SR/H--863

REPORT

OF

MATERIAL & EQUIPMENT

SECTION'S

ACTIVITIES

AT

NEW YORK SHIPBUILDING CORP.

DURING FABRICATION

OF

AXC 167 1/2

STARTING MAY 18, 1951

PART VII - SECTION III

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APRIL 28, 1954

MASTER

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INSPECTIONS PERFORMED BY DU PONT

ON

"R", "P", AND "L" UNITS

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PART VII
SECTION III

R, P, & L BOTTOM TUBE SHEET ASSEMBLIES

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59. Photo Serial #71 -, Leading and Shipment of "R" Unit Bottom Tube Sheet Assembly

"R", "P", & "L" UNIT DRAWING LIST BY SUB-ASSEMBLY

The following list covers all du Pont prints pertaining to fabrication released to the M & E Group located at New York Shipbuilding Corporation.

This list was prepared from existing drawing files at the latter location on February 27, 1954. For reference purposes and convenience, drawings are listed by sub-assembly, drawing number, title, and revision number.

A. "R" Unit

1. Bottom Tube Sheet

Drawing #	Title	Revision #
W-130947	Plan & Cross Section Arrangt.	17
W-130948	Sections & Details - Sheet #1	10
W-130949	Sections & Details - Sheet #2 Arrangt.	14
W-131057	Sections & Details - Sheet #3 Arrangt.	17
W-131093	Sections & Details - Sheet #4	5
W-131265	Main Tank Bottom Bearing Plates.	5
D-110129	Vertical Rod Cups.	1
D-110149	Instrument Well.	1
D-112637	Split Retaining Ring & Flange.	3
D-112651	Pre-Machined Finish of Non-Bearing Tubes	1
D-112652	Pre-Machined Finish of Bearing Tube	2
D-112668	Collars	5
D-114901	Baffle Plate	9

B. "P" Unit

1. Bottom Tube Sheet

W-132760	Tank Bottom Tube Sheet Plan & Cross Section	14
W-132761	Tank Bottom Tube Sheet Section & Detail Sheet #3 Arrangt.	2
W-132762	Tank Bottom Tube Sheet Section & Detail Sheet #1 Arrangt.	3

Drawing #	Title	Revision #
W-132763	Tank Bottom Tube Sheet Section & Detail Sheet #2 Arrangt.	13
W-132764	Tank Bottom Tube Sheet Section & Details Sheet #4	8
D-110270	Tank Bottom Tube Sheet Instrument Well	6
D-112766	Pre-Machined Finish of Non-Bearing Tube in Bottom Tube Sheet	7
D-112767	Pre-Machined Finish of Bearing Tube in Bottom Tube Sheet	7
D-112845	Tank Bottom Tube Sheet Collars	2
D-112846	Split Retaining Ring & Flange for Tank Bottom Tube Sheet	0
D-114483	Tank Bottom Tube Sheet Baffle Plate	3

C. "L" Unit

1. Bottom Tube Sheet

Drawing #	Title	Revision #
W131395	Tank Bottom Tube Sheet Plan & Cross Section Arrangt.	21
W-131396	Tank Bottom Tube Sheet Sections & Details - Sheet #2	13
W-131400	Tank Bottom Tube Sheet Sections & Details - Sheet #1	8
W-131416	Tank Bottom Tube Sheet Sections & Details - Sheet #3	5
W-131433	Tank Bottom Tube Sheet Sections and Details - Sheet #4	7
D-110152	Vertical Rod Cup for Tank Bottom Tube Sheet	0
D-110168	Tank Bottom Tube Sheet Instrument Well	2
D-112667	Pre-Machined Finish of Non-Bearing Tube in Tank Bottom Tube Sheet	8
D-112672	Pre-Machined Finish of Bearing Tube in Tank Bottom Tube Sheet	8
D-112687	Split Retaining Ring & Flange for Tank Bottom Tube Sheet	2
D-112689	Tank Bottom Tube Sheet Collars	5

PART VII - SECTION III BOTTOM TUBE SHEET
INSPECTIONS PERFORMED BY DU PONT ON "R", "P" AND "L" UNITS

1. Plate Preparation

A. "R" Unit

(1) Plate Inspection

The Type 304 stainless steel plate material for the top, bottom, and baffle tube sheets was inspected in a similar manner to that discussed in Part II-A, Section 1-a. All inspections were satisfactory.

(2) Plate Fit-up, Welding and Radiograph Inspection

After the material for the top and bottom tube sheets and baffle plate was inspected for thickness, surface cracks, laminations, and other mechanical defects, each of the three plates that make up a tube sheet blank were laid out to drawing dimensions with excess material on the O.D. to allow for tube weld shrinkage. After laying out baffle and tube sheet plates, they were placed on a flat slab and checked for levelness and then straightened where necessary using a 150 ton deep throat press. Next, each of the three plates that form a tube sheet blank were planned square on an edge planer and beveled on both sides for welding. The angle of bevel was checked by inspectors at random on each plate using an adjustable angle square and found satisfactory.

The three plates were then laid on a flat slab and butts mated until they were flush. After the plates were properly fitted, the two joints were tack welded with 1" tack spaced approximately 10" on center. The weld tacks were wire brushed and defects ground out. These operations were witnessed by a du Pont inspector.

Next, the tube plate edges were clamped to a slab and an aircomatic track welding machine and tracks were set up for welding the joint. Suitable weights were placed on the tube plate blank at established locations to minimize weld buckle. Both joints of the tube plate blank were welded using the established welding procedure adapted for this job.

After all welding was completed, the welds were ground flush. (See Part II-A, Section 1, photo serial #4 for view of grinding operation) Welding was then inspected for undercutting, cracks, and other mechanical defects. Necessary repairs were made, re-inspected and released for x-raying.

The top and bottom tube sheets and the baffle plate welds were then x-rayed 100%. Radiographs were examined in accordance with the non-destructive test as specified in paragraph U-68 (h) (2) to (10) inclusive of the A.S.M.E. Code for Unfired Vessels, 1949 Edition. Unacceptable defects were repaired and re-x-rayed.

After all x-ray work was completed, each tube sheet blank was set up on suitable supports for burning the outside diameters. The top and bottom tube plates were then burned using a stainless steel cutting torch and flux approximately four inches oversize. The baffle plate was cut approximately two inches oversize. Tube sheets had to be left full in diameter due to welding shrinkage which had been established from experience on the NYX unit. Since no additional welding was ever done on the baffle plate after trepanning and assembling into the unit, it did not require as much excess material for fabrication. After burning the plates to the required diameter, the tube sheet edges were straightened on a 350 ton press. Weld joints were straightened on a 70 ton deep throat press. The above fabrication operations were witnessed by a du Pont inspector.

B. "P" Unit

(1) Plate Inspection

This inspection was performed in a similar manner to those performed on the "R" unit as described above in Section 1A-(1). All inspections were satisfactory.

(2) Plate Fit-up, Welding and Radiograph Inspections

These inspections were performed in a similar manner to those performed on the "R" unit as described above in Section 1A-(2). All inspections were satisfactory.

C. "L" Unit

(1) Plate Inspection

This inspection was performed in a mimilar manner to those performed on the "R" unit as described above in Section 1A-(1).

(2) Plate Fit-up, Welding and Radiograph Inspections

These inspections were performed in a similar manner to those performed on the "R" unit as discussed above in Section 1A-(2), except as follows: It was requested by the du Pont Inspection Department that New York Ship stencil x-ray identification mumbers on the outside of all tube sheets on "L" and subsequent units in such a manner that they would stay there.

Heretofore, x-ray numbers on tube sheets were stenciled on the outside of all tube plates. In some cases, after assembling of a unit, x-ray numbers on tube plates were in the inside of the unit and there was no way to match the radiograph with the weld seam. New York Ship complied with request on "L" and subsequent units and put x-ray numbers on the outside.

Finel grain x-ray film was used in lieu of coarse grain film on this unit. This change was a result of difficulty in reading x-rays on "P" unit expansion joint. All x-ray film for this unit ("L") was interpreted according to the revised x-ray reading technique discussed in "P" unit expansion ring inspections. (Part VII, Section IV)

2. Tube Inspection (Pre-Assembly)

A. "R" Unit

Inspection of pre-machined bottom tube sheet tubes was performed in an identical manner to that described in Part VII, Section I, item 2A.

B. "P" Unit

Inspection of pre-machined bottom tube sheet tubes was performed in a similar manner to that described in Part VII, Section I, item 2B, except as follows:

As a result of a fabrication meeting held between du Pont Design Division, du Pont Inspection Department and New York Ship, it was concluded that the following design change be incorporated into the pre-machining of large tubes for the "P" bottom tube sheet:

1. Those tubes for the bottom tube sheet of the "P" unit which have not yet been premachined in outside vendors' shops be completed with an additional .040" on diameter in the smallest bore. This decreased the size of the bore from 3.250" diameter to 3.210" diameter. Revise du Pont drawings D-112667 and D112672 cover this change.

2. Those tubes for the bottom tube sheet of "P" unit which the smallest bore has already been finished to the originally specified 3.250" diameter were completed, accepted and shipped to New York Ship as planned.

Additional material was desirable in the small bores of the bottom tube sheet tubes since experience with NYX has indicated that the tube-welding operation tends to "bell-mouth" the outer extremity of this bore, and hence more stock was required to allow for line reaming.

C. "L" Unit

Inspection of pre-machined bottom tube sheet tubes was performed in an identical manner to that described in Part VII, Section I, item 2C.

3. Revised Drill Jigs for "R", "P" and "L" Units

The discussion for "R" plenum chamber drill jigs included the "R" bottom tube sheet. Refer to Part VII, Section I, item 3A for a detailed analysis of the problems confronted with and the steps taken to solve the problems.

4. Trepanned Bottom Tube Sheet Inspections

A. "R" Unit

The method used for inspecting the top and bottom plates and baffle plate for the "R" bottom tube sheet assembly has been discussed in Part VII, Section I, item 4A. Sketches #6 and #7 show the ligament measurements for both the top and bottom tube sheets of the "R" bottom tube sheet. The baffle plate was also measured in an identical manner. Measurements were not corrected for temperature.

B. "P" Unit

The method used for inspecting the top and bottom plates and baffle plate has been discussed in Part VII, Section I, item 4B. Sketches #12 and #13 show the ligament measurements for both the top and bottom tube sheets of the "R" bottom tube sheet. The baffle plate was also measured in an identical manner. Measurements were not corrected for temperature.

C. "L" Unit

The method used for inspecting the top and bottom plates and baffle plate has been discussed in Part VII, Section I, item 4C. Sketches #18 and #19 show the ligament measurements for both the top and bottom tube sheets of the "L" bottom tube sheet. The baffle plate was measured in an identical manner. Measurements were not corrected for temperature.

5. Demensional Check of Tube Sheet Ligaments and Bores

A. "R" Unit

(1) Bottom Tube Sheets (top, bottom and baffle)

Ligament measurements on the top, bottom and baffle plates for the bottom tube sheet assembly were obtained in a similar manner to that described in Part VII, Section I, item 5A-(1).

B. "P" Unit

(1) Bottom Tube Sheets (top, bottom and baffle)

Ligament measurements on the top, bottom and baffle plates for the bottom tube sheet assembly were obtained in a similar manner to that described in Part VII, Section I, item 5B-(1).

C. "L" Unit

(1) Bottom Tube Sheets (top, bottom and baffle)

Ligament measurements on the top, bottom and baffle plates for the bottom tube sheet assembly were obtained in a similar manner to that described in Part VII, Section I, item 5C-(1), except as follows: On the top plate of the "L" bottom tube sheet, it was requested by the du Pont Inspection Department that New York Ship locate and layout rod cup positions. Typical layout for locating rod cups on the top plate of the bottom tube sheet can be seen by referring to du Pont drawing W-132760, Detail "V". Also, see du Pont drawing W-132762, detail "Z" for "as welded" position of rod cups. Welding of rod cups to the top plate was done in the field. Photograph serial #6, presented herewith, illustrates pictorially how layout lines were established by New York Ship layout men.

6. Inspection of Tube Sheets after Grinding and Acid Washing

A. "R" Unit

This inspection was performed in a similar manner to that discussed in Part VII, Section I, item 6A.

B. "P" Unit

This inspection was performed in a similar manner to that discussed in Part VII, Section I, item 6B.

C. "L" Unit

This inspection was performed in a similar manner to that discussed in Part VII, Section I, item 6C.

7. Assembling of "R", "P" and "L" Bottom Tube Sheets

A. "R" Unit

(1) Gusset Plate Pre-assembly Inspections

The design of gusset plates was altered slightly on the "R" bottom tube sheet assembly. In addition to the minor changes in the gusset plates, twelve short "T" gussets were added to the unit. Du Pont drawing W-130949 shows where these were located.

Thirty gusset plates were laid out; twelve off-set, six straight and twelve short "T" gussets. All gusset plates were burned to layout and then the burned edges were chipped and dressed to parent metal. Next, the gussets were planed to height and then beveled for weld preparation. The twelve offset gusset plates were then bent to conform to a template layout. Stiffener bars were planed to length, beveled for weld preparation, and

Serial Number 6

New York Shipbuilding Corporation
Camden, New Jersey
August 11, 1952

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This view shows the laying out of the rod cup positions on the top plate of the Tank Bottom "L" Unit.

Layout of rod cup positions is done in the shop and welding of the rod cups to the top sheet is done in the field.

The layout man is using a circular layout tool set to one-half the pitch of a ligament. Using each tube hole (3) surrounding the rod cup position, three lines are scribed, thus locating the center of the ligaments with respect to the three tube holes. Using this point as the center, two circles are scribed. Layout for positioning rod cup is now complete.

On the right is a view of the rod cup that will be welded in the field.


SER # 6

then dressed and fitted to the twelve offset and six gusset plates. Two stiffener plates were then tacked and fully welded to each of the above gusset plates. After welding, straightening, and dressing stiffeners joined to the twelve offset and six straight gusset plates, all welding was visually inspected by du Pont inspectors for porosity, cracks, undercutting and other mechanical defects. Necessary repairs were made; re-inspected and found satisfactory.

Next, the twelve short "T" gussets were fit, tacked, welded, dressed, straightened and inspected in a similar manner to that described above.

End stiffening bars were laid out, planed to length, beveled for weld preparation, and pieces dressed.

The thirty gusset plates were then sandblasted, acid washed, ferroxyl tested and accepted for assembling into the bottom tube sheet.

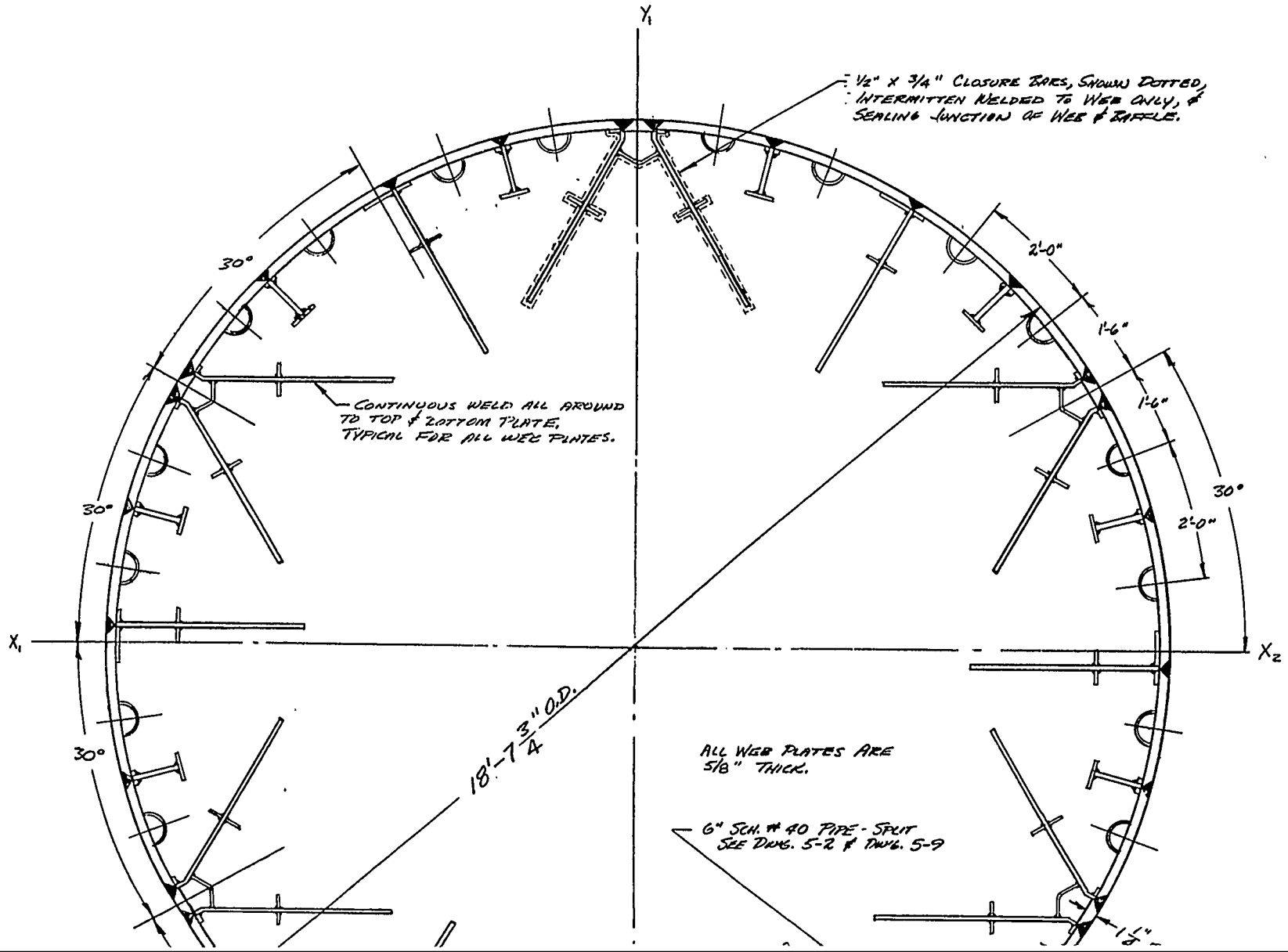
(2) Inspections Performed During Assembling of Gusset Plates into Unit.

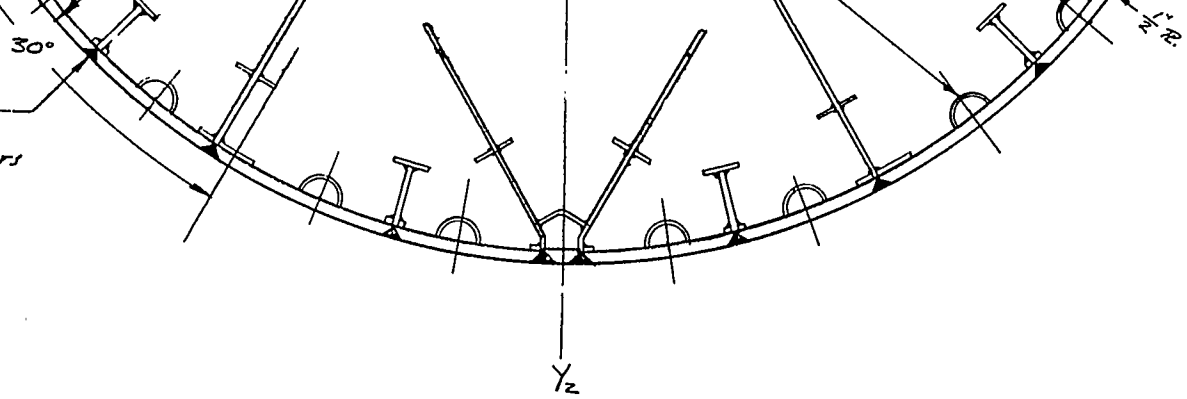
The top tube plate was placed with the top side down on a level platen and gusset plates positioned and tack welded. (In the bottom tube sheet assembly, location of the baffle requires building of the bundle in an inverted position). (See photo serial #129 & 130 in Part II-B-4a). The relative position of the gussets with respect to the X and Y axis was checked. This was done by placing the baffle sheet on top of the top tube plate and checking gusset layout against slots cut in the baffle plate. After the X and Y centerlines on the baffle plate were matched to the X and Y centerlines of the top tube sheet, measurements were taken around the outer edges of the two plates to determine if the baffle plate was centered over the top tube plate, and at the same time measurement were also taken again between baffle plate slots and the up-right tack welded gusset plates to determine if sufficient clearance was being maintained between baffle slots and gusset plates. After fully welding all gusset plates (or web plates) to the bottom side of the top tube plate, welding was visually inspected for cracks, undercutting, porosity and other mechanical defects and necessary re-pairs made. See dwg. 5-3 for bottom tube sheet gusset plate (or web) layout.

(3) Baffle Plate Spacers, Sandblasting, Acid Washing and Ferroxyl Testing

The baffle plate was removed from the partially built assembly and made ready for welding 30-1" thick support blocks (See du Pont dwg. D-114901). These support blocks were located symmetrically around the outer portion of the baffle plate. After fitting support blocks to layout and tacking, they were fully welded using a manual "aircomatic" welding machine. Weld splatter was removed from the baffle plate and then the

BOTTOM TUBE SHEET WEB PLATE LAYOUT





1. WRAPPER PLATE WELDS ARE SUBJECT TO VISUAL, FREON, HAMMER, & HYDROSTATIC TESTS
2. WEB PLATE WELDS ARE VISUALLY INSPECTED.

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DW'G. 5-3

[redacted]
BY: SAR. COCHRAN
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welding was dressed. After this all welding was visually inspected for porosity, undercutting cracks and other mechanical defects. Repairs were made, re-inspected and approved.

Next, the baffle plate was sandblasted, acid washed, ferroxyl tested and accepted for assembling into the unit.

(4) Collar Inspection

The large tube collars for spacing the baffle plate on the inside of the bottom tube sheet assembly were checked for thickness only. This was necessary to insure that a level plane would be maintained when the baffle plate was bolted in place. The required thickness of all tube collars was 1". This was measured using 0-1" outside micrometer.

Next, the large tube, instrument well and instrument lead collars were acid washed and then ferroxyl tested. Photo serial #84 in Part II illustrates pictorially acid washing of large tube collars.

The large tube collars were then fitted and tack welded to the bottom side of the top tube plate. Since shoulder tubes hold their collars firm against the tube plate, they were not fitted at this time. (see du Pont drawing W-130948). Shoulder tube collars were later set in place with shoulder tubes holding them firmly in position during preliminary assembly operations. Ten instrument well collars were tack welded in place with a small tack on each of the three legs. (See du Pont drawing D-112668-H). Instrument lead tube collars were identical to rod tube collars used in the top tube sheet assembly. These were fit and tack welded to the bottom side of the top plate. Du Pont drawing W-131093 shows where the different type collars were located and the number required. All of the above assembly operations were witnessed by a du Pont inspector.

(5) Verticality Check After Placing Tube Sheets in Circumferential Handling Jig.

This inspection was performed in a similar manner to that discussed in Part II-A, section 4, except as follows: During tube sheet layout, the X and Y axis were extended to the edges of both tube sheets. After aligning the top and bottom tube sheets in the circumferential handling jig to the best verticality, these extended axes or match marks were checked for vertical alignment with surface gage and box level by New York Ship mechanics and witnessed by du Pont inspectors. (See photo serial #323 in Part VII, section 7A-(1).

(6) Gusset Plate Welding Inspections

After the top and bottom tube plates were mated for best verticality, the bottom edge of each gusset plate was tack welded and then fully welded. All welding was dressed and then visually inspected for porosity, cracks,

undercutting and other mechanical defects. Repairs were made, re-inspected and approved.

Sealing bars were then laid out, cut to length, and cutouts machined in the bar sides so as to clear large tube outside diameters. These bars were used to seal off the opening between the baffle plate and gusset plate. Sealing bars were then dressed, acid washed, ferroxyl tested and accepted for fitting and welding into the bottom tube sheet assembly. End sealing bars for gusset plate and stiffeners were cut, fit and tacked as a small assembly. When the unit was ready, sealing bars and end assemblies were acid washed again, fit and tacked to the gusset plate to seal off openings around baffle slots. All tack welding was dressed by grinding and then inspected. Sealing bars near the outer periphery of the unit were left out until the unit was turned and the end stiffeners welded in position to the bottom side of the top tube plate. The remaining seal bars were fit, welded, dressed, and then cleaned with SAFE-TEE SOLVENT F. O. 128 (Fine Organics). A visual inspection was made by du Pont inspectors for cleanliness and weld defects. Necessary repairs were made, re-inspected and passed as being satisfactory.

The tube holes near the vicinity of the gusset plates were distorted by welding of the gusset plates to the top and bottom tube plates. Portable drills were set up and holes were again reamed to original size in order to pass large tubes freely.

(7) Preliminary Cleaning

Before inserting and tacking large tubes, the unit was given a preliminary cleaning externally and internally to remove dirt, oil, and other foreign material which had collected during fabrication. This was done by first air jetting the unit at approximately 100 psi to remove all loose material. After this, the top and bottom sides of each tube sheet, gusset plates, and all other accessible areas were wiped clean using a clean cloth saturated in CCl_4. After cleaning, the unit was inspected, accepted and released for further fabrication.

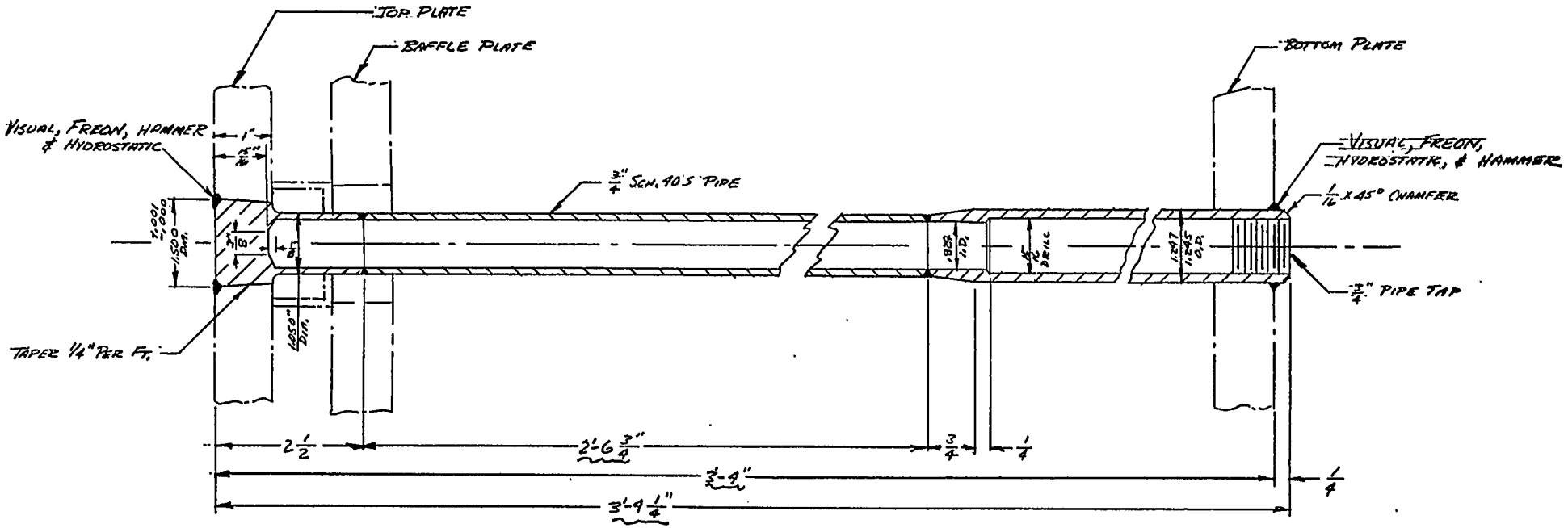
(8) Large Tube Assembly, Instrument Well and Tack Welding Inspections

Starting in the center of the unit and working out, large tubes were progressively cleaned with CCl_4, inserted in the unit, and tack welded to the inside of the bottom tube plate. Tack welding was visually inspected for undercutting, cleanliness and necessary repairs made. Tube assembly was witnessed by du Pont inspectors.

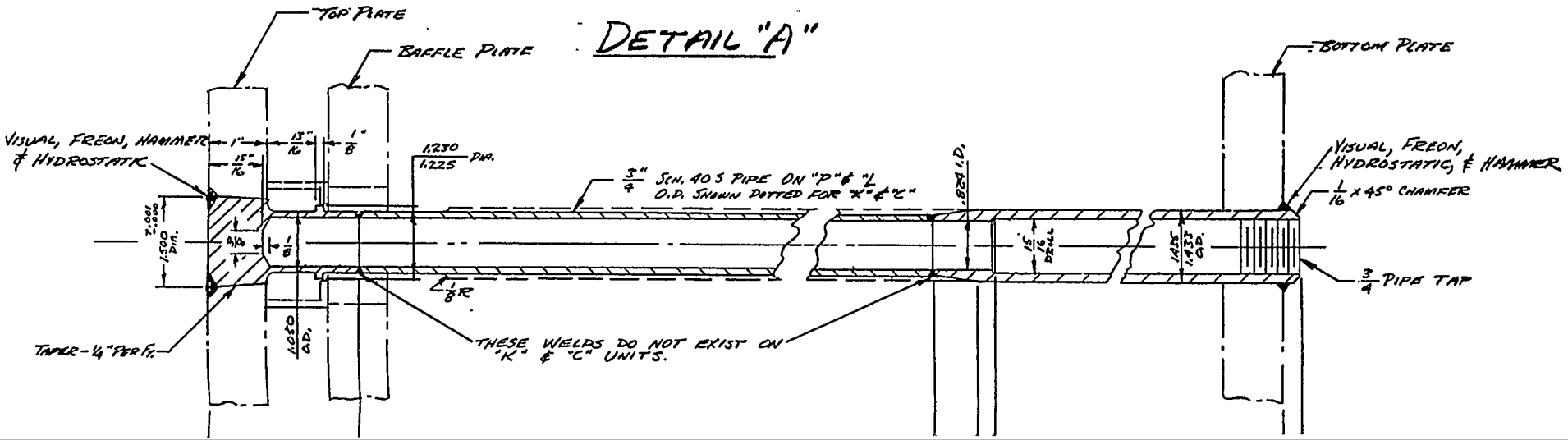
As shown on drawing 5-4, ten (10) instrument wells were required for the "R" bottom tube sheet. (There were none in the NYX unit). New York Ship fabricated the required number of instrument wells from type 304

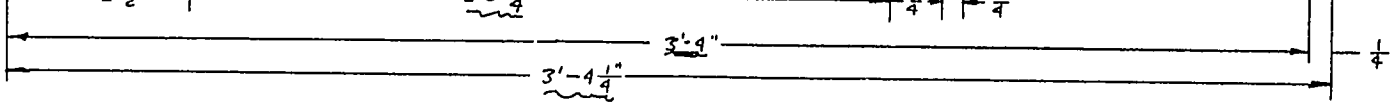
[redacted]

BOTTOM TUBE SHEET — THERMOCPL WELLS



DETAIL "A"





DETAIL "B"

UNIT	NUMBER REQ'D.	DRAWING NUMBERS ARRANGEMENT	DRAWING NUMBERS DETAIL
R	10	W130947 W131093	110149-A
P	~~3~~ 7	W131473 W131395	110168-A 110168-B
L	10	W132760 W132764	110270-B
K	10	W133386 W133389	110293-A
C	13	W134310 W134132	110319-A

NOTE:
1. INSIDE WELDS INSPECTED FOR DEGREE OF PENETRATION WITH BORESCOPE & ARE SUBJECTED TO HYDROSTATIC & FREON TESTS, PRIOR TO INSTALLATION.
2. DETAIL "A" REPRESENTS "R" & 3 OF D110168-A ON "P"
3. DETAIL "B" REPRESENTS "L", "K", & "C" & 7 OF D110168-B ON "P"

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[redacted]
BY: S.R. COCHRAN
JAN.-1958

stainless steel bar stock and pipe. Referring to the above mentioned drawing, each instrument well was fabricated in three sections and then the pieces butt welded at two joints to form the instrument well. The top section of the well was machined from bar stock of suitable size with a 1/4" taper/foot on the outside diameter. A male and female taper gauge was machined to fit the pieces and to check the hole diameters. A special taper reamer was made for reaming the top tube sheet (in unit) for receiving the top part of the tapered well section. The centering section of the well was a piece of 3/4" sch. 40 S pipe cut to the required length with both ends beveled for weld preparation. The lower piece of the well was a piece of bar stock, bored, turned, threaded and beveled for welding as shown on drawing 5-4.

After the three sections that form a instrument well were butt welded, they were dressed and then visually and dimensionally inspected by the du Pont Inspection Department. Visual inspection of the bore in some of the wells indicated the presence of weld splatter. This was removed by passing a reamer through the bore of the well. A small functional gage (.824" diameter) was used to gage all ten instrument wells. They all passed the functional gage freely. All other dimensions were checked using a 6' steel tape, 1-2" outside micrometers and a taper gauge.

Next, the ten instrument wells were hydrostatically tested at 2000 psi for ten minutes. Several leaks were found and repaired. Wells that were repaired were re-tested and found satisfactory.

The ten instrument wells were assembled and welded into the bottom tube sheet assembly. Welding at the top and bottom ends joining the wells to the top and bottom tube sheet was visually inspected for defects and passed as being satisfactory.

After the bottom tube sheet assembly was accepted at New York Ship and shipped to the field, it was discovered that the butt welds on the inside bore of the instrument wells had not been visually inspected at the vendor's plant for weld penetration. Therefore, a du Pont inspector from New York Ship was sent to the Savannah River Plant to perform this inspection. Results of this inspection revealed that all ten instrument wells were satisfactory. For a resume covering the manner in which this inspection was carried out in the field, see Exhibit #1.

(9) Types of Tubes Assembled in "R" Bottom Tube Sheet Assembly

The approximate number of each of the various types of 3-15/16" O.D. tubes assembled in the "R" bottom tube sheet was as follows:

Type of Tube	Number of Each Assembled in Unit
Seamless	106
Cast	85
Welded	482

EXHIBIT #1

INSPECTION OF WELD PENETRATION

AT THE TWO WELDED JOINTS IN TEN

INSTRUMENT WELLS

E. I. DU PONT DE NEMOURS & CO., INC.

Construction Division

[redacted]

Report Number 288-R

CC: H. W. Gosney, F.P.M.
R. K. Mason, F.P.M.-SRP-3
H. L. Bunker - J.G. Brewer
J. G. Brewer
H. B. Gage
F. C. Breuninger
R. D. Bradway (NYS)
R. H. Potts (2)
J. B. Johnson - File

October 7, 1952
New York Ship - Camden, N. J.

#12

FIELD INSPECTOR'S REPORT

This material contains information affecting the national defense of the United States within the meaning of the espionage laws, Title 18, U.S.C., Secs. 793 and 794, the transmission or revelation of which in any manner to an unauthorized person is prohibited by law.

TO C. J. VEITH - M & E FILE

FROM R. H. Potts DATE October 5, 1952

PROJECT NO. 8980 PLANT Savannah River ORDER NO. AXC-167½

EQUIPMENT Instrument Wells-Bottom Tube Sheet EQ.PC.NO. 153-R

DRAWING NOS. D-110149 JOB RATING

VENDOR New York Shipbuilding Corporation LOCATION Camden, N. J.

Scope: To visually inspect the butt welds (inside bore) in "R" unit tank bottom instrument wells. This inspection was made at the Savannah River Plant site on October 1, 1952.

Procedure: Using a 5/8" O.D. borescope the 10 instrument wells in the subject unit were inspected for weld penetration in 2 butt joints on I.D. of wells.

Results:

Instrument Well Number	Per cent penetration Top Butt	Bottom Butt
X-52; Y-44	90%	100%
X-32; Y-47	100%	100%
X-44; Y-7[illegible]	100%	100%
X-34; [illegible]	90%	90%
X-31; Y-61	100%	80%
X-22; Y-58	100%	100%
X-25; Y-35	100%	100%
X-[illegible]; Y-46	90%	100%
X-[illegible]; Y-[illegible]	100%	100%
X-[illegible]; Y-11	100%	100%

OCT 31 1952 CONSTRUCTION XY

[redacted]

Ex 1-2

FIELD INSPECTOR'S REPORT

Report Number 288-R

FROM: R. H. Potts

Note: The per cent of penetration refers to the per cent of circumference that is fully penetrated.

In the case of welds listed as 80 per cent or 90 per cent penetration, the weld on the remaining percentage of circumference showed in all cases at least 80 per cent of full penetration.

By issuing of this report the subject instrument wells are accepted.

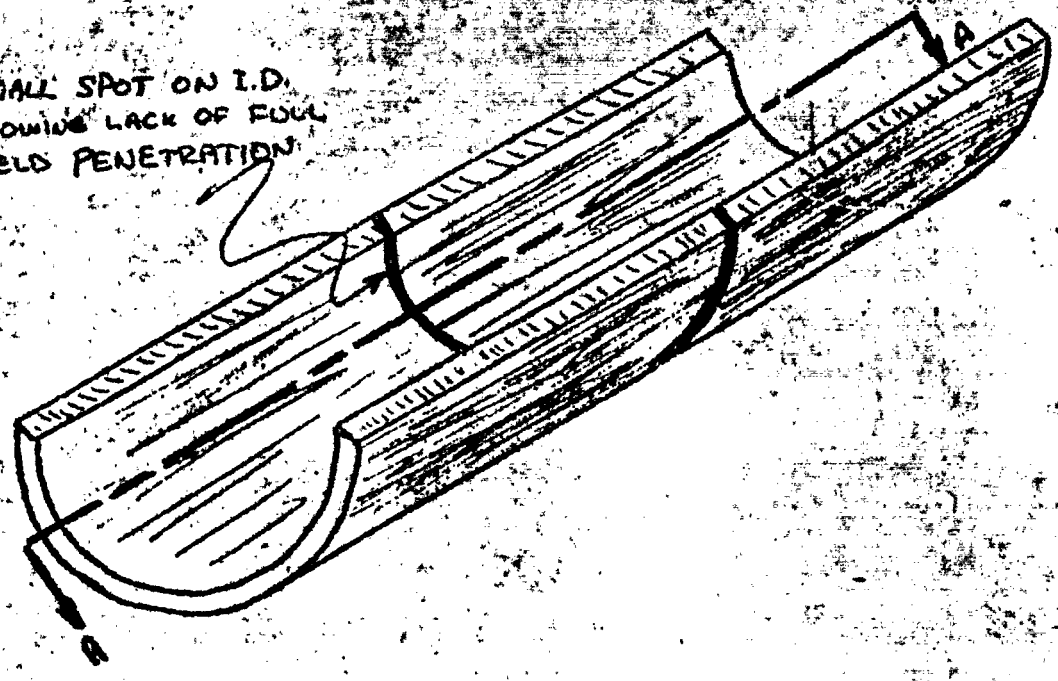
Report Number 252-R is now void.

lmw
Attach.

PRODUCTION
OCT 31 1952

EX #3

SKETCH - SHOWING CUT AWAY SECTION OF THE INSTRUMENT WELL BUTT WELD WHICH WAS SUBJECT OF INSPECTION



SECTION A-A

SHOWING LACK OF PENETRATION



SECTION A-A

SHOWING FULL PENETRATION



PROD. 8028 CONSTRUCTION XVM
RECEIVED
OCT 31 1952

These figures which are only approximate were obtained from existing shipping records, records of defective tubes subsequently replaced (after assembling of unit) and other such records not necessarily kept for this purpose.

The locations of these different tube types in the tube sheet assembly could not be determined since such records were not previously made, and no pre-determined method of assembling the tubes as to type was followed.

(10) Measurements Before Large Tube Welding to Determine Unit Shrinkage

After all large tubes had been inserted into the unit, aligned and tack welded, initial shrink measurements were taken across three major diameters. Part II-A, section 5-c, describes the method incorporated to take these measurements. Results of these measurements (before welding large tubes) for the top and bottom sides are shown in sketches #1 and #2.

2. The average measurement for the top side was calculated to be 182.271". The average measurement for the bottom side was calculated to be 182.300" (All measurements bore to bore)

(11) Measurements After All Tubes Had Been Welded

All large tubes were welded in this unit using the same procedure discussed in Part II-A, section 5-d.

After all large tube welding was completed, measurements were again taken using the procedure discussed in paragraph (10) above. Results of these measurements for the top and bottom sides are shown in sketches #3 and #4. The average measurements for the top side was calculated to be 181.985". The average measurements for the bottom side was calculated to be 182.003".

Since Design Division specified that the top and bottom side measurements (after welding) had to be within 0.0321" of each other or less, it can be seen by analyzing the results that the measurements were within the specified limit, i.e.,

Bottom Side	182.003"
Top Side	181.985"
	0.018" Difference

Therefore, no additional shrink welding was necessary, and the unit was released for further fabrication.

(12) Visual Inspection and Repair of Tube Welding

After all large tube welding was completed, weld passes around the tubes on top and bottom sides of the unit were visually inspected with the aid of a flashlight for porosity, crater cracks, undercutting, and other mechanical defects. Defective welds were marked

Ex #1-4

BTJ 2-1

2-19-52

ORDER

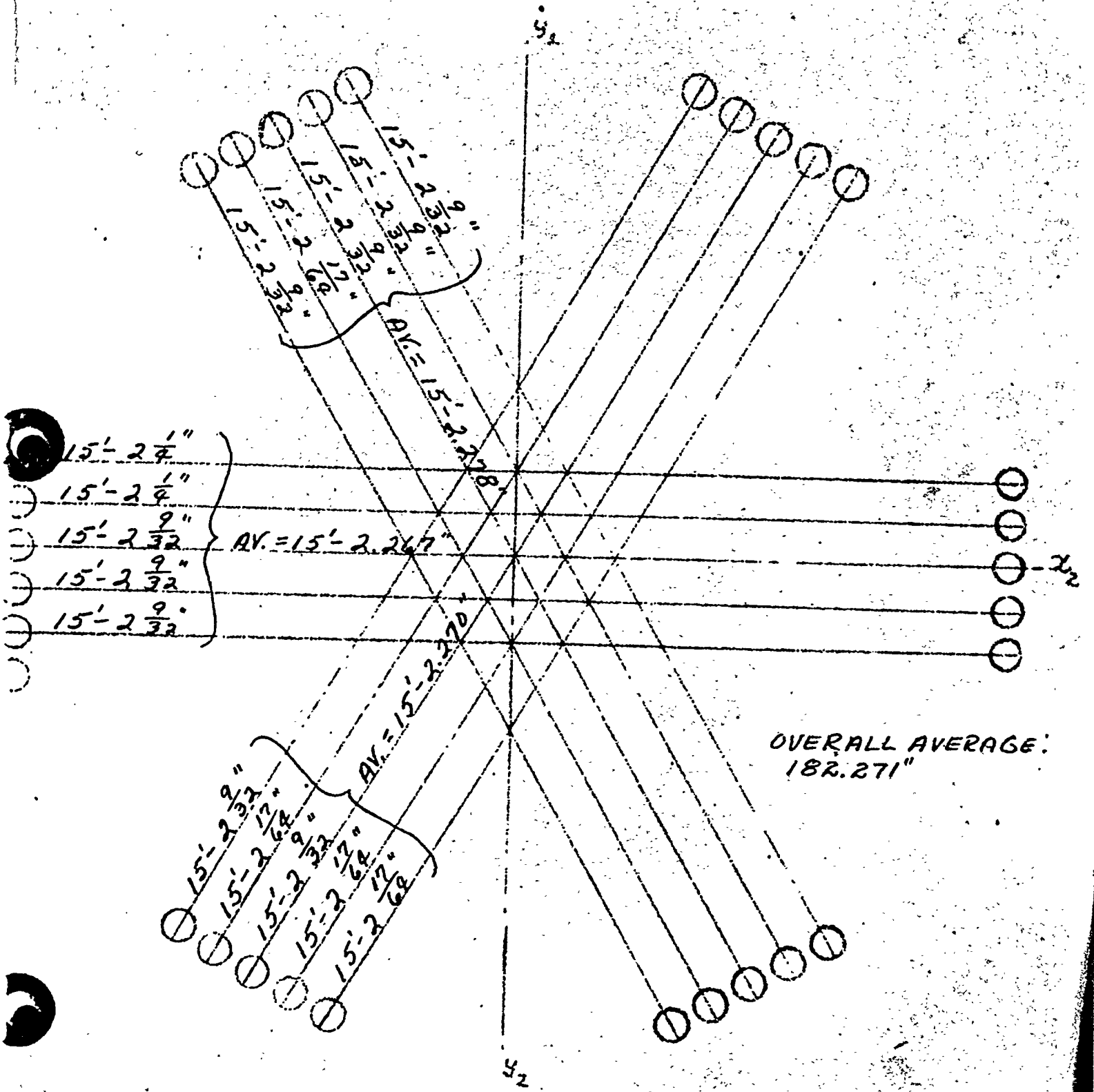
UMENT

TOP SIDE OF TOP PLATE

AMBIENT TEMP. 68° F.

MEAS. TAKEN WITH 50' STARRET TAPE (S/S)

INITIAL SHRINK MEASUREMENTS BEFORE TUBES WERE WELDED ON TOP SIDE OF UNIT



OVERALL AVERAGE: 182.271"

SKETCH #1

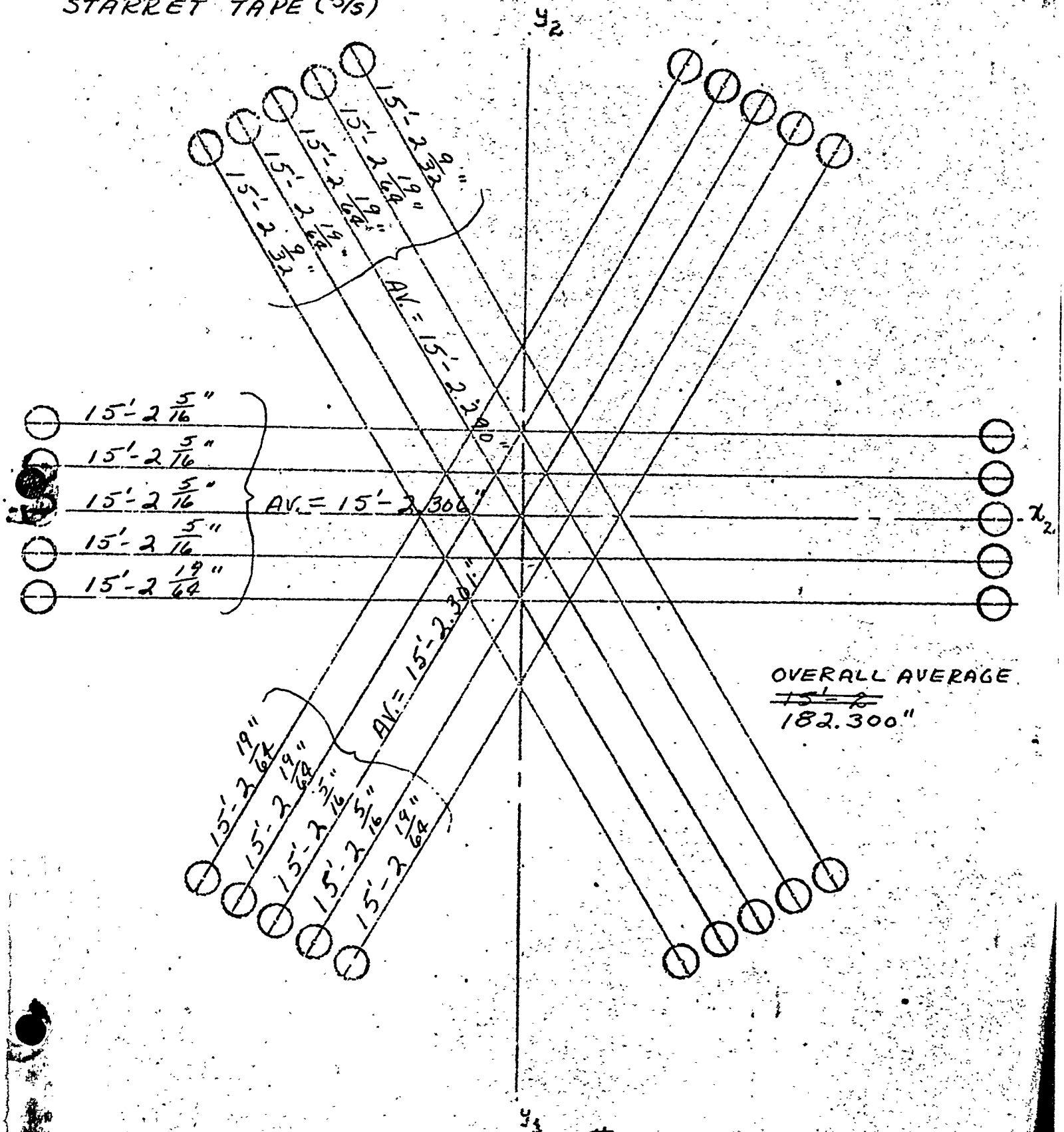
Ex "1-5

SHEET BTS 2-2
DATE 2-19-52
RECORDER
INSTRUMENT
MEAS. TAKEN WITH 50' STARRET TAPE (S/S)

BOTTOM SIDE OF BOTTOM PLATE.

AMBIENT TEMP = 68° F.

INITIAL SHRINK MEASUREMENTS BEFORE TUBES WERE WELDED ON BOTTOM SIDE OF UNIT



OVERALL AVERAGE
~~15'-6~~
182.300"

SKETCH #

EX III-6

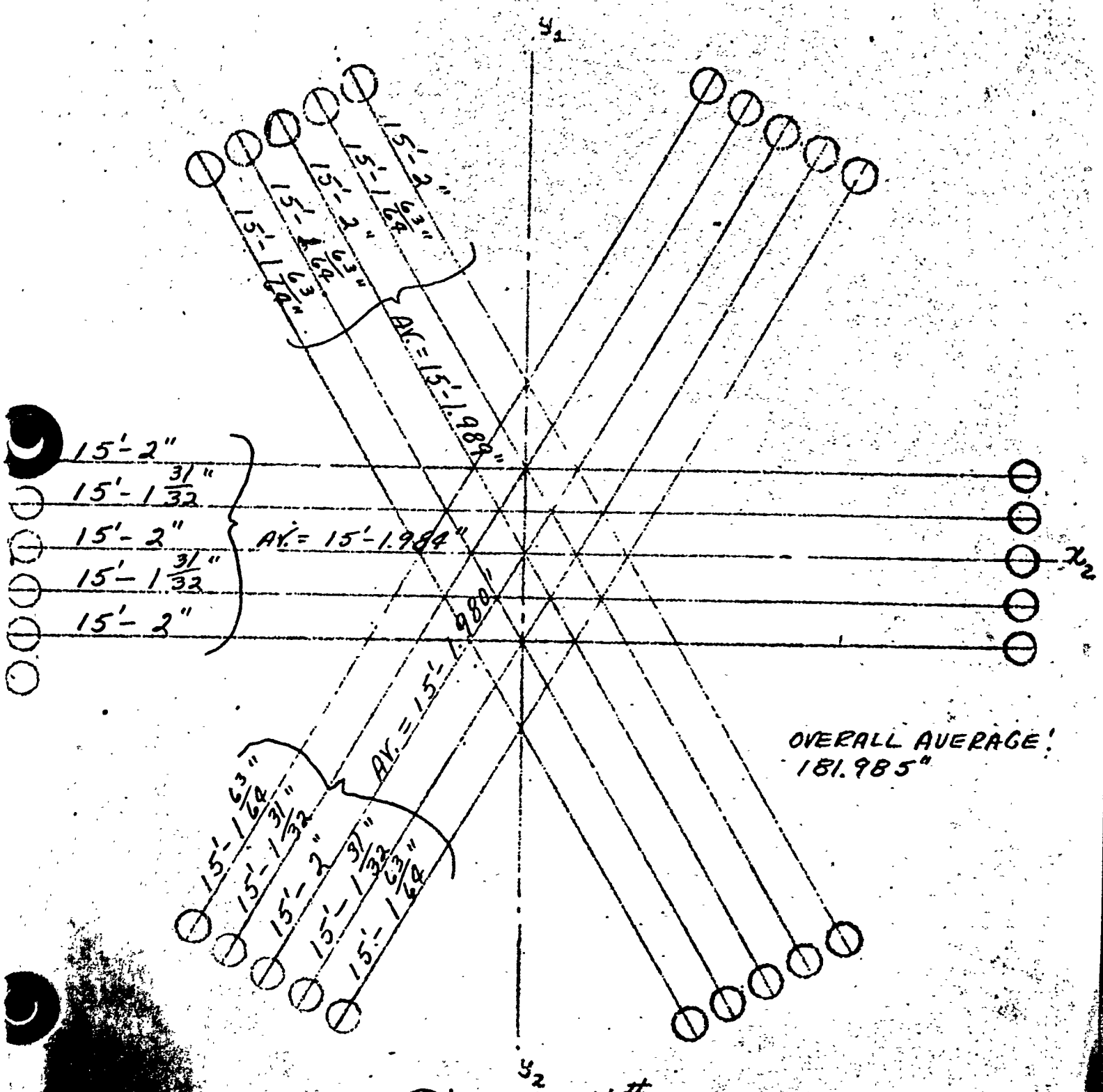
SHEET BTS 2-1
DATE 2-25-52
ORDER
CUMENT

MEAS. TAKEN WITH 50' S/S STARRET TAPE.

TOP SIDE OF TOP PLATE

AMBIENT TEMP. 68 °F.

FINAL SHRINK MEASUREMENTS AFTER TUBES WERE WELDED ON TOP SIDE OF UNIT.



OVERALL AVERAGE! 181.985"

SKETCH # 3

SHEET BTS 2-2

DATE 2-25-52

RECORDER

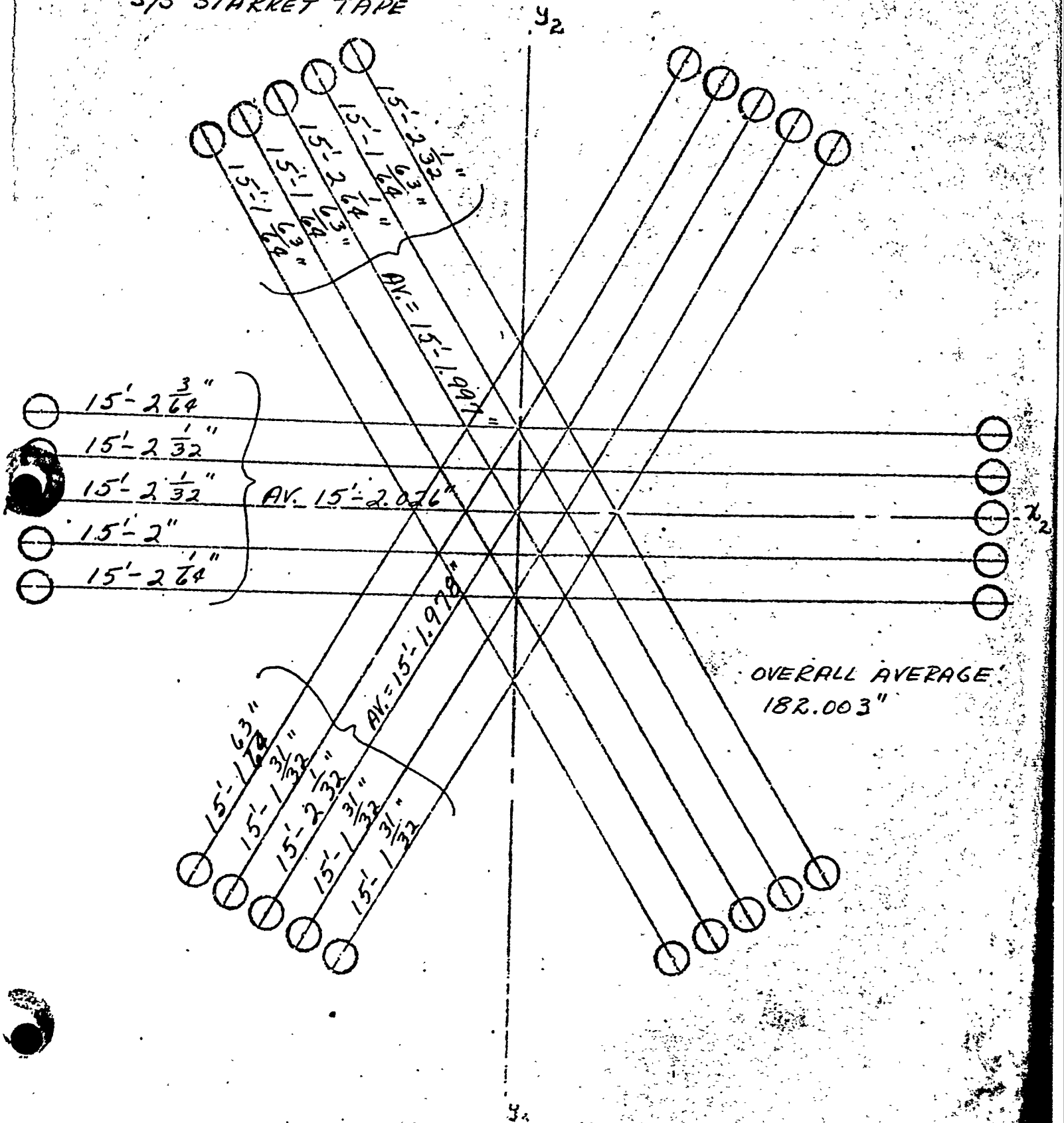
INSTRUMENT

MEAS. TAKEN WITH 50' S/S STARRET TAPE

BOTTOM SIDE OF BOTTOM PLATE

AMBIENT TEMP = °F.

FINAL SHRINK MEASUREMENTS AFTER TUBES WERE WELDED ON BOTTOM SIDE OF UNIT



SKETCH # 4

and necessary repairs made by chipping, grinding and re-welding (if necessary).

7. Assembling of "R", "P" and "L" Bottom Tube Sheets

B. "P" Unit

(1) Gusset Plate Pre-assembly Inspections

Inspections were performed in a similar manner to that discussed in Section 7A-(1) of this manual.

(2) Inspections performed during Assembling of Gusset Plates into Unit

Inspections were performed in a similar manner to that discussed in Section 7A-(2) of this manual.

(3) Baffle Plate Spacers, Sandblasting, Acid Washing and Ferroxyl Testing

Inspections were performed in a similar manner to that discussed in Section 7A-(3) of this manual.

(4) Collar Inspection

Inspection of tube collars was performed in a similar manner to that discussed in Section 7A-(4) of this manual.

(5) Verticality Check After Placing Tube Sheets in Circumderential Handling Jig

This inspection was performed in a similar manner to that discussed in Section 7A-(5) of this manual, except as follows: The Wild NIII precision level and lighted target was used to level the tube sheets clamped in the circumferential handling jig prior to taking verticality readings. For use of the Wild NIII level in leveling of units, see Part III, section II-J.

(6) Gusset Plate Welding Inspections

These inspections were performed in a similar manner to that described in Section 7A-(6) of this manual.

(7) Instrument Well Inspections

As shown in drawing 5-10 (section 7A-(8) of this manual), ten instrument wells were required for the "P" bottom tube sheet. New York Ship fabricated the required number of instrument wells from type 304 stainless steel bar stock and pipe. Referring to the above mentioned drawing, each instrument well was fabricated in three sections and then the three pieces butt welded at two points to form the instrument well. The top section of well was machined from bar stock of suitable size with a 1/4" taper/foot on the outside diameter. A male and female taper gauge was machined to fit the pieces and to check the hole diameters. A special taper reamer was

made for reaming the top tube sheet (in unit) for receiving the top part of the tapered well section. The center section of the well was a piece of 3/4" schedule 40S pipe cut to the required length with both ends beveled for weld preparation. The lower piece of the well was a piece of bar stock, bored, turned, threaded and beveled for welding as shown in drawing 5-4.

