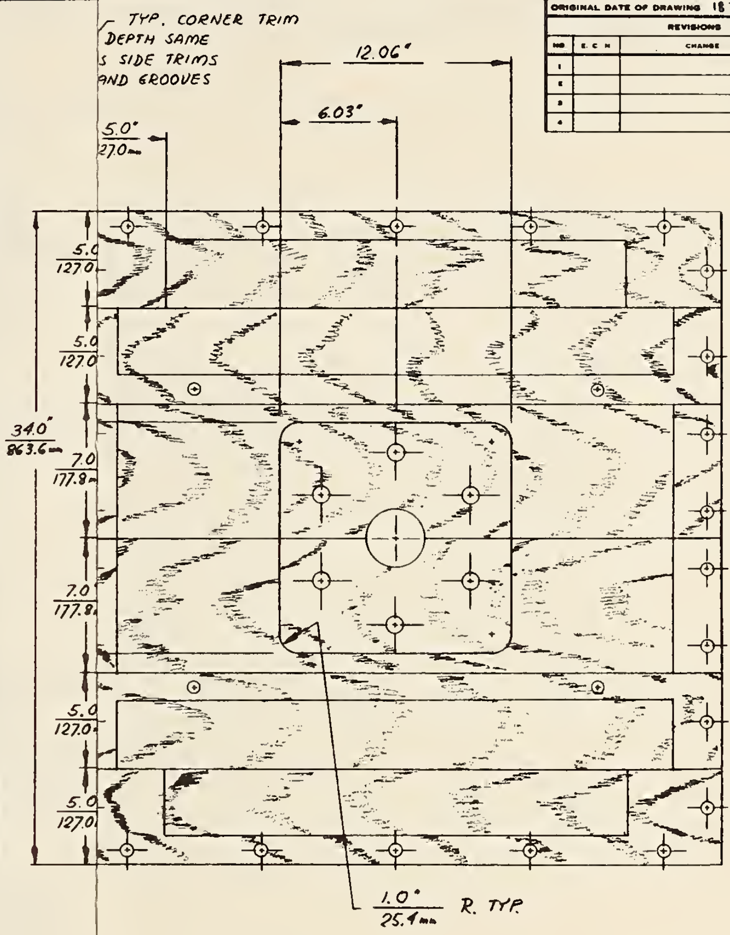

ORIGINAL DATE OF DRAWING 18 AUGUST 1978
REVISIONS
CORNER BRACKET)
SIDE OF FRAME
INCL. FRAME
INNER GUIDE)
BORE .53" / 13.5 mm DEEP
.62" / 15.9 mm DIA.
5.75" / 146.0 mm
ROUND CORNERS BOTH ENDS
DETAIL ~ DOWEL PIN
MAT'L - SUGAR PINE
4 REQ'D
25.0" / 635.0 mm
3.5" / 88.9 mm REF.
3.5" / 88.9 mm REF.
3.0" / 76.2 mm
DETAIL ~ CORNER BRACKET (4 REQ'D)
SHOWN HOLES ARE DRILLED THRU AT ASS'Y
SEE RESPECTIVE NOTES ON FRONT AND SIDE VIEWS OF ASS'Y
11.0" / 279.4 mm
5.5"
1.00" / 25.4 mm
.62" / 15.9 mm DIA. DRILL THRU
4 HOLES FOR DOWEL PINS
(IF THIS ITEM MADE UP OF SEPARATE LAYERS OF WOOD)
1.00" / 25.4 mm
.88" / 22.3 mm DIA. DRILL THRU
1.5" / 38.1 mm DIA. C'BORE .75" / 19.0 mm DEEP
THIS AND OPPOSITE SIDE
4 HOLES
1.00" / 25.4 mm
4.937" / 125.4 mm DIA.
.69" / 17.5 mm DIA. DRILL THRU
2 HOLES
SHOWN HOLES ARE DRILLED AT ASS'Y — SEE FRONT VIEW OF ASS'Y.
1.5" / 38.1 mm
4.750" / 120.7 mm DIA.
3.50" / 88.9 mm
ETAIL ~ ELEVATOR DRIVE SUPPORT
TE: MAY BE MADE UP OF LAYERS OF WOOD
1 REQ'D
OD — ALL MAT'L TO BE SUGAR PINE
ENTS AND ANY OTHER CHEMICAL MEDIA
COMPONENTS IS STRICTLY PROHIBITED
ONS INCLUDING HOLES DIA. : ±.031" (0.8 mm)
UXILIARY DIMS.
OF COMPONENTS MAY BE FABRICATED
SO, TEMPORARY USE OF STEEL SCREWS
NATIONAL BUREAU OF STANDARDS
BOULDER, COLORADO, 80303
ASSEMBLY "T" ~ BASE OF TABLE
TEM CELL
SCALE 1/4
VICTOR LOCINDO
J. S.
M.L. CRAWFORD
J.L. WORKMAN
EH (10 kHz-100 MHz) - 1/355 D
SHEET 30 OF 32