After the three sections that form a instrument well were butt welded, they were dressed and then visually and dimensionally inspected by the du Pont Inspection Department. (Visual inspection on side of well bore was not done at this time). A small functional gage (.824" in diameter) was used to gage all ten instrument wells. They all passed the functional gage freely. All other dimensions were checked using a 6' steel tape, 1-2" outside micrometer and a taper gage. The above inspections were satisfactory and the wells were released for testing.

Next, the ten instrument wells were hydrostatically tested at 2000 psi for ten minutes. Several leaks were found, repaired, re-tested and found satisfactory.

Finally, the instrument wells were freon tested. Each was individually connected to a freon bottle and tested at a bottle PRESSURE of approximately 100 psi). The instrument wells were subjected to this pressure for approximately 15 minutes and then the two butt welded joints were checked for leaks using a General Electric type "H" Halide Leak Detector. In addition, all other areas on the wells were checked for possible leaks. None were found and the ten instrument wells were released for assembling and welding into the bottom tube sheet assembly. Instrument wells were welded in the unit during final welding of gusset plates to tube sheets discussed above in Section 7A-(6).

(8) Preliminary Cleaning

Before inserting and tacking large tubes, the unit was given a preliminary cleaning externally and internally to remove dirt, oil, and other foreign material which had collected during fabrication. This was done by first air jetting the unit at approximate 100 psi to remove all loose material. After this, the top and bottom sides of each tube sheet, gusset plates, and all other accessible areas were wiped clean using a clean cloth saturated in F.O. 128. (Fine Organcs Safe-Tee Solvent). After cleaning, the unit was inspected, accepted and released for further fabrication.

(9) Large Tube Assembly and Tack Welding Inspections

Starting in the center of the unit and working out, large tubes were progressively cleaned with F.O. 128 inserted in the unit, and tack welded to the inside of the bottom tube plate. Tack welding was visually inspected for undercutting, cleanliness, and necessary repairs made. Tube assembly was witnessed by du Pont inspectors.

(10) Types of Tubes Assembled in "P" Bottom Tube Sheet Assembly

As a result of the problems encountered in the use of welded tubes in "R" bottom tube Sheet (See Section 14A-(3) of this manual), Design Division requested that only cast and seamless tubes be assembled and welded into the "P" bottom tube sheet. For location of seamless and cast tubes in the "P" B.T.S., see Exhibit #2 presented herewith.

(11) Measurements before Large Tube Welding to Determine Unit Shrinkage

After all large tubes had been inserted into the unit, aligned and tack welded, initial shrink measurements were taken across three major diameters. Part II-A, Section 5-c, describes the method incorporated to take these measurements. Results of these measurements (before welding large tubes) for the top and bottom sides are shown in Sketches #3-a and #4-a. The average measurement for the bottom side was calculated to be 182.309". (All measurements bore to bore). This average measurement for the top side was calculated to be 182.288".

(12) Measurements After All Tubes had been Welded

All large tubes were welded in this unit using the same procedure discussed in Part II-A, Section 5-d.

After all large tube welding was completed, measurements were again taken using the procedure discussed in paragraph (11) above. Results of these measurements for the top and bottom sides are shown in Sketches #5 and #6. The average measurement for the top side was calculated to be 181.995". The average measurement for the bottom side was calculated to be 182.018"

Since Design Division specified that the top and bottom side measurements (after welding tubes) had to be within 0.0321" of each other or less, it can be seen by analzying the results that the measurements were within the specified limit, e.i.,

Bottom Side	182.018"
Top Side	181.995"
	0.023" Difference

Therefore, no additional shrink welding was necessary, and the unit was released for further fabrication.

(13) Visual Inspection and Repair of Tube Welding

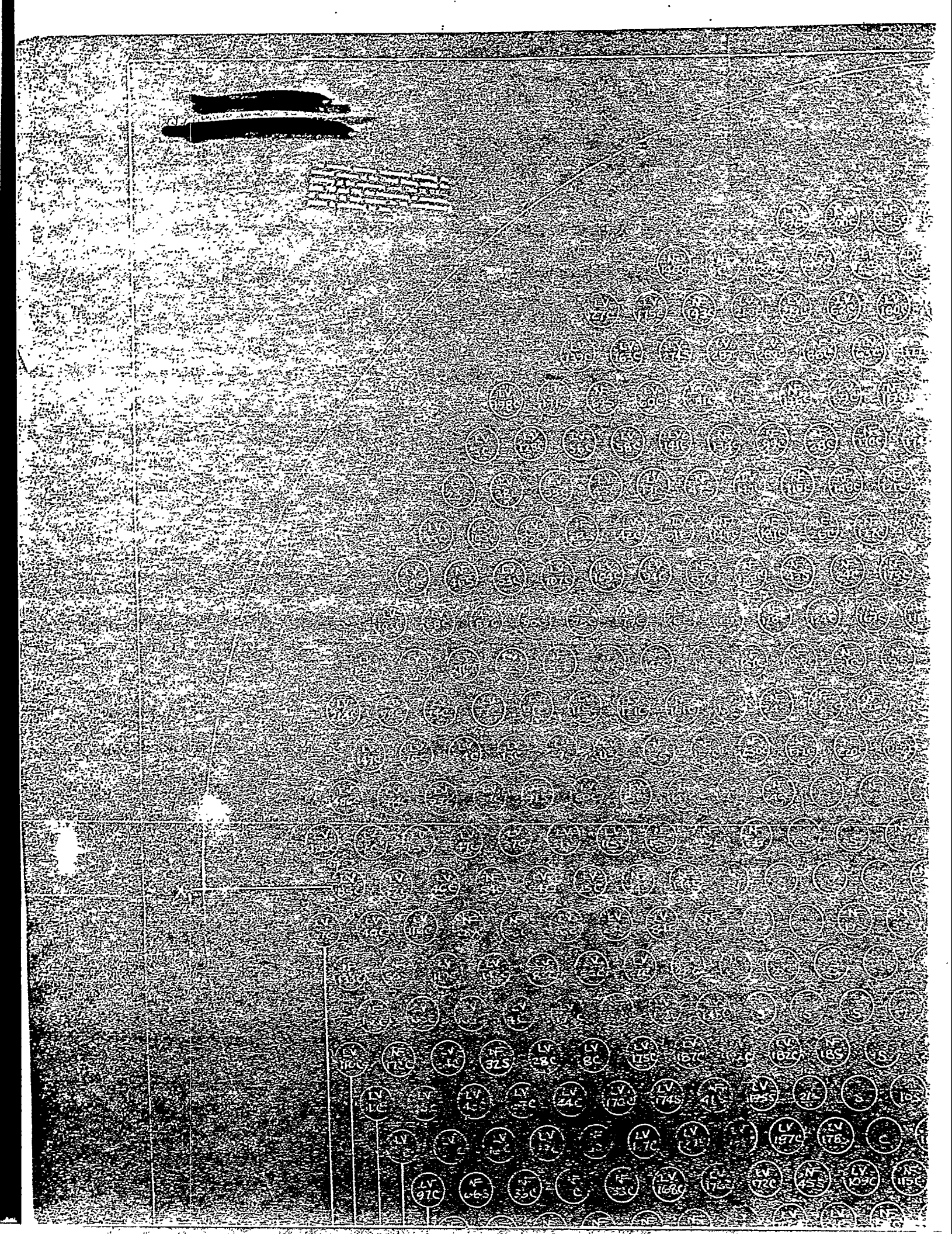
This inspection was performed in a similar manner to that described in Section 7A-(12) of this manual.

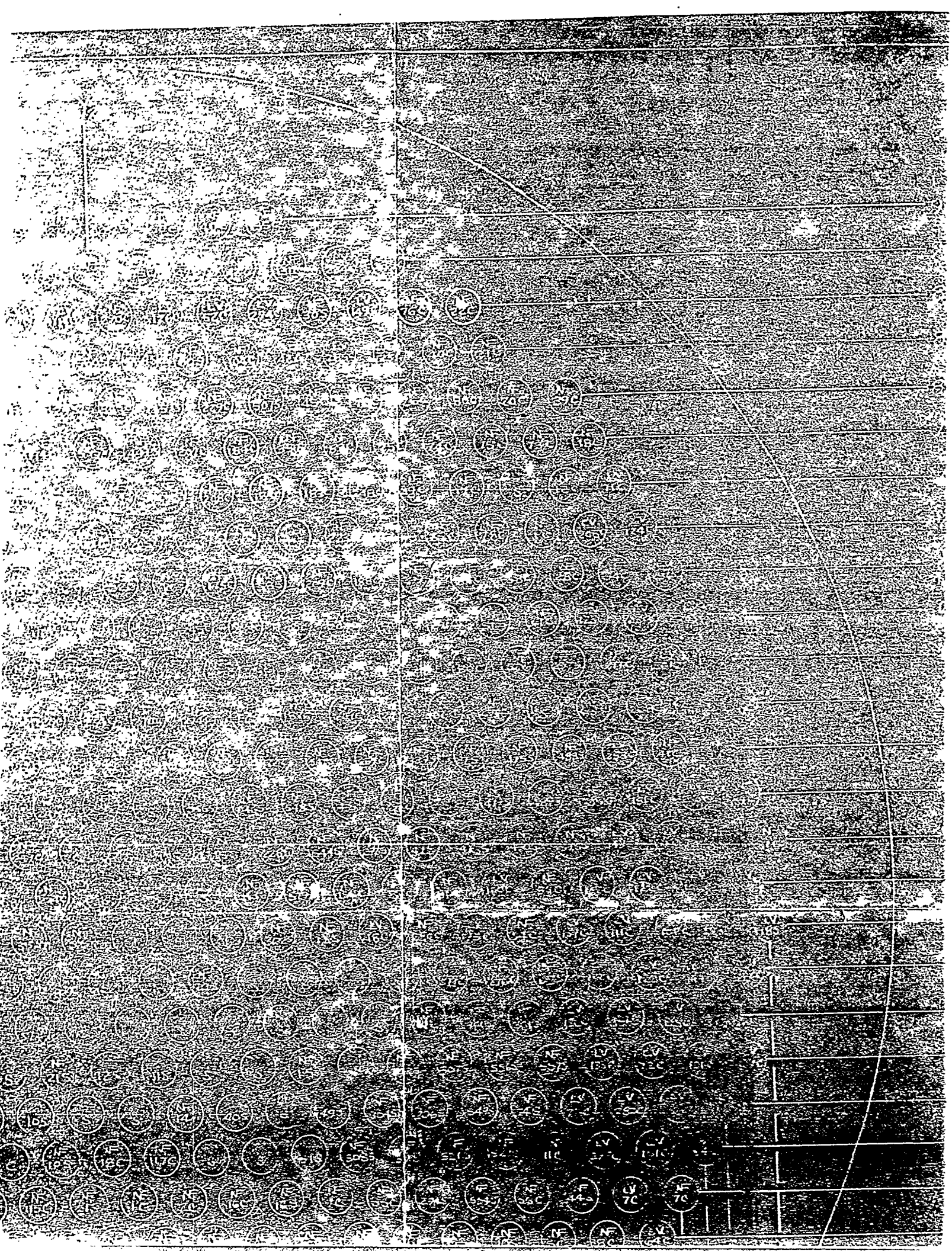
(14) Replacement of Tubes as a Result of Weld Burn Through

At various stages during the fabrication of this assembly, it was necessary to remove the following tubes:

EXHIBIT #2

TYPES OF TUBES ASSEMBLED IN "P" BOTTOM TUBE SHEET ASSEMBLY

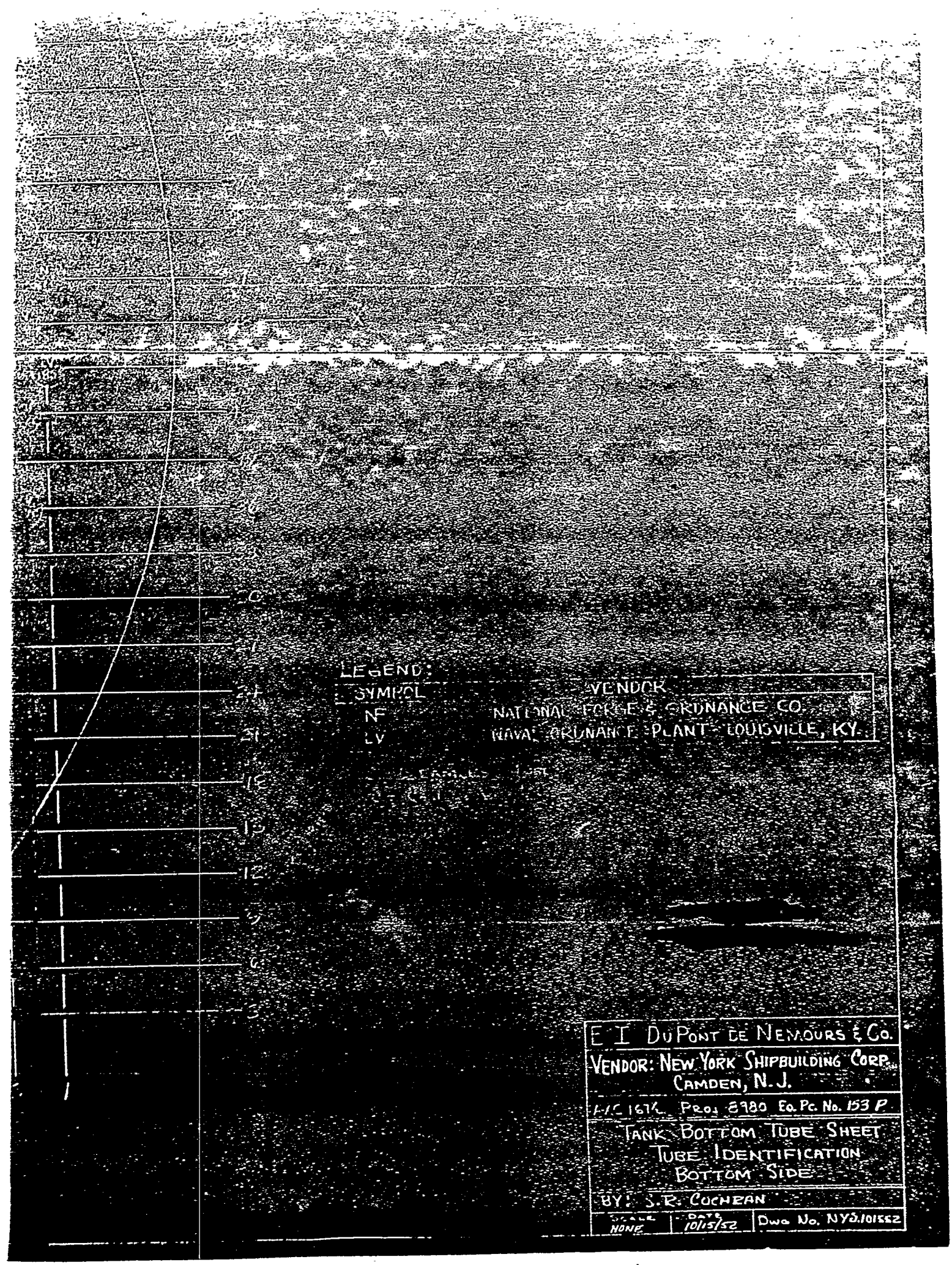


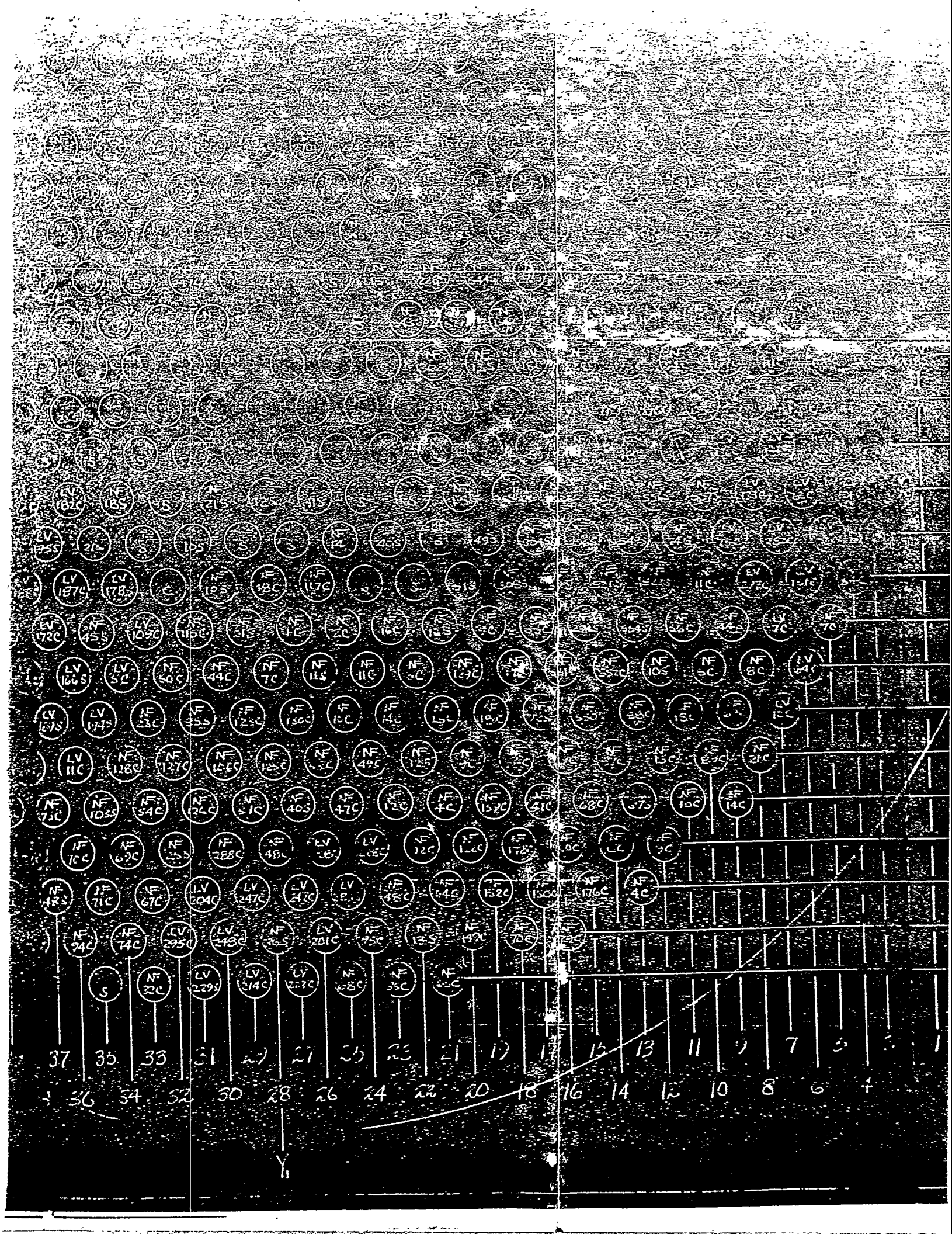


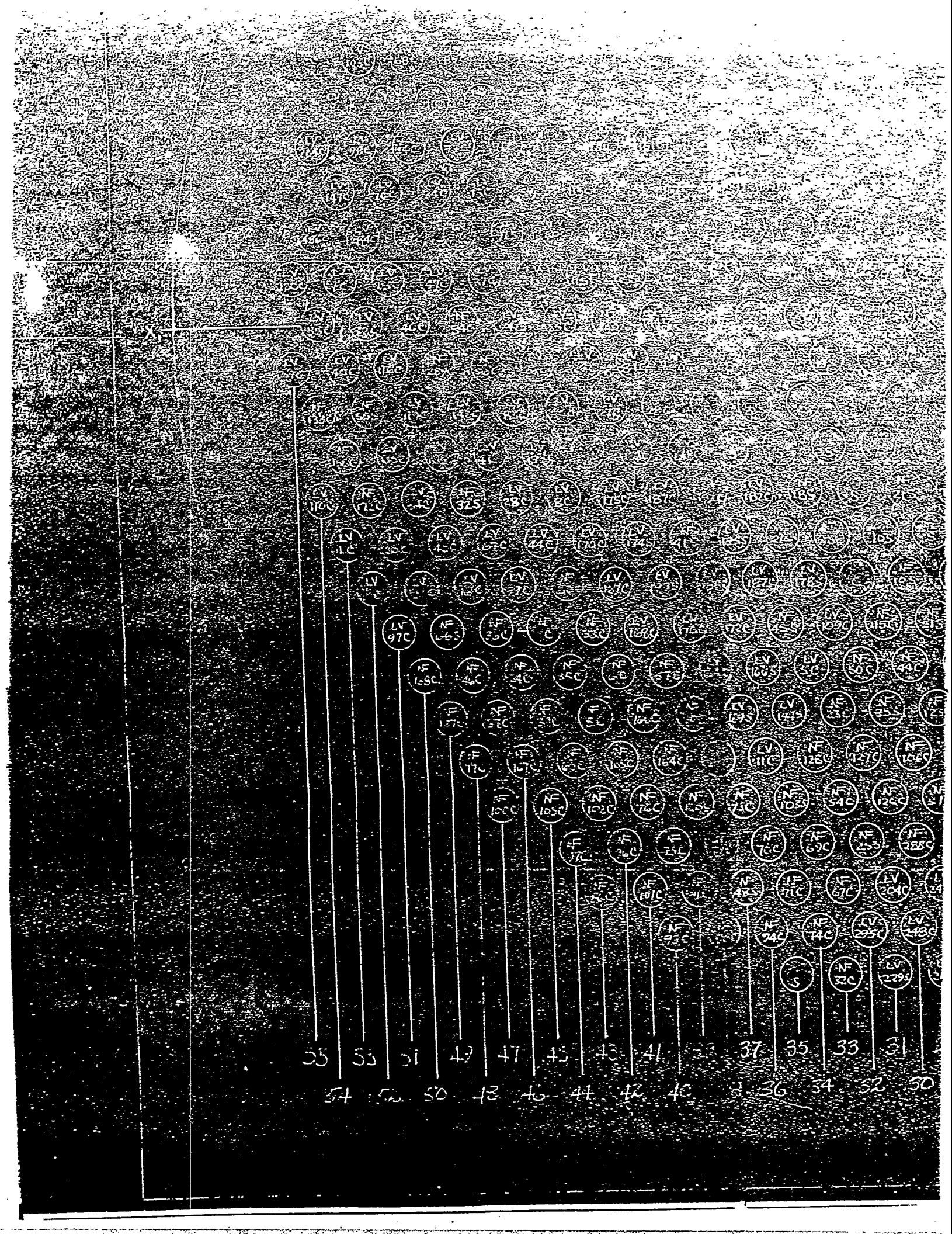
LEGEND:

SYMBOL

VENDOR


LEGEND:
SYMBOL
NF
LV
VENDOR
NATIONAL FORGE & ORDNANCE CO.
NAVAL ORDNANCE PLANT - LOUISVILLE, KY.
E I DuPont de Nemours & Co.
VENDOR: NEW YORK SHIPBUILDING CORP.
CAMDEN, N.J.
H-C 167K Proj 8980 Eq. Pc. No. 153 P
TANK BOTTOM TUBE SHEET
TUBE IDENTIFICATION
BOTTOM SIDE
BY: S.R. COCHRAN
SCALE NONE
DATE 10/15/52
Dwg No. NYS.101552


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Y1



Ex #1-8

SHEET B.T.S. 3-1 (P)

DATE 6-6-52

OBSERVER

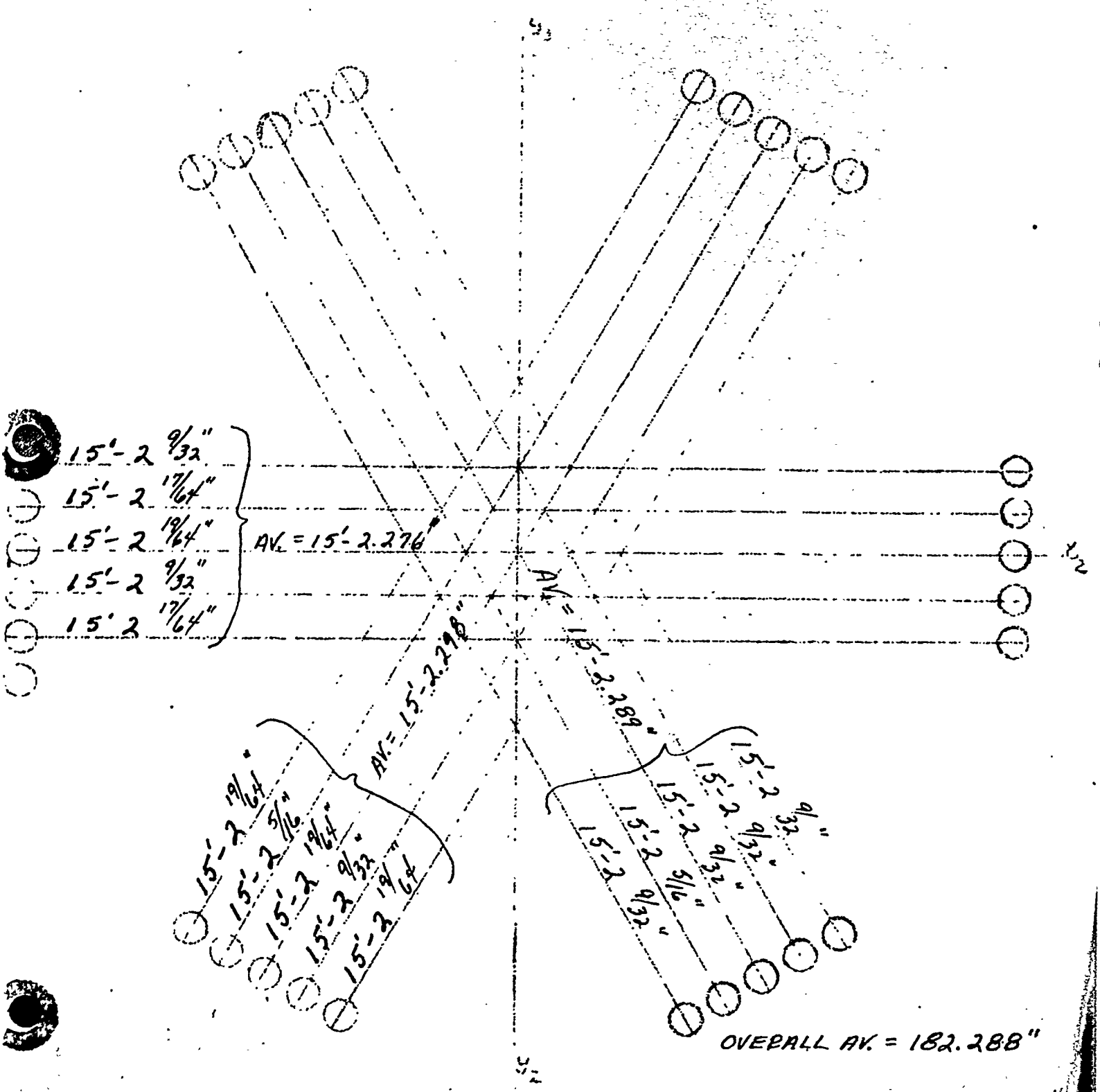
INSTRUMENT

MEASUREMENTS TAKEN WITH 50'S/S STARRET TAPE

TOP SIDE OF TOP PLATE

AMBIENT TEMP. 80 °F.

INITIAL SHRINK MEASUREMENTS BEFORE TUBES WERE WELDED ON TOP SIDE OF UNIT



SKETCH #3-A

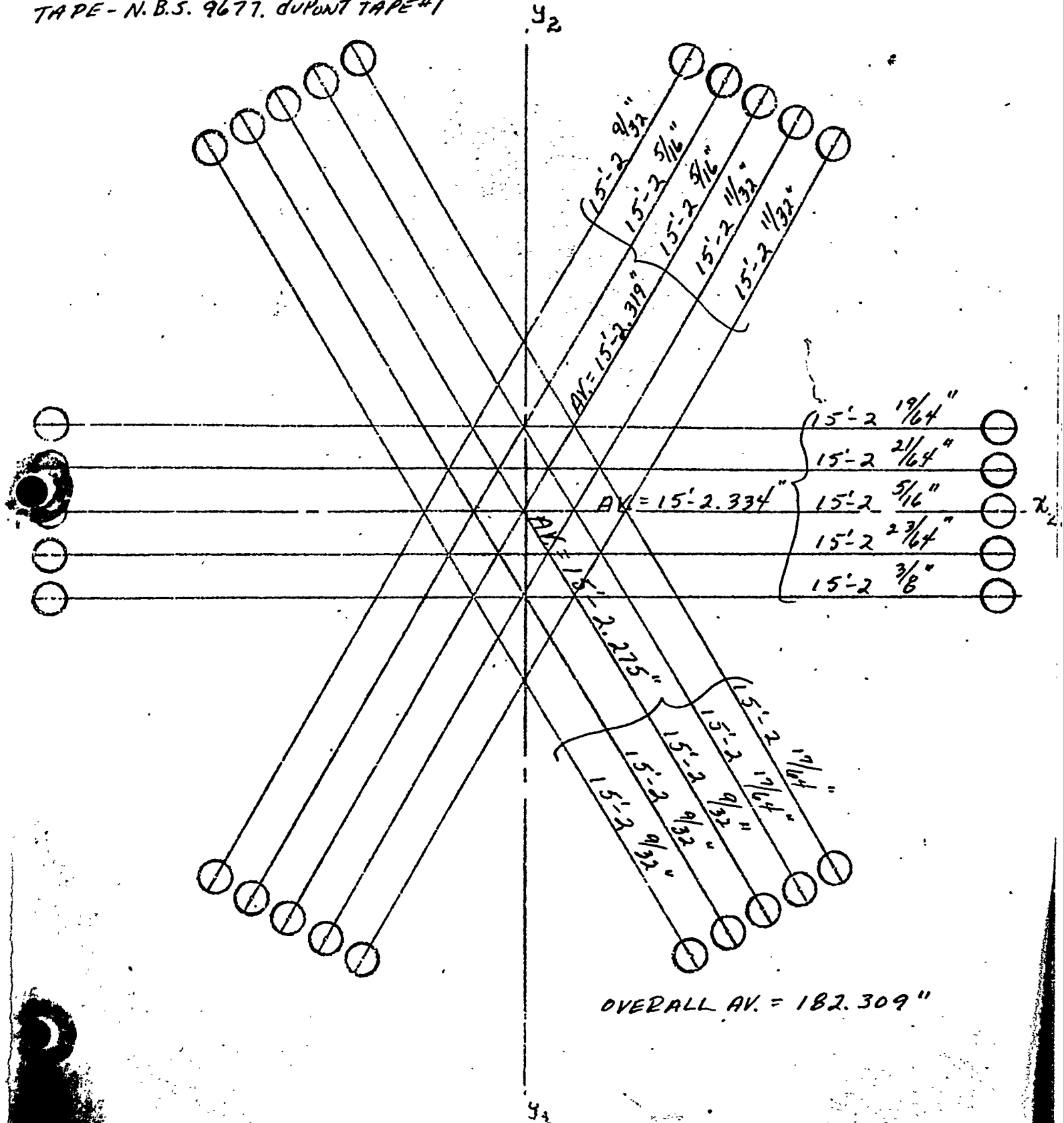
SHEET B.T.S. 3-2 (P)
DATE 6-6-52
RECORDER
INSTRUMENT

MEAS. TAKEN WITH 100' S/S STARRET TAPE - N.B.S. 9677. DUPONT TAPE #1

BOTTOM SIDE OF BOTTOM PLATE

AMBIENT TEMP = 80° F.

INITIAL SHRINK MEASUREMENTS BEFORE TUBES WERE WELDED ON BOTTOM SIDE OF UNIT



OVERALL AV. = 182.309"

SKETCH # A-A

B.T.S. 3-1(P)
6-12-52

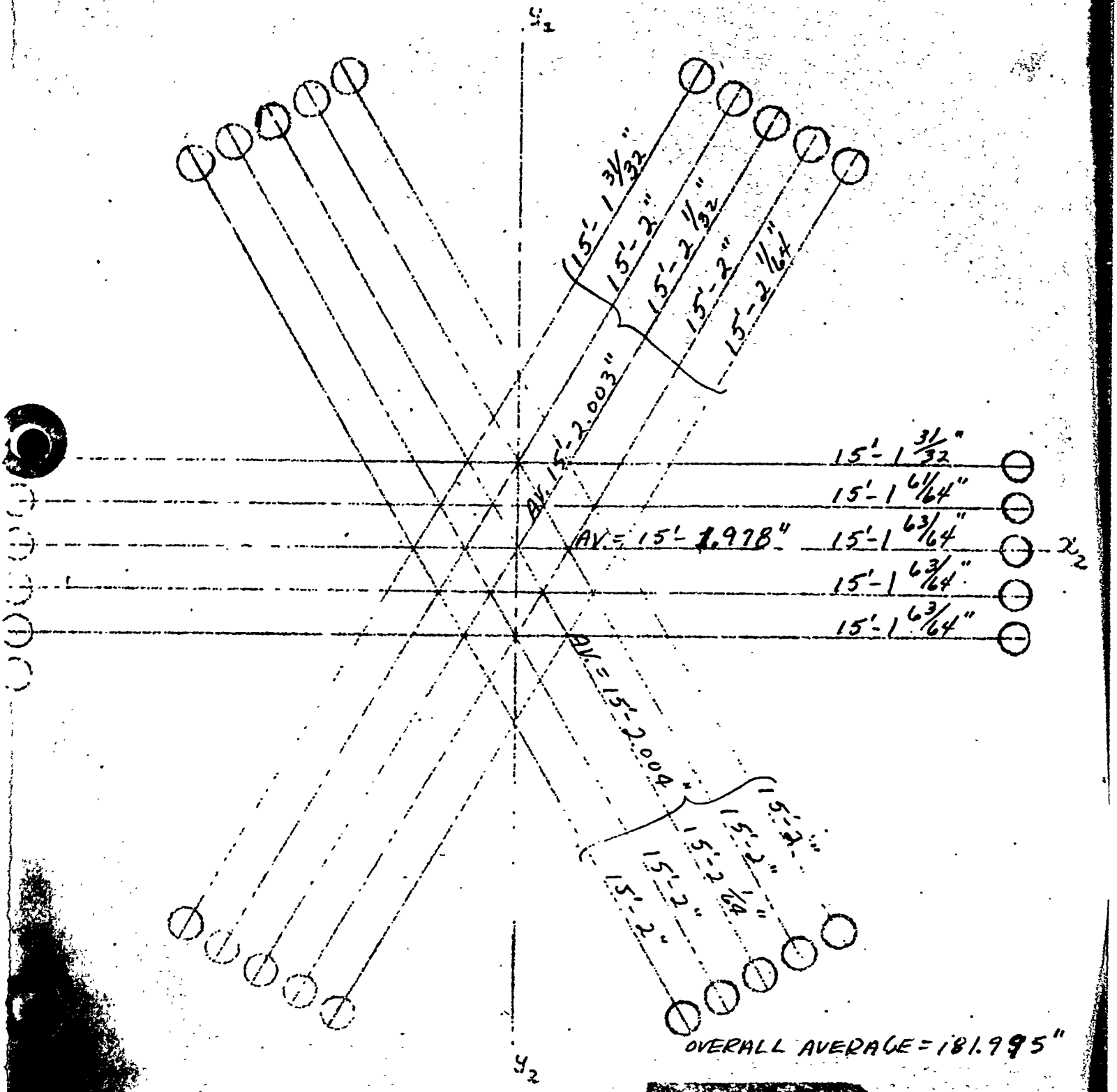
TOP SIDE OF TOP PLATE

EX. #10

AMBIENT TEMP 80 °F

FINAL SHRINK MEASUREMENTS AFTER TUBES WERE WELDED ON TOP SIDE

MEAS. TAKEN WITH 100' S/S STARRET TAPE
N.B.S. 9677 - duPONT TAPE #1



OVERALL AVERAGE = 181.995"

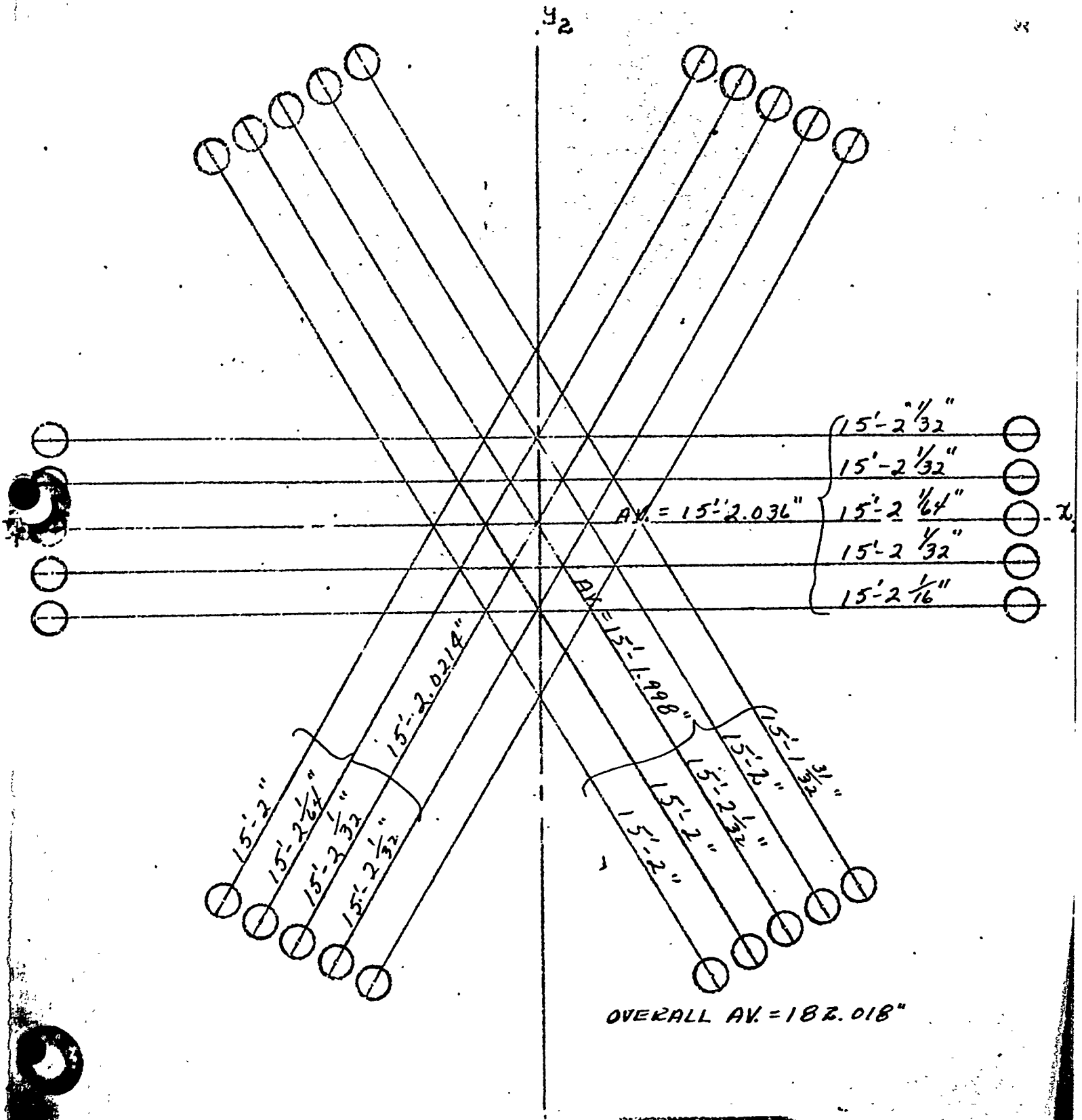
SKETCH # [redacted] #5

SHEET B.T.S. 3-2
DATE 6-16-52
RECORDER
INSTRUMENT

BOTTOM SIDE OF BOTTOM PLATE:

AMBIENT TEMP = 90°F

FINAL SHRINK MEASUREMENTS AFTER TUBES WERE WELDED ON BOTTOM SIDE OF UNIT



OVERALL AV. = 182.018"

SKETCH # [redacted] #6

Tube Position	Reason for Removing
X35-Y3	Laminations and weld burn through
X37-Y57	Weld burn through
X31-Y81	Weld burn through
X27-Y45	Weld burn through
X37-Y39	Weld burn through
X11-Y75	When original weld joining tube to bottom plate was found defective and cut out, inspection of tube revealed a weld burn on O.D. It was thought that re-welding would burn through tube.
X22-Y6	Record incomplete
X34-Y90	Record incomplete

After the above tubes were replaced, welded and tube weld overlay ground, all welding was visually inspected by du Pont inspectors for cracks, craters, undercutting, weld burn through, and porosity. Minor defects were removed by grinding. Tube welds were re-inspected and approved.

A shrinkage pattern was again taken by du Pont inspectors to determine if additional welding on replacement tubes distorted the tube pattern. Measurements were repeated in a similar manner described in Section 7B-(12) of this manual. Final results indicated the tube pattern on the top and bottom sides was still within Design's specified limit. The unit was accepted and released for further fabrication.

C. "L" Unit

(1) Gusset Plate Pre-assembly Inspections

Inspections were performed in a similar manner to that discussed in Section 7A-(1) of this manual.

(2) Inspections Performed During Assembling of Gusset Plates into Unit

Inspections were performed in a similar manner to that discussed in Section 7A-(2) of this manual.

(3) Baffle Plate Spacers, Sandblasting, Acid Washing and Ferroxyl Testing

Inspections were performed in a similar manner to that discussed in Section 7A-(3) of this manual.

(4) Collar Inspection

Inspection of tube collars was performed in a similar manner to that discussed in Section 7A-(4) of this manual.

(5) Verticality Check After Placing Tube Sheets in Circumferential Handling Jig

This inspection was performed in a similar manner to

that described in Section 7A-(5) of this manual, except as follows: During tube assembling operations, du Pont inspectors recorded the location of all tubes and the type. Large tubes were identified by a serial number stenciled near one of the tube ends. Prior to assembling of tubes into this unit, inspections performed on the tubes were recorded for each using the newly adopted tube numbering system, thereby tying in tubes welded in the unit with their pre-assembly inspection measurements. This new numbering system was necessary since there was no method used in the past for comparing tubes in the assembly with pre-assembly inspection results. In addition, incoming field complaints pertaining to tube discrepancies could not be readily compared with those taken at New York Ship which further necessitated the adoption of a tube numbering system.

(6) Gusset Plate Welding Inspections

These inspections were performed in a similar manner to that described in Section 7A-(6) of this manual.

(7) Instrument Well Inspections

As shown on Dwg. 5-4 (Section 7A-(8), Detail "B" of this manual), ten instrument wells were required for the "L" bottom tube sheet assembly. Prior to assembling and welding wells in the bottom tube sheet, the following inspections were made:

a. Each of the ten instrument wells were visually inspected by inserting a six foot long x 1/2" Rd. Lico Borescope into the well and slowly rotating it until the entire circumferential welded butt joints were inspected for amount of weld penetration. Both butt welds in each instrument well showed full weld penetration and were accepted.

b. The I.D. of each well was checked with a 0.824" diameter plug gage. All wells accepted the gage freely and were accepted.

c. Each well was connected to a cyclinder of freon 12 and the gas was allowed to enter the well at approximately 100 psi pressure. A General Electric, type "H" Leak Detector was used for detecting any leaks in the instrument wells. Gas was retained in the well for a ten minute period. No leaks were detected.

d. Each well was connected to a hydrostatic testing fixture and water was pumped into the well until 2000 psi gage pressure was attained. After holding pressure for 15 minutes, a visual inspection was made for leaks. None were found.

The above pre-assembly inspections were satisfactory, and the ten instrument wells were released for fabricating into the "L" bottom tube sheet assembly.

(8) Preliminary Cleaning by Dowell, Inc.

During the initial stages of fabricating "L" unit internal cleanliness of the various sub-assemblies became a major problem. This came about as a result of the establishing of strict cleaning specifications by plant site personnel. Heretofore, minor complaints had been received from the field pertaining to the cleanliness of "R" and "P" units which prompted the du Pont Inspection Department to take immediate steps to better clean internally all future sub-assemblies.

Steps were immediately taken by du Pont Inspection Department to develop and write preliminary cleaning procedures for the various sub-assemblies still in the early stages of fabrication. A preliminary cleaning procedure was written for internally cleaning the "L" bottom tube sheet prior to assembling and welding of wrapper plates. This procedure is presented herewith as Exhibit #3.

The preliminary cleaning procedure was carried out in its entirety by the Dowell Corporation and witnessed by a du Pont inspector.

After cleaning the unit was visually inspected on the inside and accepted as being clean. The "L" B.T.S. was then released for further fabrication.

(9) Instrument Lead Tube, Large Tube and Instrument Well Assembly and Tack Welding Inspections

As shown on du Pont drawing W132764, seven (7) additional tubes were added to the unit. These tubes were rod tubes used in the top tube sheet but were fabricated into this unit to serve as instrument lead tubes. These seven tubes were the first to be welded into the unit. The seven tubes were set to their proper height and then tack welded to the inside of the bottom tube plate. Tack welding was visually inspected by du Pont inspectors for undercutting, melt downs and other mechanical defects. All tack welds were then cleaned to remove weld smoke, oxides and other foreign material using a stainless steel wire brush. Wire brushing of tube tack welds was requested by the du Pont Inspection Department as a cleanliness preventive measure, and also to make for a better unit insofar as internal cleanliness of the unit was concerned.

After all instrument lead tubes were tack welded, inspected and approved, they were fully welded using the automatic aircomatic tube welding process.

Starting in the center of the unit and working out, pre-inspected large tubes were progressively inserted into the unit and tack welded to the inside of the bottom tube plate. All large tubes were identified by a symbol designating the vendor and serial number. Section 7C-(5) of this manual explains why this identification system

EXHIBIT #3

PRELIMINARY CLEANING PROCEDURE FOR "L" BOTTOM TUBE SHEET ASSEMBLY PRIOR TO WELDING OF WRAPPER PLATES

E. I. DU PONT DE NEMOURS & CO., INC.

Construction Division

Serial Number 219

CC: H. W. Gosney, F.P.M. (2)
R. K. Mason, F.P.M.-SRP (3)
H. L. Bunker - J. G. Brewer
H. B. Gage
J. A. Collins
C. J. Veith
L. H. Arning
J. F. Elliot
Dowell Inc. (2)
S. R. Cochran (2)
J. B. Johnson - File

July 7, 1953
New York Ship - Camden, N. J.

MEMORANDUM

This material contains information affecting the national defense of the United States within the meaning of the espionage laws, Title 18, U.S.C. Secs. 793 and 794, the transmission or revelation of which in any manner to an unauthorized person is prohibited by law.

TO: R. H. BARTO - J. W. REID (5)
NEW YORK SHIPBUILDING CORP.
CAMDEN, NEW JERSEY

FROM: J. B. JOHNSON - R. V. GRAHAM RVG

CLEANING PROCEDURE BOTTOM AND TOP TUBE SHEET ASSEMBLY BEFORE WRAPPER PLATES INSTALLED

The following procedure supersedes the cleaning procedure on the same subject serial number 206 and is essentially the same with a few additions and corrections.

Install raschig ring loading cradle.

Set up vertically.

Cleaning solution will be by weight:

0.1% Deterger
Remainder - Deionized water
Temperature 150° - 190°F.

Jet using stainless steel nozzle upper 60° for 15 minutes

Rinse with manual hose using hot deionized or distilled water, upper 60° for 15 minutes.

Jet additional 120° each side with cleaning solution for 1 hour keeping hot rinse water hose on upper 60°.

[redacted]

Rinse additional 120° each side with hot deionized or distilled water keeping manual hose on upper 60° for 1 hour.

Rotate assembly 60° either way, jet with detergent, original bottom 60° for 15 minutes and rinse same area for 15 minutes.

Time: 8 hours.

During all jetting be sure to cover area between top sheet and baffle as well as baffle and bottom sheet area.

lmw

was incorporated on this unit. Exhibit #4 presented herewith shows the location of all tubes. After each large tube was inserted in the unit and tack welded, the weld was wire brushed to remove oxides and weld smoke. Du Pont inspectors witnessed this operation and visually inspected each tack weld for cleanliness, undercutting and melt down.

The ten instrument wells repuired for this unit were installed and fully welded. Welding was visually inspected for porosity, cracks, undercutting and other mechanical defects. Necessary repairs were made, re-inspected, and instrument well welding accepted.

The remainder of fabrication and inspection performed during and after large tube assembly is similar to that discussed in Sections 7A-(6) of this manual.

(10) Types of Tubes Assembled in "L" Bottom Tube Sheet Assembly

All 3-15/16" O.D. tubes assembled into the "L" bottom tube sheet were seamless tubes.

(11) Measurements Before Large Tube Welding to Determine Unit Shrinkage

After all large tubes had been inserted into the unit, aligned and tack welded, initial shrink measurements were taken across three major diameters. Part II-A, Section 5-C, describes the method incorporated to take these measurements. Results of these measurements (before welding large tubes) for the top and bottom sides are shown in Sketches #7 and #8. The average measurement for the top side was calculated to be 182.275". The average measurement for the bottom side was calculated to be 182.317". (All measurements bore to bore).

(12) Measurements After All Tubes Had Been Welded

All large tubes were welded in this unit using the same procedure discussed in Part II-A, Section 5-d.

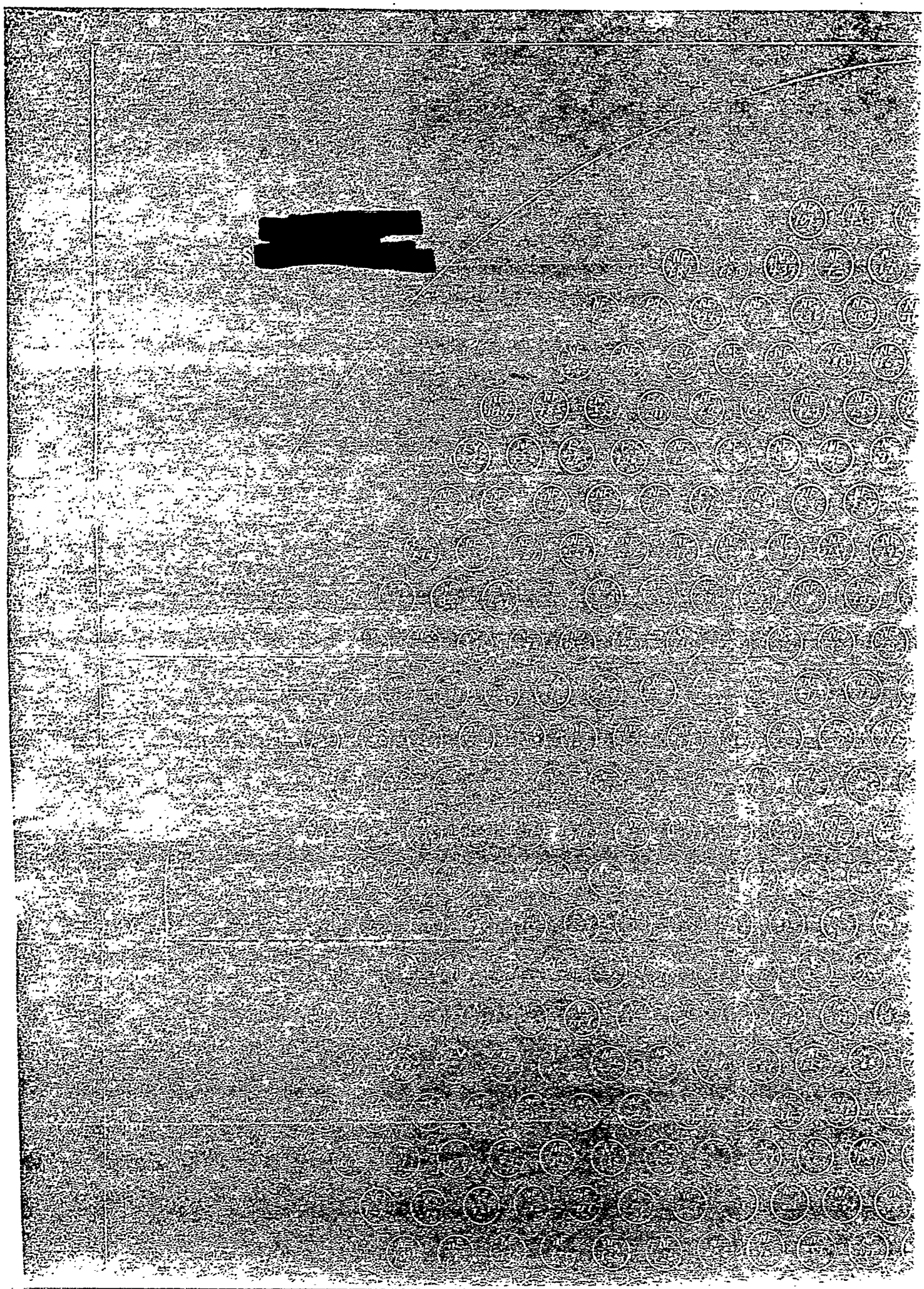
After all large tube welding was completed, measurements were again taken using the procedure discussed in paragraph (11) above. Results of these measurements for the top and bottom sides are shown in Sketches #9 and #10. The average measurements for the top side was calculated to be 181.995". The average measurement for the bottom side was calculated to be 182.046".

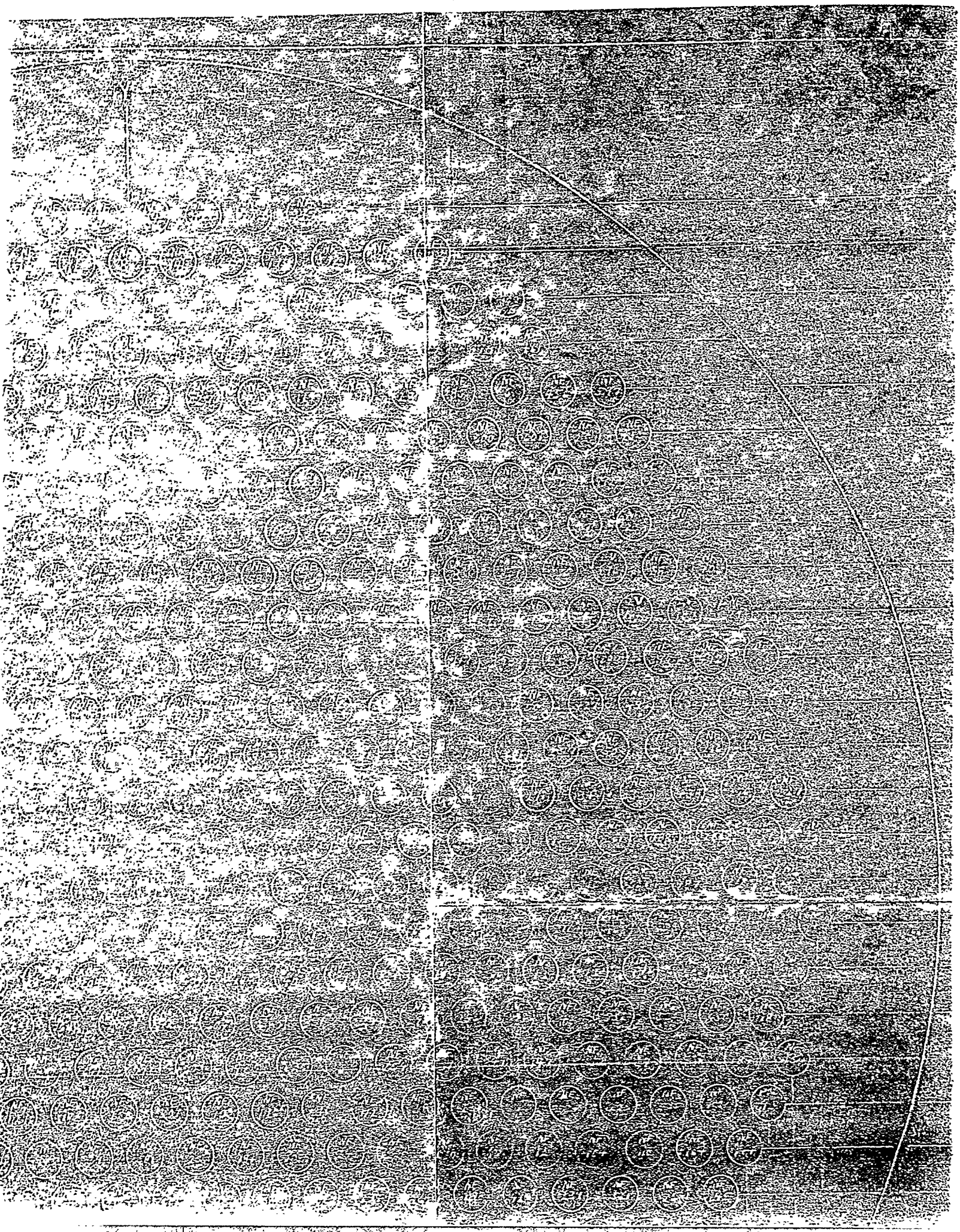
Since Design Division specified that the top and bottom side measurements (after welding tubes) had to be within 0.0321" of each other or less, it can be seen by analyzing the results that the difference lay outside the specified limit, i.e.,

Bottom Side	182.046"
Top Side	181.995"
	.041"

EXHIBIT #4

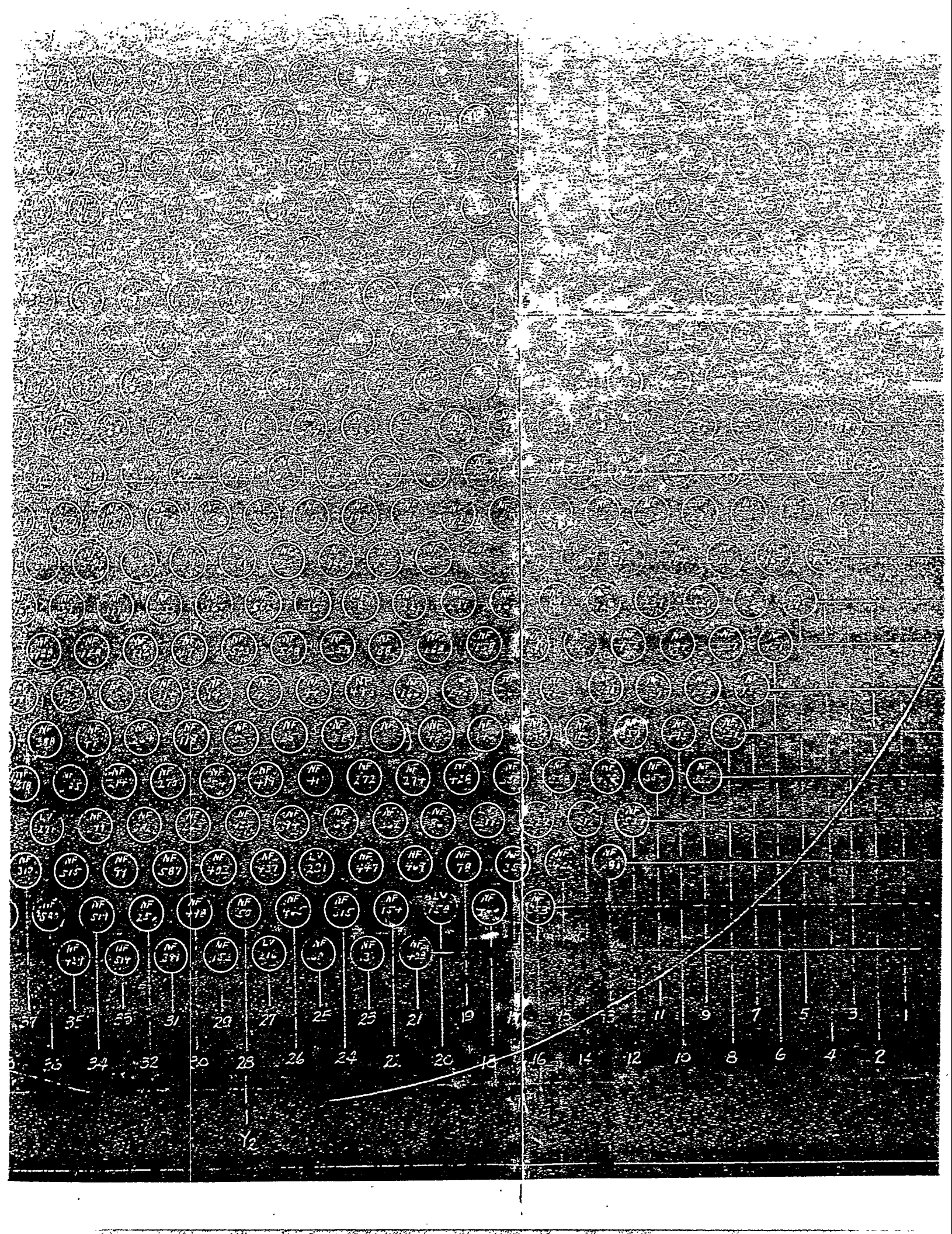
TUBE IDENTIFICATION OF ALL LARGE TUBES IN THE "L" BOTTOM TUBE SHEET





[illegible]

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32


Y2

NOTE:

1. TUBE IDENTIFICATION [illegible] CANNOT BE LOCATED [illegible]
2. ALL TUBE [illegible] SEAMLESS TUBE.
3. IDENTIFICATION OF VENDOR [illegible]

SYMBOL	[illegible]	LOCATION
NF	National Forge & Ordnance Co	Irvine, Pa.
LV	Naval Ordnance Plant	Louisville, Ky.
POC	Naval Ordnance Plant	Pocatello, Idaho



E. I. DuPont de Nemours & Co.

VENDOR: New York Shipbuilding Corp. Camden, N. J.

AXC 1617 - Proj. 8980 Eq. R.

TUBE IDENTIFICATION
TANK BOTTOM TUBE SHEET
TOP SIDE - "L" UNIT

BY: R.W. MEASE

SCALE	DATE	Dwg. No.
NONE	12/22/52	NYS122225

SHEET B.T.S. 4-1 (L)

DATE 10-8-52

ORDER

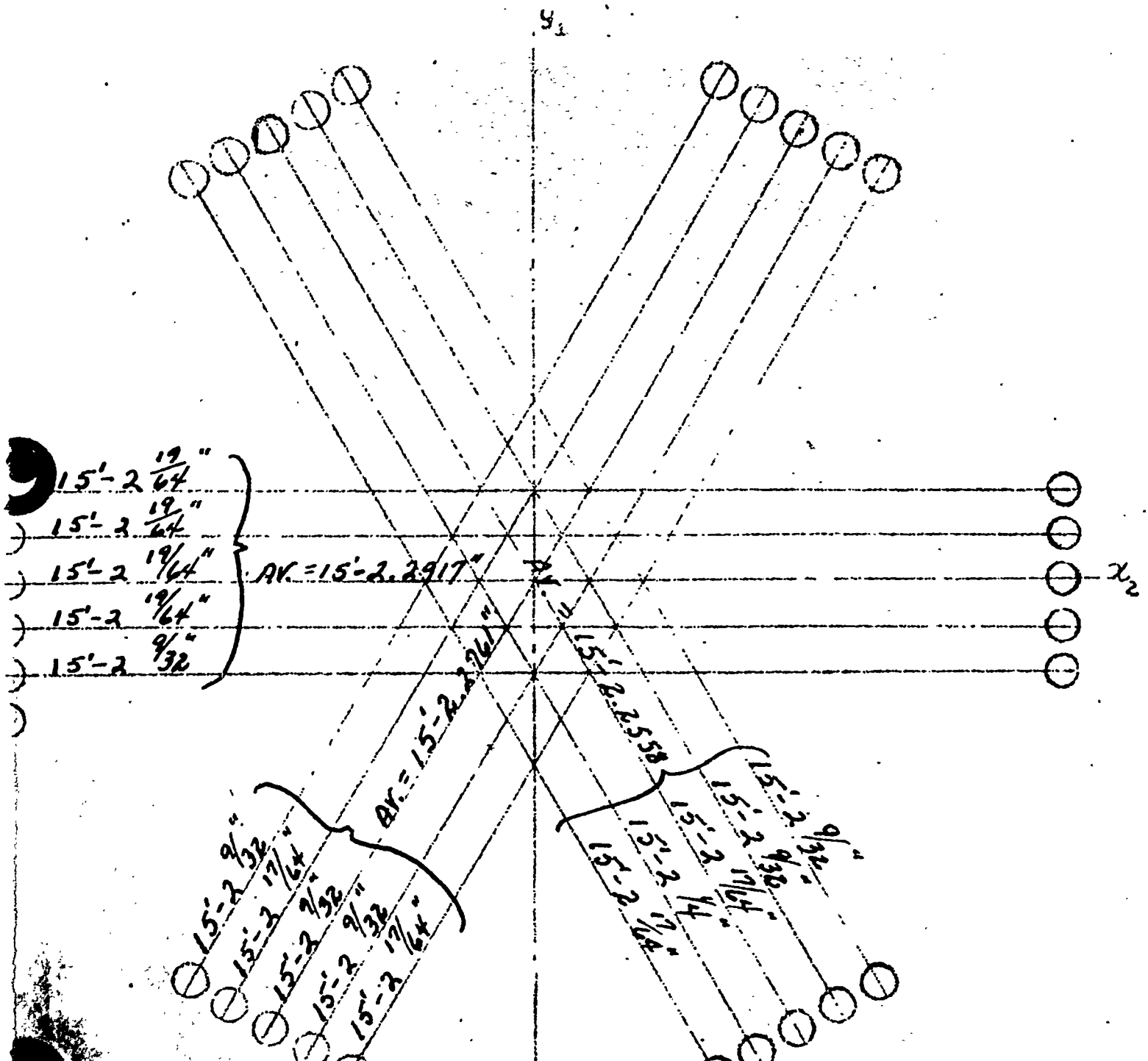
JMENT

TOP SIDE OF TOP PLATE

AMBIENT TEMP. 57 °F.

* INITIAL SHRINK MEASUREMENTS BEFORE TUBES WERE WELDED ON TOP SIDE OF UNIT

MEAS. TAKEN WITH duPONT TAPE #R (100'S/S TAPE)



HEET B.T.S. 4-1 (L)

TE 10-8-52

ORDER

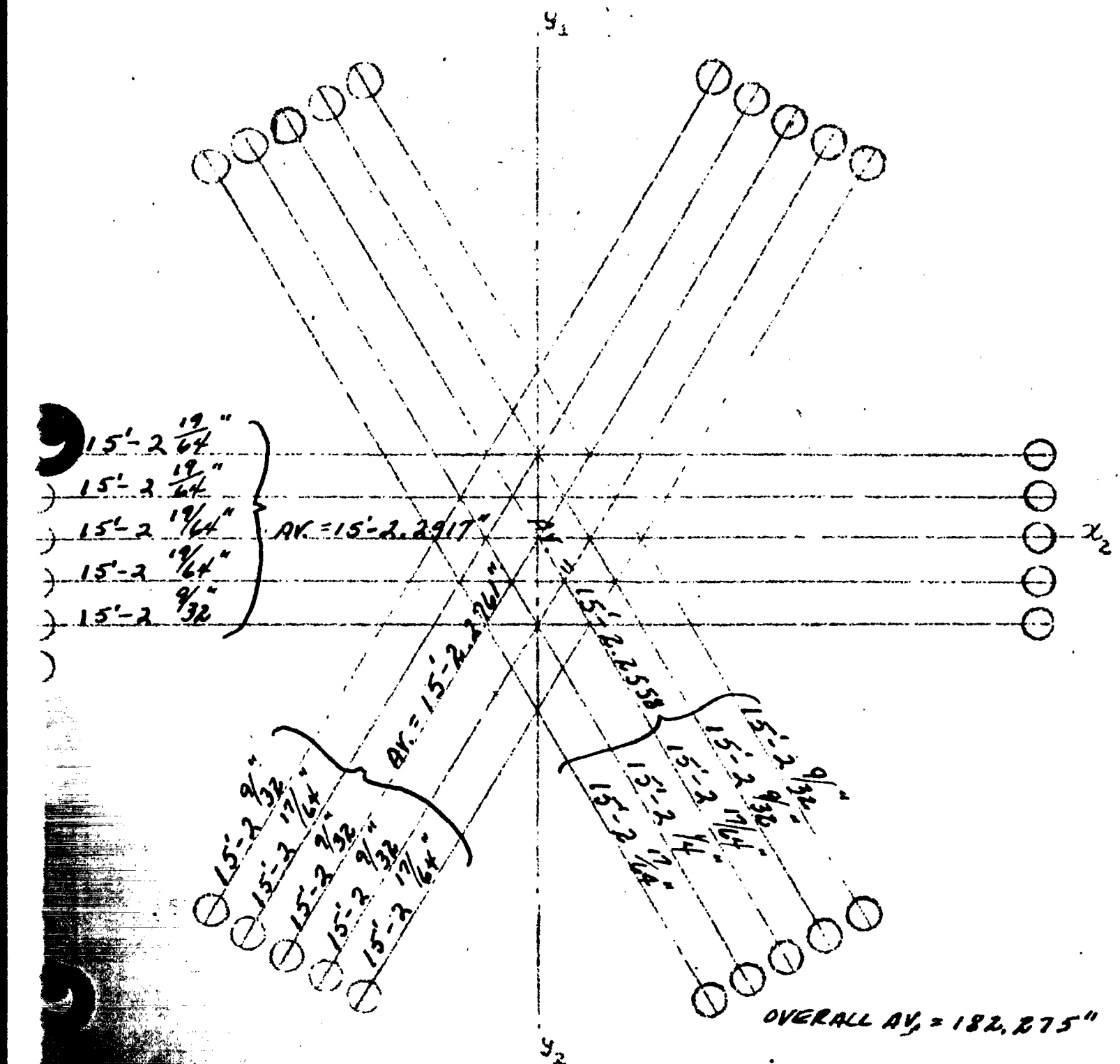
JMENT

TOP SIDE OF TOP PLATE

AMBIENT TEMP. 57 °F.

* INITIAL SHRINK MEASUREMENTS BEFORE TUBES WERE WELDED ON TOP SIDE OF UNIT

MEAS. TAKEN WITH duPONT TAPE #2 (100' S/S TAPE)



SKETCH #7

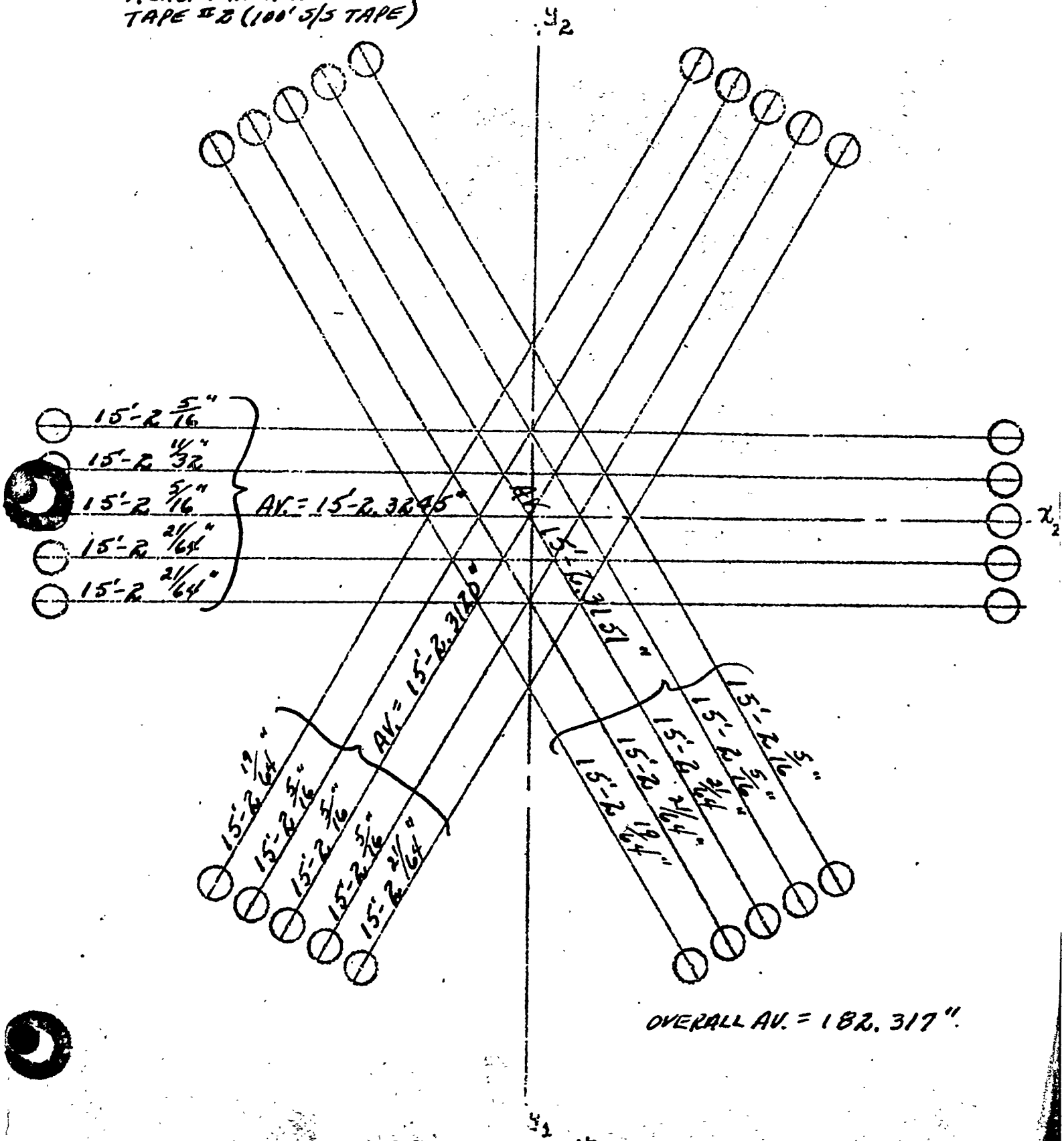
SHEET B.T.S. 4-2 (L)
DATE 10-7-56
RECORDER
INSTRUMENT

BOTTOM SIDE OF BOTTOM PLATE

AMBIENT TEMP = 57° F.

INITIAL SHRINK MEASUREMENTS BEFORE TUBES WERE WELDED ON BOT. SIDE

MEAS. TAKEN WITH DUPONT TAPE #2 (100' S/S TAPE)



OVERALL AV. = 182.317".

SKETCH # 8

SHEET B.T.3. 4-2 (L)

DATE 10-20-52

RECORDER

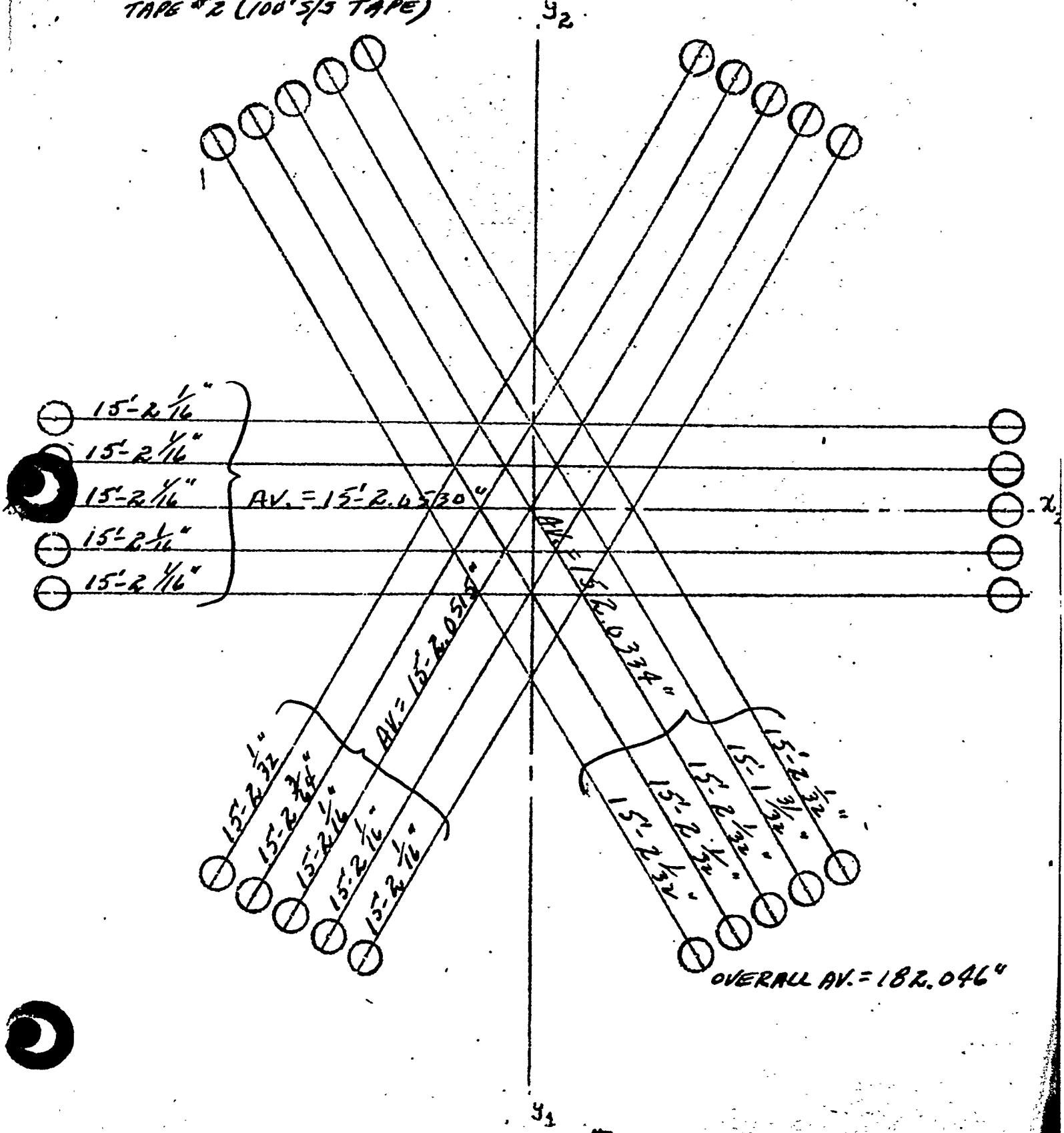
INSTRUMENT

BOTTOM SIDE OF BOTTOM PLATE

AMBIENT TEMP = 65° F.

FINAL SHRINK MEAS. AFTER TUBES WERE WELDED ON BOTTOM SIDE

MEAS. TAKEN WITH DUPONT TAPE #2 (100'S/S TAPE)



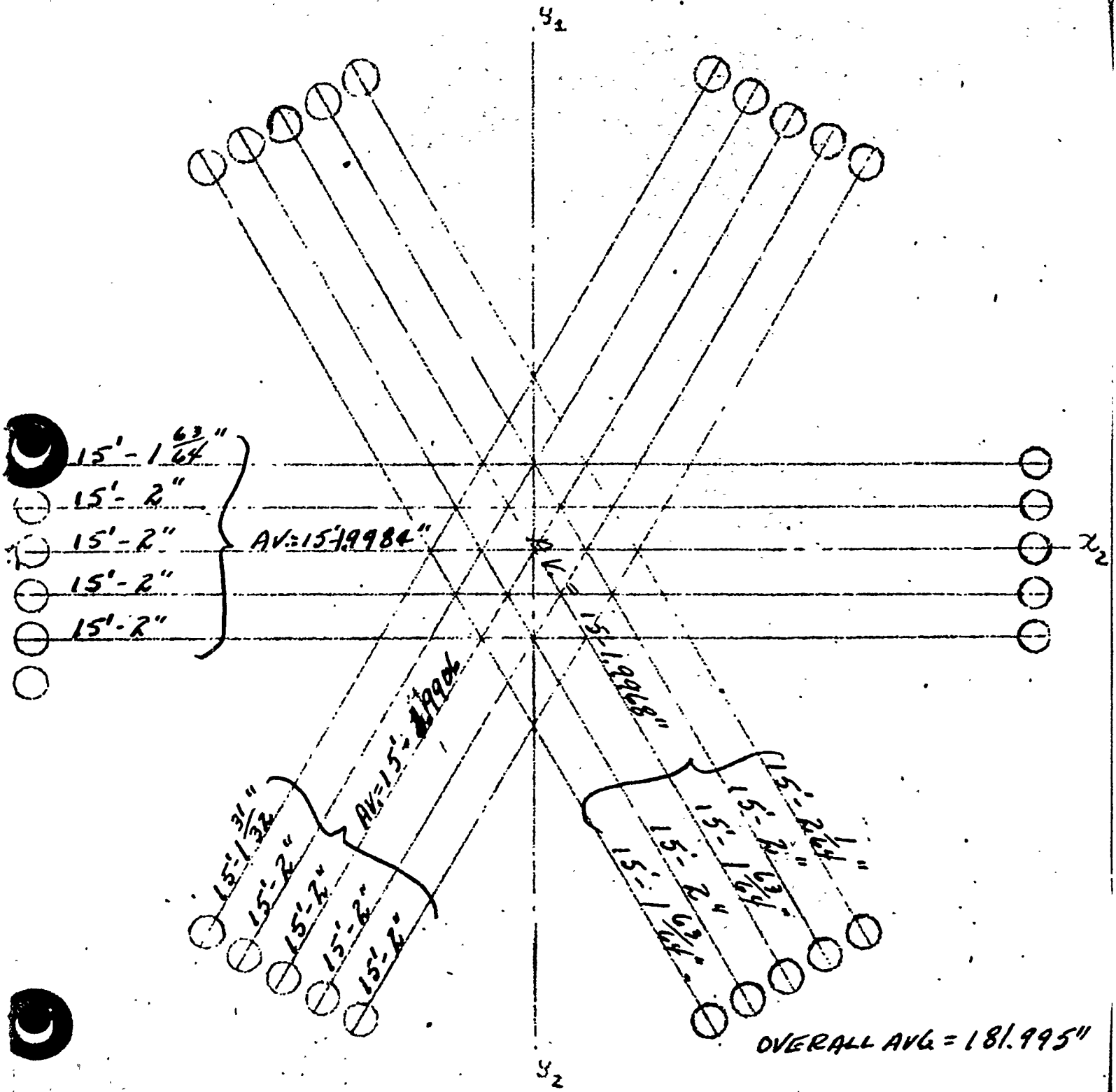
SKETCH #9

SHEET B.T.S 4-2(L)
DATE 10-20-52
RECORDER
INSTRUMENT

TOP SIDE OF TOP PLATE
AMBIENT TEMP. 65°F.

FINAL SHRINK MEAS. AFTER TUBES WERE WELDED ON TOP SIDE

MEAS. TAKEN WITH duPONT TAPE #2 (100'S/S TAPE)



SKETCH #10

However, when the above figures were reported to Design, they accepted the difference as being satisfactory, thereby eliminating additional shrink welding on the bottom tube sheet assembly in order to bring the top and bottom side within the desired tolerance.

(13) Visual Inspection and Repair of Tube Welding

Inspection of tube welding on this unit was performed in a similar manner to that described in Section 7A-(12) of this manual. For a detail discussion on tube weld inspection technique and how it developed, see Part VII, Section I, item 7B-(2)f.

(14) Replacement of Large Tubes as a Result of Weld Burn Through

Visual inspection of all large tube bores revealed that the following tubes had weld melt throughs:

X32-Y12	X44-Y30
X36-Y18	X39-Y33
X17-Y21	X48-Y36
X21-Y27	X24-Y42
X35-Y27	X35-Y51
X30-Y30	X11-Y75

A meeting was held between the du Pont Inspection Department and Design Division to discuss the disposition of the above listed tubes. As a result of this conference, it was decided that the following inspections would be performed to determine whether or not the tubes would be cut out and replaced.

(a) Grind out melt through and ream out weld neck

(b) Inspect with borescope

(c) Hydrostatic test @ 2000 psi for thirty minutes

(d) Inspect again with borescope

The above inspections were performed and all tubes were found satisfactory, except tube number X11-Y75. Laminations were noted at the weld melt through line after the bore was reamed to size. This tube was cutout and replaced with another pre-inspected seamless tube. Re-inspection of tube after replacing indicated all tube welding was satisfactory, and the unit was released for further fabrication.

8. Machining Wrapper Plate Weld Preparation and Gusset Plate Milling.

A. "R" Unit

After tube welding on both sides of the unit had been inspected and repaired, the bottom tube sheet assembly was set up on a 12' open mill. Tube sheet diameters were machined to size and then beveled for weld preparation. After this, the mill was stopped and two portable horizontal mills were set up next to the unit

for milling gusset plate edges to size. Gusset plates were milled to size and then preparations were made to move the unit to a open platen for further fabrication. During this time tube plates were machined to size and beveled for weld preparation and while gusset plates were being milled to size, a du Pont Inspector was present checking on the progress and quality of work. No other measurements were taken at this time.

B. "P" Unit

This operation was performed in a similar manner to that described in Section 8A of this manual.

C. "L" Unit

This operation was performed in a similar manner to that described in Section 8A of this manual.

9. Fitting End Stiffeners to Gusset Plates and Assembling of Inlet and Outlet Cups.

A. "R" Unit

The bottom tube sheet assembly was removed from the 12' open mill and placed on a platen for further fabrication. Gusset plate edges were laid out and beveled for weld preparation. End stiffeners were cut, fit, and tack welded to gusset plates. (See photo serial #99. This is a view of fitting stiffeners to top tube sheet gusset plates; however, this same fabrication operation is performed on the bottom tube sheet.) Concurrent inspection by du Pont Inspectors revealed that gusset plate edges showed evidence of burned metal. During fabricating of gusset plates, the edges were flame cut on the end next to the wrapper plates. The burned gusset plate edges were milled to size as stated in paragraph (8A) above; however, in some cases all burned metal was not removed by milling. To correct this, the gusset plate edges (where required) were chipped back to parent metal, dressed and then ferroxyl tested by the du Pont Inspection Department.

To prevent a reoccurrence of the above situation on subsequent units (P, L, K, and C), it was requested by the du Pont Inspection Department that all gusset plate edges be machined or chipped 1/4" in from the burned edges. This applied not only to gusset plates but to all stainless steel material that was flame cut with a cutting torch and flux. New York Ship complied fully with this request and no further trouble was encountered with this problem.

After all stiffeners had been fitted, welded, straightened and dressed, du Pont inspectors visually inspected all welding for evidences of porosity, cracks, undercutting and other mechanical defects. Repairs were made, re-inspected and the job approved.

Serial Number 99

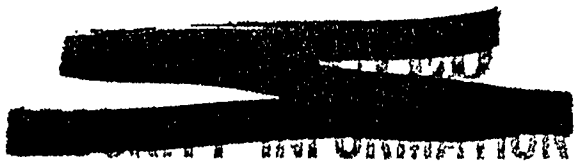
[redacted]

New York Shipbuilding Corporation
Camden, New Jersey
August 11, 1952

PROJECT 8980 - SAVANNAH RIVER PLANT

This view shows the fitting of stiffeners to the outer ends of the gusset plate on the Top Special Assembly "P" Unit. The stiffeners are clamped in place and welded with an Aircomatic Welding Machine. All welding is ground flush and stiffeners straightened (caused by welding) before closing unit with wrapper plates.

This [redacted] contains information affecting the nati[redacted]e meaning of the espionage [redacted] U.S.C. Secs. 793 and 794 [redacted] lation of [redacted] orized per[redacted]




SER #99

Concurrent with fitting and welding of end stiffeners, inlet and outlet cups were fitted and welded into the bottom tube sheet assembly. Extra inlet and outlet cups fabricated for the NYX bottom tube sheet were salvaged and used in the "R" bottom tube sheet. (see drawing 5-9). A grand total of forty-eight (48) inlet and outlet cups were assembled and welded into this assembly. Twenty-four (24) outlet cups were fit and welded to the top, middle end of those wrapper plates which were in line with outlet cup location in the baffle plate. The other twenty-four inlet cups were fit and welded to the unit directly under the outlet cups.

All inlet cups were acid washed and ferroxyl tested before assembling into the unit. Since outlet cups were welded to the wrapper plates, these were acid washed and ferroxyl tested after subjecting the wrapper plates to this same cleaning operation.

Before proceeding with any further fabrication of the unit, it was decided by the du Pont Inspection Department to have the Dowell Corp. internally clean the unit. This cleaning operation is covered in Section (10)-A of this manual.

B. "P" Unit

Inspection of fitting and welding end stiffeners to gusset plates and assembling of inlet and outlet cups was performed in a similar manner to that described in Section 9A of this manual.

C. "L" Unit

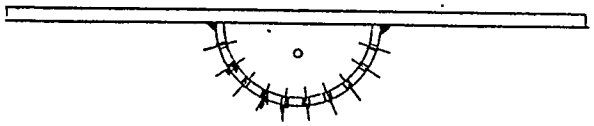
Inspection of fitting and welding end stiffeners to gusset plates and assembling of inlet and outlet cups was performed in a similar manner to that described in Section 9A of this manual.

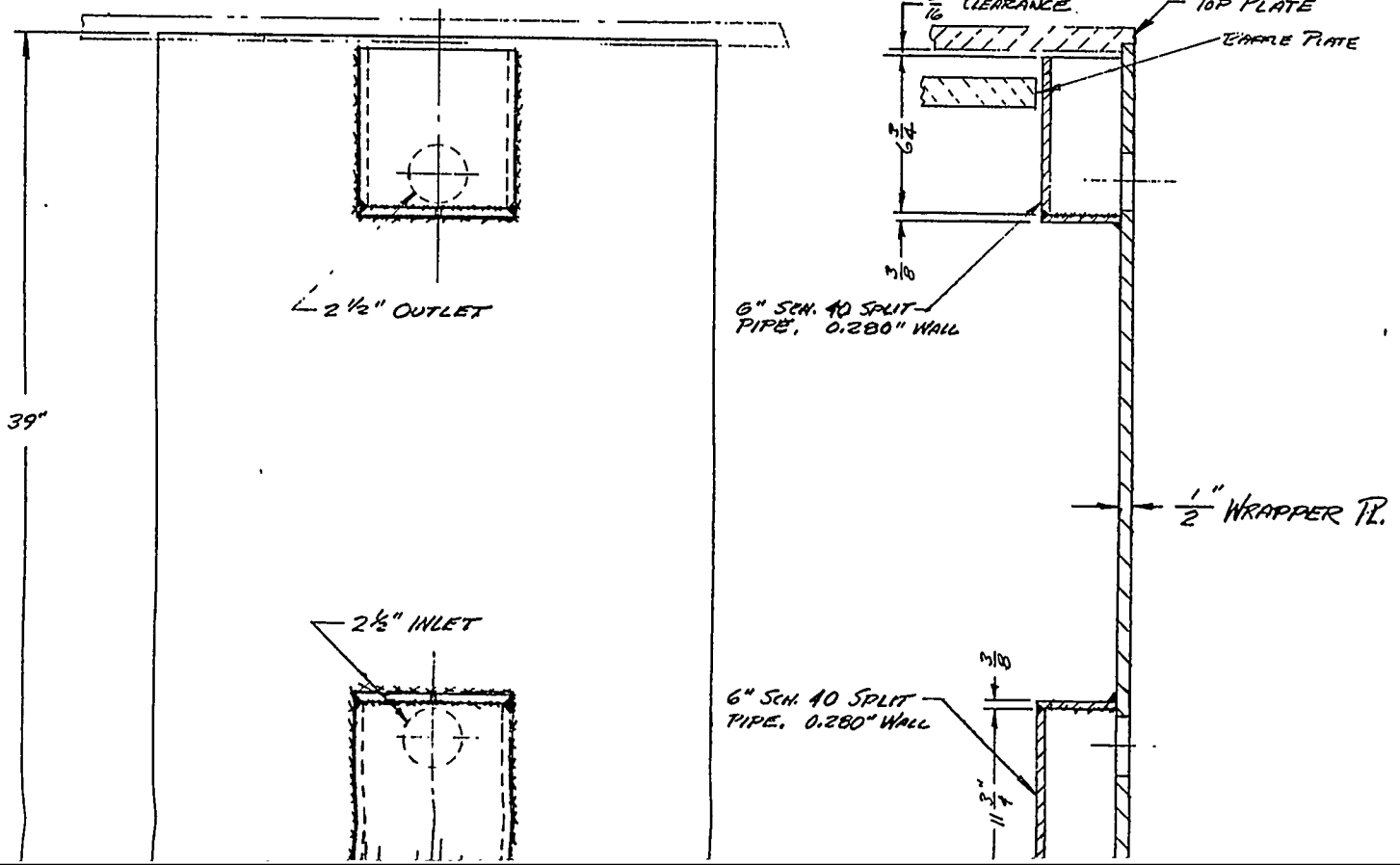
10. Preliminary Cleaning by Dowell Corp.

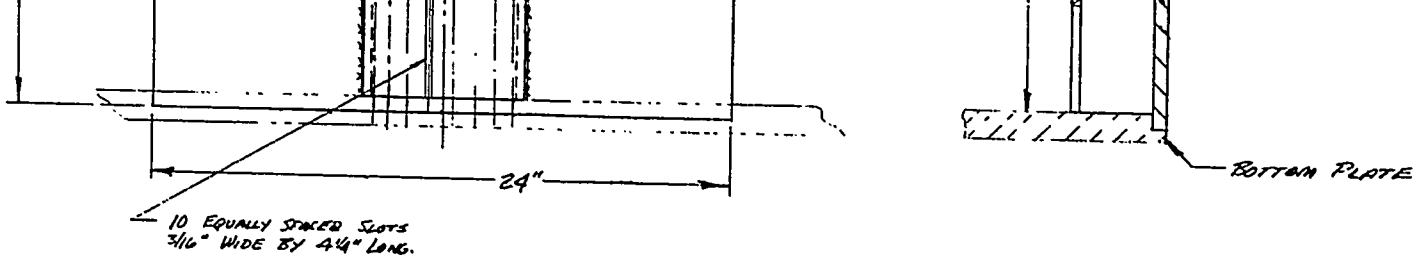
A. "R" Unit

Before welding wrapper plates to the bottom tube sheet, it was decided by the du Pont Inspection Department to internally clean the unit to remove dirt, oil, and other foreign material that had collected on the inside during fabrication. It was postulated that this preliminary cleaning would make for a cleaner unit internally when the time came for final cleaning. The problem as to how and what to use to clean the unit was of great concern. At this time no preliminary cleaning procedure had been developed and written for the preliminary cleaning of bottom tube sheet sub-assemblies. From the experience gained in the cleaning of the NYX sub-assemblies by the Dowell Corp., it was decided to turn the problem over to them.

BOTTOM TUBE SHEET - STRAINER CUPS







NOTE:
1. ALL WELDS SUBJECT TO VISUAL INSPECTION.

M & E SECTION
GOV'T. CONTRACTS

DW'G. 5-9

[redacted]
BY: S.R. COCHRAN
MAR.-53

Dowell Corp. was contracted to internally wash the unit prior to assembling of wrapper sheets. The following method was used by them to clean the unit: The unit was placed in a washing pit top side up and slightly inclined to provide drainage. Dowell's high pressure car unit was used for supplying the high pressure jetting action. The solution first used to clean the unit was a wetting agent (F-29). This wetting agent was jetted into the unit using a long 1/2" open end galvanized pipe working from all sides of the unit. The unit was internally jetted with the wetting agent for several hours. After this the interior of the unit was jetted with high pressure distilled water to provide additional cleansing action and to remove the wetting agent. This rinsing was done over a period of several hours, and then the unit was visually inspected by du Pont inspectors and accepted.

B. "P" Unit

Preliminary cleaning by Dowell Corp., was not performed on this unit. However, the following cleaning steps were performed by New York Ship.

(1) Bottom side of unit was acid washed. Top side was not.

(2) Tube bores were swabbed with F.O. 128.

(3) All exterior surfaces on gusset plates, top and bottom tube plates, large tubes, baffle plates, etc., inside the B.T.S. were wiped clean manually with the aid of F.O. 128 Safe-Tee solvent. Clean, white cloths were attached to a long wood stick for cleaning those surfaces not readily accessible by hand. This cleaning was considered adequate after all interior surfaces of the bottom tube sheet had been visually inspected.

C. "L" Unit

During the initial stages of fabricating the "L" unit, internal cleanliness of the various sub-assemblies became a major problem. This came about as a result of the establishing of strict cleaning specifications by plant site technical personnel. Heretofore, minor complaints had been received from the field pertaining to the internal cleanliness of "R" and "P" units which prompted the du Pont Inspection Department to take immediate steps to better clean the "L" sub-assemblies.

For the "L" bottom tube sheet, a method to internally clean the unit before installing wrapper plates was studied. All data and methods of cleaning used on previous units was analyzed. As a result of this, a revised preliminary internal cleaning procedure was written and followed for cleaning the "L" bottom tube sheet.

The step by step procedure developed and used for internally cleaning the "L" bottom tube sheet was as follows:

(1) Install raschig ring loading cradle to perphery of unit.

(2) Set unit in vertical position and place on loading cradle bed located next to a washing pit.

(3) Cleaning solution will be by weight:
0.1% Deterger
Remainder - Deionized water
Temperature 150°-190°F

(4) Jet using stainless steel nozzle upper 60° for 15 minutes.

(5) Rinse with manual hose using hot deionized or distilled water, upper 60° for 15 minutes.

(6) Jet additional 120° each side with cleaning solution for one hour keeping hot rinse water hose on upper 60°.

(7) Rinse additional 120° each side with hot deionized or distilled water keeping manual hose on upper 60° for one hour.

(8) Rotate assembly 60° either way; jet with detergent, original bottom 60° for 15 minutes and rinse same area for 15 minutes.

Time: 8 hours - During all jetting be sure to cover area between top sheet and baffle as well as baffle and bottom sheet area.

The above procedure was carried out in its entirety by Dowell Inc. Upon completion of preliminary cleaning, the unit was visually inspected by du Pont inspectors and accepted.

11. Cleanliness and Visual Inspection of Wrapper Plates.

A. "R" Unit

After Dowell cleaning, the bottom tube sheet was set up for fitting and tacking wrapper plates. However, before this took place, the du Pont Inspection Department requested that New York Ship wipe the interior and exterior of the unit with a acid solution in a further attempt to remove any oil, dirt or free iron that may not have been removed during preliminary Dowell cleaning. All acid cleaning was done at room temperatures using the following solution.

3 qts. of HNO_3
5 gal. of H_2O
1 pt. of HF

Acid washing was done by swabbing the solution on the surface to be cleaned and then following up with a water rinse. After the unit had been cleaned, various spots were ferroxyl tested to determine if any free iron was present. This test along with a visual inspection proved satisfactory and the unit was released for welding wrapper plates.

All wrapper plates were acid washed and ferroxyl tested as previously discussed in section 9-A, and then fit and tack welded to the circumference of the unit. Next, the unit was placed on a welding positioner for downhand work while welding the circumferential joints. (See photo serial #100 in Part II-B section 4d) Due to inaccessibility, circumferential welding could not be x-rayed. After removing the unit from the welding positioner, butt welded wrapper plates were dressed and then visually inspected for porosity, undercutting, cracks and other mechanical defects and necessary repairs.

B. "P" Unit

All wrapper plates were acid washed and ferroxyl tested as previously discussed in Section 9A of this manual, except on this unit (P) and "L" wrapper plates were sandblasted and then acid washed. The plates were then fit and tack welded to the circumference of the unit. Next, the unit was placed on a welding positioner for downhand work while welding the circumferential Joints. (See photo serial #100 in Part II-B, section 4d). Due to inaccessibility, circumferential welding could not be x-rayed. After removing the unit from the welding positioner, butt welded wrapper plates were dressed and then visually inspected for porosity, undercutting, cracks, and other mechanical defects and necessary repairs made.

C. "L" Unit

Cleanliness and visual inspection of wrapper plates for this unit was performed in a similar manner to that discussed in sections 11A and 11B of this manual.

12. Machining of Bottom Tube Sheet Tube Ends, Tube Reaming and Tube Repair.

A. "R" Unit

(1) Facing Operation and Inspections.

The bottom tube sheet assembly was set up and leveled bottom side up under three radial drill presses by New York Ship mechanics and checked by du Pont inspectors using the Wild NIII Precision level and target. Next, preparations were made to ream all "spider web tubes" at the top and bottom weld necks in the bore. This reaming was necessary in order that the "hour glass effect" (shrinkage) at the weld line (caused from welding tube to tube sheet) on the I.D. of the tubes could be reamed to original dimensions, allowing the bottom tube

sheet verticality gage to pass through when the unit was top side up on the 20' mill table. No other tubes were to be reamed other than the "spider web tubes" in this operation; however, since the 20' mill was not available, all tubes were neck reamed at the bottom neck weld in order to save time. (See Part II-A, section 3-a for location of "spider web tubes"). The top ends of the remaining tubes were reamed at a later date. During the reaming operation, du Pont Inspectors inspected finished reamed tubes for evidence of any machined steps in the bore, and also bore diameters were checked at the weld line using a standard dial indicator bore gage and ring gage. This was necessary to determine whether or not bores were being reamed to original sizes.

During the above reaming operation, the bottom side of the bottom tube sheet was laid out for the 12 bearing pads. The bearing pads were fit, set, tack welded to layout, fully welded, dressed and welding inspected and accepted.

When the 20' mill was cleared of other work, the bottom tube sheet assembly was placed on the mill (top side up) and preparations made for machining tube ends and the 12 bearing pads.

First, the unit was set to the best verticality using the spider web tubes" for verticality readings. (see Part III, section II-L for use of verticality gage) This optimum position was obtained by shimming the unit to the required amount as indicated by previous sets of verticality readings. Results of these final readings are shown in Sketch #11.

After verticality of the unit was taken and accepted (with the unit clamped to the mill table), level readings were taken on five reference tubes. These level readings were taken with the Wild NIII Precision Level and target. The five reference tubes were: (1) X54-Y48 (2) X2-Y48 (3) X15-Y9 (4) X15-Y87 (5) X28-Y48. These level readings or bench marks were given to New York Ship's machinist for final set-up for machining the tube ends.

The top ends of the tubes were machined to finished size and then deburred, inspected and found satisfactory. Before turning the unit bottom side up to machine the bottom tube ends and twelve bearing pads, profile readings in the X and Y directions were taken using a 18' straight edge and feeler gages. Results of this inspection are shown in Exhibit #4A. These measurements were satisfactory and the unit was turned over and the bottom ends of the tubes and twelve bearing pads were machined to size. (See photo serial #142, Part II-C, section 5) Before the unit was removed from the 20' mill, the following measurements were made by du Pont inspectors:

(1) Profile readings in the X & Y direction (Bottom Side)

VERTICALITY MEASUREMENTS

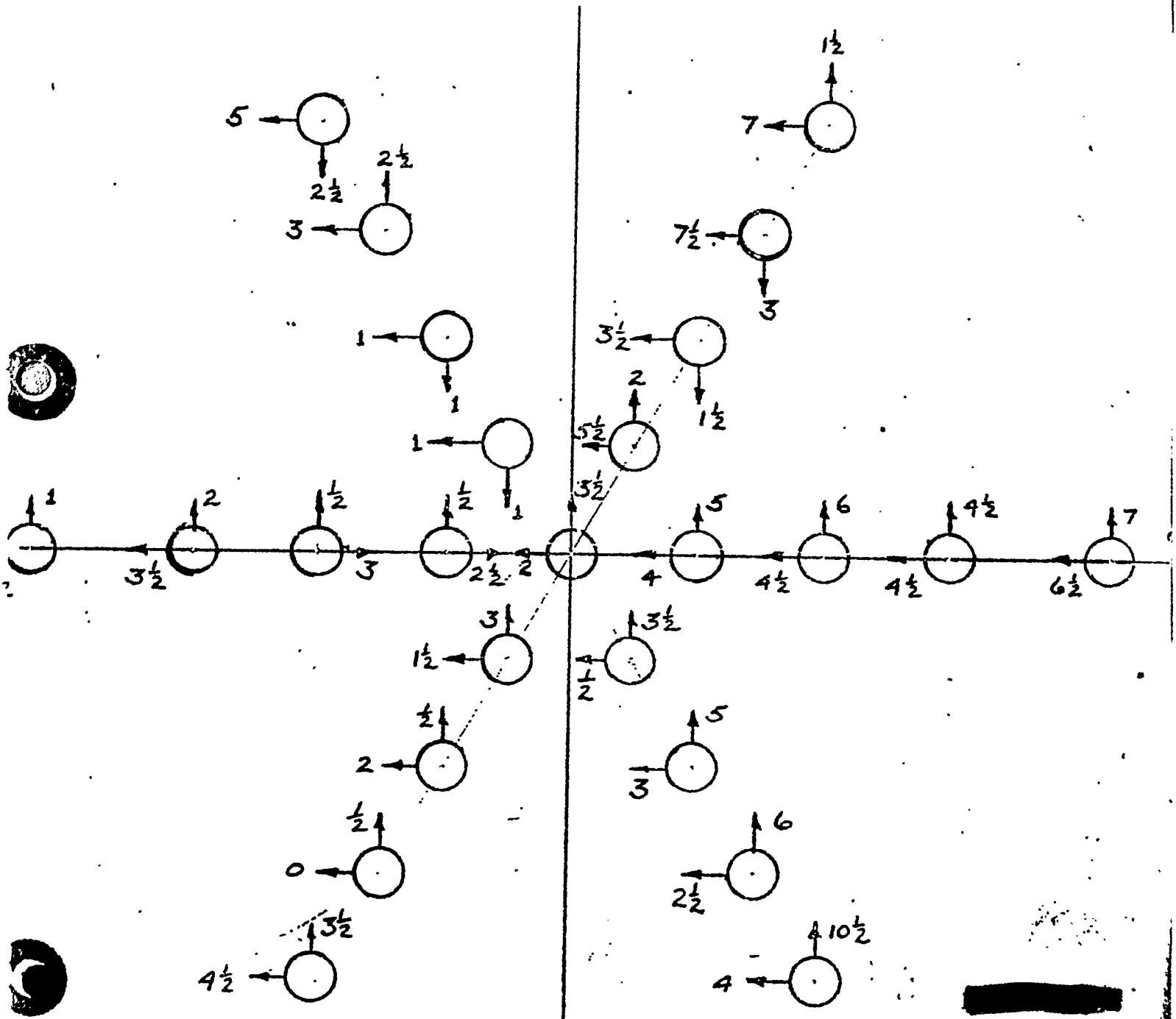
SHEET BTS 2-1

DATE MARCH 29, 1952

RECORDER LELAND

INSTRUMENT LELAND

NOTE: READINGS ARE IN .000" PER FOOT



SKETCH #11 PLAN VIEW

EXHIBIT #4-A

PROFILE READINGS ON TOP SIDE OF "R" BOTTOM TUBE SHEET AFTER MACHINING TUBE ENDS

Ex 4-A-1

E. I. DU PONT DE NEMOURS & CO., INC.

[redacted]truction Division

[redacted]

Report Number 177-R

CC: C. E. Buckley, F.P.M.
R. K. Mason, F.P.M.-SRP (3)
H. L. Bunker - J.G. Brewer
J. G. Brewer
H. B. Gage
F. C. Breuninger
A. H. Hughes
R. H. Potts (4)
C. W. Dunn - File

August 8, 1952
New York Ship - Camden, NJ

#82

FIELD INSPECTOR'S REPORT

This material contains information affecting the national defense of the United [redacted] within the meaning of the espionage [redacted] 18, U.S.C., Secs. 793 and 794, the transmission or revelation of which in any manner to an unauthorized person is prohibited by law.

TO C. J. VEITH - M & E FILE

FROM D. J. Smathers - R. Baker DATE August 8, 1952

PROJECT NO. 8980 PLANT Savannah River ORDER NO. AXC-167½

EQUIPMENT Bottom Tube Sheet EQ.PC.NO. 153-R

[redacted]ING NOS. W-130947 JOB RATING

VENDOR New York Shipbuilding Corporation LOCATION Camden, N. J.

Scope: Results of measurement of clearance between tube end surfaces and straight edge placed on these surfaces. (This report covers only top side of bottom tube sheet). These measurements were made to determine if tube ends were in a level plane. (This work performed on 4-2-52.)

Procedure:

After tube ends had been faced on 20' boring mill, a straight edge was placed on the end surfaces of tubes located along X1-X2 axis. The clearances between the tube end surfaces and the straight edge were then determined by inserting feeler gages between them.
This procedure was then repeated with straight edge placed on tubes located on Y1-Y2 axis.

Results:

See attached sketch.

[redacted]ch.

[redacted]

BOTTOM TUBE SHEET - TOP SIDE - "R" UNIT

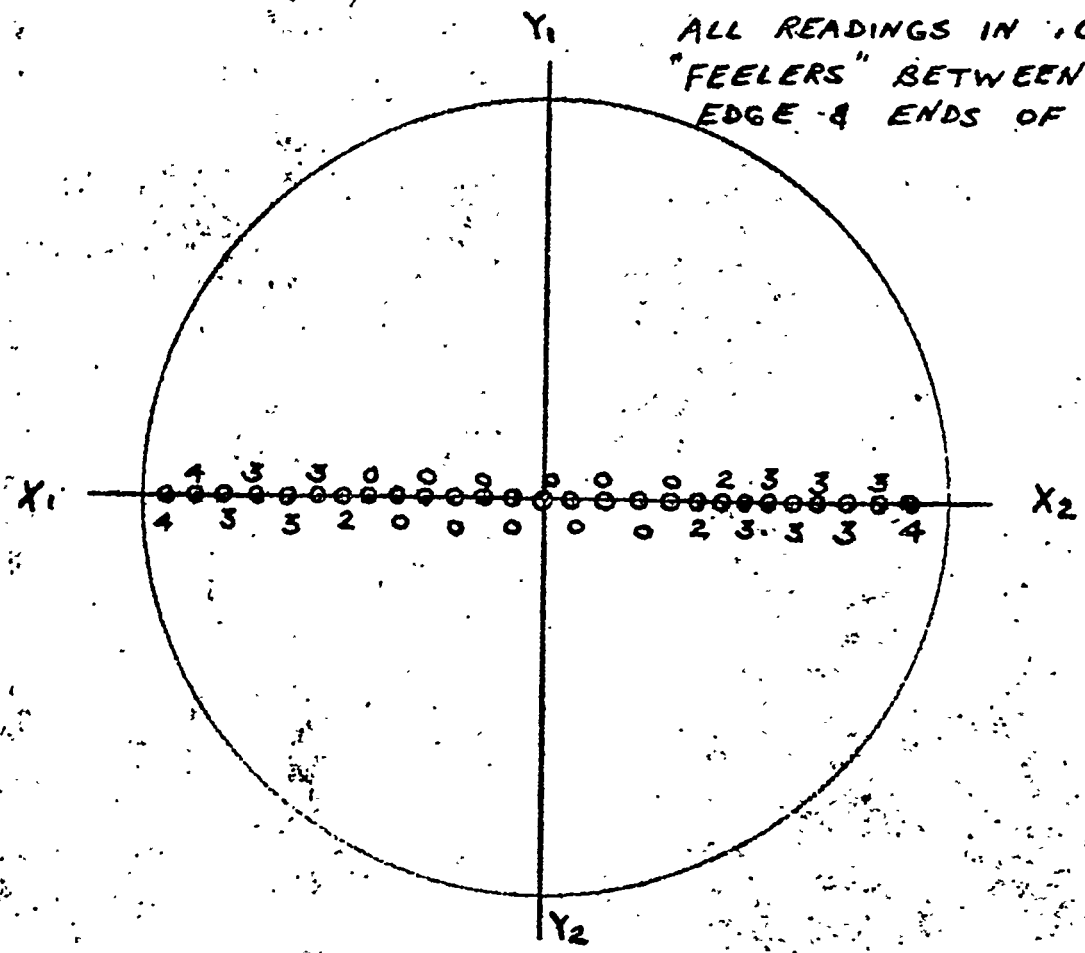
4-2-52

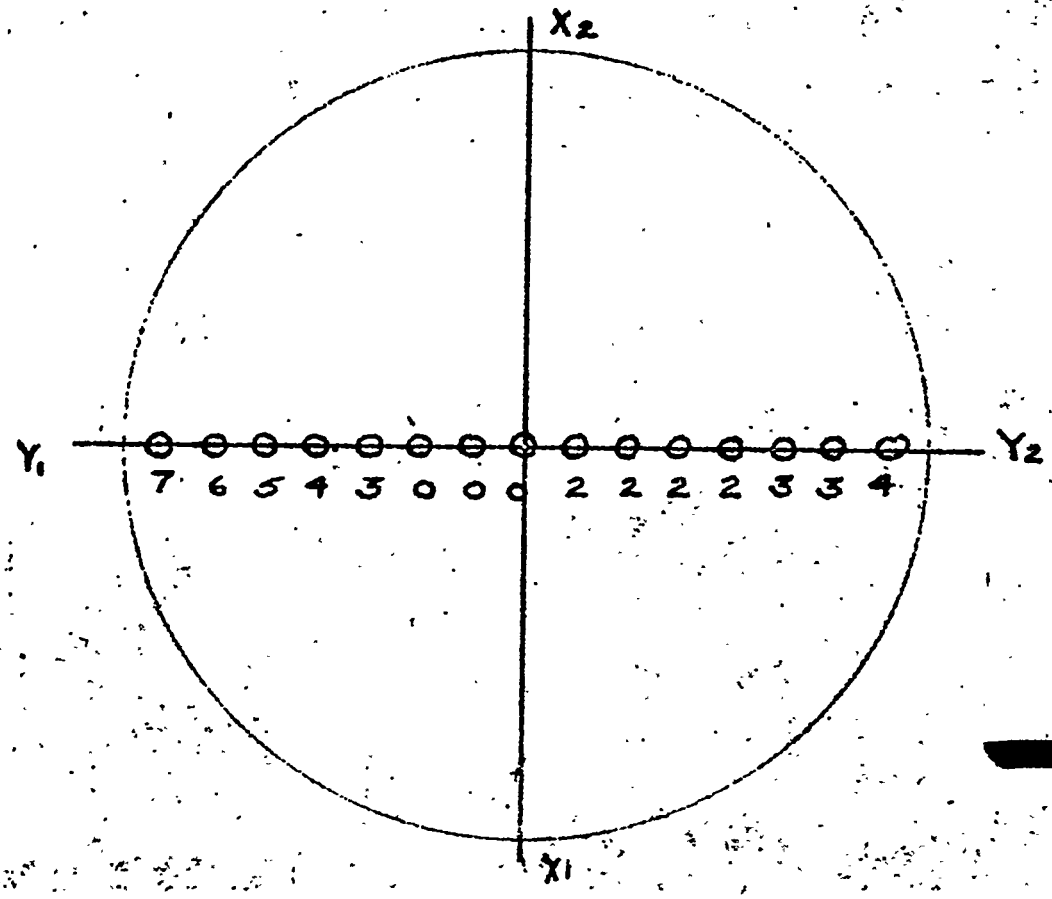
[redacted]

KER - SMATHERS

CHECK TO DETERMINE IF TUBE ENDS ARE IN SAME PLANE AFTER MACHINING

ALL READINGS IN .001 BY "FEELERS" BETWEEN STRAIGHT EDGE & ENDS OF TUBES





[redacted]

(2) Distances from the bottom side of each bearing pad to the tube ends on the top side of the unit.

(3) Overall length of tubes.

The results and method used for taking the above measurements are covered in Exhibit #5. All final measurements were satisfactory and the job was approved.

(2) Tube Reaming Operation

The bottom tube sheet assembly was removed from the 20' mill and set up under three radial drills (bottom side up) to ream out the "hour glass effect" (shrinkage) at the weld line. (Caused from welding tube to tube sheet). It was necessary to place the unit bottom side up because the top land pre-machined dimension (3.210"-3.217") was smaller than the tube bore finish machined dimension. Hence, working from the bottom side of the unit, it was only necessary to change the large reamer (used for reaming out "hour glass effect" nearest bottom end of tube) to a smaller reamer to remove the same condition in the top land, and also to finish ream the latter to size.

As stated in Section 10-A (1) above, the hour glass effect nearest the bottom end of the tube had all ready been removed, and hence it was only necessary to ream the top land to required finished dimensions. Dwg. 2-4 presented herewith shows where the two lands were located, and the required finish machined dimensions.

As a result of facing tube ends and reaming tubes, many of them were damaged. These descrepancies were found through concurrent inspection during machining operations and are treated in section (3) below.

(3) Tube Repairs

a. Bottom Land I.D.

Visual inspection of tube ends on the bottom side of the bottom tube sheet after facing and reaming tubes revealed that approximately fifteen tubes had been distorted or "caved in" on the bottom end tube wall. This condition resulted from feeding the cutting tool too deep during facing of the bottom tube ends. As shown in Dwg. 2-4, the large tube bottom land I.D. was machined to finished dimensions prior to assembling and welding into the unit. Since tube bottom lands were to finished size, it was decided to repair the tubes rather than replace them with new ones. New York Ship attempted to swage the bottom lands to original dimensions, and in doing so, seven of the tubes were swaged oversize. This method was discontinued because swaging resulted in "belling" of the tube end. To bring the tube bores within tolerance, the

EXHIBIT #5

FINAL BEARING PAD MEASUREMENTS AND

PROFILE READINGS TAKEN ON BOTTOM SIDE

OF "R" BOTTOM TUBE SHEET AFTER MACHINING

EX 5-1

[redacted]

E. I. DU PONT DE NEMOURS & CO., INC.
WILMINGTON, DELAWARE

Construction Division

CC: C. E. Buckley, F.P.M.
R. K. Mason, F.P.M.-SRP(3)
H. L. Bunker - J.G.Brewer(2
H. B. Gage
F. C. Breuninger
A. H. Hughes
C. W. Dunn - File

RDH. print

This material contains information affecting the national defense of the United States within the meaning of the espionage law, Title 18, USC, Sec. 793 and 794, the transmission or revelation of which in any manner to an unauthorized person is prohibited by law.

FIELD INSPECTOR'S REPORT

TO C. J. VEITH - M & E FILE

FROM S.R. COCHRAN-C.H.HEIST-M.H.SCHOLES DATE APRIL 10, 1952

PROJECT NO. 8980 PLANT SAVANNAH RIVER ORDER NO. AXC-167½

EQUIPMENT TANK BOTTOM TUBE SHEET EQ.PC.NO. "R" UNIT

DRAWING NOS. W-130947 & W-130948 JOB RATING

VENDOR NEW YORK SHIPBUILDING CORP. LOCATION CAMDEN, N. J.

The following report pertains to the measurements made on the "R" unit tank bottom tube sheet with the tube bundle in a bottom side up position on a vertical boring mill table just after the finish "facing" operation.

Exhibit "A"

With the tube bundle clamped to the mill table in a bottom side up position and the whole rotated such that the X_1-X_2 axis was parallel with the cutting rail, a straight edge was placed on the end surfaces of the tubes. "Feeler" gages were inserted between the straight edge and end surfaces of the tubes. The clearances measured are shown on the sketch on Page 3.

Exhibit "B"

The measurements determined for Exhibit"B" were obtained by the same procedure as in Exhibit "A" with the exception of the straight edge being placed on the Y_1-Y_2 axis. The results are shown on the sketch on Page 3.

Following the completion of the procedures of Exhibits "A" and "B" the tube bundle was checked for levelness. This was done by placing a level on the straight edge while same was resting on the X_1-X_2 and Y_1-Y_2 axes respectively. The results indicated the overall tube bundle to be level within .0005" per foot.