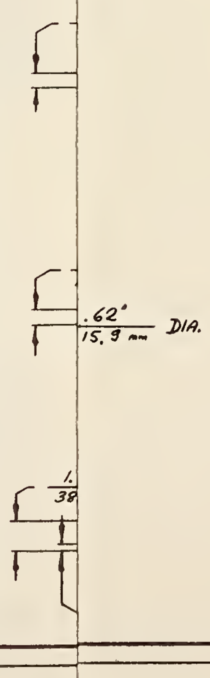

FRONT VIEW
SIDE VIEW
VIEW A - A
DETAIL ~ DOWEL PIN
DETAIL - CORNER BRACKET (4 REQ'D)
SHOWN HOLES ARE DRILLED THRU AT ASS'Y
SEE RESPECTIVE NOTES ON FRONT AND SIDE VIEWS OF ASS'Y
DETAIL ~ ELEVATOR DRIVE SUPPORT
NOTE: MAY BE MADE UP OF LAYERS OF WOOD
ELEVATOR DRIVE SUPPORT SEE DETAIL
CORNER BRACKET SEE DETAIL
SUB-ASS'Y BASE FRAME
SUB-ASS'Y INNER GUIDE
THESE SURFACES FINE GRIT SAND FINISH TO BE FLAT AND PARALLEL AT FINAL ASS'Y
ASS'Y ~ BASE FRAME WITH INNER GUIDES
MAT'L ~ SUGAR PINE
1 REQ'D
SCALE ~ 1/4
NOTES:
1). CRITICAL REQUIREMENTS
A. DO NOT USE ANY OTHER WOOD — ALL MAT'L TO BE SUGAR PINE
B. USE OF GLUE, EPOXY, SOLVENTS AND ANY OTHER CHEMICAL MEDIA FOR COATING OR FASTENING COMPONENTS IS STRICTLY PROHIBITED
2). TOLERANCE FOR ALL DIMENSIONS INCLUDING HOLES DIA. : ± .031" (0.8 mm)
3). ALL REF. DIMENSIONS ARE AUXILIARY DIMS.
4). FASTENERS FOR CONNECTION OF COMPONENTS MAY BE FABRICATED BY OTHER CONTRACTORS - IF SO, TEMPORARY USE OF STEEL SCREWS AND/OR BOLTS IS ALLOWED
NATIONAL BUREAU OF STANDARDS
BOULDER, COLORADO, 80303
ASSEMBLY "T" - BASE OF TABLE
TOM CELL
SHEET 30 OF 32


ORIGINAL DATE OF DRAWING 18 AUGUST 1978
REVISIONS
ADDITIONAL DOWEL PINS MAY BE ADDED
HOLE FOR GUIDE PIN SEE NOTE SHEET # 29 OF THIS DWG.
ADDITIONAL ROW (ROWS) OF DOWEL PINS MAY BE ADDED
SECTION G2-G2
SECTION G3-G3
DETAIL ~ CORNER BRACKET (4 REQ'D)
SHOWN HOLES ARE DRILLED THRU AT ASS'Y SEE RESPECTIVE NOTES ON FRONT AND SIDE VIEWS OF ASS'Y
NATIONAL BUREAU OF STANDARDS
BOULDER, COLORADO, 80303
ASSEMBLY "T" ~ TABLE TOP FRAME
TEM CELL
SHEET 31 OF 32


TOP VIEW
SIDE VIEW
FRONT VIEW
VIEW A-A
VIEW B-B
SECTION G1-G1
SECTION G2-G2
SECTION G3-G3
CENTER, BOTH AXIS OF SYMMETRY
SUB ASS'Y OUTER GUIDE
VERTICAL BRACE SEE DETAIL
CORNER BRACKET SEE DETAIL
SUB ASS'Y TABLE TOP FRAME
THESE SURFACES FINE GRIT SAND FINISH TO BE FLAT AND PARALLEL AT FINAL ASS'Y
.69" DIA DRILL THRU 25 HOLES LOCATE AT ASS'Y WITH TABLE TOP
.69" 17.5mm DIA DRILL THRU 4 HOLES LOCATE AT ASS'Y WITH TABLE TOP
1.25" 31.8mm DIA C'BORE .53" 13.5mm DEEP
2 HOLES (IDENTICAL ON OPPOSITE SIDE OF FRAME - 2 HOLES) FOR ASS'Y WITH CORNER BRACKET
.62" 15.9mm DIA, 1.0" (25.4mm) DEEP THIS AND OPPOSITE END 2 HOLES FOR DOWEL PINS
HOLE FOR DOWEL PIN SEE SECTION G3-G3
DETAIL - VERTICAL BRACE (4 REQD)
INDICATED HOLES ARE DRILLED THRU AT ASS'Y SEE SECTIONS G1-G1 AND G2-G2
DETAIL CORNER BRACKET (4 REQD)
ASS'Y - FRAME WITH GUIDES FOR TABLE TOP
MAT'L - SUGAR PINE
1 REQ'D
SCALE - 1/4
NOTES:
NATIONAL BUREAU OF STANDARDS