[redacted]

FIELD INSPECTOR'S REPORT

M Cochran/Heist/Scholes

April 10, 1952

Exhibit "C"

The dimensions shown on the sketch on Page 4 are maximum and minimum dimensions pertaining to all 12 bearing pads and tubes adjacent to bearing pads.

The overall tube length was determined by means of a pin gage set at 49.4375" and "feeler" gages. These dimensions are observed to be from .0025" to .0035" greater than the tolerance of 49.4375" ±.030". This was passed as being satisfactory by Mr. A. H. Hughes.

The distances from tube tops to bearing pads are observed as being 41.513" to 41.514" which is within the tolerance of 41.500" ± .015". These dimensions were determined by means of a pin gage set at 41.500" and "feeler" gages.

EX3-3

4/10/52

BTS 2-2 "R" UNIT

ALL READINGS IN .001" BY "FEELERS" BETWEEN STRAIGHT EDGE & ENDS OF TUBES.

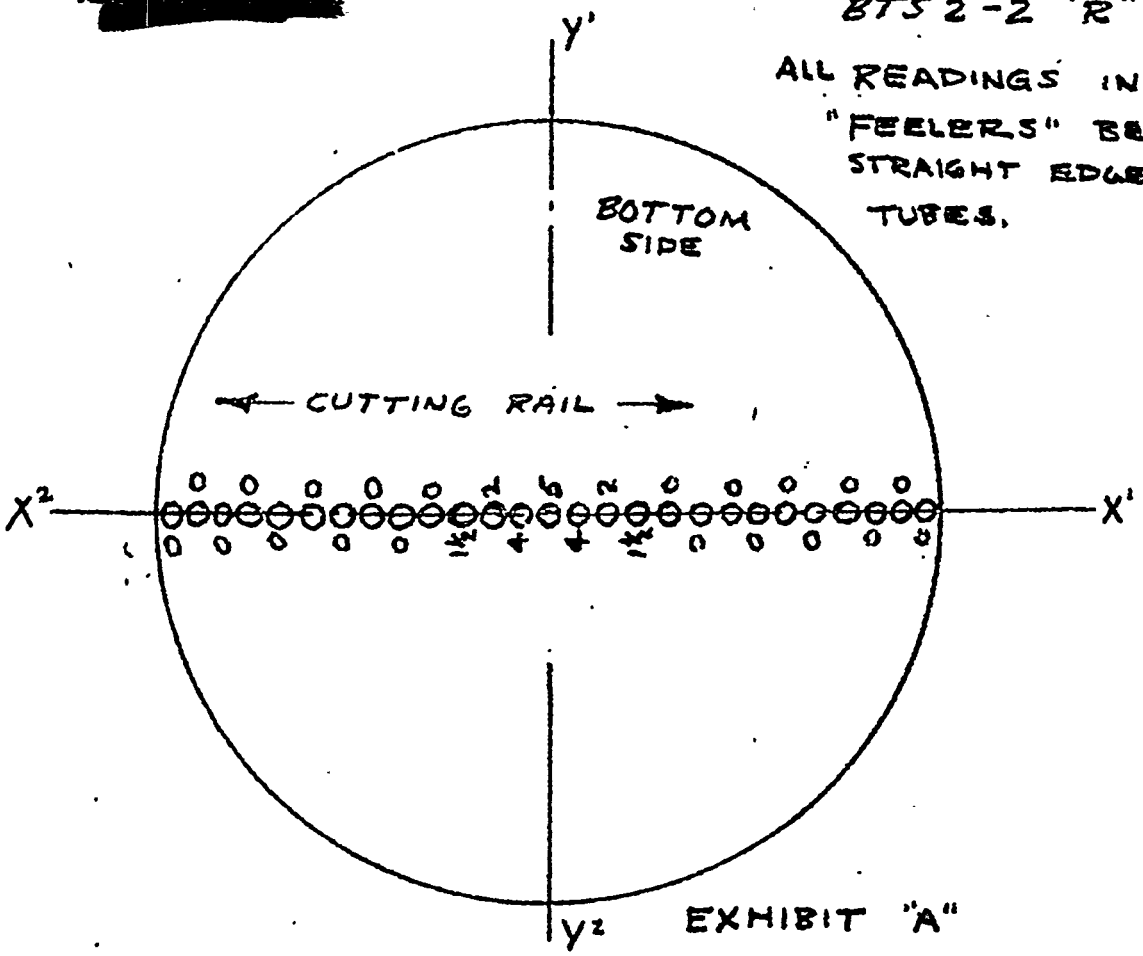


EXHIBIT "A"

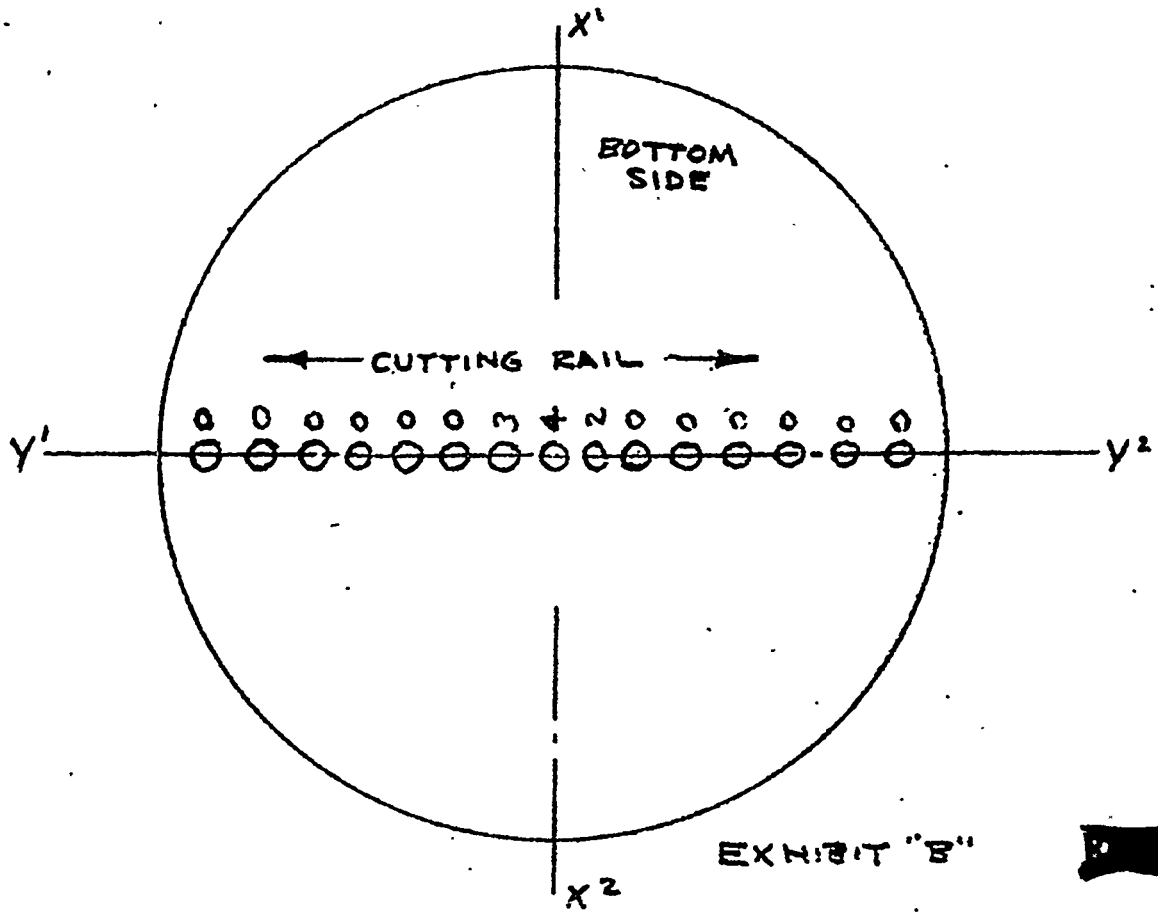


EXHIBIT "B"

4/10/52

BTS 2-1 ?R UNIT
BTS 2-2 ?R UNIT

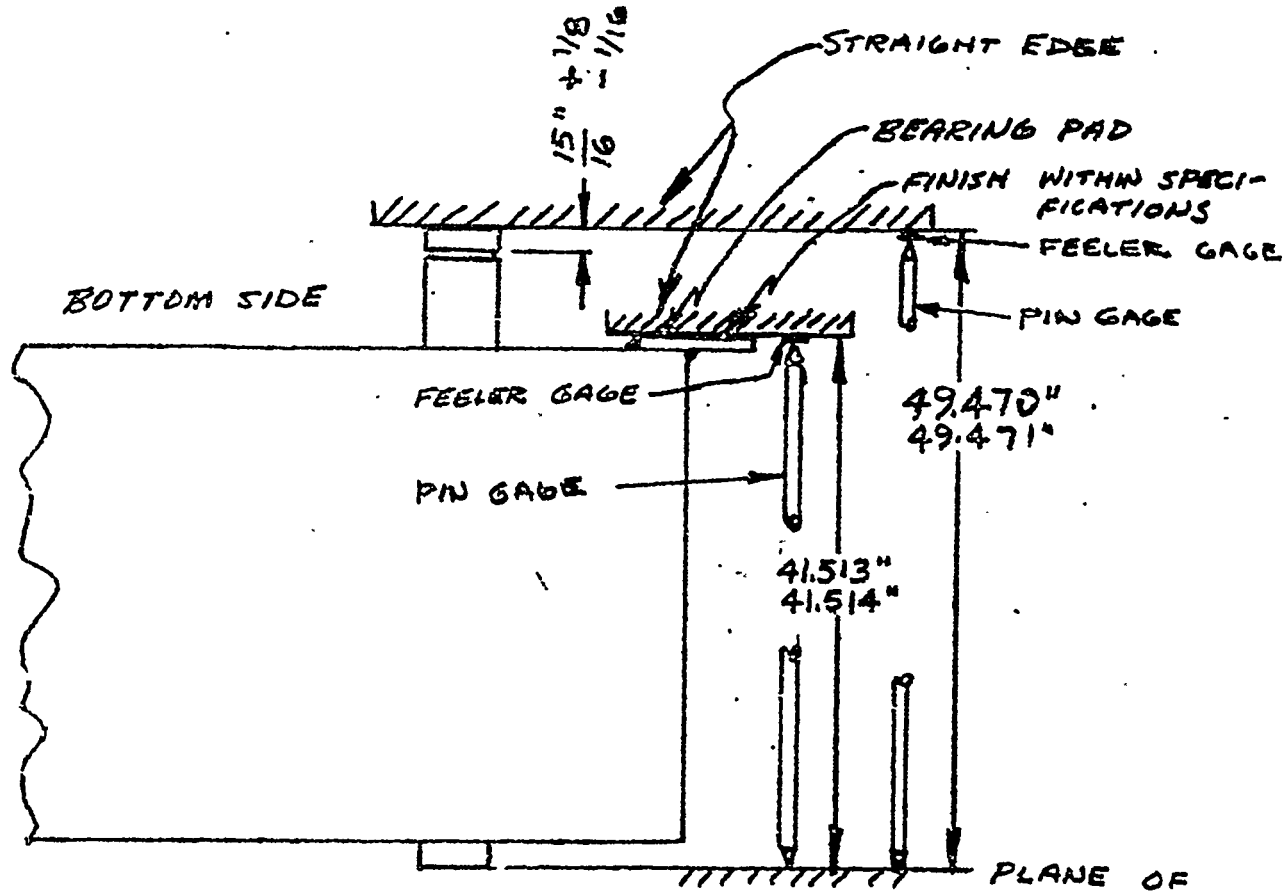
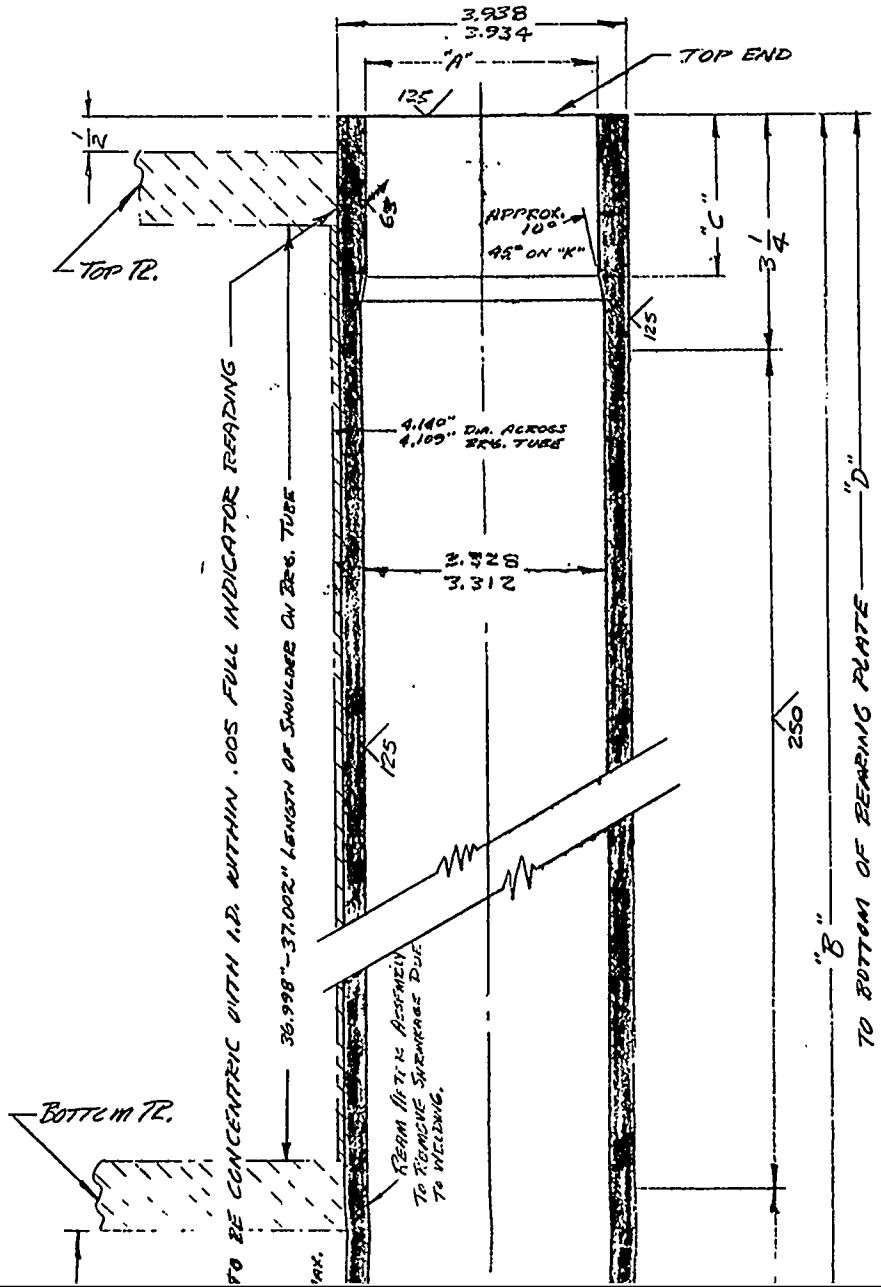


EXHIBIT "C"

TANK BOTTOM TUBE SHEET - "R" UNIT

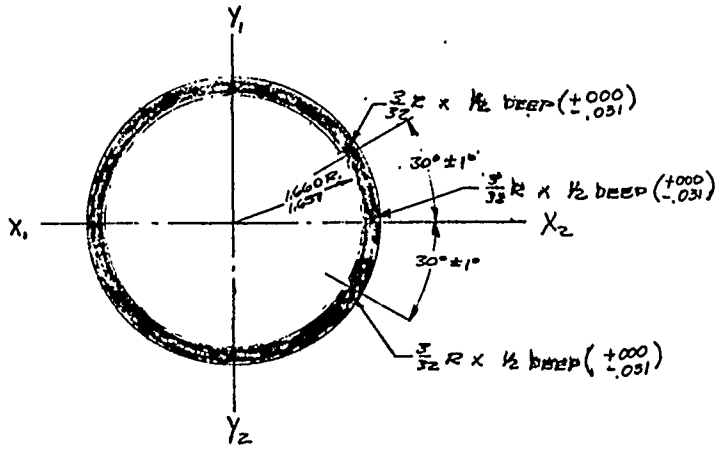
BOTTOM TUBE SHEET-LARGE TUBE



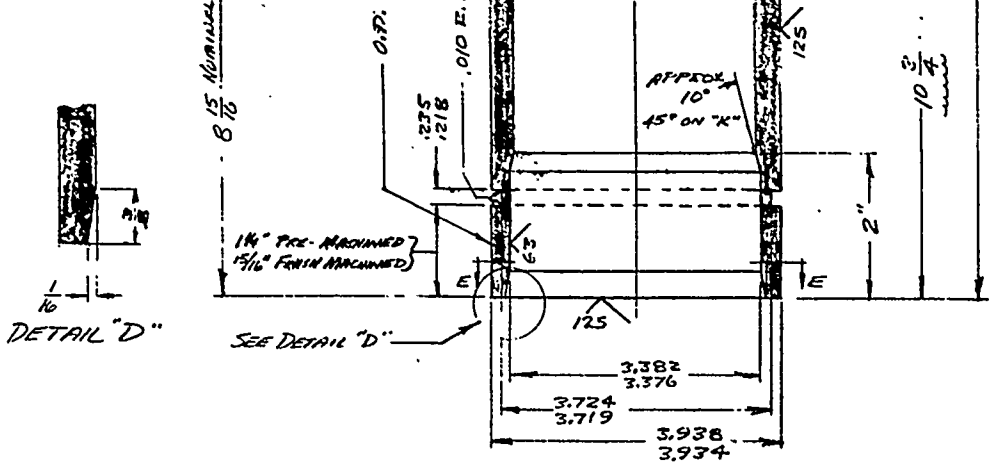
DIM.	PRE-MACHINED	FINISH MACHINED
"A"	3.210 - 3.217	3.270 - 3.277
"B"	49.985 - 50.015	49.4375 ± .030
"C"	2.219 - 2.281	2" NOMINAL
"D"	———	41.500 ± .015"

NOTES:

1. TOP ENDS OF TUBES FINISHED IN PLANE PARALLEL WITH PLANE OF BEARING PLATES WITHIN .015"
2. BOTTOM ENDS OF TUBES FINISHED IN PLANE PARALLEL WITH PLANE OF TOP ENDS OF TUBES WITHIN .015."
3. FINAL MACHINING CONSIST OF:
   - A. FACING TOP & BOTTOM ENDS OF TUBES.
   - B. REAMING TOP BORE OF TUBES.
   - C. CHAMFERING BOTTOM ENDS OF TUBES.
   - D. DRILLING 3 DOWEL PIN GROOVES AS SHOWN IN SECTION E-E.
4. HOLE CAMBER NOT TO EXCEED .005"
5. TUBE BORES TO BE VERTICAL WITH PLANE OF ERG. PADS WITHIN .020" END TO END, (.005" PER FT.).
6. ALL TUBES ARE NECK REAMED IN AREA ADJACENT TO BOTTOM PLATE.



SECTION E-E
SHOWING 3 GROOVES FOR DOWEL PINS



NOTE:
SEE DWG 1-2 & 2-5 FOR LOCATION OF "O" RING & PISTON RING SEAL AREAS.

PRE-MACHINED & FINISH MACHINED LARGE TUBE. TYPICAL FOR 600 NON REWORK & 73 BEARING TUBES ON "R", "T", "L", "C"; 582 NON REWORK & 91 REWORK TUBES ON "K".

M & E SECTION
GOV'T CONTRACTS

DWG. 2-4

BY: S.R. COCHRAN
MAR-53

EXHIBIT #6

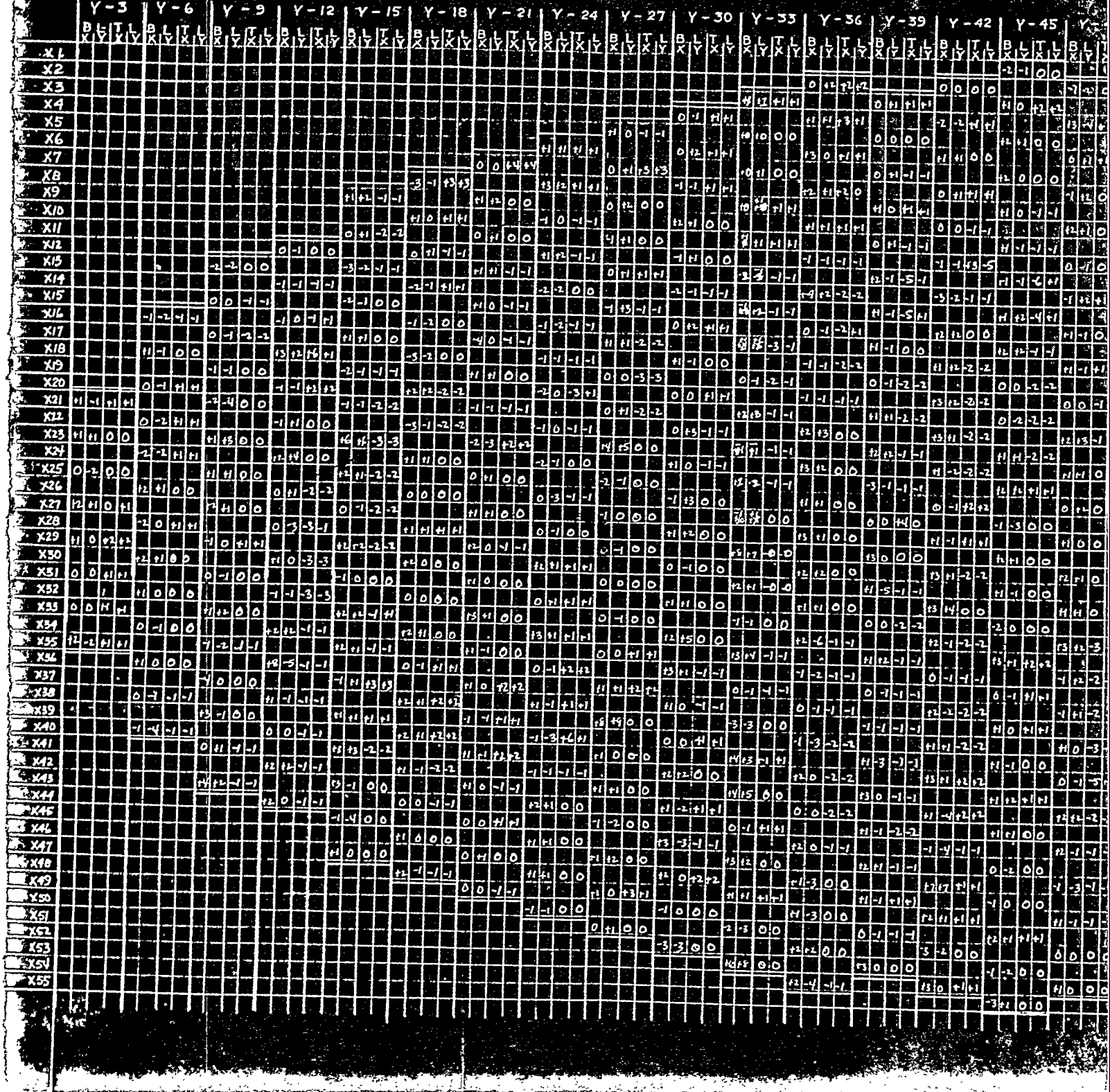
RESULTS OF TOP AND BOTTOM LAND BORE DIAMETERS IN THE "A" BOTTOM TUBE SHEET ASSEMBLY.

REPORT # 217-R

DC
~~DES~~
BTS

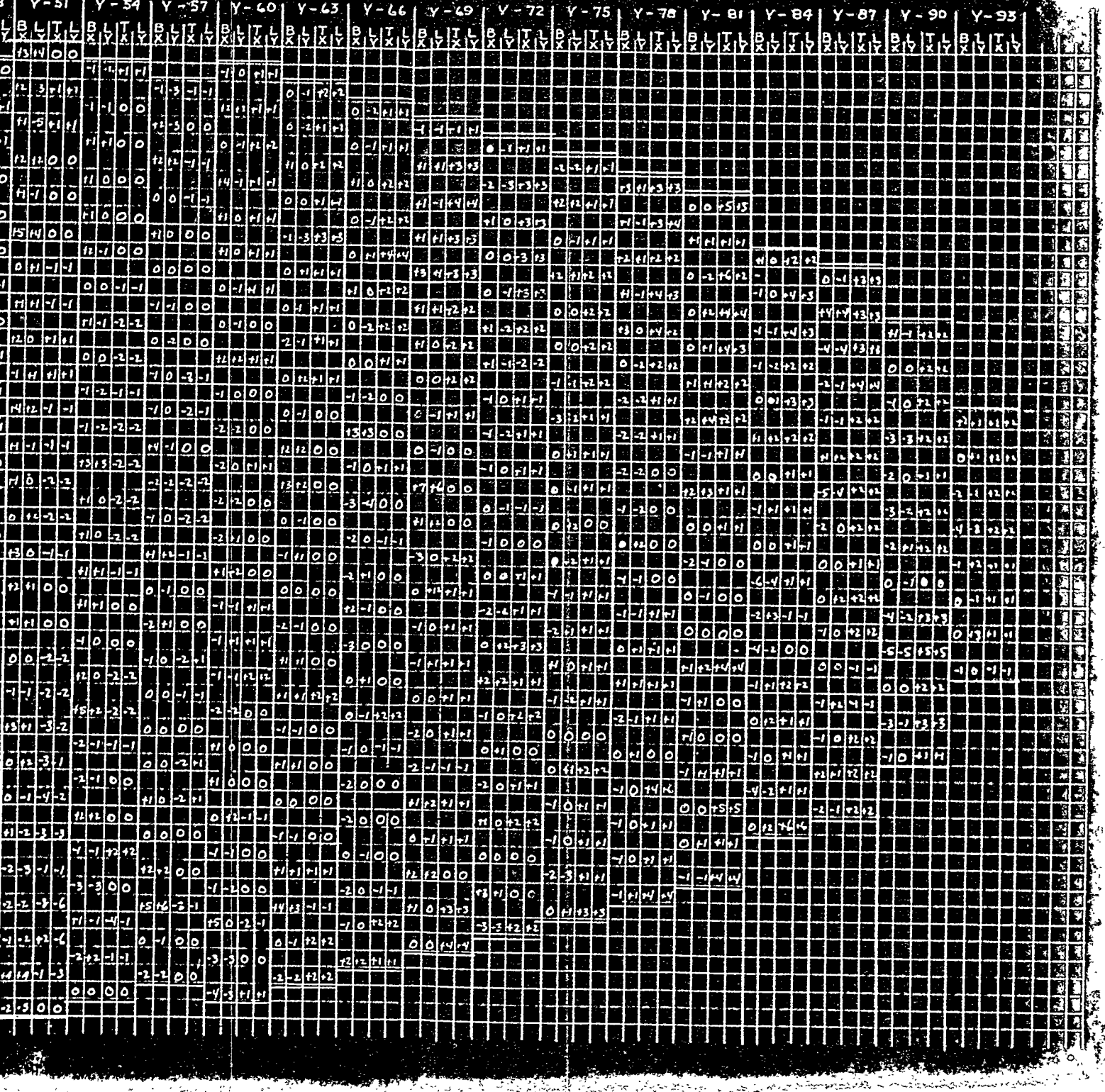
BORES

DATE TOP LAND 6-14-52
BOTTOM LAND 4-20-52



R-UNIT

BASIC ID TOP LAND 3.275
BOTTOM LAND 3.376



seven tubes were shrunk by welding a series of beads around the bottom O.D. of the tube. Heli-arc welding without filler metal was used to shrink all seven tubes. After shrinking the bottom land bore was honed to 3.377". Tubes were then inspected for finish and bore size and found within tolerance.

Next, the bottom land finish was checked using a profilometer. The specified finish was 63 RMS micro-inches. Of the 673 tubes checked, twenty-one (21) were found to have finishes ranging from 100 RMS to 400 RMS. All others were 100 RMS or less. The twenty-one tubes with bore finishes ranging from 100 RMS to 400 RMS were honed to improve the finish, and in cases where the 3.382" maximum diameter was exceeded, the tube was shrunk (heli-arc method without filler metal) and re-honed to the specified diameter and finish. However, the specified bore finish (63 RMS) was relaxed by the Design Division to 100 RMS. This relaxation in specification was necessary since the finish machined bottom land bores were not within drawing specifications upon receipt at New York Ship. Also, there was a shortage of tubes and what was on hand at the time had to be used to expedite the completion of the NYX Program, and in addition, further honing to improve bore finishes to 63 RMS resulted in tube bores going out-of-round and oversize.

Based on the above relaxed finish specifications, all bottom land bores were either honed or clover-leafed to acceptable finishes. Bore diameters were measured using a standard dial indicator bore gage and ring gage. Bores were measured in two directions, parallel to the XX axis and paralled to the YY axis. Measurements were taken down approximately 1" from the bottom end of the tube. Exhibit #6 presented herewith lists the final bore diameter measurements. Tolerance on bottom land I.D. ranged between 3.376" and 3.382". All measurements were satisfactory and approved by the du Pont Inspection Department.

After the "A" bottom tube sheet assembly was received at the plant site, a sub-standard condition was found to exist in the bottom land of tube X45-Y81. This condition was discovered during the course of field cleaning the bottom tube sheet tubes preparatory to monitor pin installation. Photographs were taken of the tube and forwarded to the du Pont Inspection Department. These pictures showed an overlapping crescent effedt in the internal bore of the tube. In addition, field measurements were taken in the bottom land O-ring sealing area and were as follows: XX axis - 3.382", YY axis 3.389". These measurements taken by field personnel, indicated that the YY axis was .007" over the design tolerance and that an out-of-round condition of the same magnitude existed.

In reply to the field's complaint, the overlapping crescent effect in the internal bore of the tube (which was estimated by the Inspection Group at N.Y.S. from the photos to be 2-2½" from the face of the tube) was in an area where it could be tolerated as confirmed by Design. The inspection report issued by the du Pont Inspection Department at New York Ship, which covered the final bore measurements in the bottom 1-11/16" counter-bore, accepted all bores as being within tolerances. The subject tube X45-Y81 was recorded as X-3.376" and Y-3.377" which was within tolerance. The manner in which inspectors checked these bores at New York Ship before accepting was as follows: (1) precision ring gage (3.375" dia.) was used to set a dial indicator bore gage. (2) All measurements were taken 1" from tube end. (3) Results were recorded. It was suggested to the field that they used this method and re-inspect tube X45-Y81. Measurements re-taken by the field in the tube bore indicated that it conformed closely with the official NYX measurements. (NYX measurements: XX-3.376", YY-3.377"; Field revised measurements: XX-3.3755", YY-3.3775"). The substandard bore was then checked by the field to determine if the O-ring could be inserted without damage. The check was performed without apparent damage to the ring, and no other problems were encountered in this tube.

b. Top Land I.D.

After line reaming the top land of all bottom tube sheet large tubes, the following inspections were made:

1. Bore diameter measurements in X & Y direction taken 1" below top ends of tubes. These measurements were taken with a standard dial indicator bore gage and ring gage (final results are shown in Exhibit #6).

2. Finish in RMS micro-inches using a profilometer.

3. Visual inspection for burrs, scratches, steps, and other mechanical defects that might be present in top land bore.

As stated in (1) above, bore measurements were taken in the top land to determine if bores were within tolerance. During this inspection tube number X44-Y18 was measured in the X & Y direction and found oversize and out-of-round. Measurements were: XX direction - 3.280", YY direction 3.292". Specified bore size ranged from 3.270" to 3.277". This tube diameter was reamed .015" oversize and .012" out-of-round. In view of this discrepancy, the du Pont Inspection Department requested this tube be cut out and replaced. Tube was replaced, inspected and accepted. All other tubes were within tolerance and accepted.

Next, the finish in the top land of all tubes were checked using a profilometer. Many of the tubes were found to have finishes greater than the specified 63 RMS. These tubes were either honed or clover-leafed until the bore finish was satisfactory.

A final visual inspection was made on the top land to determine if any scratches, burrs, tool steps or any other mechanical defects were present. Any found were removed by one of the three following methods: (1) honing (2) cloverleafing (3) smoothing out defect with crocus cloth. After minor repairs were made, all top land bores were approved as being satisfactory.

B. "P" Unit

(1) Zy-glo testing on Top Edges of Tubes on Both Sides of Assembly.

As a result of finding laminations, cracks and other mechanical defects in the large tubes in the "R" bottom tube sheet, covered in Section 14A-(3) of this manual, it was decided to zy-glo the ends and bores of all large tubes in the "P" unit bottom tube sheet to determine their final disposition.

The zy-glo process was followed in its entirety (See section 14A-(3) of this manual for procedure) and all of the 673 tubes were tested on top edges and bores for determining presence of laminations or cracks. All were found to be satisfactory. However, a crack 1-3/8" long was found in the top side of top plate ¼" from the fillet weld on tube X11-Y75. This cracked area was chipped to a size of 2½" long x 3/8" wide x 5/32" deep, ground smooth, zy-gloed, and then welded. After welding, it was ground smooth and zy-gloed, and accepted as being satisfactory.

(2) Facing Operation and Inspections

The bottom tube sheet assembly was set up and leveled bottom side up under three radial drill presses by New York Ship mechanics and checked by du Pont inspectors using the Wild NIII Precision Level and target. Next, preparations were made to ream all "spider web tubes" at the top and bottom weld necks in the bores. This reaming was necessary in order that the "hour glass effect" (shrinkage) at the weld line (caused from welding tube to tube sheet) on the I.D. of the tubes could be reamed to original dimensions, allowing the bottom tube sheet verticality gage to pass through when the unit was bottom side up on the 20' mill table. No other tubes were reamed other than the spider web tubes" in this operation.

During the above tube reaming operation, the bottom side of the bottom tube sheet was laid out for the 12 bearing pads. (See du Pont drawing W-131564 for location

and specifications). The 12 bearing pads were fit, set, tack welded to layout, fully welded, dressed and welds dy-cheked and accepted.

The bottom tube sheet assembly was placed on a 20' mill (bottom side up) and preparations made for machining tube ends and the 12 bearing pads. First, the unit was set to the best verticality using the "spider web tubes" for verticality readings. (See Part III, Section II-L for use of verticality gage). This optimum position was obtained by shimming the unit to the required amount as indicated by previous sets of verticality readings. Results of these final readings are shown in Sketch #12.

After verticality of the unit was taken and accepted (with unit now clamped to the mill table), level readings were taken on five reference tubes. These level readings were taken with the Wild NIII Precision Level and target. The five reference tubes were: (1) X-54-Y48 (2) X15-Y9 (3) X2-Y48 (4) X15-Y87 and (5) X28-Y48. These level readings or bench marks were given to New York Ship's machinist for final set-up for machining the tube ends.

The bottom ends of the large tubes and 12 bearing pads were finished machined to drawing sizes, then deburred, inspected and found satisfactory. Exhibit #7 presented herewith covers all inspections made on bottom side of this unit.

After the bottom side was inspected and accepted, the unit was turned top side up for machining tube ends on this side to finish size. The top ends of all large tubes were machined to drawing size, tubes deburred and then inspected. Exhibit #8 presented herewith covers all inspections made on the top side of this unit.

(3) Tube Reaming Operation

This operation was performed in a similar manner to that described in Section 12A-(2) of this manual.

(4) Tube Repairs

a. Bottom Land I.D.

Visual inspection of tube ends on the bottom side of the bottom tube sheet after facing and reaming tubes revealed that eight tubes had been distorted or "caved in" on the bottom end tube wall. This condition resulted from feeding the cutting tool too deep during facing of the bottom tube ends. As shown in drawing 2-4, the large tube bottom land I.D. was machined to finished dimensions prior to assembling and welding into the unit. Since tube bottom lands were to finish size, it was decided to repair the tubes rather than replace them with new ones. To bring the tube bores within tolerance, the eight (8) tubes

REPORT # 179-P Ex 5-5

VERTICALITY MEASUREMENTS

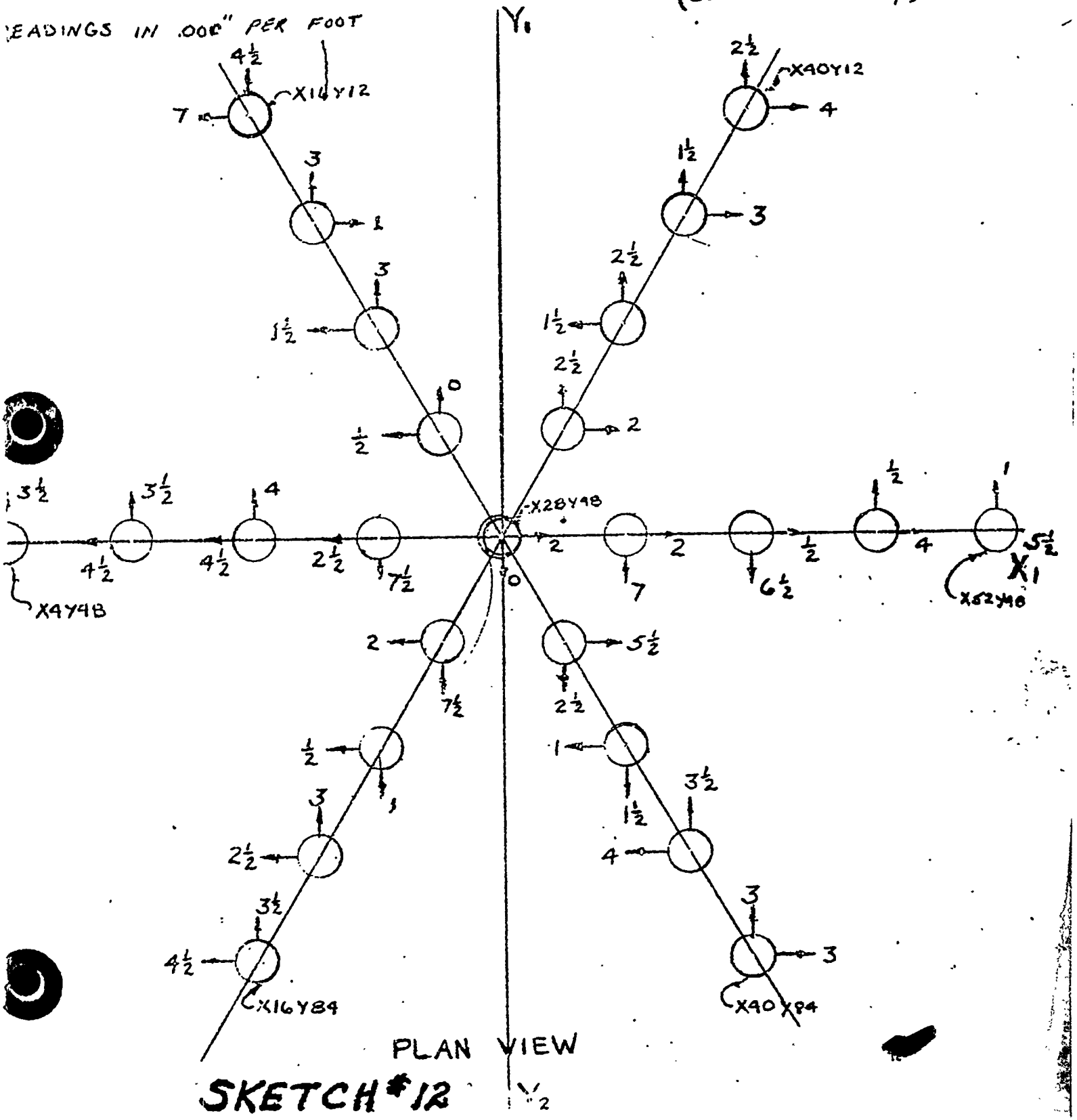
[redacted] BTS 3-2

7-22-52

ORDER Frandsen-Potts

STRUMENT Leland-DeBIKE

NOTE: Average Verticality of "P" UNIT Bottom Tube Sheet Before FACING Ends of Tubes (Bottom Side Up)



PLAN VIEW

SKETCH #12

EXHIBIT #7

INSPECTIONS PERFORMED AFTER MACHINING TUBE ENDS AND TWELVE BEARING PADS ON BOTTOM SIDE OF "P" BOTTOM TUBE SHEET ASSEMBLY.

E. I. DU PONT DE NEMOURS & CO., INC.

Construction Division

[redacted]

Report Number 163-P

CC: C. E. Buckley, F.P.M.
R. K. Mason, F.P.M.-SRP-3
H. L. Bunker -J.G.Brewer
J. G. Brewer
H. B. Gage
F. C. Breuninger
A. H. Hughes
R. H. Potts (4)
C. W. Dunn - File

August 6, 1952
New York Ship - Camden, N.J.

This material contains information affecting the national defense of the United States within the meaning of the espionage laws, Title 18, U.S.C., Secs. 793 and 794, the transmission or revelation of which in any manner to an unauthorized person is prohibited by law.

FIELD INSPECTOR'S REPORT

TO C. J. VEITH - M & E FILE
R. E. Chaney, R. W. Mease, R. R. Baker

FROM C. H. Heist, D. J. Smathers DATE July 28, 1952

PROJECT NO. 8980 PLANT Savannah River ORDER NO. AXC-167½

EQUIPMENT Bottom Tube Sheet EQ.PC.NO. 153-P

DRAWING NOS. W-131395 & W-131400 JOB RATING

VENDOR New York Shipbuilding Corporation LOCATION Camden, N. J.

Scope: Measurements made on the following after machining bottom ends of tubes and bottom surfaces of 12 bearing pads.

1. Bottom ends of tubes in rows X-28 & Y-48 to determine deviations, if any, of end surfaces of tubes from a plane.
2. Bottom surface of 12 bearing pads.
   A. To determine deviations, if any, of bottom surfaces of bearing pads from a plane.
   B. To determine surface finish in r.m.s. micro inches of bottom surfaces of bearing pads.
3. Tube ends and bottom surface of bearing pads to determine if plane of tube ends and plane of bottom surface of bearing pads are parallel.

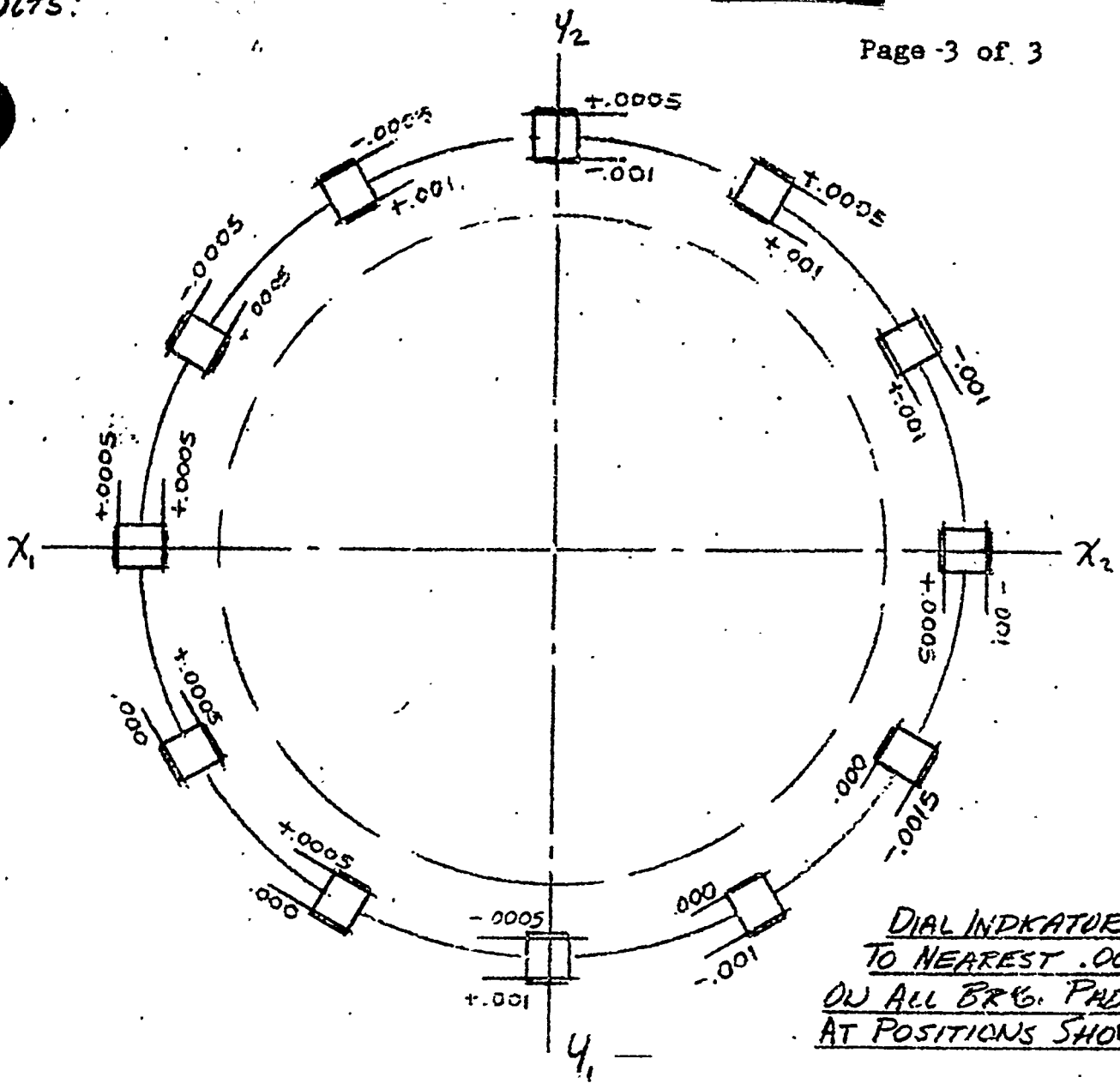
Procedure:

1. With tube sheet clamped to the mill table in a bottom side up position, a straight edge was placed on the X1-X2 axis (row Y-48). Measurements were obtained by inserting "feeler" gages between the tube ends and straight edge. Above procedure repeated for Y1-Y2 axis (row X-28).

2a. With a dial indicator clamped to the tool post of the boring mill at an elevation such that the bottom surfaces of the bearing pads could be indicated, readings were taken on each of the 12 bearing pads by revolving the tube sheet with the mill table.

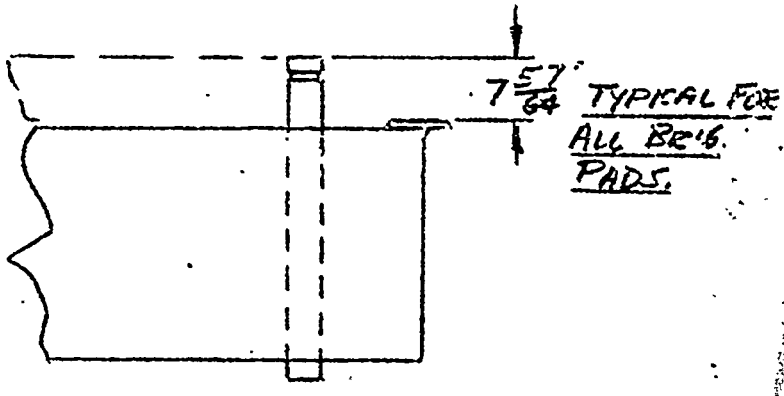
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RESULTS:



DIAL INDICATOR RD'GS TO NEAREST .0005" ON ALL BRG. PADS. TAKEN AT POSITIONS SHOWN.

TANK BOTTOM TUBE SHEET - BOTTOM VIEW (PART 2.A.)



SECTION THRU X_1-X_2 (PART 3)

2b. Surface finish of bearing pads determined by means of a profilometer.

3. Parallel check of 2 planes, (plane of tube ends and plane of bearing pads), by measuring distance from bottom surface of bearing pads to end surface of tubes.

Results: 1. Plane of tube ends: Inspectors: Chaney, Mease, Baker; Date: July 27, 1952

Tube	Clearance	Tube	Clearance	Tube	Clearance
X-54, Y-48	.000"	X-52, Y-48	.000"	X-28, Y-90	.000"
50 "	.000"	2 "	.000"	" 84	.000"
48 "	.0015"	4 "	.000"	" 78	.000"
46 "	.002"	44 "	.002"	" 72	.006"
42 "	.000"	40 "	.002"	" 66	.004"
38 "	.000"	36 "	.000"	" 60	.005"
34 "	.000"	32 "	.000"	" 54	.006"
30 "	.000"	28 "	.004"	" 48	.008"
26 "	.003"	24 "	.000"	" 42	.006"
22 "	.000"	20 "	.000"	" 36	.003"
18 "	.000"	16 "	.000"	" 30	.002"
14 "	.000"	12 "	.000"	" 24	.002"
10 "	.000"	8 "	.000"	" 18	.0015"
6 "	.000"			" 12	.000"
				" 6	.000"

2a. See attached sketch.
b. 50 r.m.s. micro inches surface finish.
3. See attached sketch.

lmw

EXHIBIT #8

INSPECTIONS PERFORMED AFTER MACHINING TUBE ENDS ON TOP SIDE OF "P" BOTTOM TUBE SHEET ASSEMBLY.

E. I. DU PONT DE NEMOURS & CO.

Construction Division

[redacted]

Report Number 195-P

CC: C. E. Buckley, F.P.M.
R. K. Mason, F.P.M.-SRP (3)
H. L. Bunker - J. G. Brewer
J. G. Brewer
H. B. Gage
F. C. Breuninger
A. H. Hughes
~~R. H. Petts (4)~~
C. W. Dunn - File

August 22, 1952
New York Ship - Camden, N. J.

FIELD INSPECTOR'S REPORT

This material contains information affecting the national defense of the United States within the meaning of the espionage laws, Title 18, U.S.C., Secs. 793 and 794, the transmission or revelation of which in any manner to an unauthorized person is prohibited by law.

TO C. J. VEITH - M & E FILE
M. H. Scholes

FROM L.W. Mergenthaler, I.R.Louder, W.J.Laughlin DATE August 18, 1952

PROJECT NO. 8980 PLANT Savannah River ORDER NO. AXC-167

EQUIPMENT Bottom Tube Sheet EQ.PC.NO. 153-P

DRAWING NOS. W-131395 JOB RATING

VENDOR New York Shipbuilding Corporation LOCATION Camden, N. J.

Scope:

1. To determine if tube ends (3-15/16" O.D. Tubes) on top side of tube sheet are located in same plane.
2. To determine if bearing pads are located in same plane.
3. To determine if plane of tube ends and plane of bearing pads are parallel.

Results:

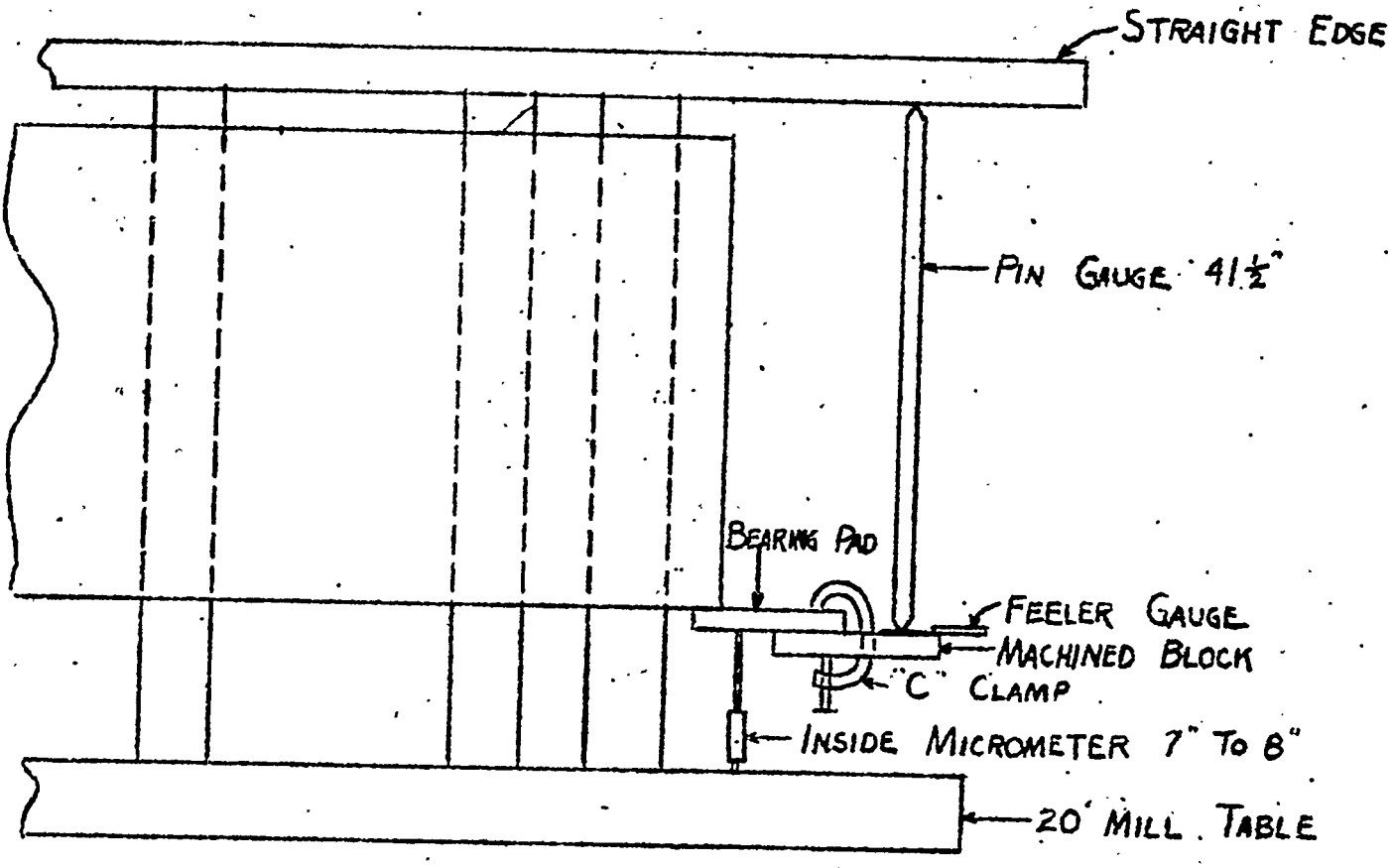
See attached sheets

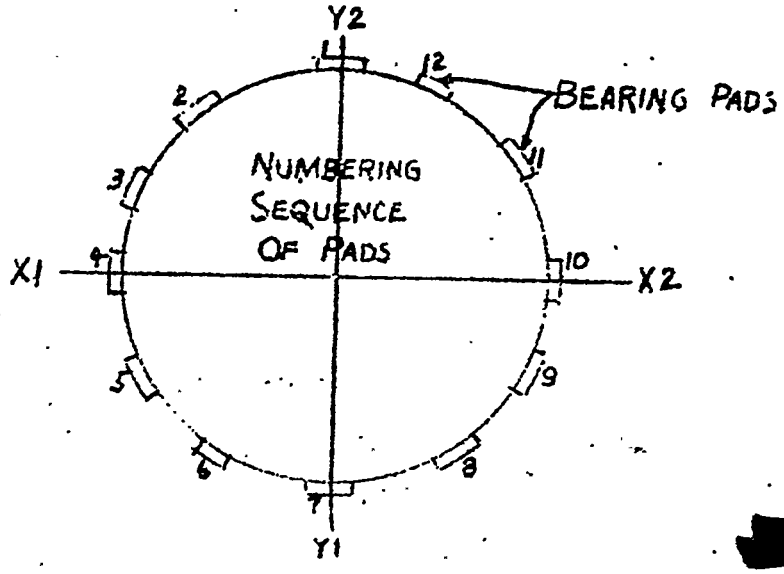
lmw
Attach. 2

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[redacted] P UNIT BOTTOM TUBE SHEET

METHOD USED TO CHECK TUBE LENGTHS





[redacted]

AXIS $X_2 - X_1$	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	
VARIATION IN .001"	0	0	-2	0	-2	-4	-4	-3	-4	-4	-4	-4	-3	-7	-4	-3	-4	-3	-4	-3	-4	-3	-5	-3	0	-1.5	0	
AXIS $Y_1 - Y_2$	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90													
VARIATION IN 001"	-2	-3	-4	-5	-5	-3	-3	-9	-4	-4	-4	-4	-4	-2	-1.5													

LENGTH OF THE TUBES (PIN GAUGE & FEELER GAGES)

POSITION	Y_2			X_1		Y_1				X_2		
PAD NO	1	2	3	4	5	6	7	8	9	10	11	12
LENGTH TO BEARING PAD	41.503	41.5015	41.501	41.502	41.498	41.501	41.4995	41.500	41.501	41.503	41.500	41.502
LENGTH OF TUBE	49.409	49.404	49.404	49.410	49.405	49.410	49.4055	49.403	49.405	49.412	49.407	49.406
CHECK OF THE PLANE OF PADS	1 +.001 +.002	2 -.001 -.001	3 -.001 -.001	4 BASE	5 +.001 +.001	6 +.003 +.003	7 +.006 +.006	8 +.002 +.002	9 0 0	10 +.002 +.002	11 +.002 +.002	12 +.001 +.002

METHOD OF TAKING MEASUREMENTS

CHECKING PLANE OF TUBE TOPS - 18" STRAIGHT EDGE & FEELER GAUGES

CHECKING LENGTH OF TUBES TO THE BEARING PADS - 18" STRAIGHT EDGE LAYED ACCROSS THE TOPS OF TUBES & USING A PIN GAUGE & FEELER GAUGES TO CHECK FROM STRAIGHT EDGE TO BEARING PAD

*CHECKING OVERALL LENGTH - USING AN INSIDE MICROMETER - CHECKING THE DISTANCE FROM MILL TABLE TO THE BEARING PAD & ADDING TO PREVIOUS READINGS.

CHECKING PLANE OF BEARING PADS - DIAL INDICATOR MOUNT ON THE MILL CUTTING HEAD.

*NOTE - (THE SURFACE OF THE MILL TABLE IS IN SUCH CONDITION SO AS TO MAKE THE ACCURACY OF THESE READINGS ± .008 - .010)

were shrunk by welding a series of beads around the bottom O.D. of the tube. Heli-arc welding without filler metal was used to shrink all eight tubes. After shrinking the bottom land bore was reamed to drawing size (3.376" - 3.282") and honed. The tubes were then inspected for bore size and finish. Results of this inspection was as follows:

BORE DIAMETER

Tube Number	X	Y	RMS
X21-Y9	3.378	3.379	30
X9-Y51	3.380	3.380	40
X13-Y51	3.380	3.381	15
X11-Y57	3.376	3.377	15
X21-Y81	3.379	3.379	40
X18-Y84	3.378	3.377	35
X50-Y54	3.382	3.384	40
X35-Y45	3.378	3.379	30

All of the above tubes were within drawing tolerance except tube number X50-Y54 which was 0.002" oversize in the Y direction; nevertheless, this tube was accepted. The finish of all tube bores were well within the specified 63 RMS micro-inch as noted in the above table.

Next, the bottom land finish and bore diameters were checked. The specified finish was 63 RMS micro-inches. The bottom land finish was checked using a profilometer. The specified bore diameters were measured using a standard dial indicator bore gage and ring gage. Bores were measured in two directions - parallel to the XX axis and parallel to the YY axis. Measurements were taken down approximately 1" from the bottom end of the tube. For results of this inspection, see Exhibit #9. By examining this exhibit, it can be seen that many of the bottom land bores did not meet the required finish specifications of 63 RMS micro-inches, and in addition, many of the bore diameters were oversize. To correct the above discrepancy, it was necessary to improve the finishes of three tubes that required it by one of two methods; namely, (1) cloverleafing (2) improve finish in spots using crocus cloth. In some cases it was necessary to "heli-arc" shrink the O.D. of the tube to provide sufficient metal in the bores for cloverleafing or honing to the repuired finish and at the same time, maintain the specified bore diameter. Bore diameters that were oversize were "heli-arc" shrunk until the diameters were within the specified range as determined by measuring with a bore gage and ring gage. After all tube repair work was completed, finishes and bore diameters were re-checked in a similar manner described above. All

EXHIBIT #9

RESULTS OF INITIAL BOTTOM LAND BORE FINISHES AND DIAMETERS.

I. DU PONT DE NEMOURS & CO., INC.

Construction Division

[redacted]

Report Number 189-P

CC: C. E. Buckley, F.P.M.
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H. L. Bunker - J. G. Brewer
J. G. Brewer
H. B. Gage
F. C. Breuninger
A. H. Hughes
R. H. Potts (4)
C. W. Dunn - File

August 18, 1952
New York Ship - Camden, N. J.

#12

FIELD INSPECTOR'S REPORT

This material contains information affecting the national defense of the United States within the meaning of the espionage laws, Title 18, U.S.C., Secs. 793 and 794, the transmission or revelation of which in any manner to an unauthorized person is prohibited by law.

TO C. J. VEITH - M & E FILE

FROM R. V. Graham DATE August 14, 1952

PROJECT NO. 8980 PLANT Savannah River ORDER NO. AXC-167½

EQUIPMENT Tank Bottom Tube Sheet EQ.PC.NO. 153-P

DRAWING NOS. W-130947 JOB RATING

VENDOR New York Shipbuilding Corporation LOCATION Camden, N. J.

Scope: The bottom bore of all tubes in the subject tube sheet was checked for diameter and finish. The following is a list of tubes that do not meet drawing specifications. Also included is the RMS finish as determined with a profilometer and two bore measurements for each tube.

Results: See attached sheets.

Note: Specified bore is 3.376" to 3.382".
Zero Bore gage setting was 3.375" and measurements are recorded as - .000" of this basic setting.

lmw
Attach. 4

[redacted]

TUBE X	TUBE Y	BORE X	BORE Y	FINISH RMS	TUBE X	TUBE Y	BORE X	BORE Y	FINISH RMS
29	93	+4	+4	70	22	84	+2	+1	150
20	90	+2	+2	80	18	84	+7	+6	200
24	90	+3	+2	70	16	84	+2	+1	200
30	90	+2	+1	130	14	84	-1	-2	65
34	90	+1	-1	80	9	81	cut	out	200
38	90	0	+1	70	11	81	+3	+3	85
40	90	+5	+2	130	15	81	+3	+3	140
13	87	+3	+1	80	17	81	+4	+3	85
17	87	+7	+6	80	19	81	+2	+1	70
19	87	+5	+7	70	21	81	+10	+8	160
21	87	+4	+2	175	23	81	+4	+3	85
27	87	+4	+3	110	27	81	+1	+3	80
41	87	+3	+3	70	31	81	+1	+3	70
44	84	+3	+2	70	33	81	+3	+2	150
34	84	+3	+2	90	35	81	+1	+1	125
30	84	+5	+3	70	37	81	+2	+2	110
28	84	+4	+3	80	41	81	+3	+4	125
26	84	+5	+4	100	48	78	+1	+1	80
46	78	+2	+4	80	14	72	+3	+2	160
[illegible]	78	+5	+3	165	12	72	+3	+2	125
[illegible]	78	+3	+3	90	10	72	+1	+2	110
[illegible]	78	+1	+1	125	51	69	+7	+5	225
36	78	+1	+1	150	45	69	+6	+6	70
32	78	+3	+3	80	41	69	+7	+7	75
30	78	+1	+2	140	39	69	+3	+3	90
28	78	+9	+6	75	37	69	+4	+4	120
24	78	+4	+3	70	33	69	+3	+3	70
22	78	+3	+2	120	31	69	+2	0	90
18	78	+1	+1	90	29	69	+4	+5	165
16	78	+3	+2	180	27	69	+5	+3	175
14	78	+4	+4	80	25	69	+2	+2	115
12	78	+4	+3	80	23	69	+4	+2	100
10	78	+5	+5	125	21	69	+5	+3	80
8	78	+2	0	70	19	69	+4	+4	75
11	75	+4	+1	180	17	69	+6	+7	140
17	75	+5	+3	230	15	69	+3	+3	105
21	75	+3	+3	80	13	69	+4	+2	125
33	75	0	+2	125	11	69	+1	+3	120
35	75	0	+3	110	9	69	+3	+4	100
43	75	+3	+5	165	50	66	+3	+4	150
45	75	+2	+4	130	44	66	+2	+4	80
38	72	+2	+3	115	36	66	+3	+4	150
36	72	+3	+3	140	34	66	+3	+4	145
28	72	+4	+5	120	32	66	+2	+3	125
[illegible]	72	+2	+2	80	30	66	+2	+2	115
[illegible]	72	+4	+4	70	28	66	+1	0	110
[illegible]	66	+1	+4	230	2	60	+2	+3	80
[illegible]	66	+5	+4	125	53	57	+4	+3	190
16	66	+2	+3	165	51	57	+4	+4	135

TUBE X	TUBE Y	BORE X	BORE Y	FINISH RMS
14	66	+6	+5	100
10	66	+5	+5	95
8	66	+4	+4	75
6	66	+3	+2	120
3	63	+2	+3	140
9	63	+3	+4	95
19	63	+4	+3	165
21	63	+3	+3	70
25	63	+3	+2	80
55	63	+5	+6	85
39	63	+2	+3	130
41	63	0	+1	125
43	63	+4	+5	110
47	63	+5	+5	80
40	60	+1	+2	90
38	60	+2	+2	70
34	60	+5	+6	75
32	60	+2	+2	75
[illegible]	60	+3	+3	85
[illegible]	60	+1	0	90
[illegible]	60	+4	+4	80
[illegible]	60	+4	+4	110
14	60	+4	+2	100
12	60	+4	+4	90
4	60	+3	+3	120
8	54	+3	+5	80
4	54	+5	+4	170
1	51	+3	+2	130
3	51	+2	+3	70
5	51	0	+1	70
9	51	+7	+7	190
11	51	+3	+2	130
13	51	+8	+6	70
15	51	+2	+2	150
17	51	+3	+2	80
21	51	+2	+2	110
23	51	+4	+1	80
27	51	+2	+5	110
33	51	+5	+4	100
35	51	+4	+4	100
39	51	+3	+3	80
41	51	0	-1	60
47	51	-1	+3	100
49	51	+3	+4	220
[illegible]	51	+3	+2	70
[illegible]	51	+3	+3	70
[illegible]	51	0	+3	110
[illegible]	48	+5	+7	110
52	48	+2	+5	140

TUBE X	TUBE Y	BORE X	BORE Y	FINISH RMS
49	57	+5	+5	70
47	57	+4	+4	75
39	57	+1	+1	200
37	57	+3	+3	120
35	57	+2	+2	110
33	57	+2	+1	80
25	57	+3	+2	115
21	57	0	0	85
17	57	+4	+3	150
15	57	+5	+4	110
11	57	+3	+10	130
5	57	+1	+5	120
3	57	+3	+2	110
54	54	+4	+5	160
50	54	+4	+4	190
48	54	+2	+4	180
46	54	+5	+7	80
42	54	+3	+2	80
40	54	+1	+3	70
36	54	+6	+4	70
24	54	+2	+1	80
22	54	+8	+9	30
20	54	0	0	60
14	54	+5	+4	150
12	54	+5	+6	160
14	48	+7	+5	90
12	48	+5	+7	80
8	48	+1	+3	80
6	48	+1	+5	80
4	48	+1	+5	90
55	45	+3	+5	120
47	45	+5	+3	100
41	45	+3	+3	160
39	45	+3	+2	200
37	45	+3	+4	70
35	45	+3	+7	70
31	45	+5	+3	150
29	45	+4	+3	120
17	45	+3	+4	70
15	45	0	+1	150
13	45	+4	+3	220
9	45	+4	+3	250
7	45	+3	+3	70
5	45	+4	+2	70
3	45	+3	+3	100
1	45	+5	+6	160
4	42	+3	+3	170
8	42	+2	+1	70
10	42	+5	+6	200

TUBE X	TUBE Y	BORE X	BORE Y	FINISH RMS
48	48	+2	+5	150
46	48	-1	+2	160
20	48	+1	+7	70
18	48	+3	+1	120
48	42	+5	+4	120
50	42	+4	+3	70
54	42	+2	+3	110
53	39	0	0	65
51	39	+3	+4	70
49	39	+2	+4	80
41	39	+2	+4	100
39	39	+5	+3	100
37	39	+2	+2	250
29	39	+4	+4	80
27	39	+8	+7	80
25	39	+8	+5	90
19	39	+2	+2	90
7	39	+5	+3	110
4	36	+2	+4	90
[redacted]	36	+5	+5	90
[redacted]	36	+3	+3	120
[redacted]	36	+5	+6	70
20	36	+5	+5	100
24	36	+3	+1	70
32	36	+8	+7	80
34	36	+6	+5	80
46	36	+4	+3	80
52	36	+4	+4	110
53	33	+5	+5	150
51	33	+3	+1	100
49	33	+3	+4	100
47	33	+8	+5	70
8	24	+2	-1	100
10	24	+3	+4	90
12	24	+7	+9	60
14	24	+5	+3	70
18	24	+2	+1	90
20	24	+2	+1	190
22	24	+3	+2	110
26	24	+3	+3	70
42	24	+3	+1	150
44	24	+3	+7	150
46	24	+4	+2	100
47	21	+3	+2	100
[redacted]	21	+1	+2	90
[redacted]	21	+2	0	100
[redacted]	21	+2	+2	120
[redacted]	21	+3	+3	80
37	21	+3	+3	70

TUBE X	TUBE Y	BORE X	BORE Y	FINISH RMS
12	42	+4	+3	150
14	42	+1	+1	140
24	42	+8	+5	70
46	42	+5	+4	70
43	33	+5	+5	110
41	33	+5	+4	110
37	33	+5	+3	70
7	33	+5	+2	80
3	33	+4	+3	70
6	30	+3	+4	70
8	30	+4	+4	80
10	30	+6	+4	100
22	30	+7	+7	70
24	30			70
26	30	+2	+1	90
36	30	+5	+3	80
50	30	+5	+3	80
47	27	+1	+1	110
43	27	+2	+2	150
41	27	+7	+7	110
37	27	+12	+10	160
33	27	+3	+3	70
31	27	+5	+3	100
27	27	+3	+2	130
25	27	+4	+5	70
23	27	+2	+4	100
21	27	+3	+4	100
17	27	+4	+3	110
15	27	+3	+5	150
7	27	+8	+5	90
5	27	+5	+3	150
6	24	+3	+1	70
8	18	+2	+2	120
14	18	+3	+1	80
16	18	+2	+4	90
24	18	+4	+1	90
26	18	+1	+1	100
28	18	+2	+2	120
30	18	+4	+2	110
34	18	+3	+2	120
38	18	+2	+2	90
40	18	+1	+1	100
42	18	+2	+2	110
47	15	+2	+3	110
43	15	+2	+2	120
39	15	+2	+1	120
33	15	+1	+2	100
29	15	+1	+1	90
25	15	+1	+3	150

[redacted]

TUBE X	TUBE Y	BORE X	BORE Y	FINISH RMS
35	21	±4	±5	100
33	21	±2	±2	80
29	21	±4	±2	90
27	21	±4	±4	110
25	21	±2	±2	70
23	21	±5	±2	90
15	21	±5	±9	90
13	21	±1	±1	80
11	21	±6	±6	110
9	21	±6	±3	70
7	21	±3	±3	100
28	12	±2	±2	130
34	12	±3	±2	110
40	12	±4	±3	100
44	12	±2	±2	110
39	9	±1	±2	80
33	9	±3	±2	110
23	9	±4	±3	170
[illegible]	9	±2	±1	200
[illegible]	6	±2	±2	160
[illegible]	6	±2	±4	100
[illegible]	3	±4	±4	100
31	3	±3	±4	80
27	3	±5	±5	90
23	3	±3	±3	80

TUBE X	TUBE Y	BORE X	BORE Y	FINISH RMS
23	15	±4	±3	150
21	15	±3	±2	90
17	15	±2	±1	90
12	12	±5	±3	100
14	12	±1	±2	110
16	12	±3	±3	140
18	12	±5	±4	130
20	12	±1	±2	80
22	12	±2	±2	130
24	12	±2	±3	80
28	12	±2	±2	130
30	12	±2	±3	150
36	12	±3	±3	110
42	12	±4	±3	80
41	9	±2	±2	150
35	9	±5	±3	90
27	9	±5	±4	110
21	9	±3	±4	120
15	9	±3	±4	160
20	6	±1	±1	150
40	6	0	0	50
33	3	±4	±4	140
29	3	±3	±4	100
25	3	±2	±2	130
21	3	±2	±1	150

inspections were satisfactory and approved by the du Pont Inspection Department. For final results of these inspections, see exhibit #10.

b. Top Land I.D.

Inspection and repair of the top land I.D. of large tubes in the "P" bottom tube sheet was performed in a similar manner to that described in Section 12A-(3)b of this manual. Results of this final inspection are covered in Exhibit #10.

C. "L" Unit

(1) Facing Operation and Inspections.

The bottom tube sheet was set up and leveled bottom side up under three radial drills presses by New York Ship mechanics and checked by du Pont inspectors using the Wild NIII Presision Level and target. Next, preparations were made to ream all "spider web tubes" at the top and bottom weld necks in the bores. This reaming was necessary in order that the "hour glass effect" (shrinkage) at the weld line (caused from welding tube to tube sheet) on the I.D. of the tubes could be reamed to original dimensions, allowing the bottom tube sheet verticality gage to pass through when the unit was bottom side up on the 20' mill table. No other tubes were reamed other than the "spider web tubes" in this operation.

During the above tube reaming operation, the bottom side of the bottom tube sheet was laid out for the 12 bearing pads. (see du Pont Drawing W-133138 for location and specifications) (For a detail discussion of "L" unit bearing pad revisions and additional inspections, see section 22C of this manual.) The 12 bearing pads were fit, set and tack welded to layout, fully welded, dressed, and welds dy-cheked and approved.

The bottom tube sheet assembly was placed on a 20' mill (bottom side up) and preparations were made for machining tube ends and the 12 bearing pads. First, the unit was set to the best verticality readings. (See Part III, section II-L for use of verticality gage). The unit was resting on four blocks while on the mill. The bottom tube sheet assembly was shimmed at these blocks until a satisfactory verticality pattern was obtained. Results of these final readings are shown in Sketch #13.

After verticality of the unit was taken and accepted (with unit now clamped to mill table), the Wild Level was used to establish the elevation of tube ends on the extremities of the X and Y axes and the middle tube. These five reference tubes were: (1) X54-Y48 (2) X15-Y9 (3) X2-Y48 (4) X15-Y87 and (5) X28-Y48 (middle tube in unit). The mill table was then rotated to each reference tube with a dial indicator affixed to the mill's cutting arm which registered to tube tops. The elevations that

EXHIBIT #10

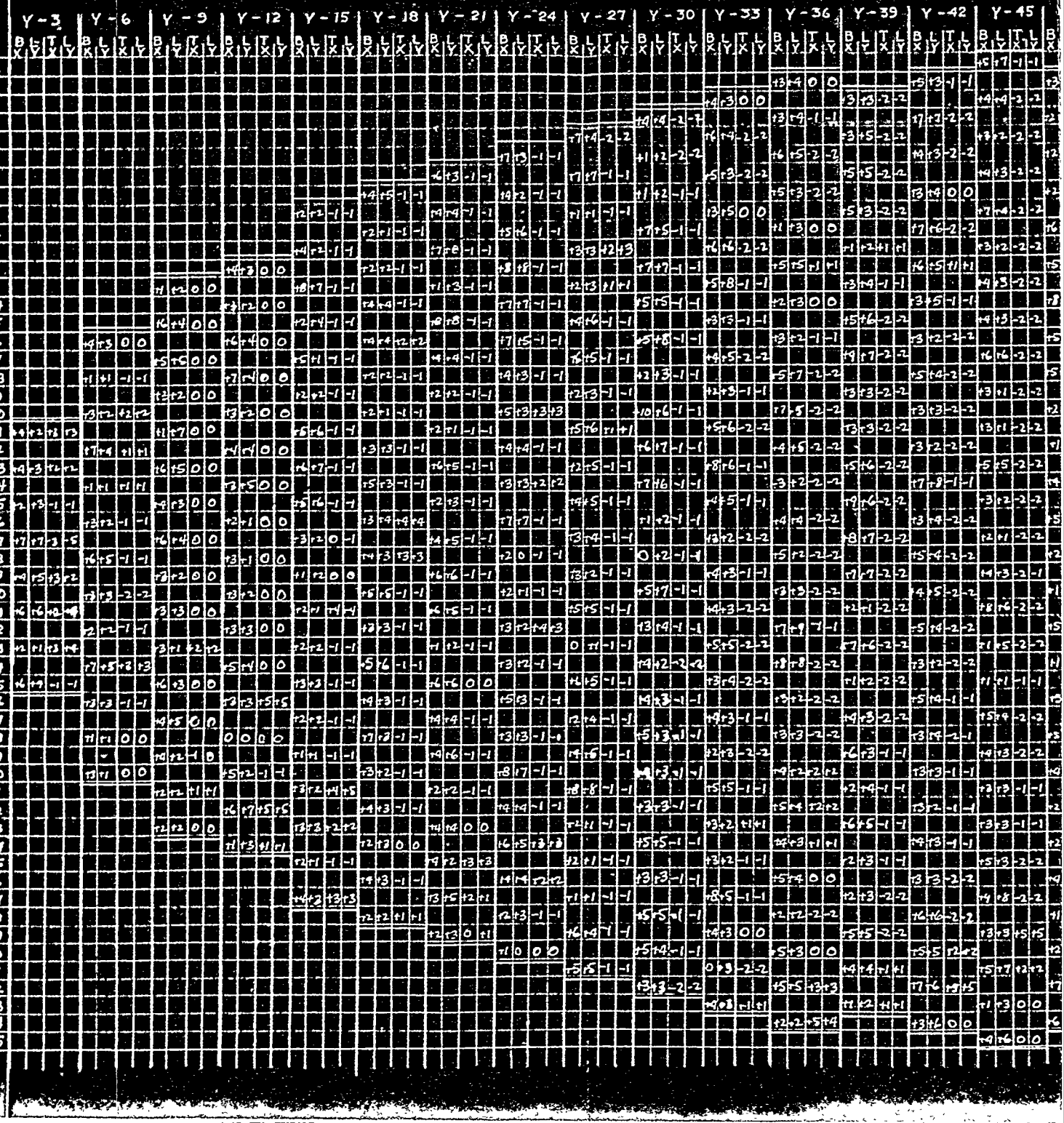
RESULTS OF FINAL BOTTOM LAND BORE FINISHES AND DIAMETERS.

~~BC~~
~~BTS~~
BTS

BORES

DATE

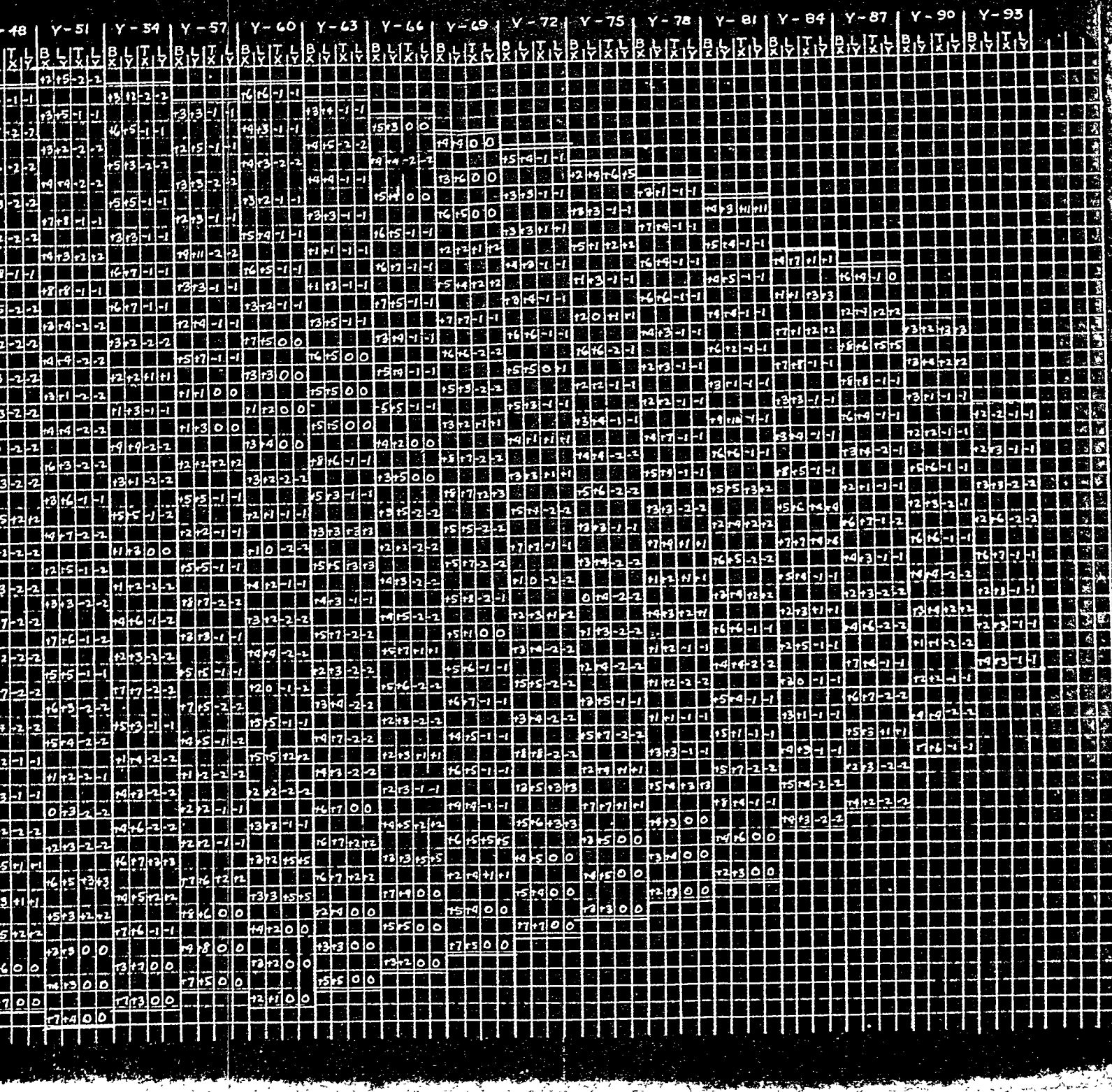
TOP LAND 8-11-52 To 9-1-52
BOTTOM LAND 8-13-52 to 9-1-52



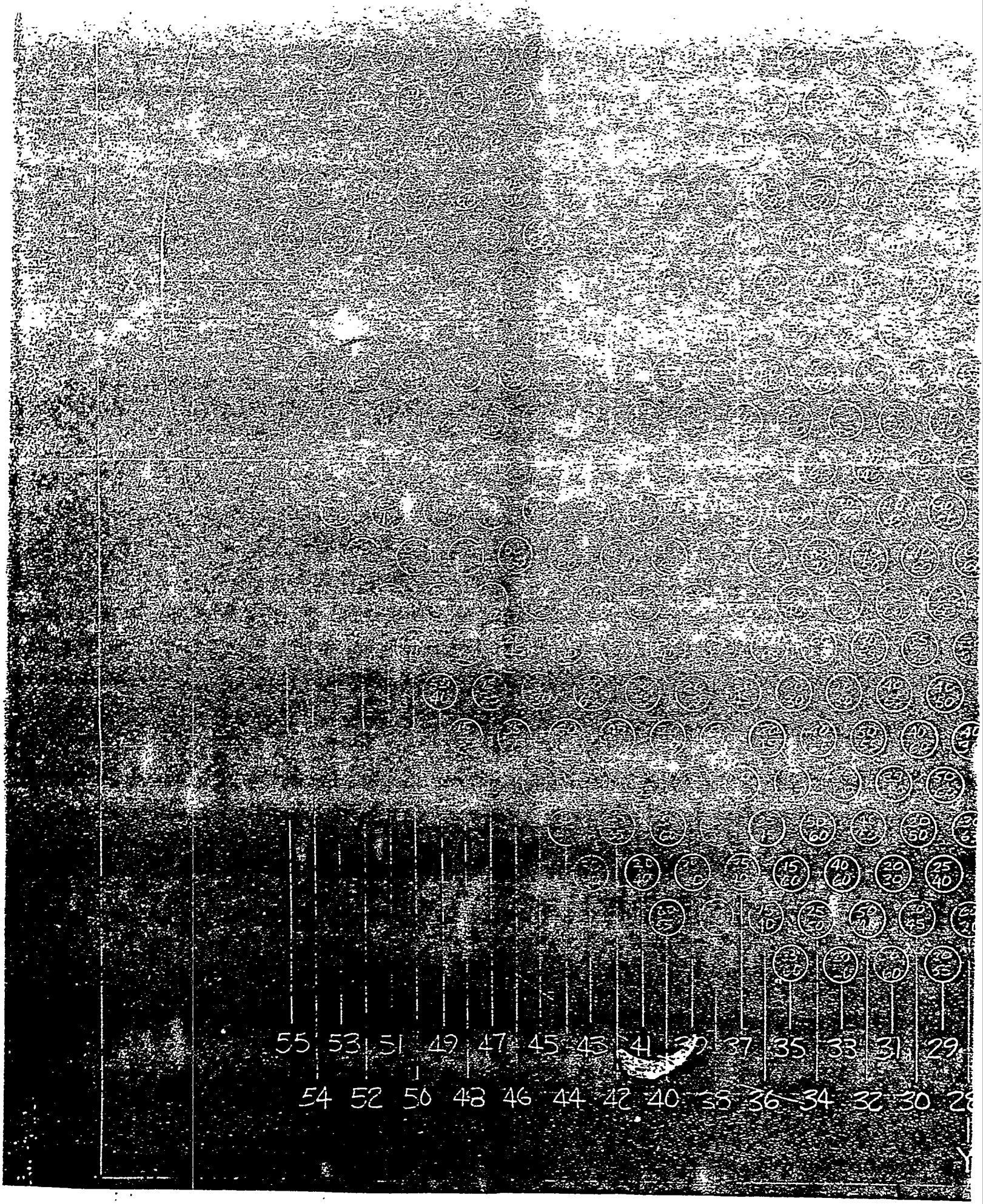
P-UNIT

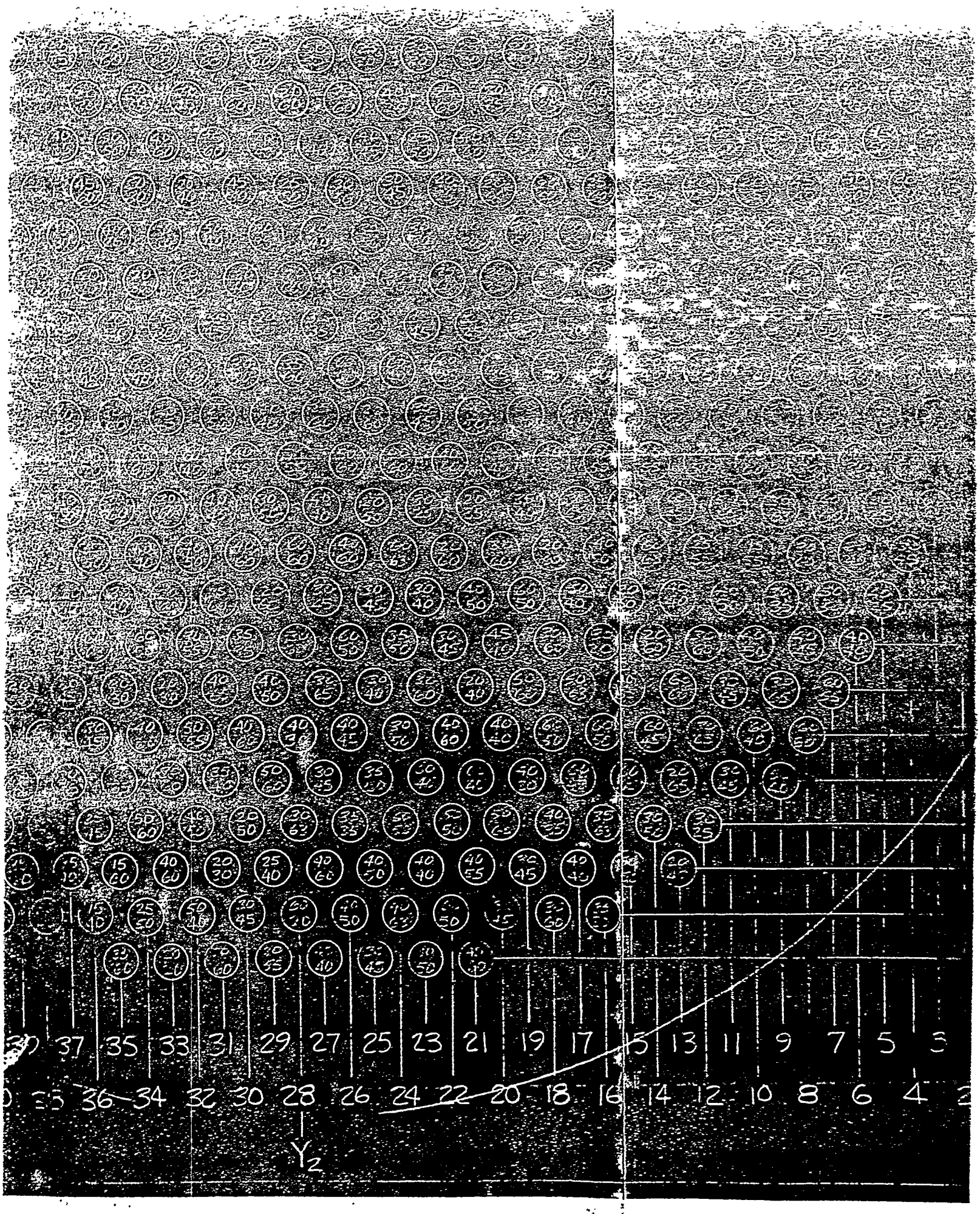
BASIC ID

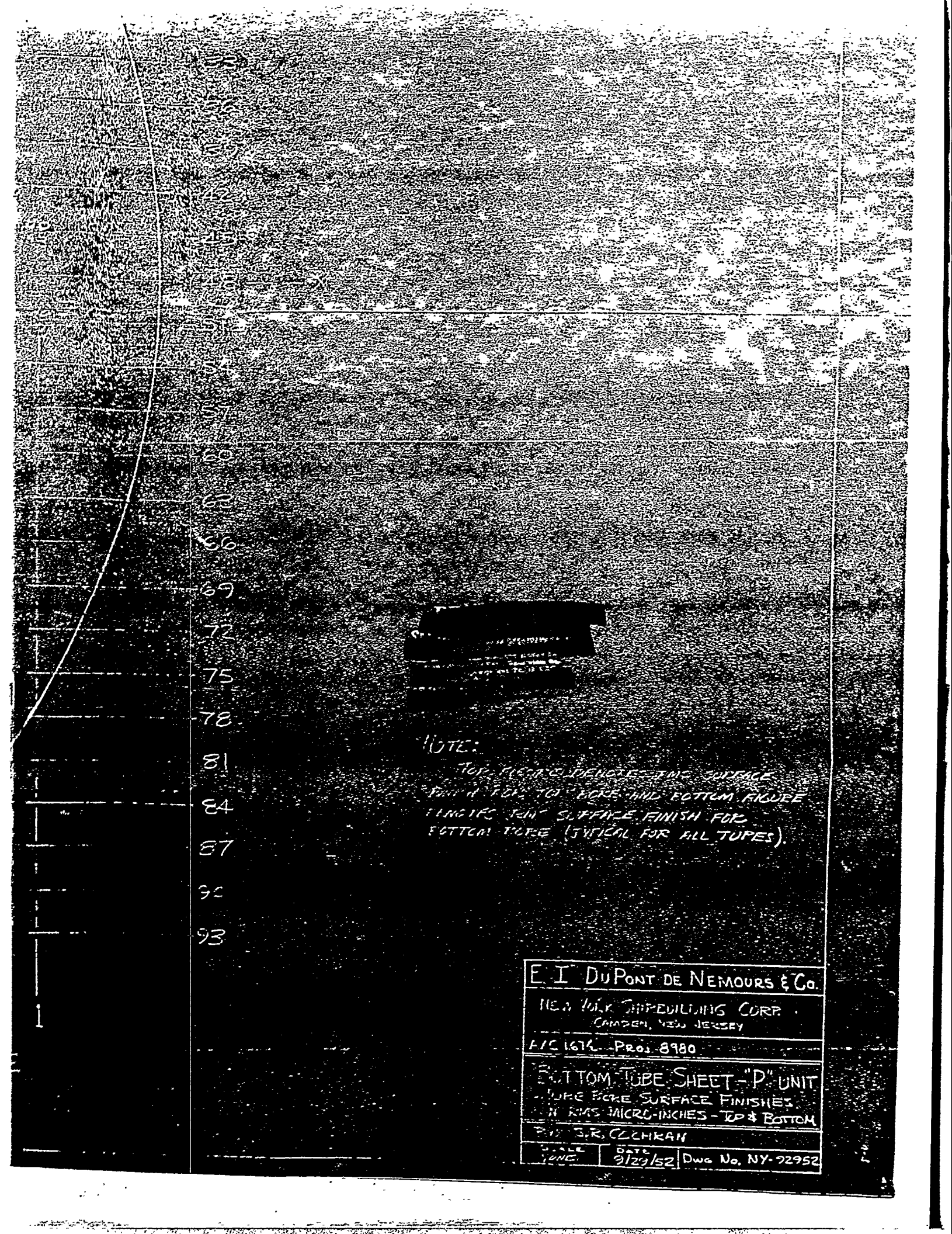
TOP LAND 3.272
BOTTOM LAND 3.375



[redacted]


55 53 51 49 47 45 43 41 39 37 35 33 31 29
54 52 50 48 46 44 42 40 38 36 34 32 30

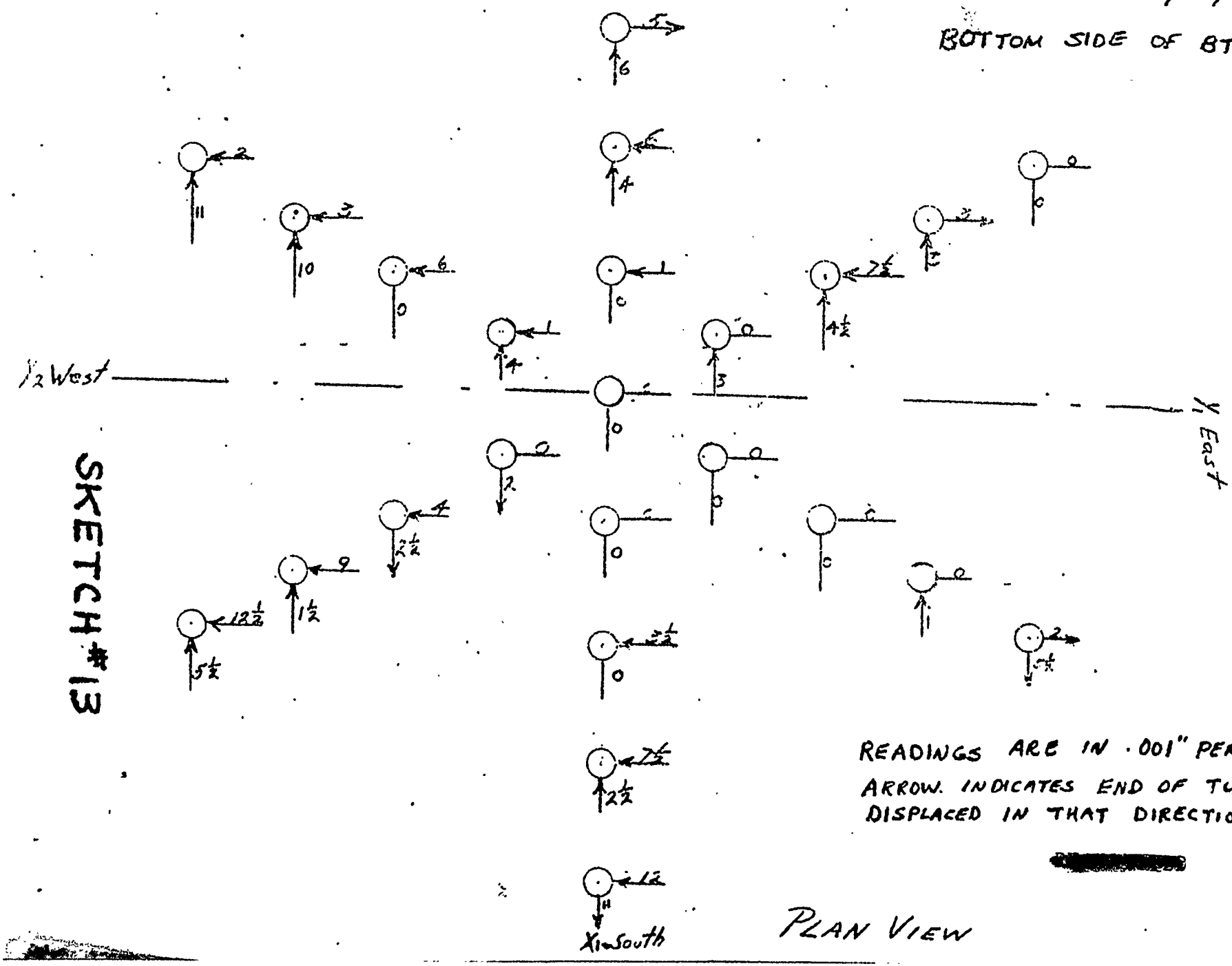

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Y_2


NOTE:
FOR FLOAT SHEET - FINE SURFACE FINISH FOR TOP BORE AND BOTTOM FLUTE FINISHES. COARSE SURFACE FINISH FOR BOTTOM TUBE (TYPICAL FOR ALL TUBES).
E. I. DuPONT DE NEMOURS & Co.
NEW YORK SHIPBUILDING CORP.
CAMDEN, NEW JERSEY
A/C 1676 - Proj. 8980
BOTTOM TUBE SHEET - "P" UNIT
TUBE BORE SURFACE FINISHES
N RMS MICRO-INCHES - TOP & BOTTOM
S.R. COCHRAN
SCALE 1/2" = 1"
DATE 9/29/52
Dwg No. NY-92952

2 UNIT TANK B[illegible]
Spider web ver[illegible] prior
to machining off of tube top.

1/27/53

BOTTOM SIDE OF BT



SKETCH #13

READINGS ARE IN .001" PER FOOT.
ARROW INDICATES END OF TUBE IS
DISPLACED IN THAT DIRECTION.

PLAN VIEW

EX-45-1

were established on the tubes were then duplicated by shimming the unit under the cutting arm as noted on the dial indicator. In this manner the twist in the mill table was compensated for so that the established verticalities would be duplicated when the unit placed in a level plane. The unit was then released to the machinist for facing tube ends and bearing pads.

The bottom ends of the large tubes and 12 bearing pads were finished machined to drawing sizes, then deburred, inspected and found satisfactory. Exhibit #11 presented herewith covers all inspections made on the bottom side of this unit.

After the bottom side was inspected and accepted, the unit was turned top side up for machining tube ends on this side to finish size. The top ends of all large tubes were machined to drawing size, tubes deburred and then inspected. Exhibit #11 covers all inspections and results taken on the top side of the unit.

(2) Tube Reaming Operation

This operation was performed in a similar manner to that described in Section 12A-(2) of this manual.

(3) Tube Repairs

a. Bottom Land I.D.

While the bottom tube sheet was bottom side up and after: (1) reaming the top land bore to finish size (3.270" to 3.277") and (2) removing the "hour glass effect" (caused from welding tube to bottom tube plate) by reaming the bottom end of tubes to original size (3.312" to 3.328"), du Pont inspectors checked the bottom land bore diameters using a standard dial indicator bore gage and ring gage. In addition, all bottom land finishes were checked using a profilometer. Many tubes were found to have finishes greater than the required 63 RMS. These tubes were honed until the required finish was obtained; being careful not to exceed the bottom land bore tolerance (3.376" to 3.382").

During the honing operation, one tube (X49-Y27) was honed 0.027" out-of-round. To correct this it was necessary to "heli-arc shrink" (without filler metal) the O.D. of the tube surrounding the bottom land bore to provide sufficient metal in the bore for honing to size. The bore was re-honed, inspected and accepted.

After all repairs were made, a preliminary re-inspection of bore sizes and finishes proved satisfactory. The unit was released for drilling dowell pin grooves in the bottom land bores of all large tubes. Section 13C covers this inspection, the problems encountered and how they were handled. Final results of bore diameters and finishes on the bottom lands are also covered in this section.

EXHIBIT #11

INSPECTIONS PERFORMED AFTER MACHINING TUBE ENDS AND 12 BEARING PADS ON THE BOTTOM SIDE AND TUBE ENDS ON THE TOP SIDE.

E. I. DU PONT DE NEMOURS & CO., INC.
Construction Division

[redacted]

Report Number 409-L

CC: H. W. Gosney, F.P.M.
R. K. Mason-D. A. Hauser
Savannah River Plant (3)
R. K. Mason-W. P. Duncan
Savannah River Plant (1)
H. L. Bunker - J. G. Brewer
J. G. Brewer
H. B. Gage
F. C. Breuninger
R. H. Barto (2) NYS
S. R. Cochran (2)
J. B. Johnson - File

March 6, 1953
New York Ship - Camden, N. J.

FIELD INSPECTOR'S REPORT

This material contains information affecting the national defense of the United States within the meaning of the espionage laws, Title 18, U.S.C., Secs. 793 and 794, the transmission or revelation of which in any manner to an unauthorized person is prohibited by law.

TO C. J. VEITH - M & E FILE

FROM A.Piatek, O.R.Frandsen, C.Heist, W.Laughlin DATE February 17,1953

PROJECT NO. 8980 PLANT Savannah River ORDER NO. AXC-167½

EQUIPMENT Tank Bottom Tube Sheet EQ.PC.NO. 153-L

DRAWING NOS. W-132760 - Rev. 14 JOB RATING

VENDOR New York Shipbuilding Corporation LOCATION Camden, N. J.

This is a report on the measurements taken on top and bottom side of the unit after the tubes and bearing pads were faced off on the 20 ft. boring mill. Inspection started February 5, 1953 and completed 2/7/53.

A. Profiles of tops and bottoms of tubes were taken with a 18ft. straight edge and feeler gages.

(1) Top Side:
The straight edge was placed on the row of tubes on the X1-X2 and Y1-Y2 axes. Feeler gages were then inserted between the straight edge and top of tubes to determine clearance between the straight edge and the top of tubes. See attached sketch.

(2) Bottom Side:
Same procedure was used as on the top side.

[redacted]

[redacted]

FIELD INSPECTOR'S REPORT Serial Number 409- L

FROM: Piatek/Frandsen/Heist/Laughlin

B. Measurement from tops of tubes to bottom of bearing pad.

(1) The straight edge was moved to a position where it was extending out over the unit on one side. A block was set under the bearing pad and jacked up flush with the bottom of the pad. A pin, 41.450 inches in length, was placed between the straight edge and the block. By inserting feelers between the pin and the straight edge, the exact length from top of tubes to bottom of bearing pad was determined. This was done at all 12 bearing pads.

(2) The finish of all 12 bearing pads was determined with a profilometer.

(3) The overall length of tubes was taken with a pin and a straight edge.

The straight edge was extended out over the unit. The bottoms of tubes were set on blocks. A pin and feeler gages were used to determine overall lengthsof the tubes. The pin was inserted between the straight edge and the blocks.

Results:

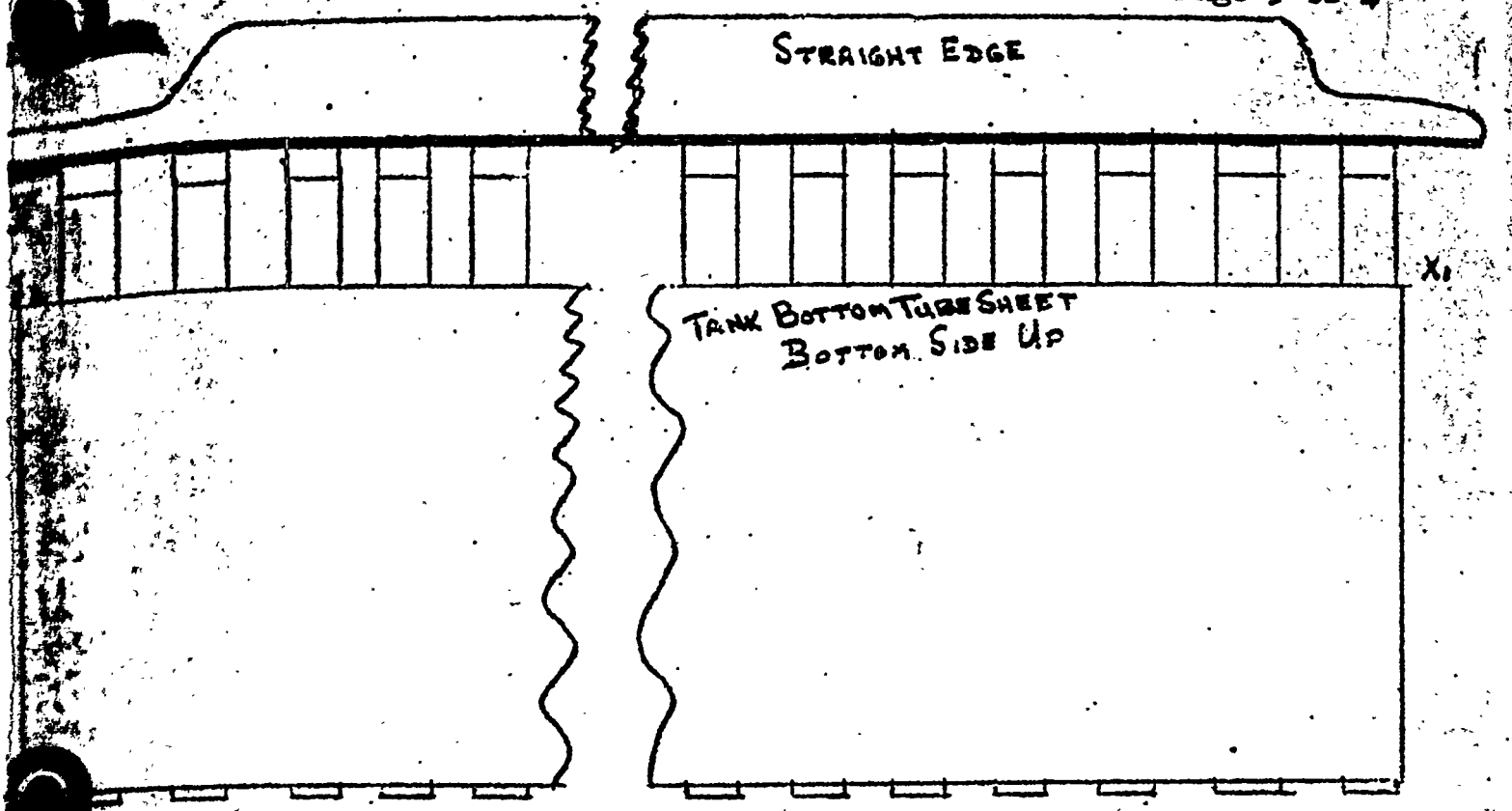
A. (1) and (2) See attached sketches.
B. (1) 41.509 to 41.515" (B.P. 41.500" -.015")
(2) R.M.S. finish of all 12 pads (20 to 30) (B.P. 32 RMS)
(3) Range from 49.4375" to 49.440" (B.P.49.4375" -.030)

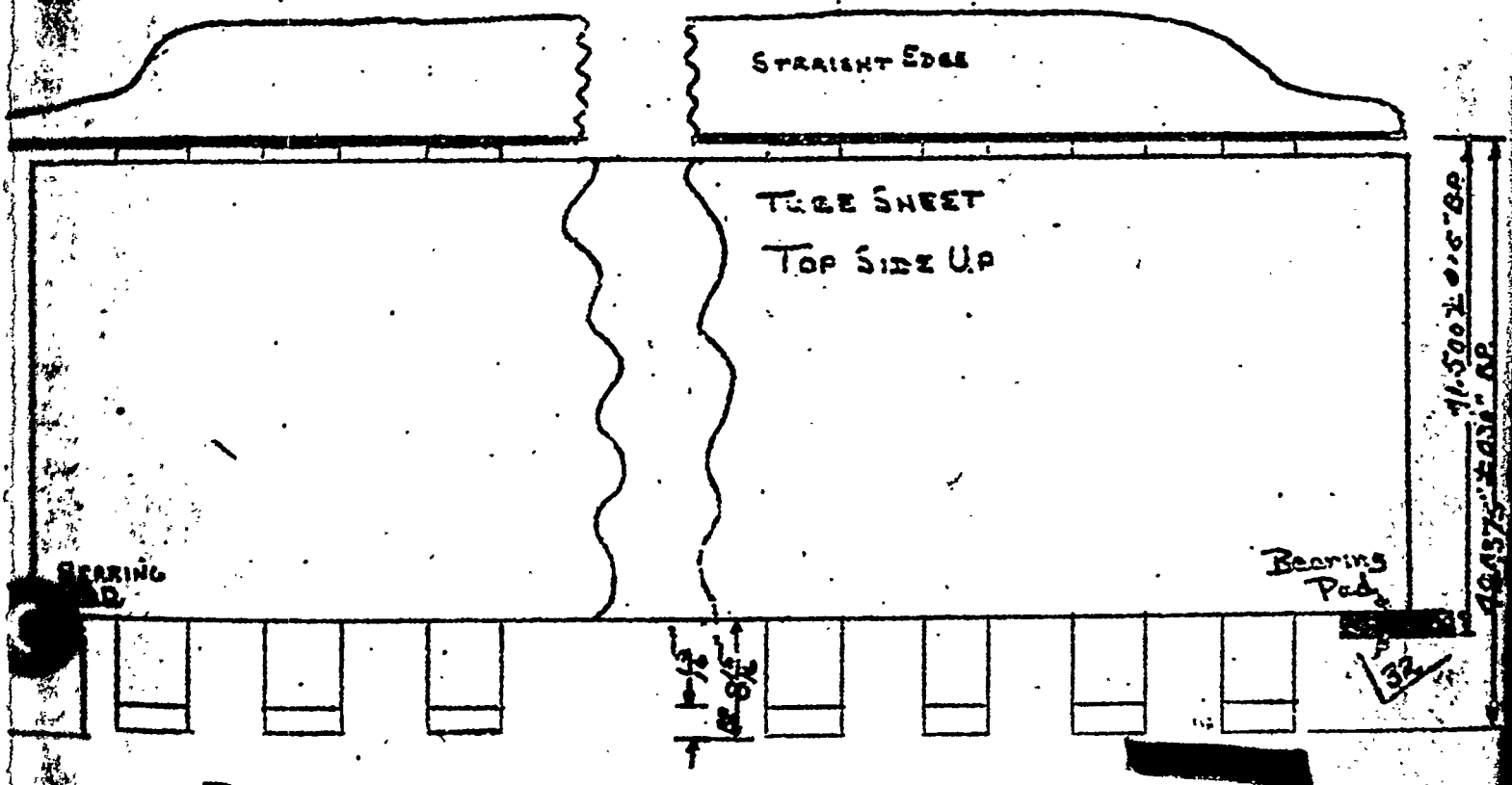
All dimensions checked were within specifications and acceptable.

lmw
Attach. 2

[redacted]

Profile Readings of tops & bottoms of tubes using a 18ft. straight edge and feeler gages

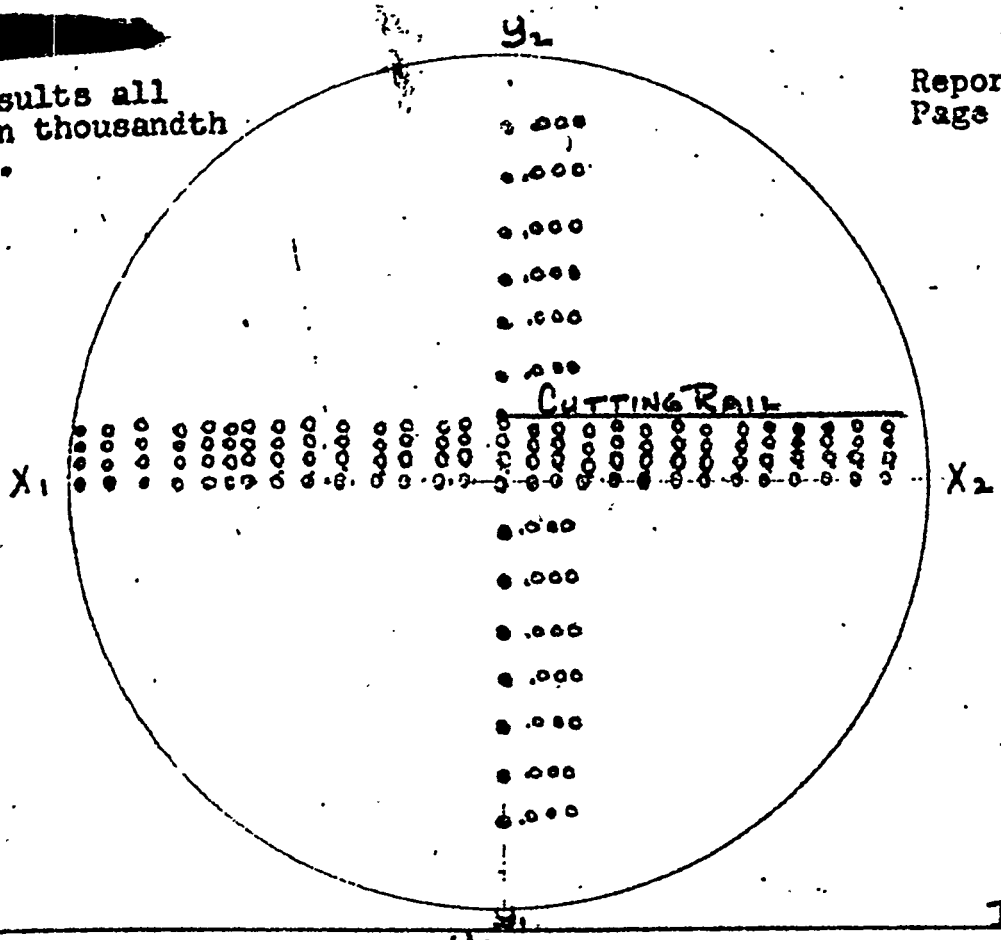




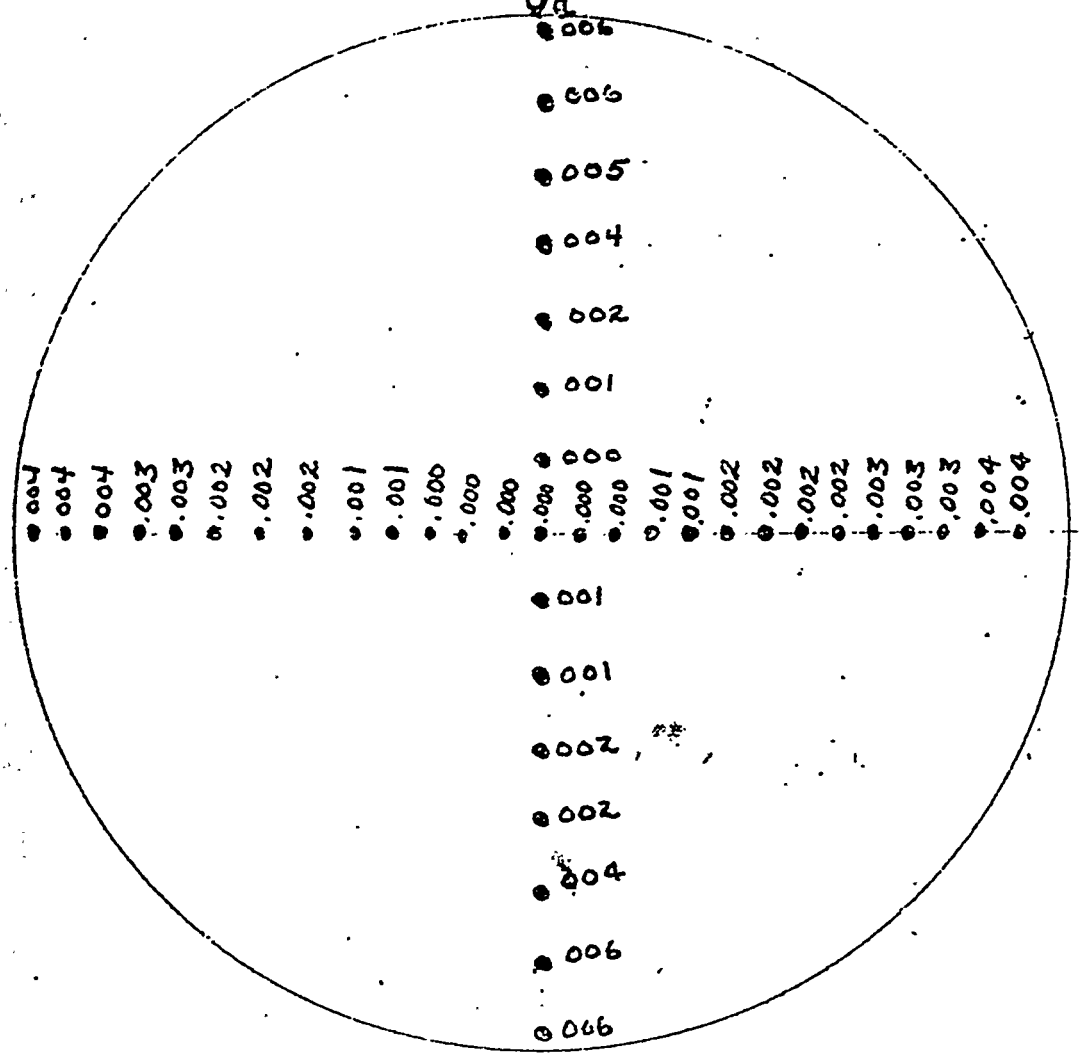
PIN USED FOR OVER ALL LENGHT OF TUBES ALSO

[redacted]

ofile results all
dings in thousandth
n inch.



BOTTOM SIDE



TOP SIDE

[redacted]

b. Top Land I.D.

After line reaming the top land of all bottom tube sheet large tubes, the following inspections were made:

(1) Bore diameter measurements in X and Y direction taken 1" below top ends of tubes.

(2) Finish in RMS micro-inches using a profilometer.

(3) Visual inspection for burrs, scratches, steps, and other mechanical defects that might be present in top land bore.

As stated in (1) above, bore diameters were taken in the top land to determine if bores were within tolerance (3.270" to 3.277"). Measurements were taken with a standard dial indicator bore gage and ring gage. Bore diameters found undersize were honed to size or cloverleafed, depending on how much metal had to be removed before bores were within the specified tolerance. All repair work was observed by du Pont inspectors. At the completion of all necessary work, bore diameters were re-measured in a similar manner to that described above and accepted. For results of this inspection, see Exhibit #12 in Section 13C of this manual.

Concurrent with the honing of tubes to required size, finishes of the top land were measured using a profilometer. Many of the tubes were found to have finishes greater than the specified 63 RMS. These tubes were either honed or cloverleafed until the bore finish was satisfactory; taking care not to exceed bore tolerances on those tubes that were all ready within tolerance, but requiring additional honing to improve the finish.