ORIGINAL DATE OF DRAWING 18 AUGUST 1978			
REVISIONS			
NO	E.C.N	CHANGE	DATE
1			
2			
3			
4			





NOTES: 1). CRITICAL REQUIREMENTS

A. DO NOT USE ANY OTHER KIND OF WOOD ALL MAT'L TO BE SUGAR PINE

B. USE OF GLUE, EPOXY, SOLVENTS AND ANY OTHER CHEMICAL MEDIA FOR FASTENING OR COATING COMPONENTS IS STRICTLY PROHIBITED

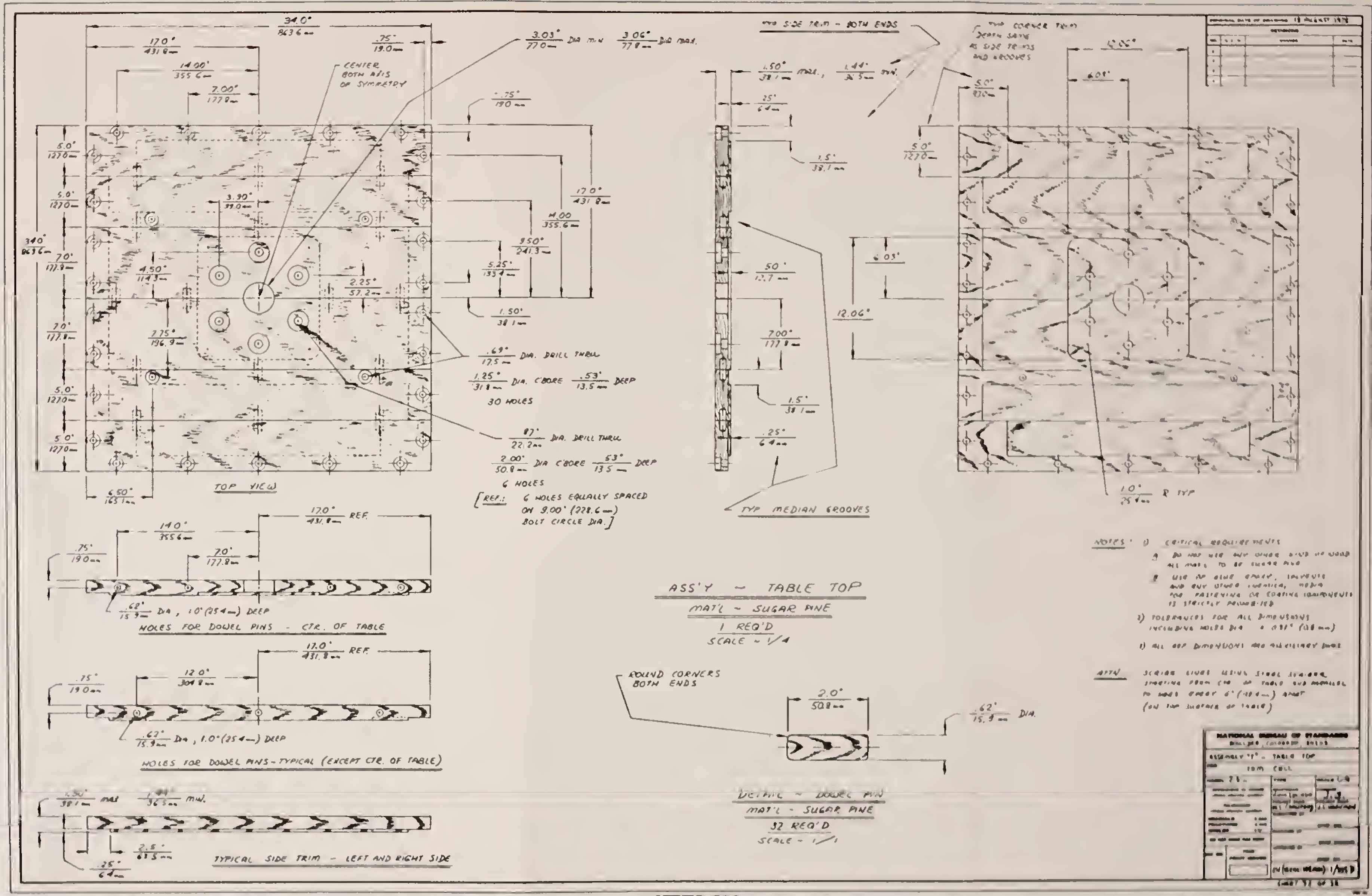
2). TOLERANCES FOR ALL DIMENSIONS INCLUDING HOLES DIA.: ±.031" (0.8 mm)

3) ALL REF. DIMENSIONS ARE AUXILIARY DIMS.