A final visual inspection was then made on the top land to determine if any scratches, burrs, tool steps, or any other mechanical defects were present. Any found were removed by one of the three following methods: (1) honing (2) cloverleafing (3) smoothing out defect with crocus cloth. After minor repairs, all top land bores were approved as being satisfactory. For final bore diameter and finish measurements, see Exhibit #12 in Section 13C of this manual. For pictorial views of the top land, see Part VII, Section I, drawing 1-2 and Section III, drawing 2-4.

c. Visual Inspection of Bore Between Top and Bottom Lands

As large tube bore work neared completion, a visual inspection for nicks, burrs and other mechanical defects were made between the top and bottom lands. To aid in the visual inspection of bores, a drop cord with a socket wired to one end and a 60 watt lamp screwed into the latter was lowered into each

tube to make for a better inspection of the tube wall I.D. Any defects noted were removed either by grinding or cloverleafing. Bore sizes (mid-length bore tolerance 3.312") were checked at random using a standard dial indicator bore gage and ring gage. After all repair work was completed, re-inspection of tube bores by du Pont inspectors was passed as being satisfactory. For view of mid-length bore between top and bottom lands, see Part VII, Section III, drawing 2-4.

13. Monitor Pin Groove Inspection

A. "R" Unit

New York Ship drilled three monitor pin grooves in the bottom land of each large tube in the bottom tube sheet assembly. For location and specifications of the dowell pin grooves, see du Pont drawing W-130948, section "M-M".

After monitor pin grooves had been drilled in the bottom ends of all large tubes, du Pont Inspectors spot checked the depth of the slots using a 6" scale and visually inspected them for evidences of any burrs. Also, a 100% visual inspection was made to determine if the three monitor pin grooves were drilled on the X2 side of the tube. All inspections were satisfactory and the job was approved.

After the bottom tube sheet assembly was received at the Savannah River Project, field personnel inspected the bottom land of large tubes before inserting monitor pins and the following conditions were found and reported to the du Pont Inspection Department at New York Ship:

(1) Scratches in the 3-3/8" diameter counter-bore in the lower end of tubes.

(2) Depth of half-round orienting grooves too shallow to permit entry of some monitor pins. Depthehere refers to the dimension perpendicular to the centerline of a tube.

(3) Length of orienting grooves (in a direction parallel to tube centerline) too great, thus violating the O-ring seating zone, or too short, thus preventing complete entry of monitor pins.

(4) Edges of half-round grooves and crown of chamfer sufficiently sharp to endanger O-ring during insertion.

To prevent occurrence of similar conditions on "L" and subsequent units, the du Pont Inspection Department took immediate steps to improve the situation encountered on the "R" bottom tube sheet as noted by the field. The revised method of inspecting monitor pin grooves in "L" and subsequent units is covered in the "L" bottom tube sheet history discussed in this manual.

B. "P" Unit

The inspection of monitor pin grooves in the bottom land of each large tube in the "P" bottom tube sheet was performed in a similar manner discussed in Section 13-A of this manual. Complaints received from the field on this unit were similar to the ones received for "R" B.T.S. These discripancies are covered in the above referenced section. Also, see Part III, II-E, for further information concerning field complaints and steps taken by the du Pont Inspection Department at New York Ship to improve the monitor pin groove problem on "L" and "K" units.

C. "L" Unit

Three monitor pin grooves were drilled in the bottom land of each large tube of the "L" bottom tube sheet in a similar manner to that performed on the "R" and "P" units. (Sections 13A & B of this manual). However, due to complaints received from the field pertaining to the finish (RMS) condition of large tube bottom land and the monitor pin grooves on "R" and "P" units (discussed in Sections 13A & B of this manual and Part III, II-E), the steps taken on "L" to prevent such conditions from re-occuring will be reiterated to describe the method of inspection and repairs necessary to render all tubes acceptable.

As pointed out in Part III-II-E, numerous discrepancies were reported from the field pertaining to monitor pin grooves and condition of the bottom lands. To prevent occurrence of similar conditions in the "L" bottom tube sheet and later units, it was requested by Design Division that the Inspection Department's inspection procedure for all tube bores on "L" unit be reviewed for adequacy. In addition to checking confirmation with all drawing specifications, such as dimensions, finish and freedom from sharp edges, each bore was requested to be independently examined as to its suitability for O-rings. This examination was to include a close visual inspection and running the hand over the surfaces involved.

In response to the above field complaints and in compliance with Design that all bottom lands in "L" unit be reviewed for adequacy, the du Pont Inspection Department immediately investigated and inspected the jig and drills used to machine monitor pin grooves. The jig itself was found satisfactory; however, 3/16" drills used were not of the proper size to produce the required depth of the half-round orienting grooves. (Depth refers to the dimension perpendicular to centerline of a tube.) The 3/16" drills originally used were replaced by a 3/8" drill ground to 7/32" O.D. pilot for 1/2". Bushings in the jig were likewise replaced with proper sizes to receive the new type drill.

After the above situation was corrected, all bottom lands in the "L" bottom tube sheet were visually inspected for finish and scratches. Where scratches were found tubes were cloverleafed until scratches were blended in. After the original check, it was found that twenty-five

(25) tubes were badly marked in the "O" ring seating area and 9 tubes were badly marked but not in the "O"-ring area. (Marks consisted of deep scratches, grind marks, gouges and tool marks). All defective tubes are listed below. Fifteen (15) other tubes (not listed) had burr marks upon the tube bore which were ground out. Since the bore sizes were up to maximum (3.382) on the twenty-five (25) tubes with O-ring area defects, it was decided by a member of Design to have plastic molds of the defects taken to determine the depth of defects. This was done and after consultation between members of Design and Construction Division, it was decided that the tolerance of 3.382" be increased to 3.385" in an attempt to clean up as many as possible of the defective tubes. This method of repair left six tubes (listed below) with defects impossible to clean up and the decision to move the O-ring seating area in the field on such tubes was reached at the aforementioned consultation.

The dowel pin functional gage and plug gage were used to check orientation of the dowel pin grooves. This gage checked location and radial depth of slots with respect to the X_1-X_2 axis. Length of grooves was checked with stainless steel 6" scale. The up-flow cooling pin functional gage with a 0.220" O-ring was used to check the grooves for sharp edges. It was found after the first inspection that all groove edges cut the O-ring. All edges were ground smooth, and all tubes re-checked. This operation was the cause of much concern because of marks left on the tube land in or near the O-ring seating area. A protector, covering the land entirely, with the exception of the grooves, was devised and fabricated from gasket material so that the land would not be scratched by the grinding tool. In this manner the sharp edges from all the dowel pin grooves were removed. For use of all gages employed in the inspection of bottom lands in the "L" bottom tube sheet, see Part III-II-E.

The list of twenty-five (25) tubes of which plastic molds were taken follows:

X41-Y81	X16-Y60	X9-Y21	X48-Y54
X24-Y72	X18-Y60	X21-Y3	X54-Y54
X10-Y72	X22-Y60	X29-Y87	X49-Y27
X21-Y75	X38-Y60	X34-Y72	X47-Y21
X21-Y69	X18-Y60	X19-Y69	X27-Y69
X30-Y54	X15-Y63	X37-Y69	X25-Y27
X19-Y57			

The following is the list of tubes in which the O-ring area had to be moved. (Defects all In O-ring area)

X21-Y69	X24-Y72	X22-Y66
X19-Y57	X25-Y27	X18-Y60

Upon final visual inspection, many tubes were found to have scratches or tool marks which were not located in the O-ring area and did not cut the O-ring after the functional gage check.

After all scratches and sharp edges were removed from the bottom land bores, final bore diameters and bore finishes were taken. All bore diameters were measured at the O-ring seating zone using a standard dial indicator gage and ring gage. Final bore finishes were recorded in RMS micro-inch values using a profilometer to obtain readings. For final results of bore diameters (bottom land and top land) and finishes, see Exhibit #12 presented herewith.

14. Preliminary Hydrostatic Test and Bottom Tube Sheet Testing Program

A. "R" Unit

(1) Hydrostatic Test

The bottom tube sheet was set up and prepared for preliminary hydrostatic testing. After sealing off all openings and filling with de-ionized water, pressure was applied to the unit. While applying pressure to the unit, a leak occurred in the weld seam of tube number X36-Y90 at approximately 22 psi. This was a welded tube. When the internal test pressure reached 52½ psi, all tube welding and tube bores were visually checked for leaks after the unit was under pressure one hour. Three leaks were found on the top side and one leak was found on the bottom side. These leaks occurred around tube welds.

The unit was drained and tube number X36-Y90 was cut out of the unit and replaced with a seamless tube. The tube was line reamed and then the ends faced to the required plane. The top and bottom land bores were inspected in a similar manner described in section 12A-(3) of this manual and found satisfactory. The three leaks on the bottom side and one leak on the top side were repaired by chipping out the defective area in the tube weld and re-welding. Repaired welds were dressed by grinding and then visually inspected and approved.

The assembly was again prepared for hydrostatic testing and tested in a similar manner described in paragraph 1 above. However, during this test another welded tube was found to be leaking in its seam. The welded tube number was X42-Y42. The second preliminary hydrostatic test was discontinued and this tube replaced in a similar manner described in paragraph 2 above.

Since there were over four hundred welded type tubes in this unit, it was decided jointly by the M & E Section, Design Division and New York Ship to discontinue the preliminary hydrostatic test (until later) and to outline a test program to thoroughly evaluate the extent of the unsatisfactory quality of welded tubes in the "R" bottom tube sheet.

(2) "R" Bottom Tube Sheet Test Program

First, a preliminary review was held by members from the M & E Section, Design Division and New York Ship to discuss problems incident to the unsatisfactory quality of the welded tubes in the "R" bottom tube sheet.

[redacted]

EXHIBIT #12

FINAL RESULTS OF SURFACE FINISHES AND BORE DIAMETERS FOR TOP AND BOTTOM LANDS OF ALL LARGE TUBES IN THE "L" BOTTOM TUBE SHEET ASSEMBLY.

[redacted]

E. I. DU PONT DE NEMOURS & CO., INC.

Construction Division

Report Number 495-L

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J. B. Johnson - File

June 2, 1953
New York Ship - Camden, N. J.

FIELD INSPECTOR'S REPORT

This material contains information affecting the national defense of the United States within the meaning of the espionage laws, Title 18, U.S.C., Secs. 793 and 794, the transmission or revelation of which in any manner to an unauthorized person is prohibited by law.

TO C. J. VEITH - M & E FILE

FROM S. R. Cochran DATE May 28, 1953

PROJECT NO. 8980 PLANT Savannah River ORDER NO. AXC-167½

EQUIPMENT Bottom Tube Sheet EQ.PC.NO. 153-L

DRAWING NOS. W-132760 - R.18 JOB RATING

VENDOR New York Shipbuilding Corp. LOCATION Camden, N. J.

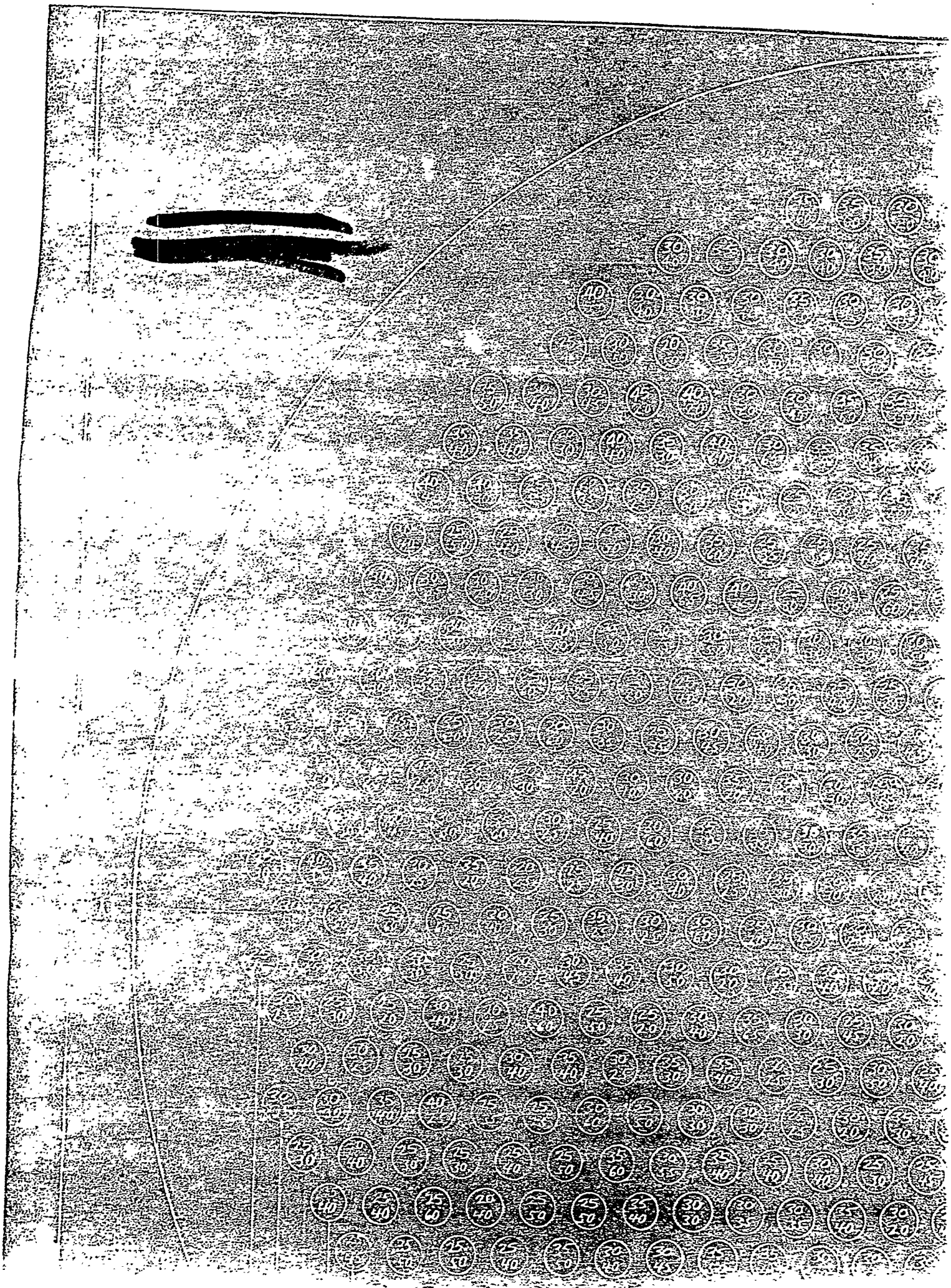
Finishes of Tube Bores

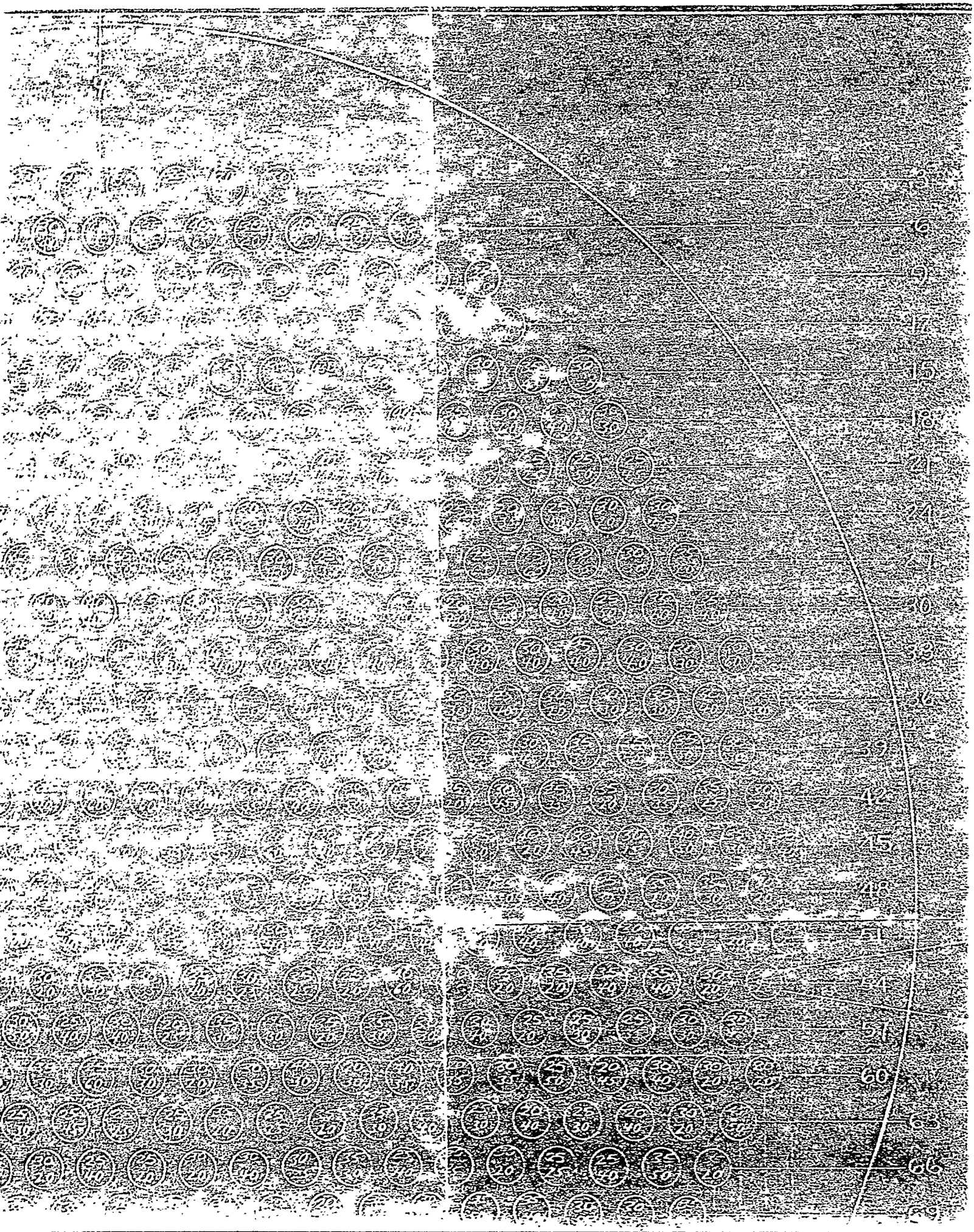
The attached drawing no. NYS 52853 is a record of surface finishes in rms-micro inches of the top and bottom bores of all tubes.

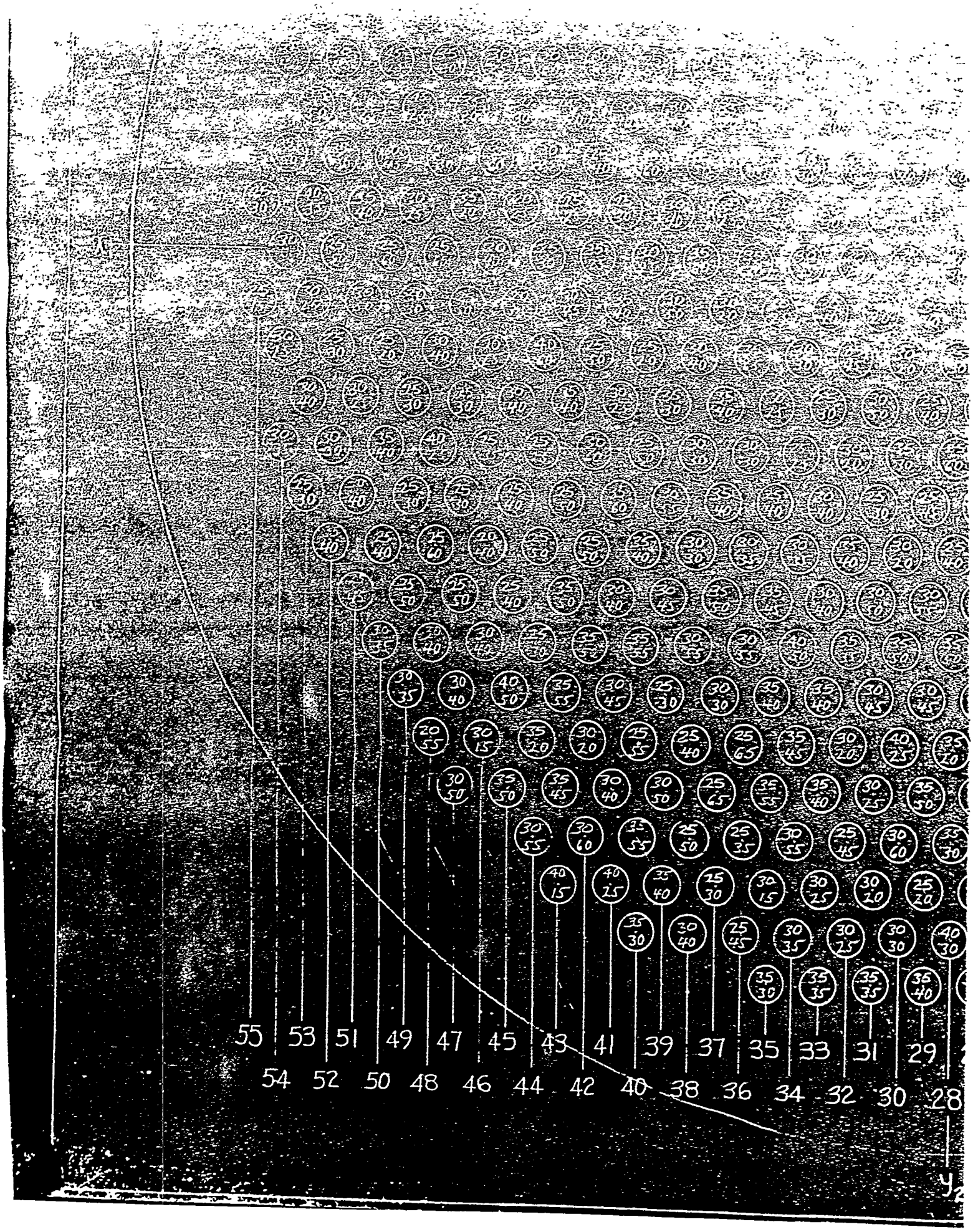
Surface finishes were taken with a profilometer in an axial direction with the tube bore. All finishes are 65 RMS or better and acceptable. (Drawing specifies finish of 63 RMS.)

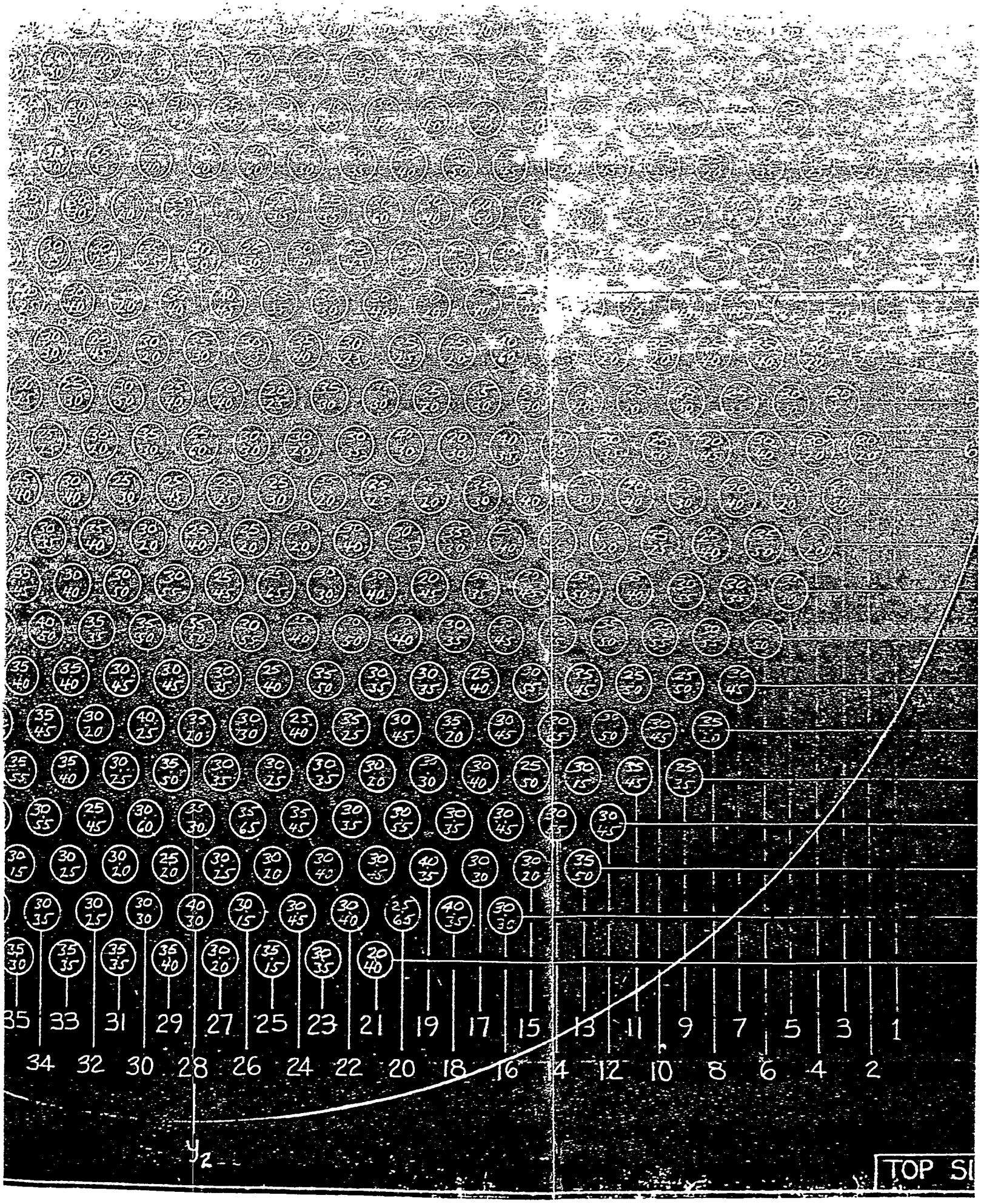
Note: Tubes X21-Y69, X22-Y66, X19-Y57, X24-Y72, X18-Y60, and X25 Y27 ~~X24-Y60~~ have scratches in the "O" ring seating area. Finish readings for these tubes as shown on attached drawing are not indicative of scratches. ~~Refer to report number 506-L for detailed information.~~

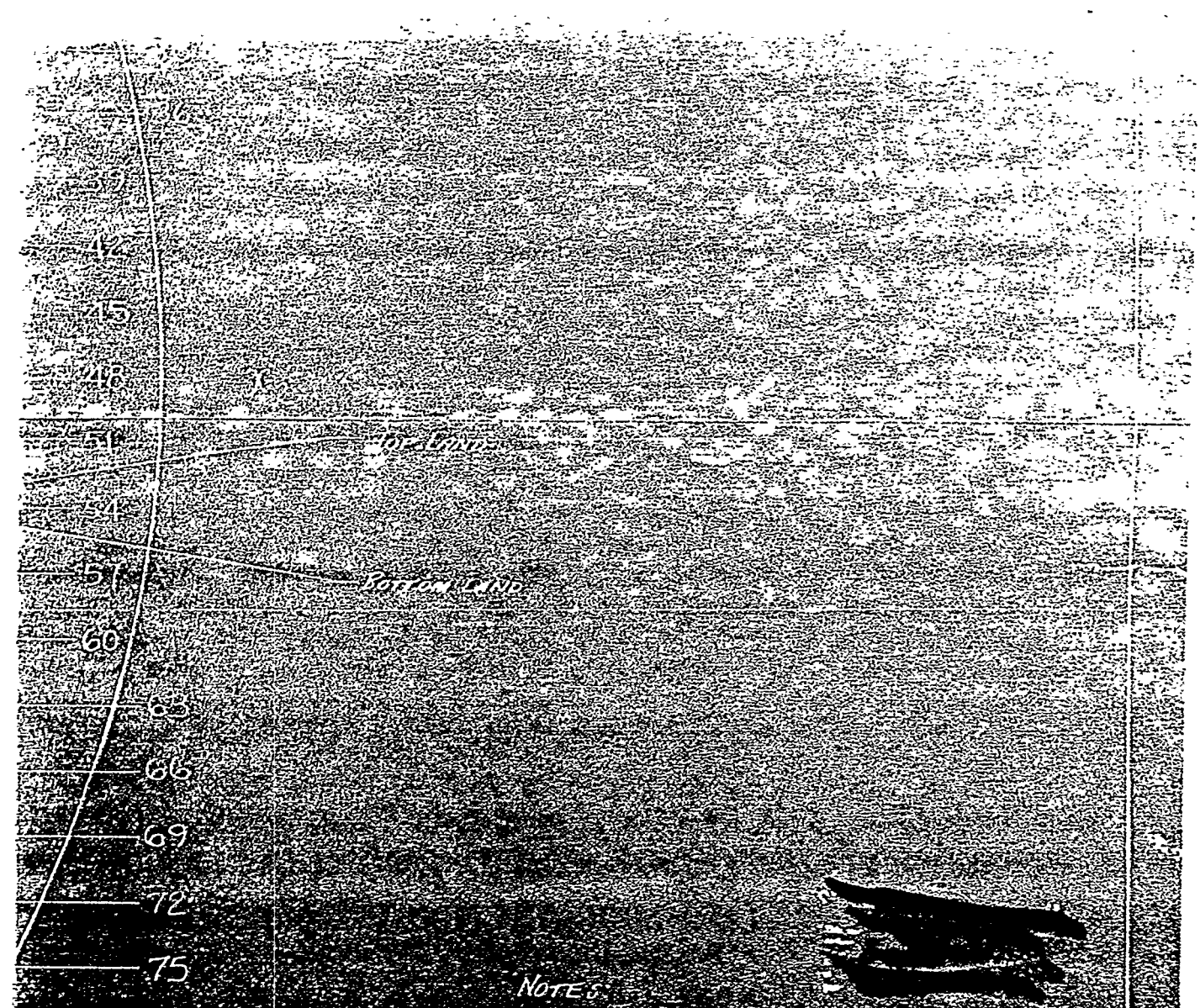
lmw
attach.






55 53 51 49 47 45 43 41 39 37 35 33 31 29
54 52 50 48 46 44 42 40 38 36 34 32 30 28


35 33 31 29 27 25 23 21 19 17 15 13 11 9 7 5 3 1
34 32 30 28 26 24 22 20 18 16 14 12 10 8 6 4 2
y_2
TOP SI



NOTES:

1. TOP FIGURE DENOTES SURFACE FINISH IN R.M.S.-MICRO INCHES OF TOP LAND, (3.270" TO 3.277" BORE), AND BOTTOM FIGURE DENOTES SURFACE FINISH IN R.M.S.-MICRO INCHES OF BOTTOM LAND, (3.376" TO 3.382" DIA. BORE).
2. TUBES 121, 169; 122, 166; 119, 157; 124, 172; 118, 160; 125, 160, HAVE SCRATCHES IN "O" RING SEATING AREA. FINISH READINGS SHOWN ON THESE TUBES ARE NOT INDICATIVE OF SCRATCHES. SEE REPORT NO. 506 L FOR DETAILED INFORMATION.

E. I. DUPONT DE NEMOURS & CO.
CONSTRUCTION DIVISION
M & E SECTION
AXC 1614 Proj. 8980-EQ. Pt. 153-L
TANK BOTTOM TUBE SHEET
BORE FINISHES, IN R.M.S.
TOP & BOTTOM LANDS
BY: S.R. COCHRAN

P SIDE OF TOP PLATE

E. I. DU PONT DE NEMOURS & CO., INC.

Construction Division

Report Number 493-L

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J. B. Johnson - File

June 2, 1953
New York Ship - Camden, N. J.

1102

FIELD INSPECTOR'S REPORT

TO C. J. VEITH - M & E FILE

FROM R. W. Mease DATE May 27, 1953

PROJECT NO. 8980 PLANT Savannah River ORDER NO. AXC-167½

EQUIPMENT Bottom Tube Sheet EQ.PC.NO. 153-L

DRAWING NOS. W-132762, R.4 JOB RATING

VENDOR New York Shipbuilding Corp. LOCATION Camden, N. J.

Subject: I.D. of 3-15/16" O.D. Bottom Tube Sheet Tubes

Attached is a record of the final I.D. of all 3-15/16" O.D. tubes in the bottom tube sheet. This list includes the bore measurement at both top and bottom of tube at approximately one inch from end in each case. Bores were measured in two directions - parallel to the X-X axis and parallel to the Y-Y axis.

Measurements were made with a standard dial indicator bore gage and all readings on attached sheet are in .001" and show deviations from basic bores.

Note: On bottom bores, measurements of tubes listed at bottom of attached dwg. were taken at maximum and minimum bore rather than in X and Y directions.

lmw
attach.

BTS

BORE

DATE

TOP LAND 5-20-53

BOTTOM LAND 5-23-53

Note - All Figures ... Indicator Read

Y-3	Y-6	Y-9	Y-12	Y-15	Y-18	Y-21	Y-24	Y-27	Y-30	Y-33	Y-36	Y-39	Y-42	Y-
B L T L	B L T L	B L T L	B L T L	B L T L	B L T L	B L T L	B L T L	B L T L	B L T L	B L T L	B L T L	B L T L	B L T L	B L T
X Y X Y	X Y X Y	X Y X Y	X Y X Y	X Y X Y	X Y X Y	X Y X Y	X Y X Y	X Y X Y	X Y X Y	X Y X Y	X Y X Y	X Y X Y	X Y X Y	X Y X
X1														7 8 3
X2											6 4 1 0		4 4 4 0	
X3										9 10 1 0		6 6 5 0		5 5 3
X4									7 9 3 2		3 2 2 2		4 5 5 4	
X5								4 4 2 2		4 4 1 0		8 7 4 2		6 6 4
X6							1 3 2 3		3 4 2 2		3 3 2 2		3 3 5 3	
X7						5 5 2 3		5 4 1 1		2 3 2 3		6 6 4 2		7 6 3
X8					4 5 1 3		5 4 3 2		3 4 2 3		6 5 3 3		6 4 2 2	
X9				3 2 1 1		9 10 2 2		5 5 4 5		4 3 3 3		3 3 3 2		5 4 2
X10					2 3 1 3		4 4 3 4		2 4 2 3		4 5 3 2		7 8 2 2	
X11				5 5 3 3		5 5 0 2		2 3 1 1		4 4 2 2		6 5 4 4		6 4 3
X12			2 5 4 1		6 8 1 4		3 5 3 3		7 8 3 3		2 4 2 1		6 5 4 3	
X13		4 5 2 1		2 2 3 0		4 6 1 3		3 0 2 2		4 4 2 2		9 6 5 5		8 8 3
X14			5 5 4 3		6 6 2 2		5 7 3 4		3 5 4 4		4 3 4 3		7 6 2 3	
X15		4 4 0 2		6 7 2 3		4 5 3 4		3 3 4 4		5 5 4 4		4 3 4 4		5 5 4
X16	4 6 0 3		5 5 1 4		6 6 1 1		6 3 3 3		2 2 2 2		5 6 3 2		6 5 1 2	
X17		3 4 1 2		5 4 5 3		6 2 3 3		3 3 4 4		3 2 2 2		6 6 3 3		4 2 4
X18	3 2 2 3		4 5 5 4		7 4 5 5		4 4 4 4		5 6 2 2		6 6 3 3		6 6 2 2	
X19		5 5 2 5		7 6 4 3		7 9 2 3		4 3 4 3		7 8 2 2		4 4 2 2		4 5 2
X20	6 6 1 2		7 8 3 3		7 8 2 2		6 4 3 3		7 5 5 5		2 4 1 1		2 1 3 3	
X21	5 10 1 3	6 6 3 3		5 6 4 3		7 9 5 4		0 2 2 3		3 3 2 2		6 7 3 4		6 5 5
X22	7 5 5 3		6 8 2 0		3 4 2 2		6 6 2 2		4 3 3 3		3 5 2 2		7 6 2 2	
X23	6 8 5 1	4 4 4 2		6 7 3 4		8 5 3 2		3 1 3 3		5 7 2 2		7 7 3 1		6 5 1
X24	7 6 3 1		3 6 2 2		5 6 3 2		5 5 2 3		6 8 1 1		2 2 2 3		3 4 2 3	
X25	4 3 5 3	6 7 2 1		2 4 4 4		6 5 2 2		9 6 2 3		1 2 3 3		3 2 3 3		2 5 3
X26	4 3 2 3		4 7 2 2		2 4 3 2		3 2 2 1		7 3 2 3		2 3 2 3		2 2 1 2	
X27	3 2 2 2	6 10 3 1		5 2 4 4		4 5 3 2		5 2 3 3		1 4 2 3		2 2 2 2		5 5 3
X28	4 3 3 2		3 3 2 1		3 3 2 2		3 1 2 2		3 2 2 2		4 8 1 2		4 9 3 3	
X29	5 6 5 3	3 4 3 1		7 3 3 5		5 4 3 2		6 4 4 4		4 3 2 2		3 3 3 3		8 9 4
X30	2 3 4 2		4 3 2 2		4 4 3 2		8 6 3 3		6 4 2 2		7 9 2 2		3 4 3 3	
X31	6 6 5 1	4 7 4 3		4 3 2 3		5 4 3 2		4 2 4 3		4 4 1 1		3 5 2 2		5 7 2
X32	3 4 4 1		4 3 3 2		8 4 3 3		6 9 2 2		2 2 2 3		4 6 3 3		6 7 2 3	
X33	7 6 3 2	5 6 3 1		6 8 6 4		3 4 3 3		7 8 2 2		2 3 2 2		7 7 2 2		6 4 1
X34	3 5 3 1		4 6 4 4		5 5 2 2		6 4 2 2		3 1 1 1		4 2 1 1		8 7 3 3	
X35	6 8 1 1	6 7 3 3		6 8 2 2		5 3 2 2		4 4 2 3		5 8 2 2		5 5 2 2		7 8 4
X36	3 3 4 7		5 3 3 3		5 2 2 3		4 1 2 2		4 4 1 2		7 7 3 3		7 9 3 3	
X37	8 5 2 3		5 8 2 3		3 3 2 3		7 6 3 2		5 7 3 3		7 8 3 4		8 7 3	
X38	6 8 2 3	6 1 2 3		6 4 2 3		8 6 2 2		8 7 2 2		7 7 1 2		8 5 5 5		4 4 3
X39	4 6 3 2		6 5 3 3		2 2 2 2		6 10 3 2		6 2 1 1		4 5 2 2		6 6 1 2	
X40	6 8 1 3	5 5 3 2		5 5 2 2		3 2 2 1		4 3 2 3		5 4 1 2		6 5 2 2		8 6 1
X41	3 4 3 2		5 6 1 2		6 5 1 2		5 2 2 3		8 8 3 3		6 5 2 2		3 2 1 2	
X42		5 4 3 4		7 3 1 3		4 3 2 4		4 3 2 3		5 6 2 2		3 3 1 1		4 3 1
X43	6 4 2 3		7 5 2 4		8 6 3 2		5 3 2 3		5 4 3 2		6 7 1 1		6 6 2 2	
X44		6 8 5 3		5 6 3 5		6 6 3 4		6 6 2 3		7 5 2 2		3 4 1 1		4 4 1
X45			7 4 2 5		8 9 2 3		3 5 1 1		2 2 3 2		4 3 5 2		8 10 3 3	
X46				7 4 1 3		8 7 1 2		4 4 3 2		5 7 2 1		7 6 3 3		7 6 3
X47			7 5 0 3		4 4 0 2		9 7 2 2		4 2 3 2		9 4 2 2		6 6 2 3	
X48						3 2 1 3		5 1 2 2		7 8 1 1		6 6 3 2		6 4 3
X49							4 3 2 3		4 3 3 2		7 5 3 2		5 5 7 6	
X50								6 6 2 3		3 4 2 2		5 6 4 2		3 3 3
X51									4 2 3 3		6 5 3 3		4 3 5 3	
X52										6 5 2 3		5 5 6 1		6 6 5
X53											7 7 1 2		6 7 5 2	
X54														7 5 2
X55														

* Bores at Poles Taken minimum of maximum reading

X 41	Y 81	X 22	Y 66	X 19	Y 69
X 24	Y 72	X 38	Y 66	X 15	Y 63
X 10	Y 72	X 18	Y 60	X 19	Y 57
X 21	Y 75	X 30	Y 54	X 48	Y 54
X 21	Y 69	X 25	Y 27	X 54	Y 54
X 27	Y 69	X 9	Y 21	X 49	Y 29
X 39	Y 69	X 21	Y 3	X 47	Y 21
X 16	Y 66	X 29	Y 87		
X 18	Y 46	X 34	Y 72		

K - BOTTOM BORES

S L-UNIT

positive
in .001"

Example
Tube X16, Y42

Bottom Land		Top Land	
X	Y	X	Y
3.382	3.381	3.271	3.272

BASIC ID

TOP LAND 3.270
BOTTOM LAND 3.376

B/P Tol

3.270
3.277
3.376
3.382 Bottom Land

Y-48 | Y-51 | Y-54 | Y-57 | Y-60 | Y-63 | Y-66 | Y-69 | Y-72 | Y-75 | Y-78 | Y-81 | Y-84 | Y-87 | Y-90 | Y-93

B L I T L
X Y X Y Y

Before outlining the test program, the following information was considered pertinent. Twenty-two tubes of the approximately 450 installed machine welded tubes were known to be questionable after, both ends of the tubes had been examined by the zy-glo technique (procedure for zy-glo testing is discussed later). Full length examination of each tube was in progress at this time. Twelve of the twenty-two tubes inspected by the zy-glo process were found to have defects in the ends of tubes extending through the top tube plate of the bottom tube sheet. Ten of the twenty-two tubes were found to have defects on the lower ends of the tubes. The difficulty encountered was apparently due to the lack of fusion in the welded path of the tubes seam.

After reviewing and analyzing all current problems pertaining to defective welded tubes thus far found, the following test program was set-up.

I. Test Program for "R" Bottom Tube Sheet as a Unit

a. Zy-glo test all welded tubes in unit.

b. Freon test unit at 35 psi. Freon to be applied to shell side of tubes.

c. Hydrostatically test each tube in unit.

d. Repeat freon test at 35 psi in the shell side.

e. Repeat zy-glo test on all tubes.

II. Test Program for Individual Tube Evaluation (Testing of Centrifugally Cast Tubes To Be Given Preference)

a. Tubes required for test

(1) 46 sigma welded bottom tube sheet tubes

(2) 5 seamless bottom tube sheet tubes

(3) 10 centrifugally cast bottom tube sheet tubes

(4) 10 extruded bottom tube sheet tubes

(5) 10 hand welded top tube sheet tubes

b. Tests at New York Ship

(1) X-ray all welded tubes at the weld section

(2) Completely x-ray all centrifugally cast and seamless tubes

(3) Zy-glo all tubes I.D. and O.D.

(4) Ship to Engineering Research Laboratory two of each type tube. Only tubes passing x-ray are to be included on item (1), (3) and (5) in section "a" above.

(5) Ship to ERL two of each items (1), (3) and (5) in section "a" above.

(6) Ship to ERL two sigma welded tubes for cyclic pressure test. One tube OK by x-ray examination, the other two show cracks.

(7) Test balance of tubes as outlined in I above.

The above test program was carried out in its entirety by all groups concerned; however, the discussion of the above testing procedure to follow will deal only with the part that the du Pont inspectors played in evaluating the "R" bottom tube sheet.

(3) "R" Bottom Tube Sheet Test Program and Special Tests Conducted by du Pont Inspectors.

a. Tube Zy-glo Test

All tubes were prepared for zy-glo testing by New York Ship personnel. For positive identification of welded tubes, the tube ends were etched, and then the welded tubes were prepared for zy-gloing from end to end. At this time it was also decided to zy-glo all tubes (welded, cast, and seamless) since the probability of cracks and laminations being present in cast and seamless tubes was not known.

The overall purpose of the zy-glo test was to determine the location of cracks, laminations and other mechanical defects that may be present in tube ends and bores. The zy-glo testing of tubes was performed in the following manner:

(1) All tube bores were swabbed clean with CCl_4 and followed up with a clean dry cloth.

(2) Zy-glo penetrate oil (Type ZL-1) was swabbed on tube ends and tube bores and allowed one hour to penetrate.

(3) Swabbed surfaces were then washed off with water and dried.

(4) The top ends and bores of tubes were dusted with developing powder (Type ZP-2) and allowed one hour to develop.

(5) Excess powder was removed by air jetting.

(6) The ends and bores of tubes were then visually inspected for cracks and laminations using a lamp rig with a self-contained General Electric 15 watt black fluorescent lamp developed by a du Pont Inspector. The lamp was used to direct rays to the areas under test. Any defect noted (crack or lamination) appeared as a yellow glow. After locating the defect, a 3/4" borescope was used to

further study the extent of the crack.

All tubes were inspected jointly by du Pont and New York Ship personnel. A total of thirty (30) tubes were found to have defects of varying nature. The majority of the defects found appeared to be lack of fusion in the welded seam of the tube. These tubes were marked and results sent to Wilmington for their final disposition.

The test of tubes submitted, and their noted defects along with Wilmington's final decision was as follows:

Tube Number	Analysis of Defect	Disposition
X5-Y69	Lack of fusion starting at inside edge of tube for a length of 10". Bottom side of tube.	Remove
X6-Y72	Lack of fusion starting at inside edge of tube for a length of 8". Top side of tube.	Remove
X11-Y81	Lack of fusion starting 2" from inside edge of tube for a length of 10". Top side of tube.	Remove
X9-Y63	Lack of fusion starting 4" from inside edge of tube for a length of 3½". Bottom side of tube.	Retain
X13-Y69	Lack of fusion starting at inside edges of tube for a length of 2½". Top side of tube.	Retain
X18-Y84	Lack of fusion starting at inside edge of tube for a length of 1". Top side of tube.	Retain
X5-Y33	Lack of fusion starting 1" from inside edge of tube for a length of 3", clean for 8" and another spot 1" long. Top side of tube.	Retain
X10-Y30	Crack outside area of tube. Bottom side of tube.	Remove
X14-Y24	Lack of fusion starting 3/4" from inside edge of tube for a length of 18". Top side of tube.	Remove

Tube Number	Analysis of Defect	Disposition
X27-Y69	Crack starting 3" from inside edge of tubes for a length of 1½". Bottom side of tube.	Remove
X33-Y87	Lack of fusion starting at inside edge of tube for a length of 5". Bottom side of tube.	Remove
X16-Y12	Crack starting from inside edge of tube for a length of 2½". Top side of tube.	Remove
X27-Y39	Crack inside top edge and outside surface for a length of 3/4". Bottom side of tube.	Remove
X27-Y33	Lack of fusion starting at inside edge of tube for a length of 2½". Spotty. Top side of tube.	Retain
X31-Y45	False showing.	Retain
X40-Y72	Crack starting at inside edge of tube for a length of 1", also top surface of tube. Top side of tube.	Remove
X43-Y75	Lack of fusion starting 3" from inside edge of tube for a length of 6". Spotty. Top side of tube.	Retain
X44-Y54	Lack of fusion starting 1½" from inside edge of tube for a length of 8". Bottom side of tube.	Remove
X38-Y36	Lack of fusion starting 18" from inside edge of tube for a length of 2". Bottom side of tube.	Retain
X38-Y30	Lack of fusion starting 2½" from inside edge for a length of 8". Bottom side of tube.	Remove
X35-Y21	Lack of fusion starting at inside edge of tube for a length of 2½". Bottom side of tube.	Remove
X39-Y21	Lack of fusion starting 4"	Retain

Tube Number	Analysis of Defect	Disposition
X39-Y21 (cont.)	from inside edge of tube for a length of 1½". Top side of tube.	Retain
X47-Y39	Lack of fusion starting 3" from inside edge of tube for a length of 10". Spotty. Top side of tube.	Retain
X44-Y18	Lack of fusion starting 1" from inside edge of tube for a length of 9". Bottom side.	Remove
X45-Y21	Lack of fusion starting 10" from inside edge of tube for a length of 2½". Bottom side of tube.	Retain
X48-Y30	Lack of fusion starting at inside edge of tube for a length of 3". Very faint bottom side of tube.	Retain
X50-Y36	Lack of fusion starting at inside edge of tube for a length of 5", also a crack on the top inside edge of tube. Top side of tube.	Remove
X51-Y27	Lack of fusion starting at the inside edge of tube for a length of 6". Top side of tube.	Remove
X54-Y36	Lack of fusion starting at the inside edge of tube for a length of 1½". Bottom side of tube.	Remove
X10-Y54	Lack of fusion starting 3/4" from the inside edge of tube for a length of 3". Spotty. Bottom side of tube.	Retain

b. Individual Tube Hydrostatic Test in Unit

However, before the above sixteen mentioned tubes were removed, each of the 673 tubes in the bottom tube sheet were hydrostatically tested using special pressure testing mandrels. Ten of these special pressure testing mandrels with O-rings were hurriedly made in anticipation of this test by an outside vendor and then sent to New York Ship. Upon receipt of the test mandrels, the top and bottom plugs (on test mandrel) that seat the O-rings which seal off the top and bottom ends of a tube for testing were found to be too large. New York Ship re-machined them to correct sizes and then added pipe fittings and valves to each test mandrel for aid in filling

and draining water during the hydrostatic test. The ten mandrels were installed in tubes to a workable pattern. Each test mandrel was connected up to a low pressure water line and filled with city water. Air trapped in the mandrel was vented through the top end by means of a 3/4" valve. After the tube was full of water, this valve was closed and each of the tubes were individually connected up to a hand pressure pump. Pressure was built up to 1000 psi and held at this pressure for a period of fifteen (15) minutes. Du Pont Inspectors checked time and pressure for each tube and recorded all data. Any drop in pressure (as noted on pressure gage) indicated a leaking tube; however, none were found in this test. The sixteen tubes that were to be removed were by-passed in this test. Some trouble was experienced with the O-ring seals leaking; however, this was eliminated by periodically changing O-rings at regular intervals.

c. Removal of Sixteen Defective Tubes

After the hydrostatic testing of tubes in the bottom tube sheet, preparations were made for removing the sixteen defective tubes listed in (3)-a above. All replacement tubes were either cast or seamless. Also, at this time, the Design Division requested that no welded tubes be used in any subsequent sub-assembly (P, L and C).

The assembly was set top side up under three radial drills and condemned tubes bored through (from top side) and tube holes in the top plate recountersunk. The unit was turned bottom side up and the tube fillet weld was machined from the condemned tubes using a special tool designed for this purpose.

The assembly was removed from the radial drill set-up and turned top side up for installing sixteen new tubes, which had been previously inspected by du Pont and approved. First, the old tubes were removed from the unit, tube holes cleaned and dressed and new tubes installed. Then, the unit was moved and set up under the automatic aircomatic tube welding machines and new tubes welded on both sides.

After welding of tubes the unit was set up under the three radial drills for facing tube ends to the required plane and reaming the top and bottom tube ends to remove the "hour glass effect" in the bore caused from weld shrinkage. During the reaming operation, one of the sixteen replaced tubes was damaged beyond repair. This tube was removed and replaced in a similar manner described above. The sixteen new tubes were then chamfered on the bottom ends, dressed, monitor pin grooves drilled and dressed and then inspected by du Pont Inspectors and found satisfactory.

Before procedding with further work on the bottom tube sheet, it was necessary to take a final shrinkage pattern since the welding of the sixteen new tubes

caused additional shrinkage. These measurements were taken in a similar manner discussed in Section 7A-(10) of this manual.

The final shrinkage measurements taken after welding all 673 tubes in the bottom tube sheet were used as initial measurements for determining final shrinkage after replacement and welding of the sixteen defective tubes.

Before Welding		After Welding	
Top Side	181.985"	Top Side	181.970"
Bottom Side	182.003"	Bottom Side	181.969"
Difference	-0.018"	Difference	0.001"

Total Shrinkage of Top and Bottom Plates After All Welding On Tube Sheets

	Top Plate	Bottom Plate
Initial trepanned plate dia....	182.350"	182.358"
Final center to center of tube bores after welding 16 replacement tubes.....	181.970"	181.969"
Total Shrinkage.....	0.380"	0.389"

The difference between the top and plates after replacing and welding sixteen defective tubes was still within the specified limits designated by Design Division (See Section 7A-(10), and therefore the shrinkage pattern was considered satisfactory by the du Pont Inspection Department.

d. Sandblasting and Acid Washing (Exterior & Top Side Only)

Before proceeding with the bottom tube sheet test program, it was decided to sandblast and acid wash the top side of the unit. All tubes on both ends were capped with wooden plugs to prevent damaging of the tube bore and finished machined tube ends during the sandblasting operation. The unit was filled with approximately 30 psi of air, placed on a railroad flat car, and pulled outside the building and sandblasted.

After sandblasting the top side was acid washed using a solution of nitric acid, hydrofluric acid and water mixed in proper proportions for this job.

The above two cleaning operations were witnessed by a du Pont Inspector. After all cleaning was completed, a visual inspection was made by a du Pont Inspector and passed as being satisfactory.

e. Preliminary Freon Test

As called for in the bottom tube sheet test program, the assembly was to be subjected to a preliminary freon

test. The purpose of this test was to determine if any leaks occurred in tube welds around the sixteen replaced tubes and also in the replaced tubes themself. The unit was prepared for freon testing by closing off all openings and then introducing 20# of freon (by weight) into the unit and raising the internal pressure to 35 psi using air. However, during the freon test inspection, a instrument well located adjacent to tube number X37-Y47 was found to be leaking. The leakage of freon from the defective instrument well was of such a quanity that it contaminated the entire atmosphere surrounding the unit rendering it impossible to use the General Electric halid leak detectors with any accuracy. The freon test was temporarily discontinued and the faulty instrument well machined out and replaced with a new one that had been hydrostatically and freon tested under the same conditions as the unit and accepted.

A second freon test was then performed on the unit for purposes as discussed in the above paragraph. However, during the second test another instrument well was found leaking. This instrument well was located X18 and X20 on the Y1-Y2 axis. The freon test was interrupted again to replace this instrument well with another that had been hydrostatically and freon tested under the same conditions as the unit and accepted.

After all leaking instrument welds had been replaced with new ones, a third freon test was started. Again, the unit was filled with 20# of freon (by weight) and brought up with air to a pressure of 35 psi. Using three General Electric Halid Leak Detectors, all tube fillet welding around the sixteen replaced tubes and the six tubes surrounding each and the instrument well welding was checked for leaks. No leaks were detected around the sixteen replaced tubes and two replaced instrument wells. Also, no leakage was detected around the tubes adjacent to each of the replaced tubes. The freon test was considered satisfactory and the repair work previously done was approved.

f. Second Zy-glo Test on Sixteen Tube Replacements and Adjacent Tubes

As a final check on the quality of tubes used, and based on the "R" bottom tube sheet test program, all sixteen (16) replaced tubes and those adjacent were zy-glo tested in a similar manner described in Section 14-(3)a of this manual. No defects were found in the tubes that were zy-gloed and it was concluded that the replaced tubes and those adjacent were of sound quality insofar as visual inspection was concerned.

g. Hydrostatic Test of the Sixteen Replacement Tubes and Adjacent Tubes

To further insure the quality of the replaced sixteen tubes, a final hydrostatic test of each individual tube and those adjacent to the replaced ones was conducted. These tubes were hydrostatically tested in a similar

manner described in Section 14-(3)b of this manual and found satisfactory.

B. "P" Unit

(1) Individual Tube Hydrostatic Test in Unit

Since the probability of cracks and laminations being present in cast and seamless tubes (the two types assembled in "P" B.T.S.) was not known, and as a direct result of welded tubes in the "R" B.T.S. leaking, it was decided to hydrostatic test each tube in the "P" B.T.S. in an identical manner to that performed on "R". Following the testing procedure outlined in Section 14A-(3)b of this manual, all of the 673 large tubes in the "P" B.T.S. were hydrostatically tested. Final results of this test indicated that no leaks were present in the tube walls. The unit accepted and released for further fabrication.

(2) Summary of Freon Testing on Bottom Tube Sheet Assembly

The following resume summarizes all freon test and major reairs made on the "P" bottom tube sheet assembly. For all tests performed, twenty (20) pounds (by weight) of freon was introduced into the interior of assembly and pressure was raised to 35 psi with air. General Electric Type "H" Leak Detectors, set at medium sensitivity, were then used to examine assembly for indication of leaks.

The first freon test performed on the unit revealed leaks between top plate and large tubes X26-Y48 and X16-Y18 and between bottom plate and instrument well X25-Y35.

The above leaks were repaired and another freon test revealed leaks in weld between bottom plate and instrument wells X34-Y32; X37-Y47; X52-Y44 and X44-Y74, and a leak in instrument well X5-Y47. After necessary repairs were made, the unit was again subjected to a freon test and no leaks were detected. (See du Pont drawing D110168-A).

Borescope inspection of instrument wells then indicated poor penetration of butt welds on the I.D., and it was necessary to replace the following wells: (See photo serial numbers 118 & 119)

Tube Number	% Weld Penetration		Quality of Weld
	Top Butt Weld	Bottom Butt	
X25-Y35	30%	40%	Poor
X13-Y11	90%	10%	Very Poor
X18-Y46	10%	30%	Poor
X34-Y32	0%	20%	Very Poor
X37-Y47	20%	40%	Fair
X44-Y74	90%	50%	Fair
X52-Y44	20%	10%	Very Poor

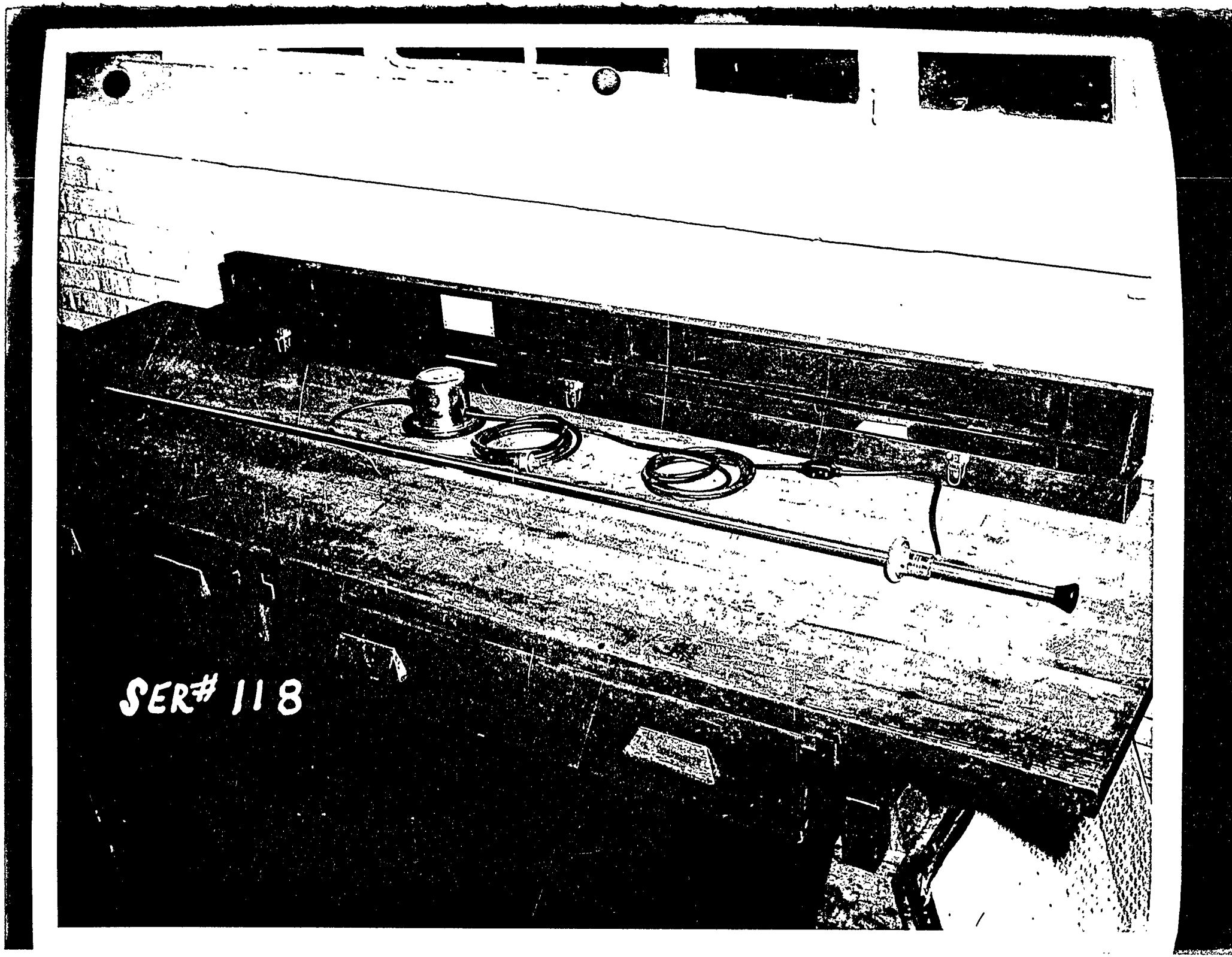
Serial Number 118

New York Shipbuilding Corporation
Camden, New Jersey
November 28, 1952

PROJECT 8980 - SAVANNAH RIVER PLANT

This is a view of the Lico Borescope for visually inspecting the weld penetration at welded joints on the inside diameters of instrument wells.

Instrument wells are later hydrostatically tested and then welded in the top tube sheet assembly.


SER# 118

Serial Number 119

[redacted]

New York Shipbuilding Corporation
Camden, New Jersey
November 28, 1952

PROJECT 8980 - SAVANNAH RIVER PLANT

The M & E Inspector is using a Lico Borescope for visually inspecting the inside diameters of instrument wells at the welded joints for weld penetration. Instrument wells are later hydrostatically tested and then welded in the top tube sheet assembly.




SER# 119

The replacement wells were individually freon tested and hydrostatically tested in the following manner;

(a) Each thermocouple well was connected to a cylinder of freon 12 and the gas was allowed to enter the well at approximately 100 psi pressure. A General Electric, Type "H" Leak Detector was used for detecting any leaks in the thermocouple wells. Gas was retained in the well for a ten-minute period. No leaks were detected.

(b) Each thermocouple well was connected to a hydrostatic testing fixture and water was pumped into the well until 2000 psi gage pressure was attained. After holding pressure for 15 minutes, a visual inspection was made for leaks. None were found.

Detail "B" on Dwg. 5-4 (Section 7A of this manual) represents seven (7) of the replacement wells installed in "P" bottom tube sheet. It was necessary to alter the design of the original (Detail "A" on Dwg. 5-4) instrument wells in order that the new ones fit the holes in the bottom tube plate which were enlarged while cutting out the defective wells. Also, it was necessary to machine a flanged neck near the top end on the replacement wells to close up the opening in the well collars which were reamed oversize so that the defective wells [illegible] prevent raschig rings from passing through the instrument baffle into the space between the latter and top tube plate. Du Pont drawing D-110168 covers the above instrument well design change.

Before installing the seven instrument wells in the assembly, it was decided to sandblast the top side and wrapper plates. The unit was placed on a railroad flat car, (top side up) and pulled outside the building for sandblasting. After this, the top and sides of the assembly were acid washed, ferroxyl tested, inspected for cleanliness and accepted as being satisfactory.

Next, the seven defective instrument wells were cut out of the unit and replaced with the seven new ones described above. (See du Pont drawing D110168-A). After welding of these instrument wells into the assembly, it was again freon tested in an identical manner described in this section. All wells and welds joining them to tube sheet plates were carefully inspected. Leaks were found in weld joining top plate and well X37-Y47 and in weld joining bottom plate and well X31-Y61. These welds were then repaired and freon tested satisfactory.

All of the above tests were made prior to filling unit with raschig rings and installation of 8" split circumferential pipe.

After loading of raschig rings and installation of 8" split pipe, another freon test revealed the following leaks:

(a) In weld joining a "B" port between X2 and Y1 to wrapper plate (Third port from Y1 toward X2 starting at port located on Y1).

(b) In weld (two leaks) joining underside of 8" split pipe to wrapper.

(c) In weld joining temporary sealing cover to water outlet at Y2

Necessary repairs were made and the 8" pipe and all ports re-freon tested, inspected and accepted.

Extensive minor weld repairs were then made on wrapper and the entire assembly (except tube welds which had already been satisfactorily checked) was again freon tested and no leaks were detected.

(3) Summary of Hydrostatic Tests on the Bottom Tube Sheet Assembly

For all tests performed the testing procedure used was the same. To prepare the bottom tube sheet assembly for the hydrostatic test, it was placed on cast iron pedestals six feet high with the top side up. A special threaded pipe with two hydro-type pressure gages attached was screwed into one of the ports. Next, a Watson-Stillman hand pump was connected to the outlet side of the de-ionized water tank and the inlet side of the bottom tube sheet. The unit was filled with water from the de-ionized water tank. The hand pump was used to bring about a few pounds of pressure inside the unit as indicated on the pressure gages. The pumping was stopped and the trapped air inside the bottom tube sheet assembly was vented through removing the pipe plugs located near the top of the assembly. It was realized that any trapped air not bled from the unit would prevent an adequate hydro test. After the assembly had been vented, the pipe plugs were re-used to seal off the unit. The Watson-Stillman pump was used to raise the hydro pressure to 52½psi gage. This pressure was held for one hour. Visual inspections by du Pont inspectors were then made with the aid of a flashlight on both sides of the unit. The "P" B.T.S. assembly was hydro tested with the top side up at all times.

The following resume summarizes all hydrostatic tests and repairs actually made on the "P" bottom tube sheet assembly while at New York Ship. During the first hydro test performed on this unit, a leak was found in the top weld of instrument well X31-Y61. After this weld was repaired, assembly was again tested, re-inspected and found satisfactory. After the above tests, borescope inspection of all bottom tube sheet instrument wells indicated poor weld penetration on I.D. butt welds of the following seven tubes: X25-Y33; X13-Y11; X19-Y46; X34-Y32; X37-Y47; X44-Y74; X52-Y44. These were replaced (See section (2) above).

After replacement wells had been welded into the tube sheet, another hydrostatic test was put on the unit and all wells and welds joining them to tube sheet plates were

visually checked. No leaks were found.

Following extensive minor weld repairs on wrapper plate and after installation of 8" split circumferential pipe, the entire assembly was satisfactorily tested. The entire bottom tube sheet assembly including the split pipe was inspected during this final test.

Hydrostatic testing of the assembly was acceptable.

C. "L" Unit

(1) Summary of Freon Testing on Bottom Tube Sheet Assembly

The following resume summarizes all freon tests and major repairs made on the "L" bottom tube sheet. The assembly was freon tested and inspected for leaks indicative of inferior welding and defective parent metal five times. All freon tests were performed on this unit after internal drying. The drying procedure preceding freon testing of the "L" bottom tube sheet is discussed in Part VII, Section I, item 16C-(2).

For each test twenty pounds (by weight) of freon was introduced into the interior of the tube sheet and pressure was increased to 35 psi with air. General Electric Type "H" leak detectors set at medium sensitivity were then used to check the entire assembly. Special attention was given to each of the exterior or pressure welds.

Three tests were put on the assembly prior to filling raschig rings and prior to welding 8" half-round pipe to the wrapper plate circumference. Four leaks were located during the first test. There was one leak in each weld joining tubes X48-Y72, X36-Y18, and X4-Y54 to the bottom plate. One leak was in the weld joining tube X15-Y51 to the top plate. After necessary repairs were made, the assembly was again tested.

During the second test, leaks were detected in the weld between the bottom plate of the assembly and tubes X15-Y39 and X7-Y69. These two welds were repaired and the assembly was subjected to another test. No leaks were detected in this third test.

After the tube sheet had been loaded with filler and the split circumferential pipe had been welded to the wrapper, the assembly was again freon tested. The forth test revealed one small leak on the weld joining bottom side of the inlet pipe between X1 and Y2 to the wrapper and one leak in an inspection port weld between X2 and Y2.

The above welds were repaired and the entire assembly was again tested and inspected for the fifth time. No leaks were detected in this final test and the unit was accepted.

(2) Summary of Hydrostatic Tests on the Bottom Tube Sheet

a. Preliminary Test

To prepare the bottom tube sheet assembly for the hydrostatic test, it was placed on cast iron pedestals six feet high with the bottom side up. A special threaded pipe with two hydro-type pressure gages attached was screwed into one of the ports. Next, a Watson-Stillman hand pump was connected to the outlet side of the de-ionized water tank and the inlet side of the bottom tube sheet. The unit was filled with de-ionized water from the de-ionized water tank. The hand pump was used to bring about a few pounds of pressure inside the unit as indicated on the pressure gages. The pumping was stopped and the trapped air inside the unit was vented through removing the pipe plugs located near the top of the assembly. It was realized that any trapped air not bled from the unit would prevent an adequate hydro test. After the assembly had been vented, the pipe plugs were re-used to seal off the unit. The Watson-Stillman pump was used to raise the hydro pressure to 45 psi for hammer testing. A drop hammer was then used at approximately five inch intervals on the bottom side to hammer test the unit. The impact force of the drop hammer on the unit was equal to a swinging blow of a ten (10) pound hammer. After the hammer test was completed at 45 psi, the unit was relieved of its pressure and some water was drained out of the unit. (Water level about 2" below tube plate). A complete hammer test was again performed on this side in a similar manner to that described above. After the second hammer test was completed, the unit was filled completely with water and the internal pressure raised to 52½ psi. The unit was allowed to stand two hours and then it was visually inspected for possible leaks around tube welded wrapper plate welding and tube sheet welding. No leaks were found. The unit was then drained of the water and turned top side up.

The above hammer testing procedure was repeated on the top side. During this test wrapper plate welding was hammered using a six (6) pound hammer with a sharp striking blow adjacent to the welding. No leaks were found on the top side of the unit.

(B) Final Test

a. After the unit was properly vented and filled with de-ionized water, the pressure was built up to 44 psi.

b. The unit was then allowed to sit for one (1) hour; pressure being maintained at 44 psi.

c. The hammer test was then performed on the wrapper plates at distances 6" apart between the half rounds and below the bottom half-round. All welds on the wrapper plates were then inspected.

d.

d. Pressure on the unit was then built up to 52½psi and the entire unit was again visually inspected for leaks

with the aid of flashlights. No leaks were found and the unit was accepted.

NOTE: During freon and hydrostatic tests on both top and bottom tube sheet assemblies, three additional steps were employed in the checking of instrument wells for possible leakage. These were:

(a) Clean wells with 25% solution of nitric acid. Sniff each instrument well with G.E. leak detector after cleaning.

(b) During all freon tests on unit, remove plugs from wells and sniff with leak detector. Replace plugs after testing.

(c) During all hydrostatic tests, remove plugs from wells and lower a clean, dry rag attached to a S/S wire into wells to determine presence of water in well by blotting action of rag.

15. Pattern Measurements

A. "R" Unit

After all machining and repair work had been completed on large tubes, final pattern measurements were taken to show the position of each tube center from the X and Y centerlines. Patterns were taken on both the top and bottom sides of the unit using ligament gages. Part II-A, section 13-a, describes how the X and Y centerlines on the top and bottom were established. Pattern coordinates were later computed and referenced from these axes. For results of pattern measurements taken on the top and bottom sides of the "R" bottom tube sheet, see Exhibit #13.

B. "P" Unit

This inspection was performed in a similar manner to that described above in Section 15A. For results of pattern measurements taken on the top and bottom sides of the "P" bottom tube sheet, see Exhibit #14.

C. "L" Unit

This inspection was performed in a similar manner to that described above in Section 15A. For results of pattern measurements taken on the top and bottom sides of the "L" bottom tube sheet, see Exhibit #15.

16. Final Internal Cleaning by Dowell Inc. and Establishing X and Y Centerlines.

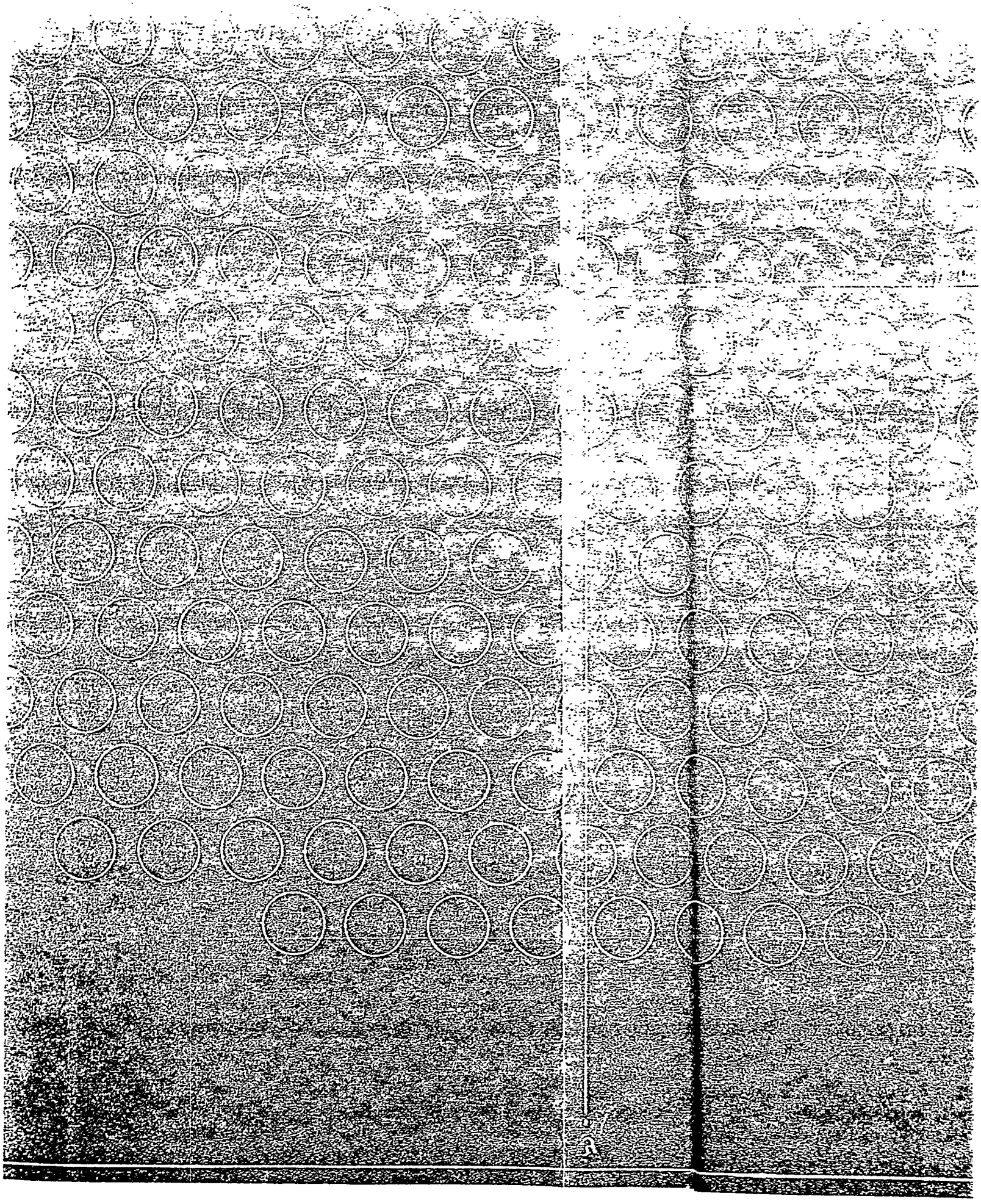
A. "R" Unit

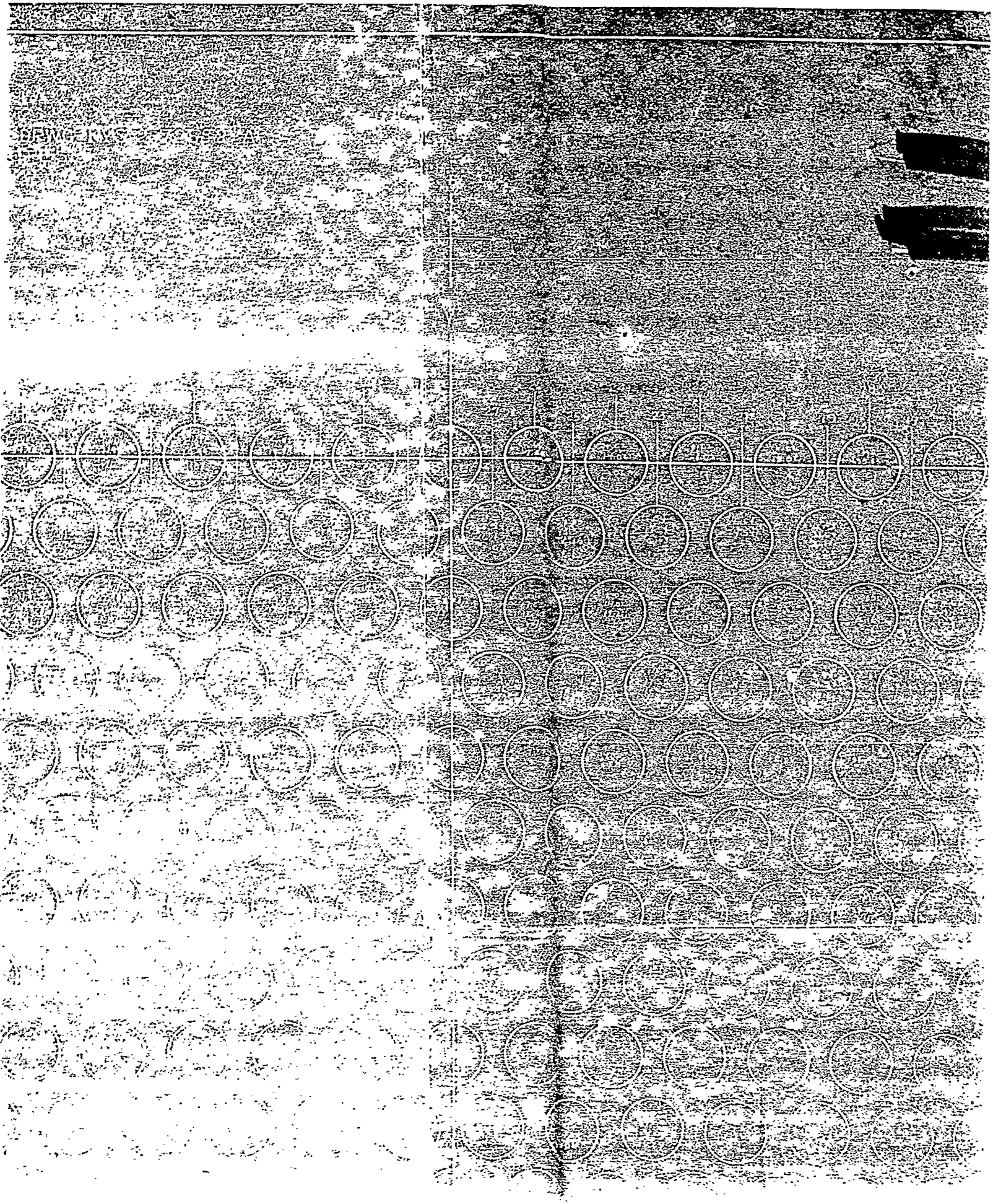
(1) Dowell Cleaning

Prior to loading raschig rings in the bottom tube sheet, Dowell Inc. of Wilmington, Delaware, chemically

EXHIBIT #13

RESULTS OF PATTERN COORDINATES TAKEN ON TOP AND BOTTOM SIDES OF THE "R" BOTTOM TUBE SHEET ASSEMBLY.

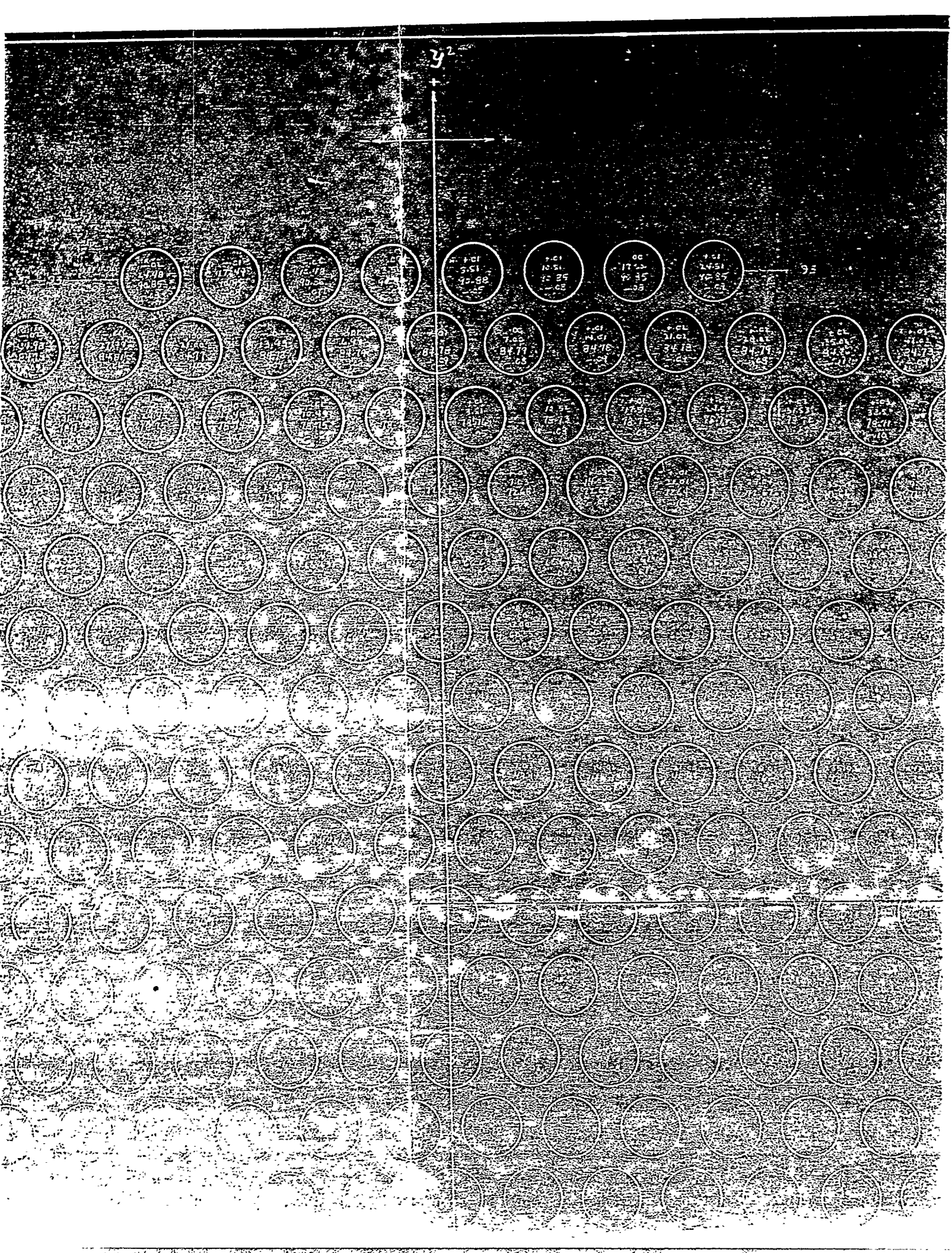


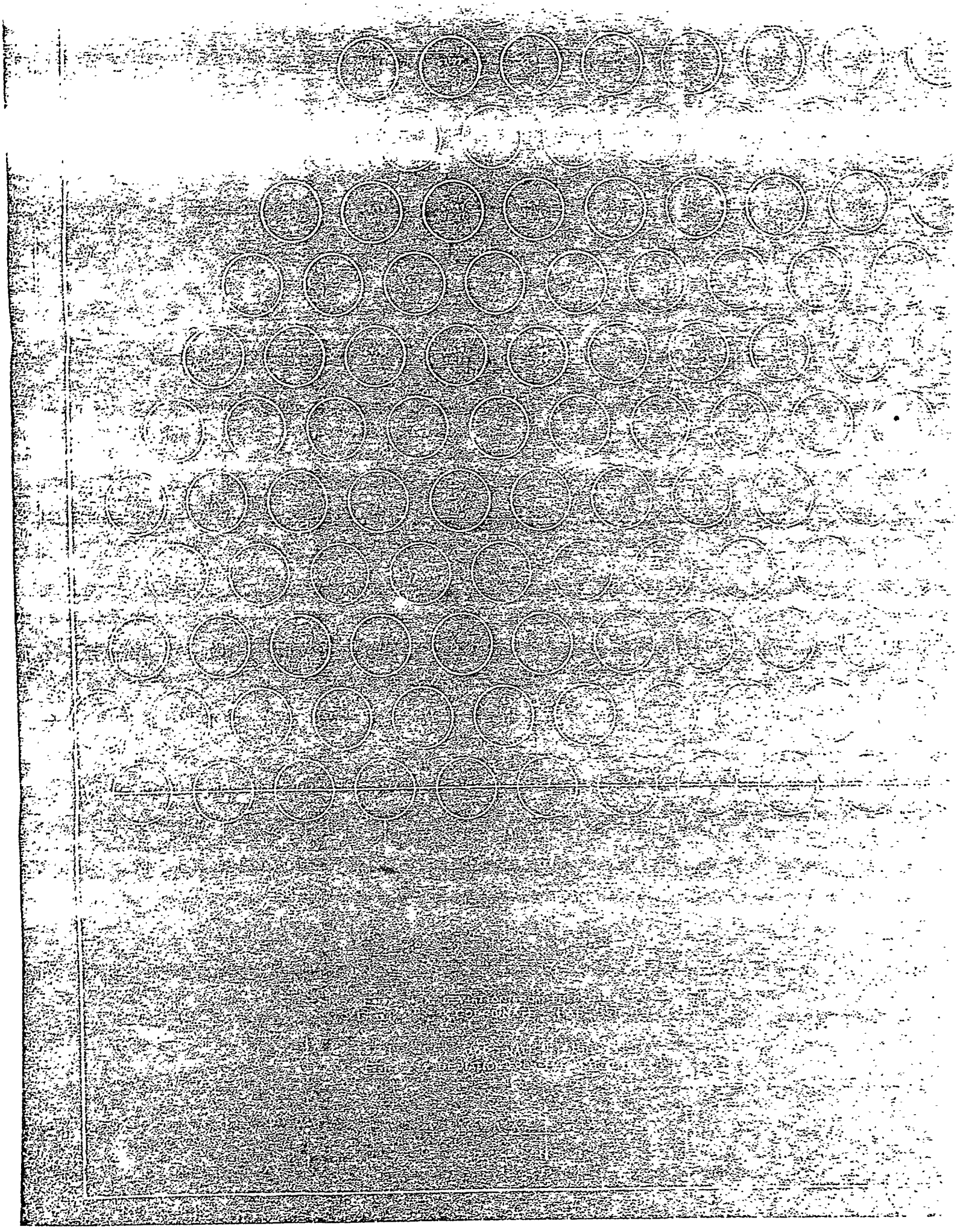


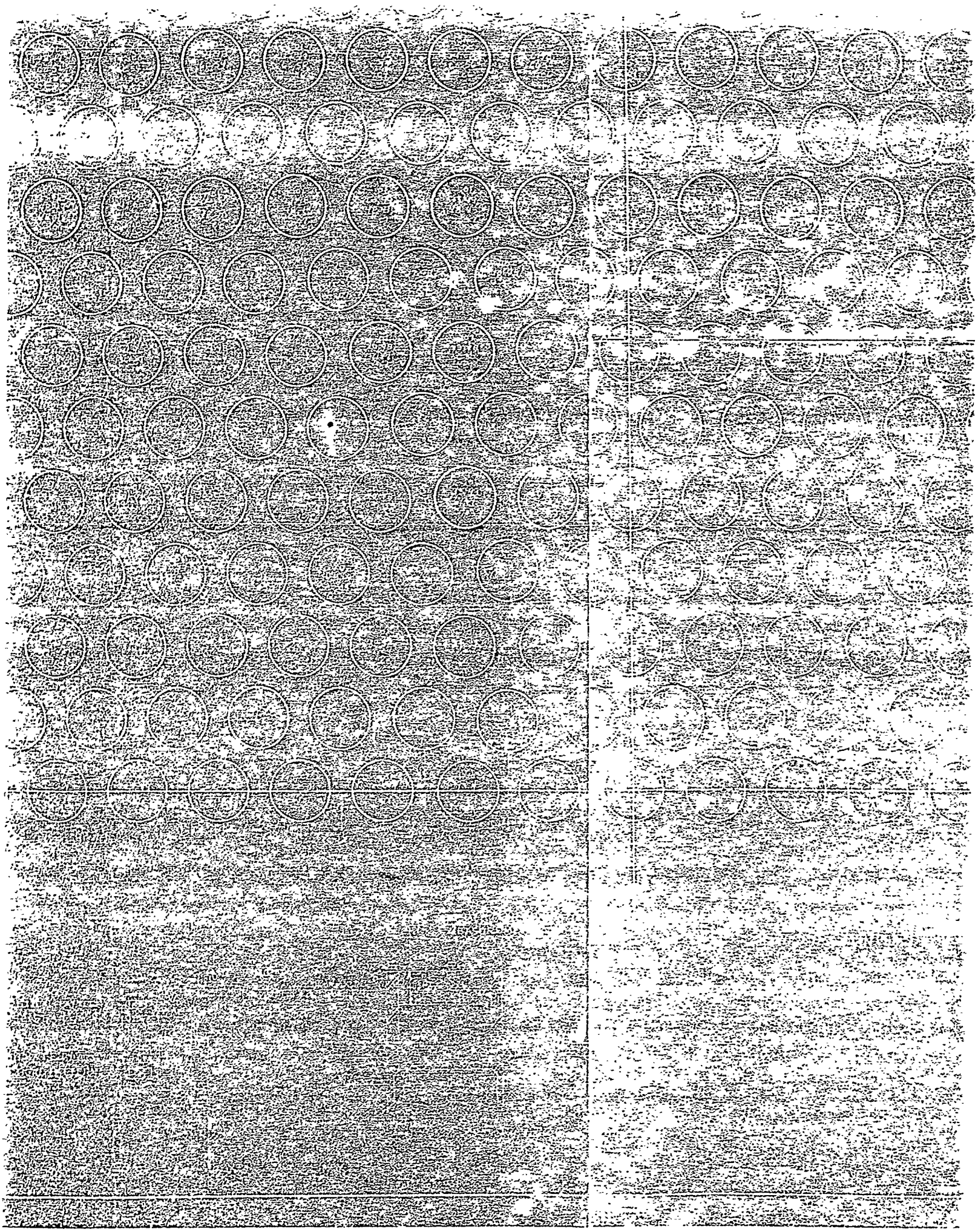
E. I. DU PONT DE NEMOURS & CO.
WILMINGTON, DELAWARE
CONSTRUCTION DIVISION
N.C.E. SECTION

TANK BOTTOM TUBE SHEET
BOTTOM SIDE - RUN 1
PATTERN COORDINATES

BY	SADOWSKI	PROJECT	8486
DATE	7-25-52		
	NO. NY- 2		


y^2

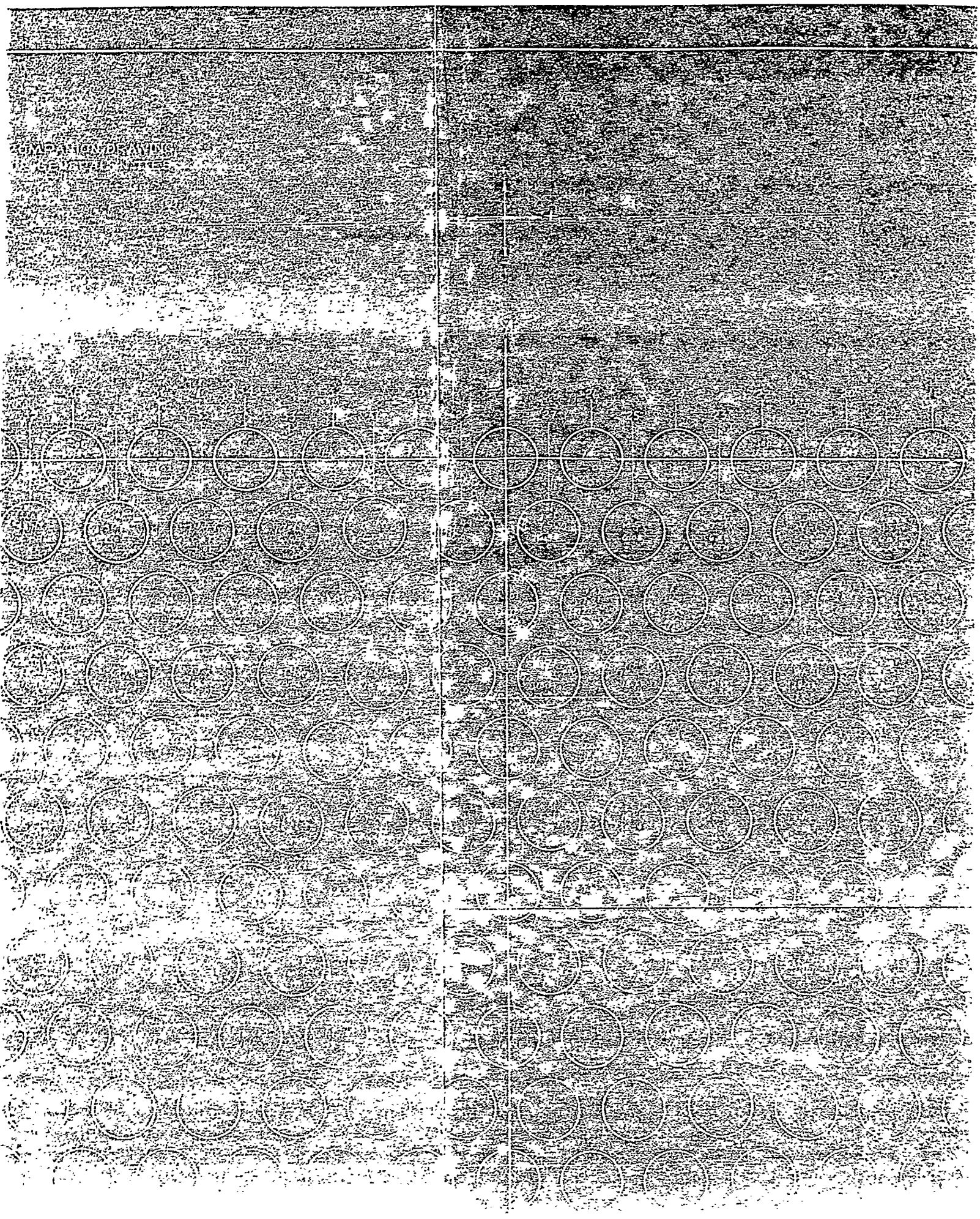




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NOTE

PLEASE SEE COMPANION



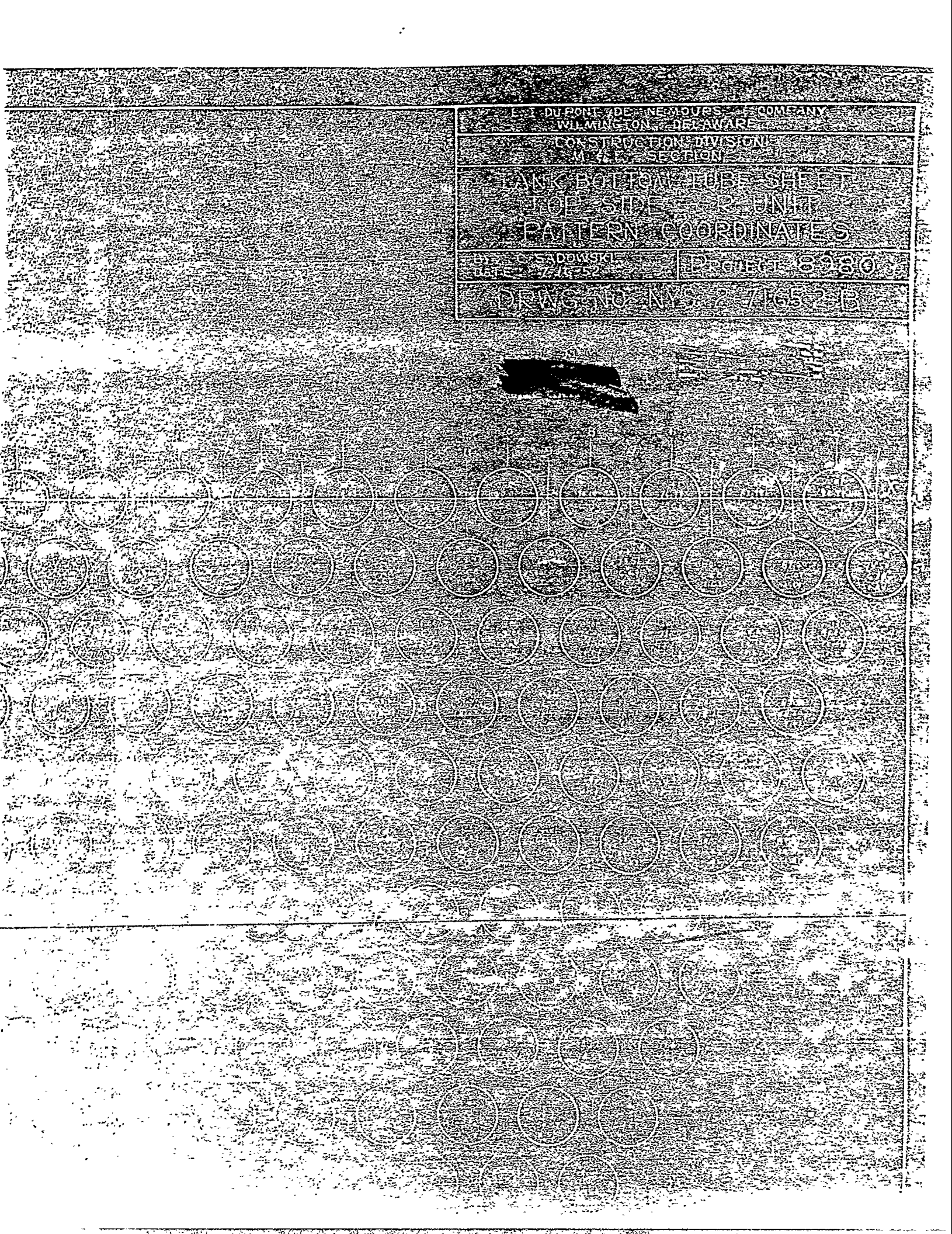
DU PONT DE NEMOURS COMPANY
WILMINGTON, DELAWARE

CONSTRUCTION DIVISION
M. & C. SECTION

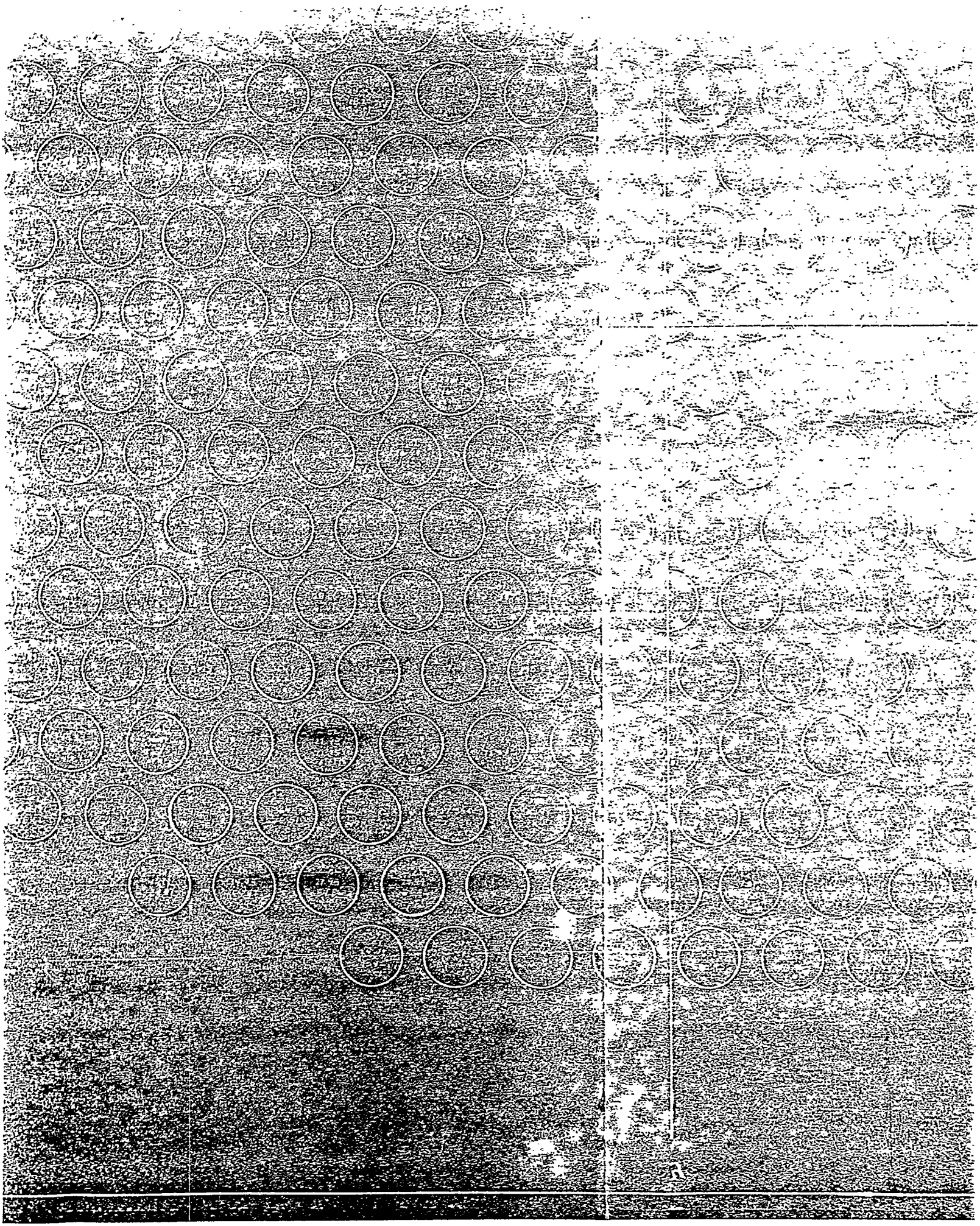
TANK BOTTOM TUBE SHEET
NOZ. SIDE R. UNIT
PATTERN COORDINATES

By S. ADOWSKI | Project 8980

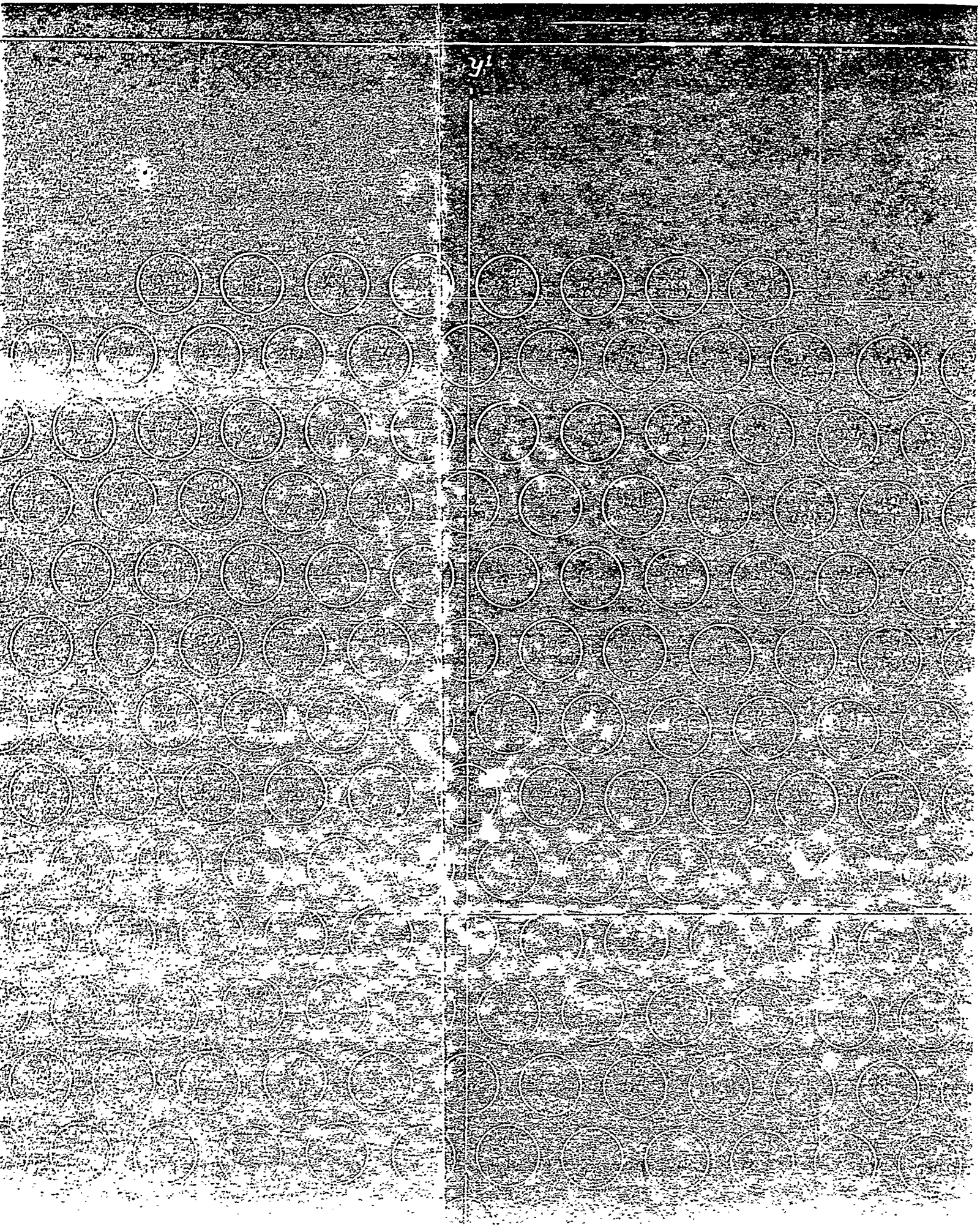
Date 7/15/52 | DRWG. NO. NYS 71652-B

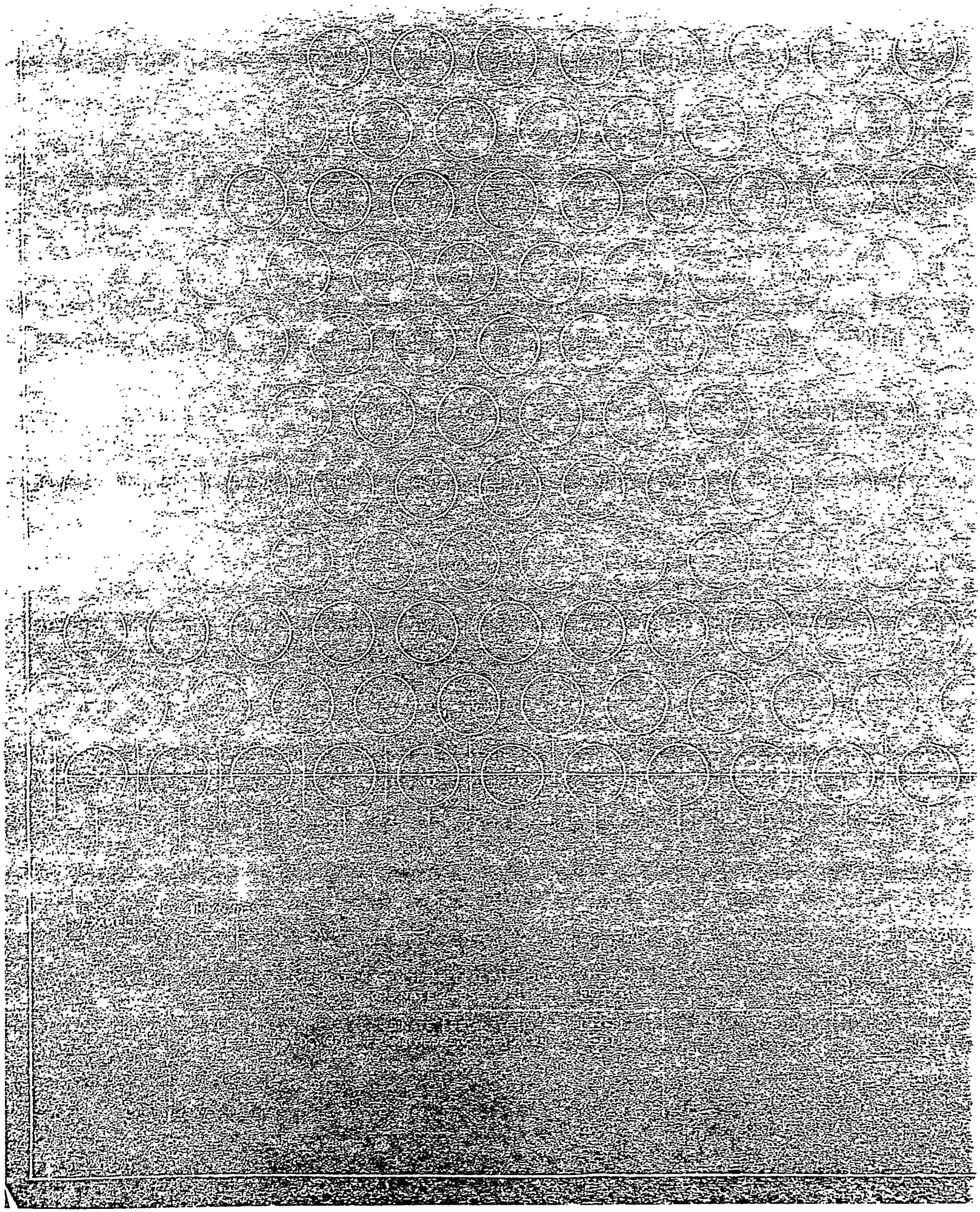


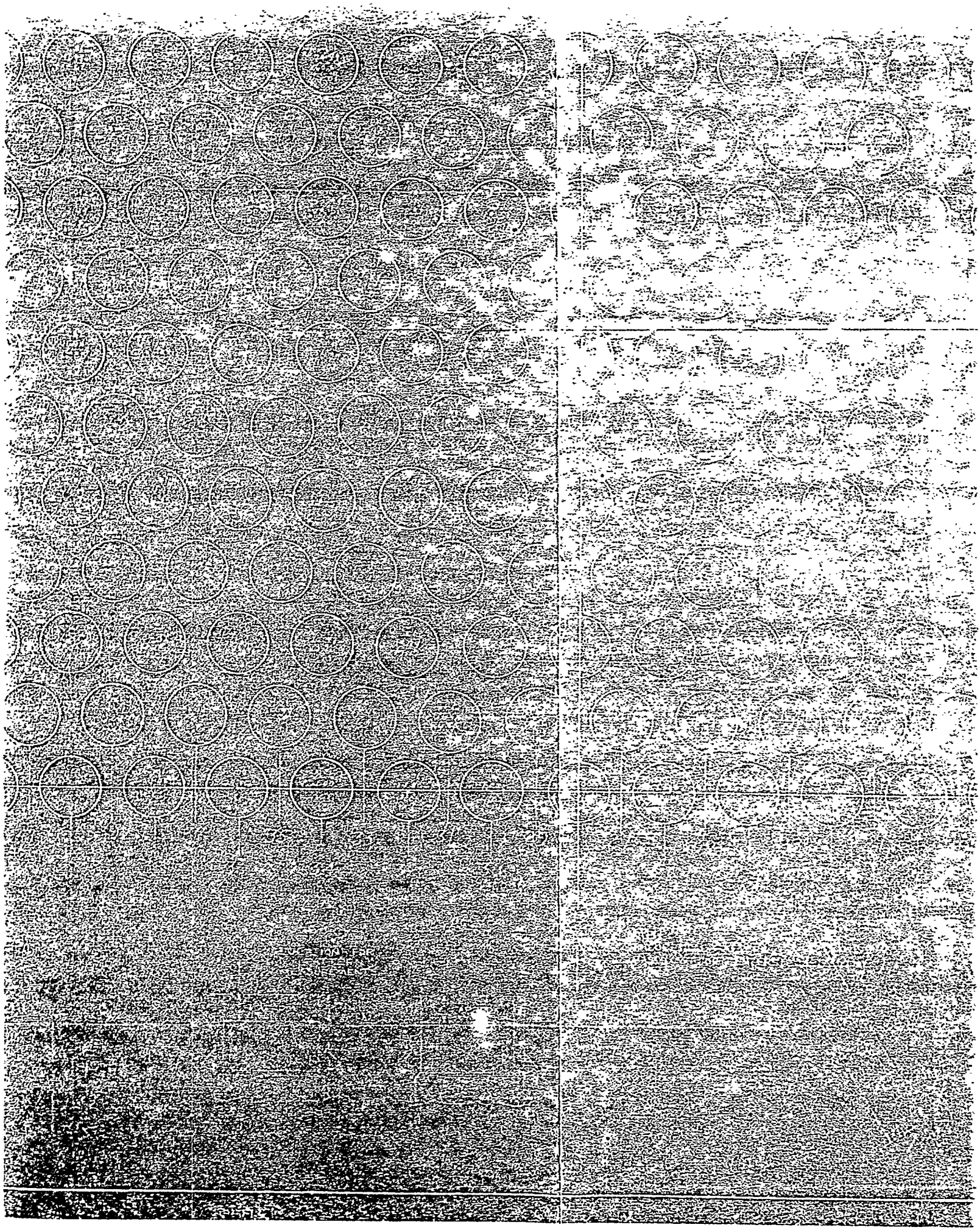
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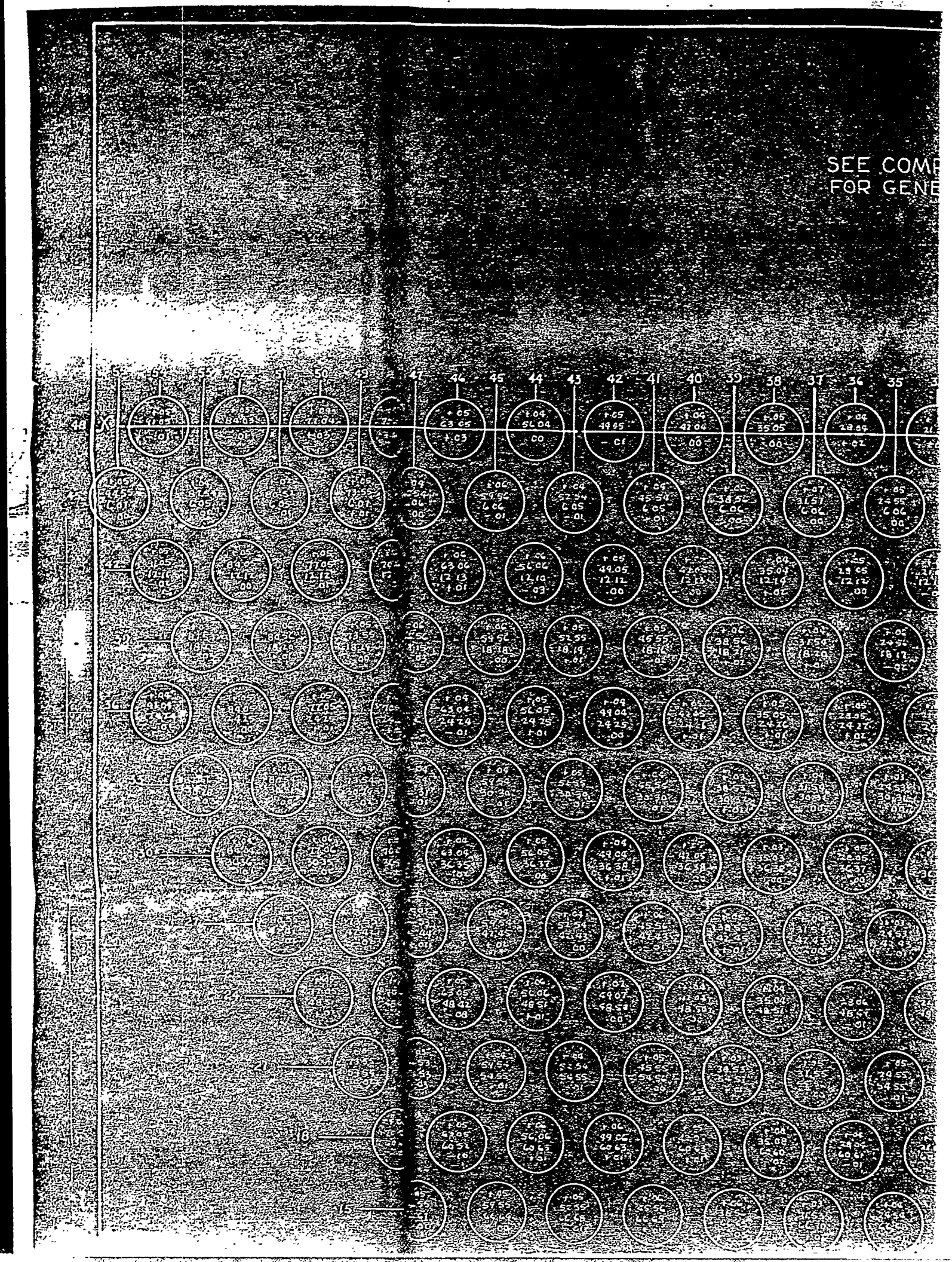


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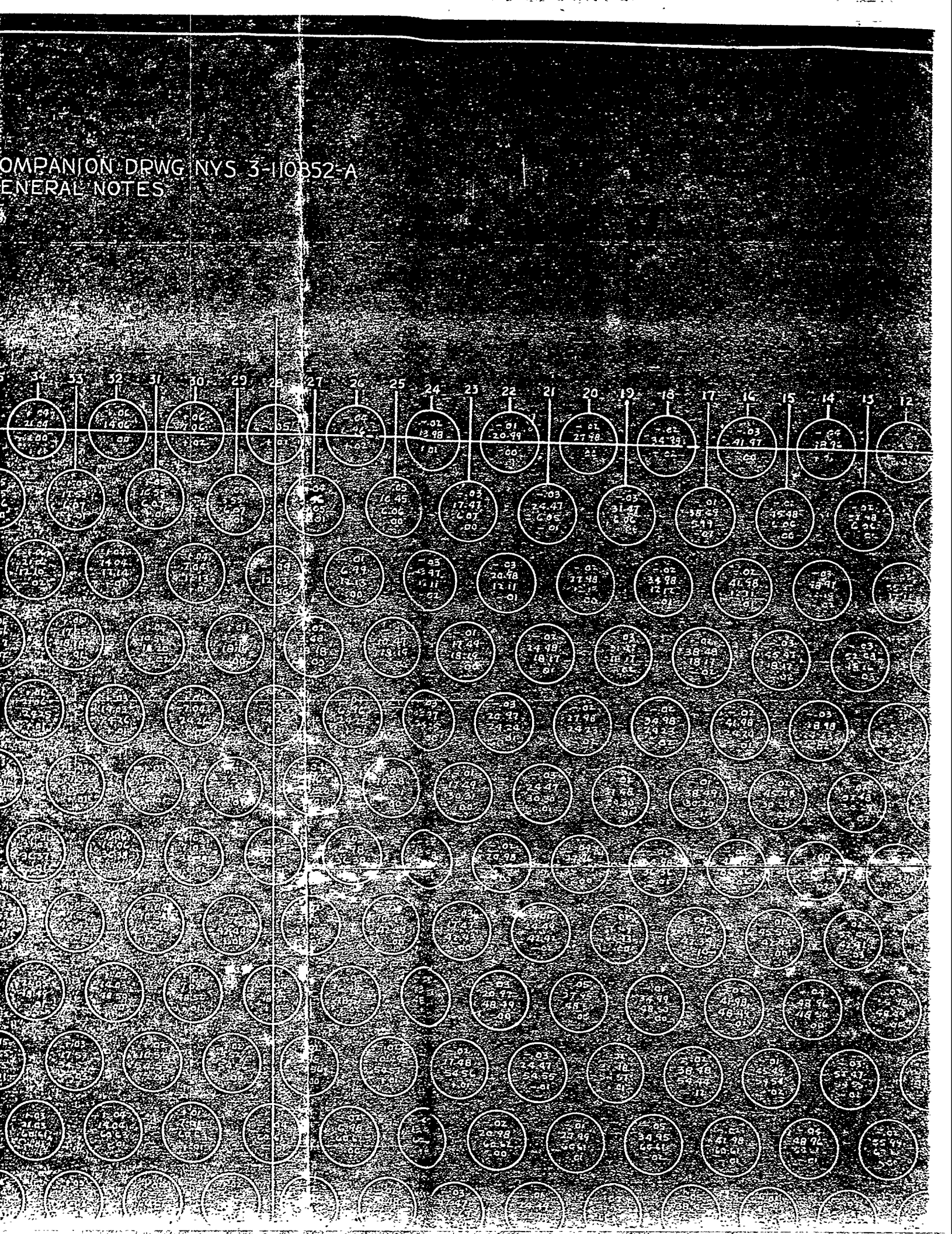
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EXHIBIT #14

RESULTS OF PATTERN COORDINATES TAKEN ON TOP AND BOTTOM SIDES OF THE "P" BOTTOM TUBE SHEET ASSEMBLY.