ATTN.: SCRIBE LINES USING STEEL SCRIBER STARTING FROM CTR. OF TABLE AND PARALLEL TO SIDES EVERY 6" (152.4mm) APART (ON TOP SURFACE OF TABLE)

NATIONAL BUREAU OF STANDARDS BOULDER, COLORADO, 80303	
ASSEMBLY "T" ~ TABLE TOP	
FOR TEM CELL	
MODEL 2.8 m	TYPE / SCALE 1/4
DIMENSIONS IN INCHES	DRAFTSMAN Victor Lelinski / CHECKED J.S.
TOLERANCES	PROJECT ENGR M.L. CRAWFORD / PROJECT ENGR J.L. WORKMAN
DECIMALS ±.000 FRACTIONS ±.010 ANGLES ±½°	SUBMITTED BY CHIEF, SEC.
DO NOT SCALE THIS PRINT	EXAMINED BY CHIEF ENGINEER
DIV. SEC. THIS PRINT ISSUED	APPROVED BY CHIEF, DIV.
	EN(10KHz-10GHz)-1/355

SHEET 32 OF 32


TOP VIEW
CENTER BOTH AXIS OF SYMMETRY
3.03" 77.0mm DIA MIN 3.06" 77.8mm DIA MAX.
.69" 17.5mm DIA. DRILL THRU
1.25" 31.8mm DIA. C'BORE .53" 13.5mm DEEP
30 HOLES
.87" 22.2mm DIA. DRILL THRU
2.00" 50.8mm DIA C'BORE .53" 13.5mm DEEP
6 HOLES
[REF.: 6 HOLES EQUALLY SPACED ON 9.00" (228.6mm) BOLT CIRCLE DIA.]
TWO SIDE TRIM - BOTH ENDS
TYP MEDIAN GROOVES
1.0" 25.4mm R TYP
.62" 15.9mm DIA, 1.0" (25.4mm) DEEP
HOLES FOR DOWEL PINS - CTR. OF TABLE
.62" 15.9mm DIA, 1.0" (25.4mm) DEEP
HOLES FOR DOWEL PINS - TYPICAL (EXCEPT CTR. OF TABLE)
TYPICAL SIDE TRIM - LEFT AND RIGHT SIDE
ASS'Y ~ TABLE TOP
MAT'L ~ SUGAR PINE
1 REQ'D
SCALE ~ 1/4
ROUND CORNERS BOTH ENDS
.62" 15.9mm DIA.
DETAIL ~ DOWEL PIN
MAT'L - SUGAR PINE
32 REQ'D
SCALE - 1/1
NATIONAL BUREAU OF STANDARDS

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8. Performing Organ. Report No.: 3620950

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WASHINGTON, D.C. 20234

10. Project/Task/Work Unit No.

11. Contract/Grant No.

12. Sponsoring Organization Name and Complete Address *(Street, City, State, ZIP)*

13. Type of Report & Period Covered

14. Sponsoring Agency Code

15. SUPPLEMENTARY NOTES

16. ABSTRACT *(A 200-word or less factual summary of most significant information. If document includes a significant bibliography or literature survey, mention it here.)*

In support of the electromagnetic interference studies underway in the Electromagnetic Fields Division of the National Bureau of Standards, a 2.8 meter transverse electromagnetic (TEM) cell was constructed by the Instrument Shops Division of the NBS Boulder Laboratories.

The cell requirements, design concepts, and fabrication procedures were developed through the coordination of both the Electromagnetic Fields Division personnel and the Instrument Shops Division personnel. This paper provides the sequential procedure used to fabricate this cell, in conjunction with a complete set of detail and assembly drawings used to illustrate the complete fabrication process. The purpose of this publication is to provide documented information sufficient for any outside vendor, with the proper facilities, to construct a similar TEM cell.

17. KEY WORDS *(six to twelve entries; alphabetical order; capitalize only the first letter of the first key word unless a proper name; separated by semicolons)*

Electromagnetic susceptibility testing; structural design and fabrication procedures; transverse electromagnetic (TEM) cell.

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