SEE COMP
FOR GENE

OMPANION DRWG NYS 3-110852-A
ENERAL NOTES



E. I. DU PONT DE NEMOURS & CO.

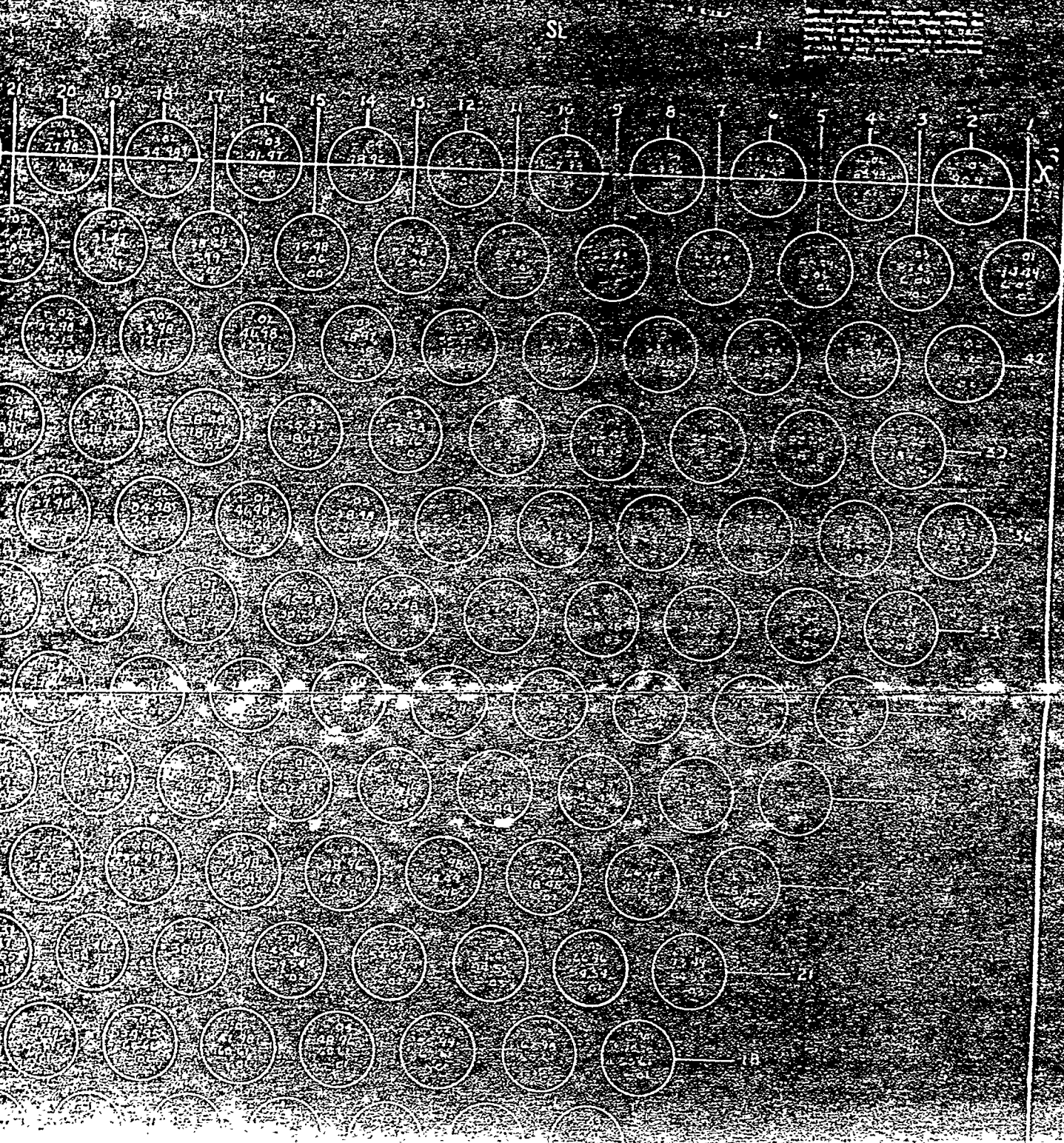
CONSTRUCTION DIVISION
M & E SECTION

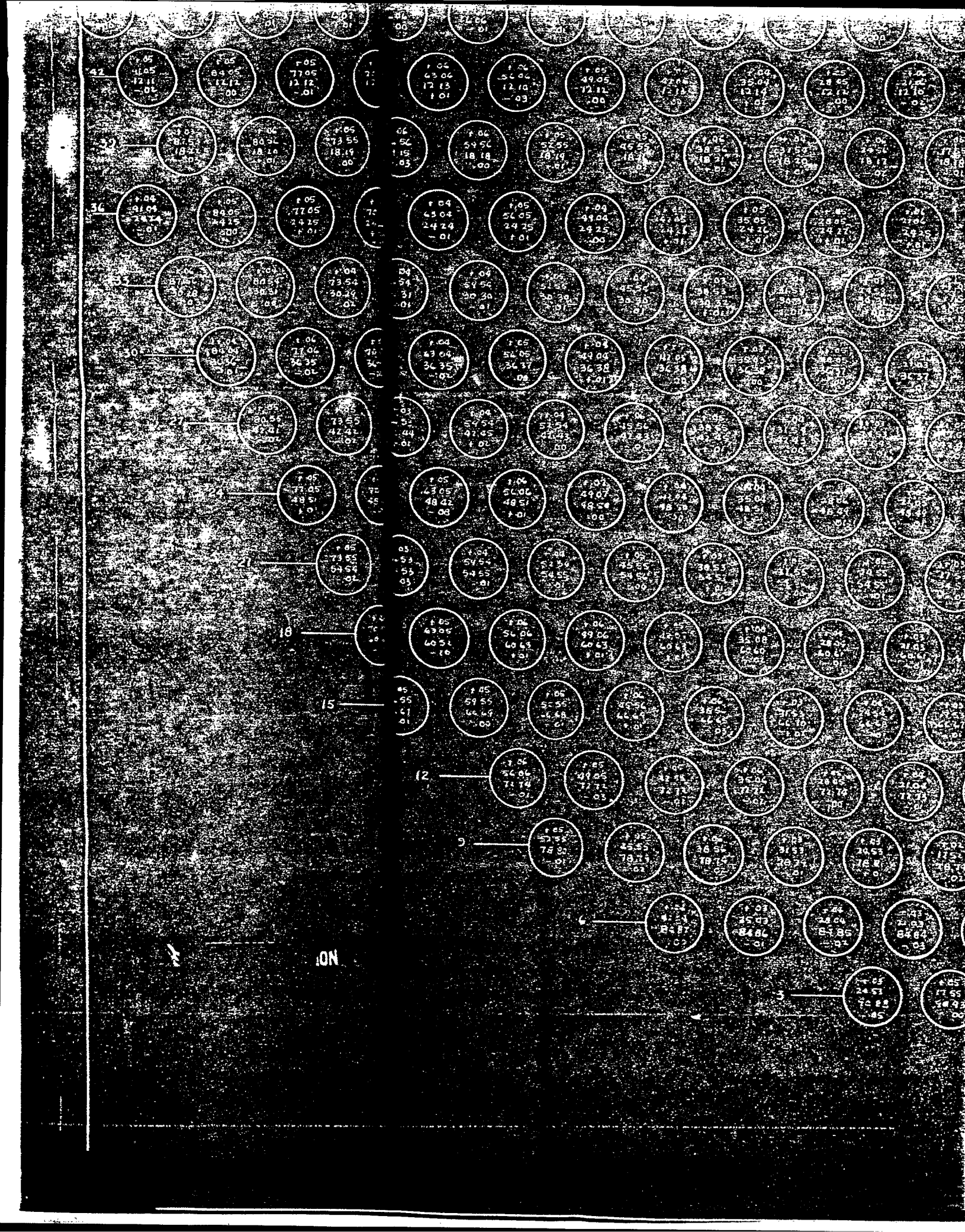
TANK BOTTOM TUBE SHEET BOTTOM SIDE - P UNIT PATTERN COORDINATES

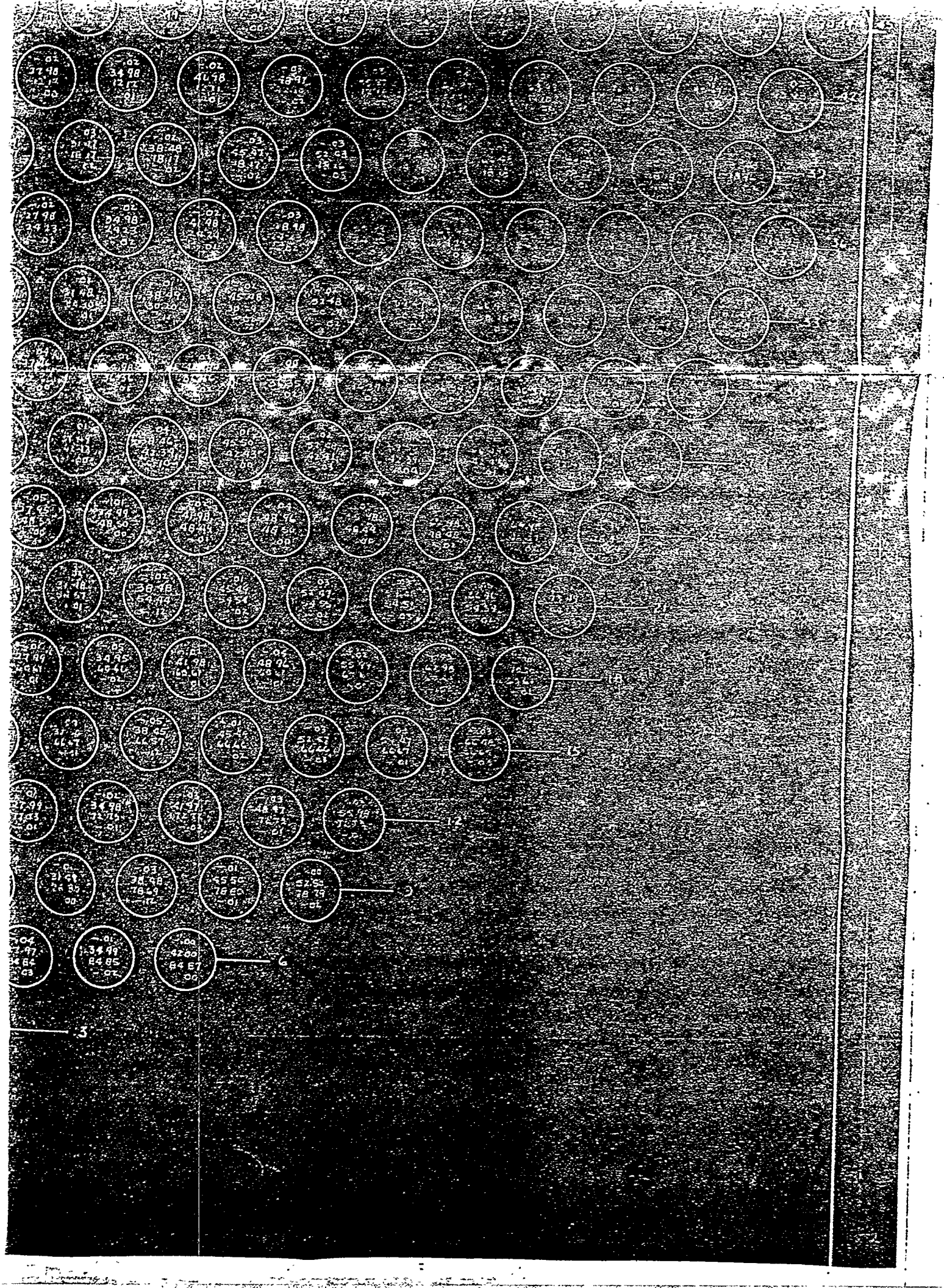
BY: C. SADOWSKI
DATE: 11-8-52

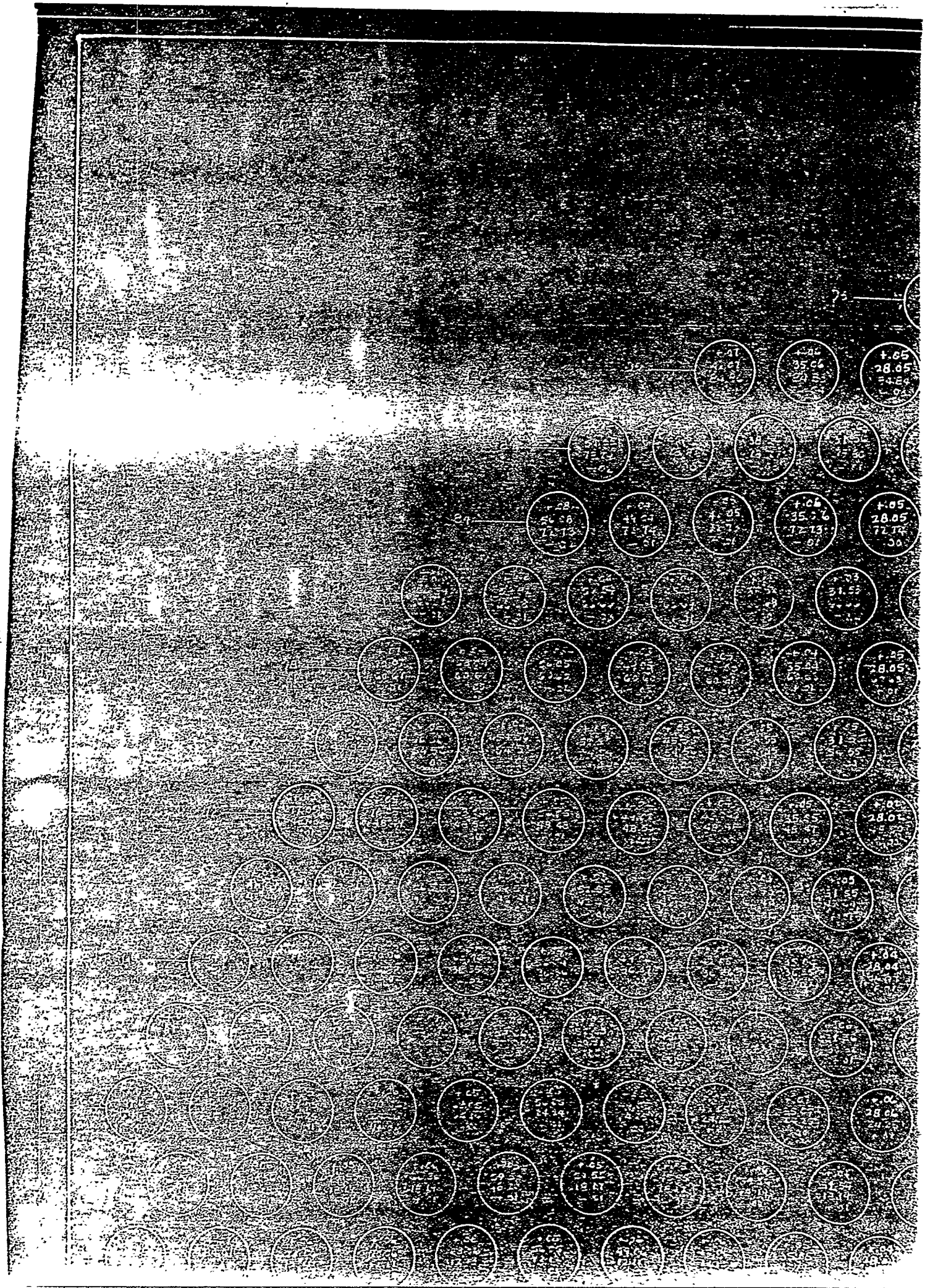
PROJECT 8980

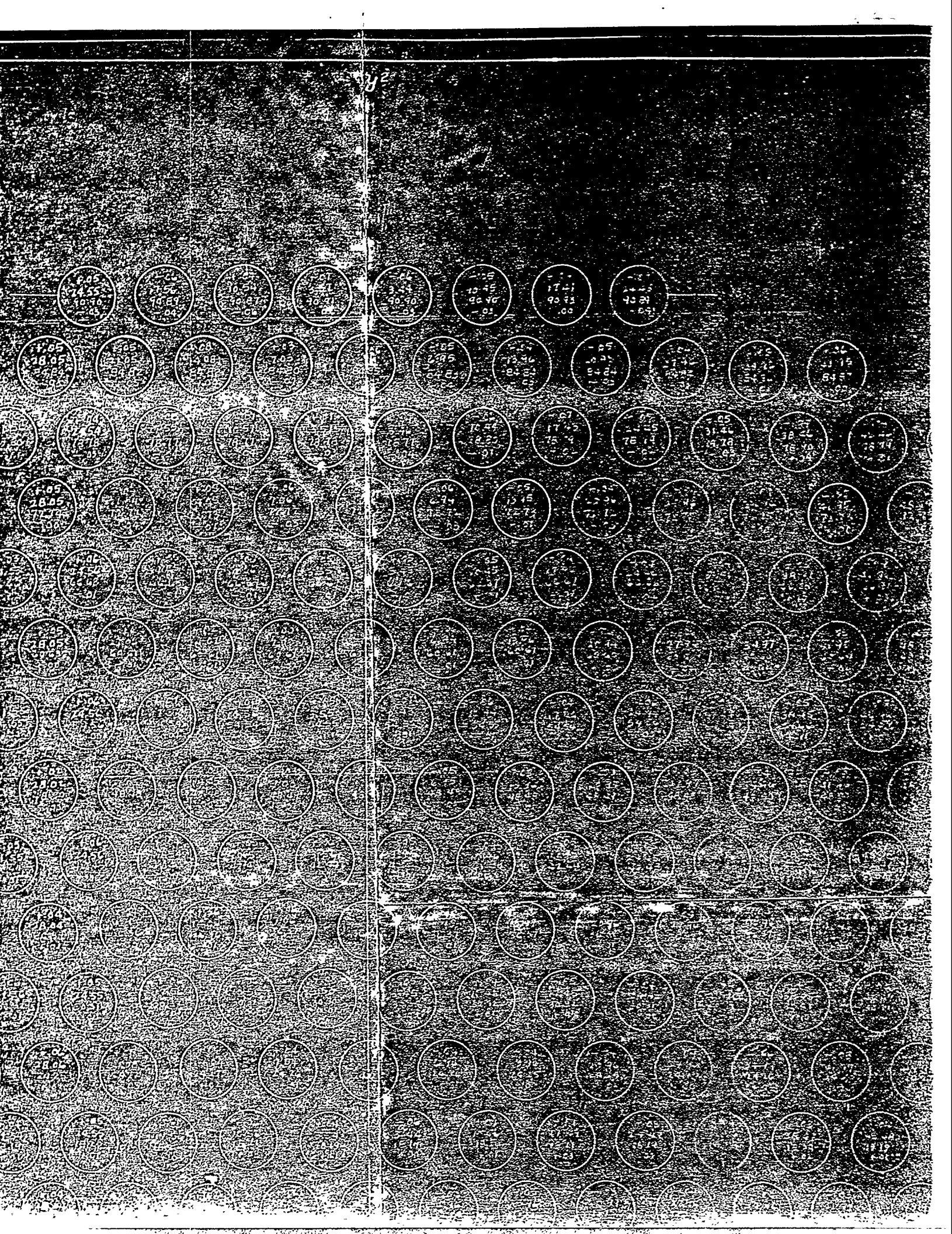
DRWG NO NYS 3-110852-B

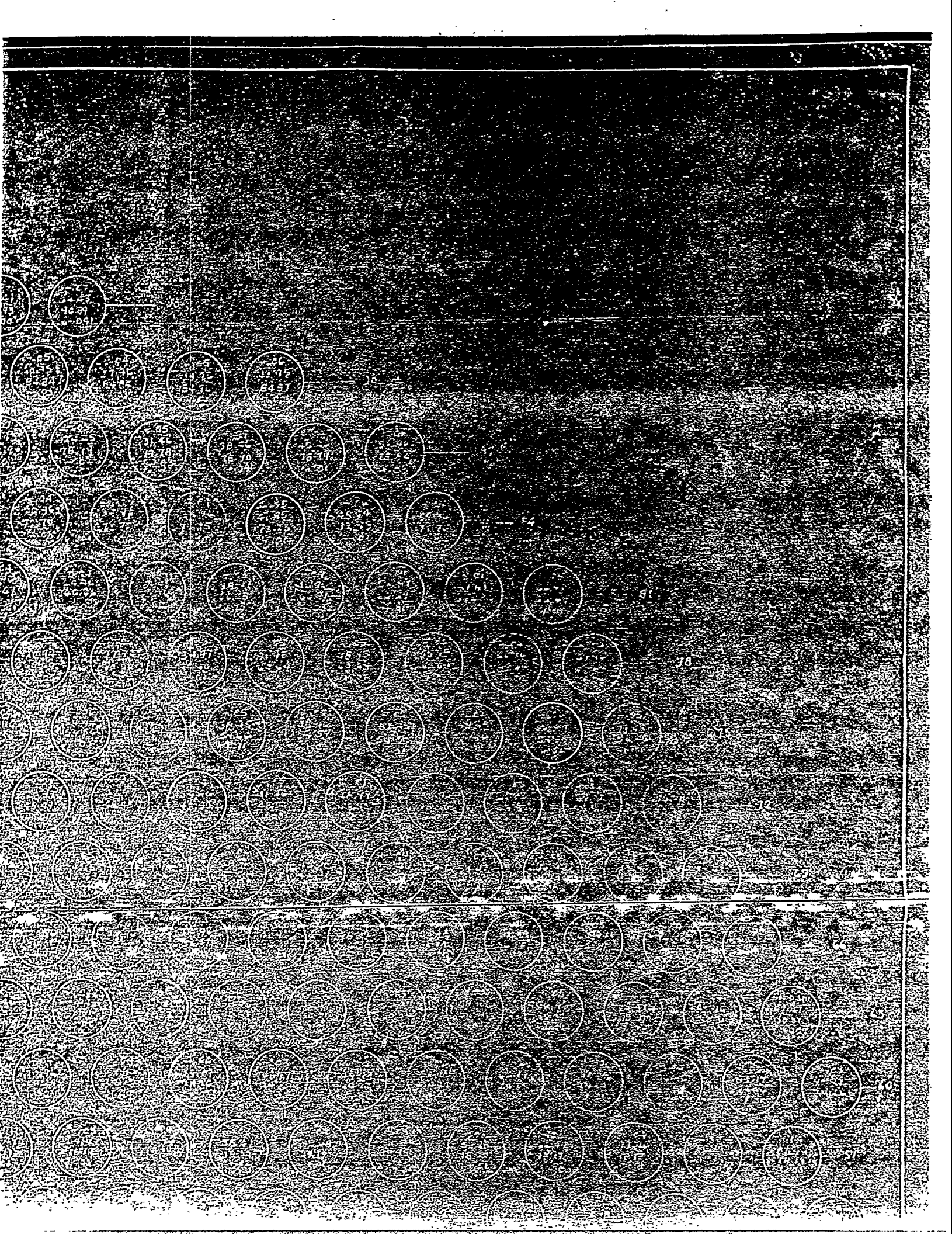


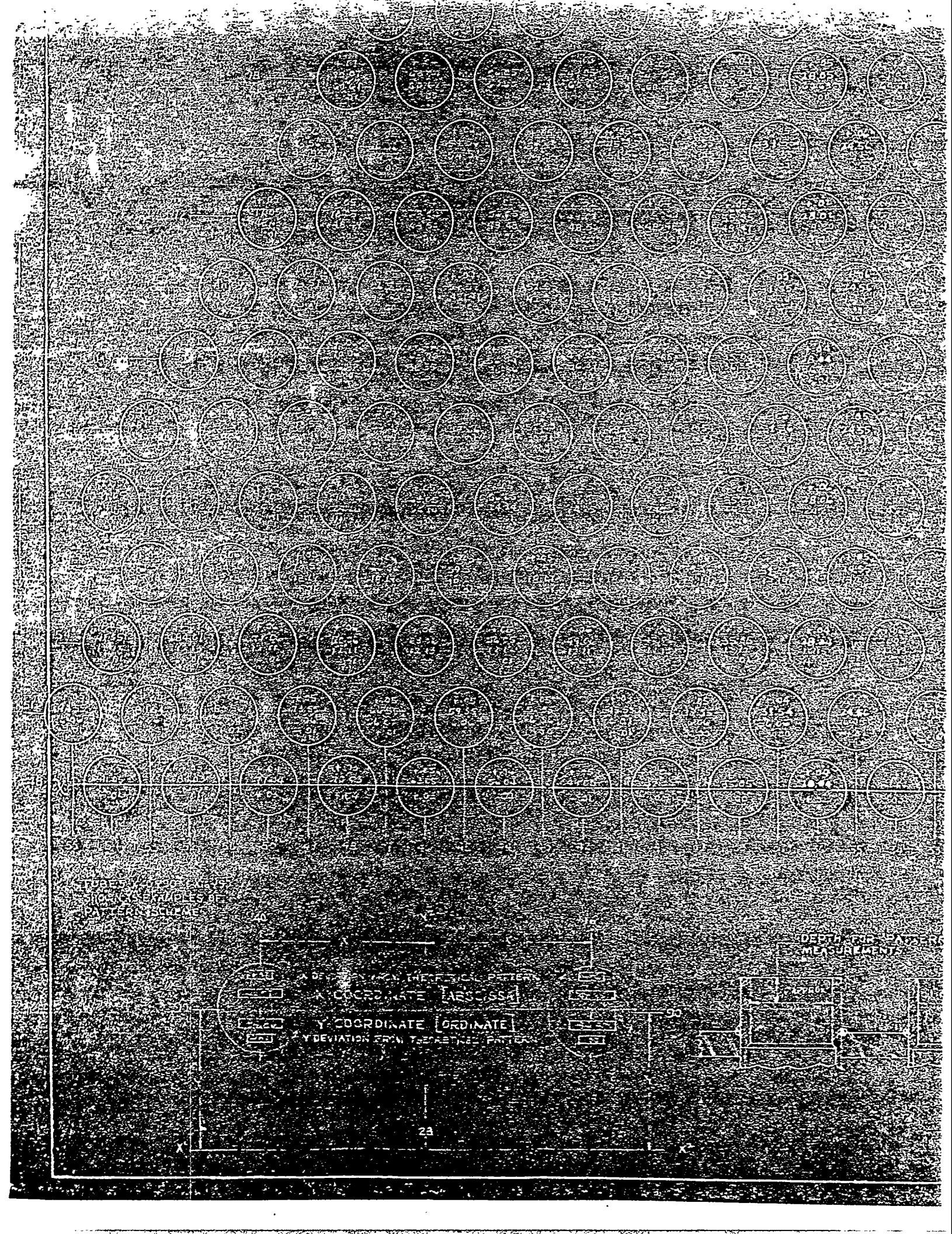


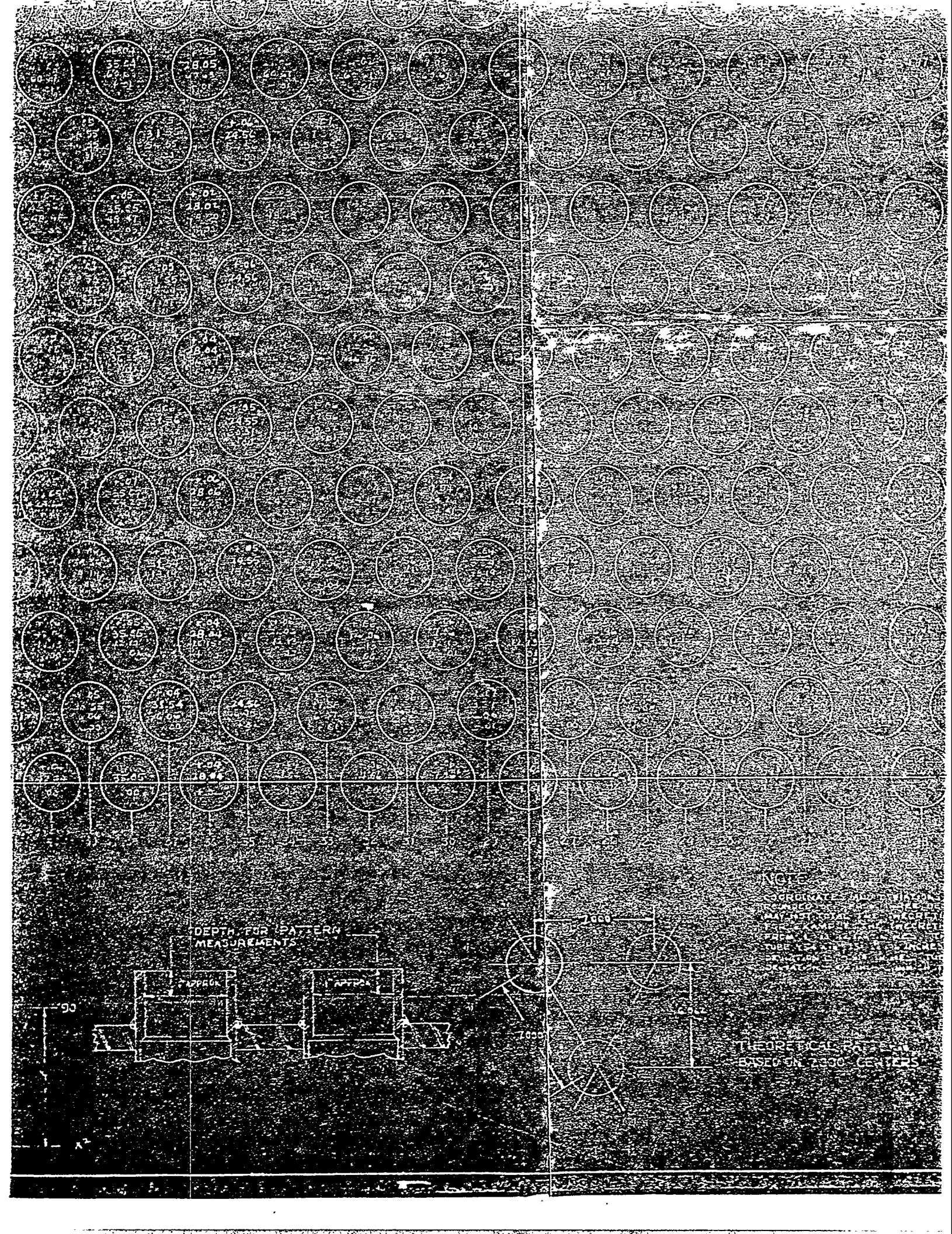


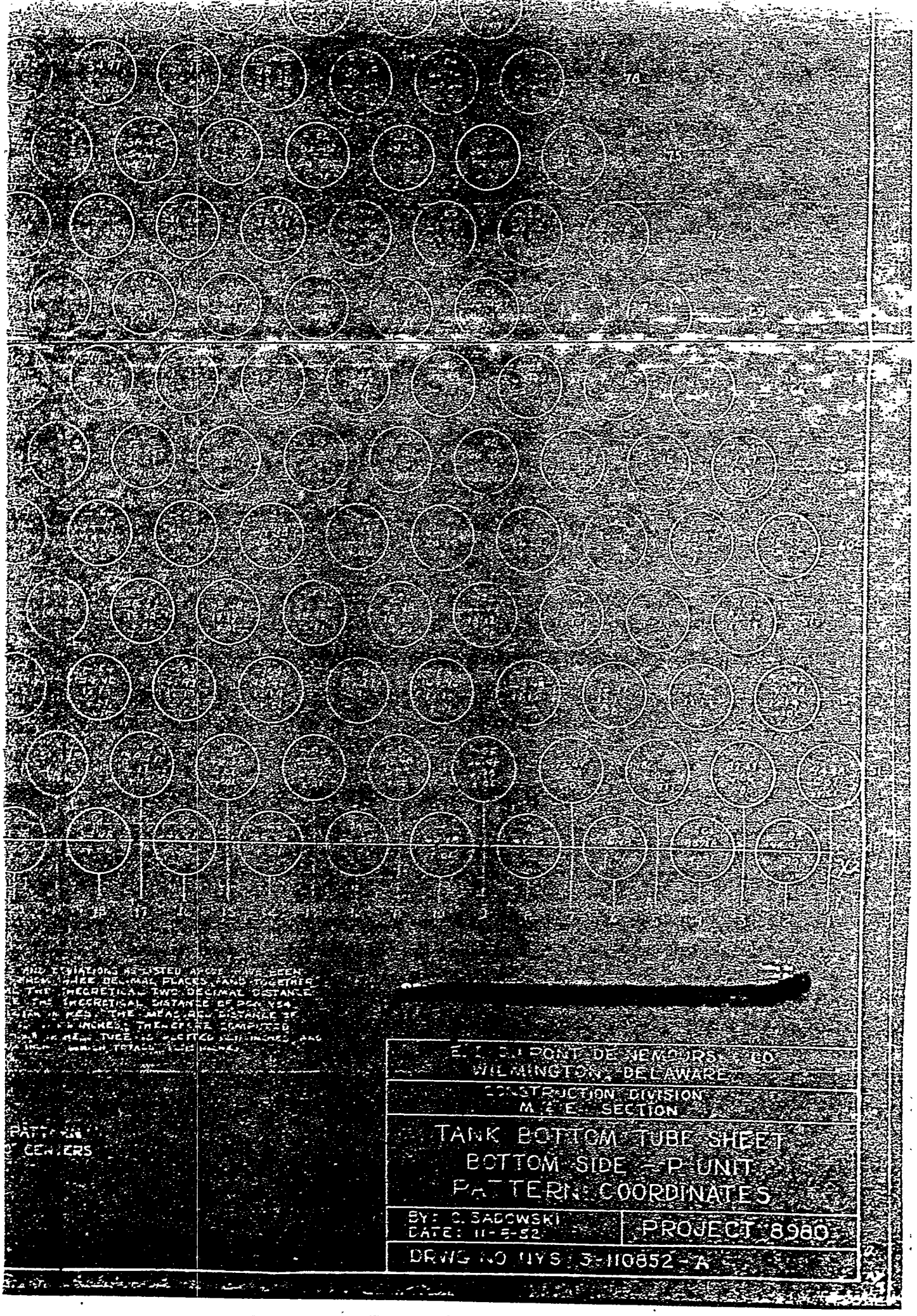


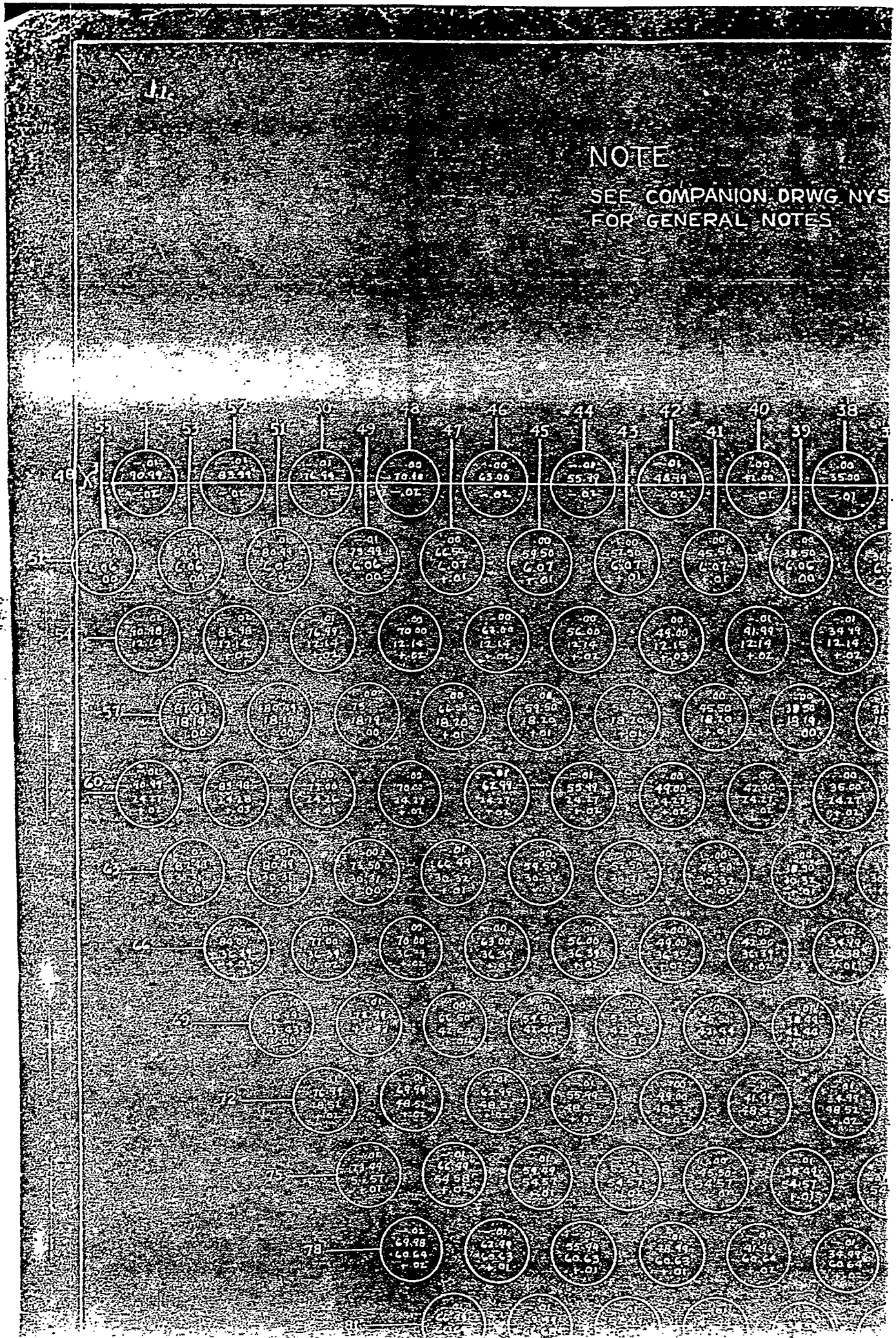


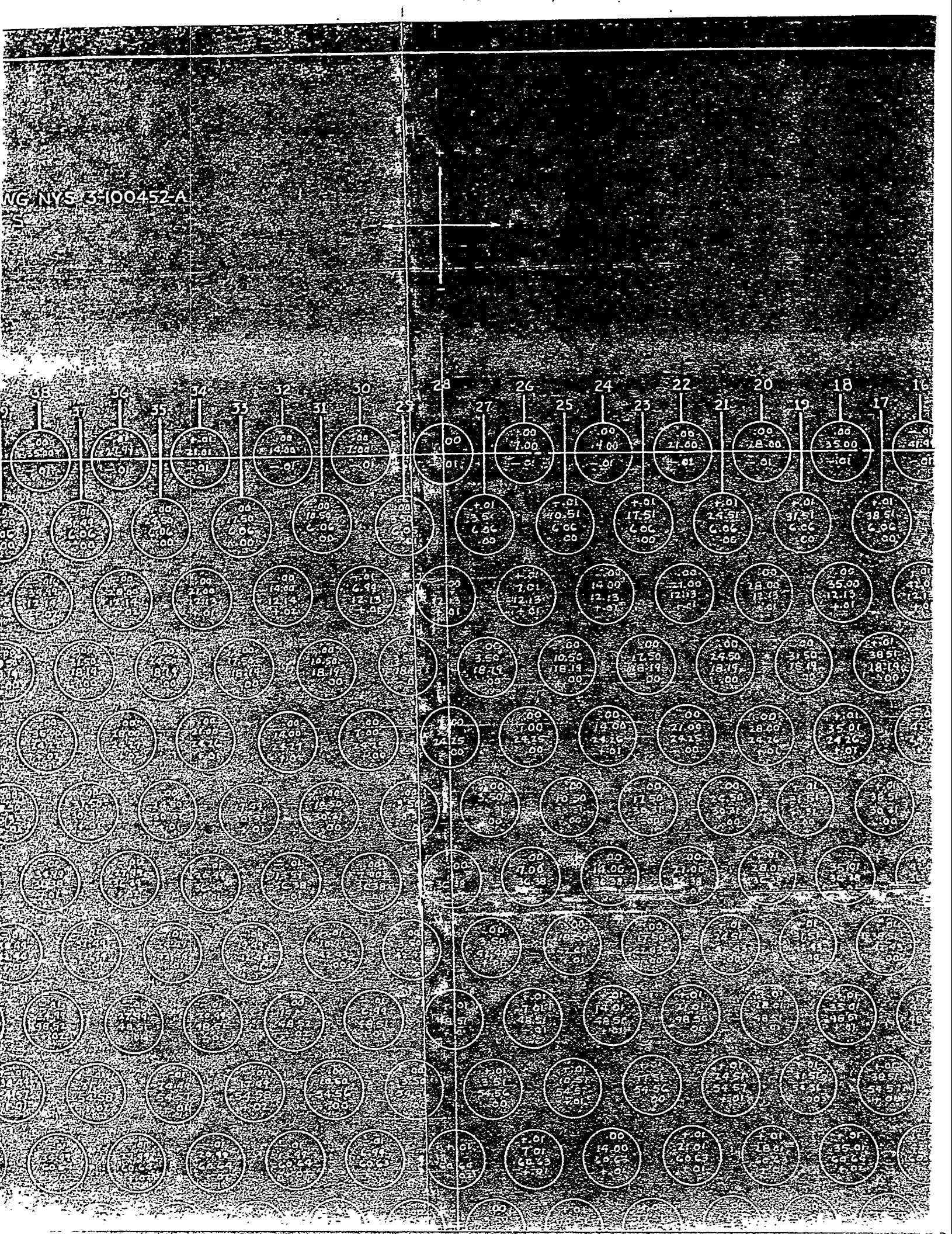



Y COORDINATE [ORDINATE]
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DEPTH FOR PATTERN MEASUREMENTS
THEORETICAL PATTERN


AND DEVIATIONS RECORDED AFTER HAVE BEEN
FROM THREE DECIMAL PLACES AND TOGETHER
THE THEORETICAL TWO DECIMAL DISTANCE
THE THEORETICAL DISTANCE OF ONE TUBE
CENTER IN RES. THE MEAN DEV. DISTANCE OF
INCHES. THE ERROR COMPUTED
ONE TUBE TO ADJACENT TUBE INCHES, AND
MEAN TOTAL ERROR INCHES.
PATTERN
CENTERS
E. I. DU PONT DE NEMOURS & CO.
WILMINGTON, DELAWARE
CONSTRUCTION DIVISION
M. & E. SECTION
TANK BOTTOM TUBE SHEET
BOTTOM SIDE - P UNIT
PATTERN COORDINATES
BY: C. SADOWSKI
DATE: 11-5-52
PROJECT 8980
DRWG NO WYS 3-110852-A


NOTE
SEE COMPANION DRWG NYS
FOR GENERAL NOTES


NG NYS 3-100452-A
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E. I. DU PONT DE NEMOURS & COMPANY
WILMINGTON, DELAWARE

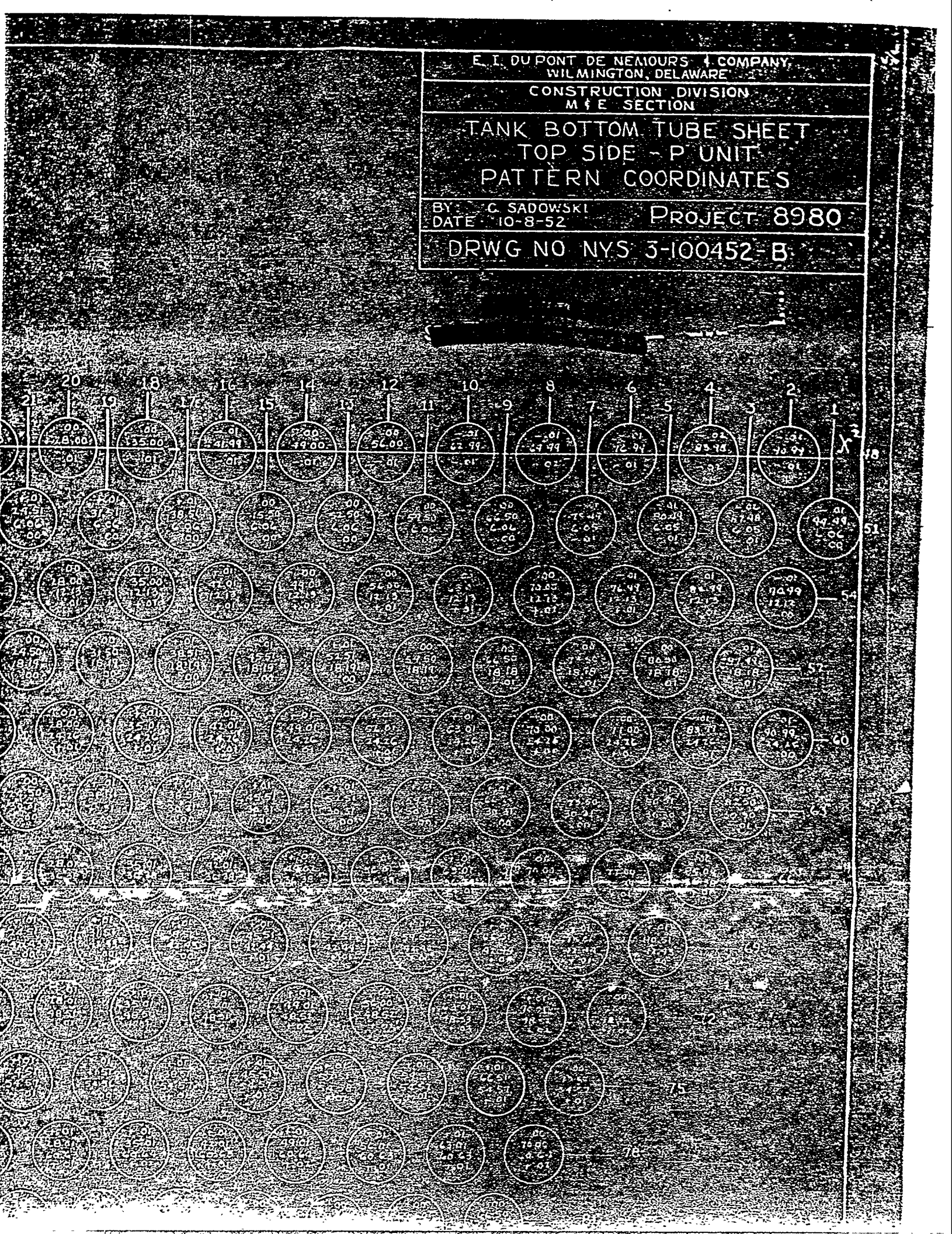
CONSTRUCTION DIVISION
M & E SECTION

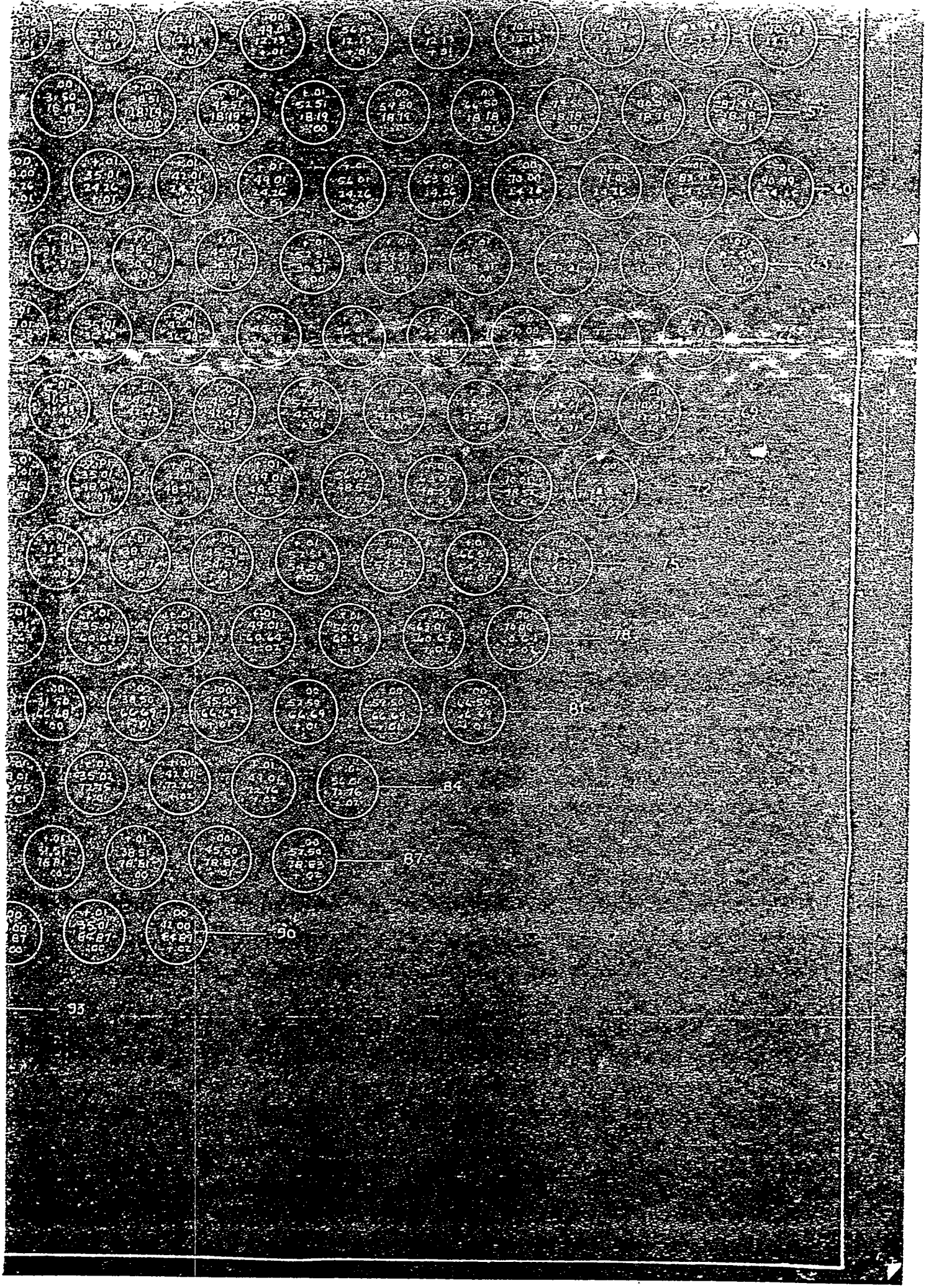
TANK BOTTOM TUBE SHEET
TOP SIDE - P UNIT
PATTERN COORDINATES

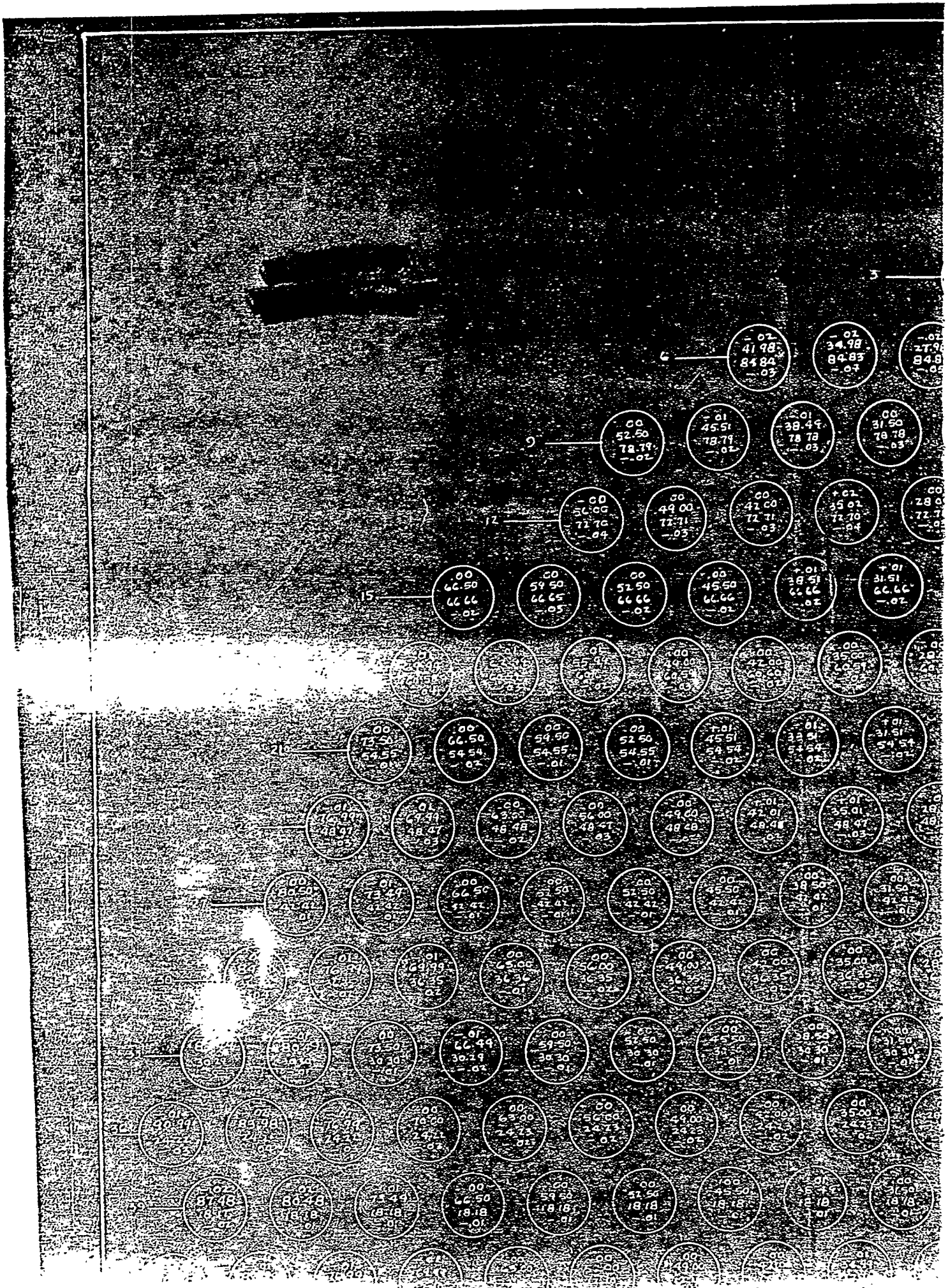
BY: C. SADOWSKI
DATE: 10-8-52

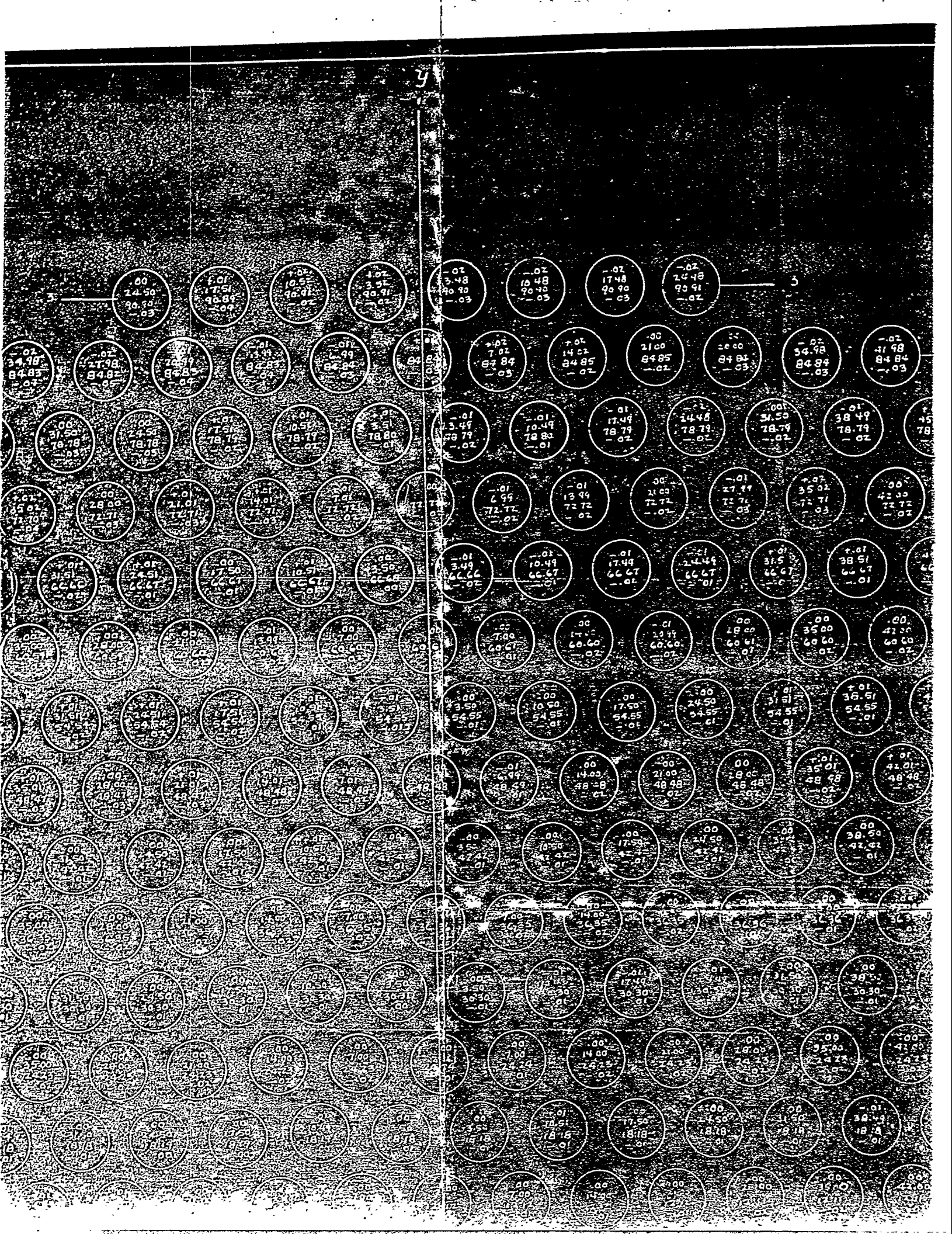
PROJECT 8980

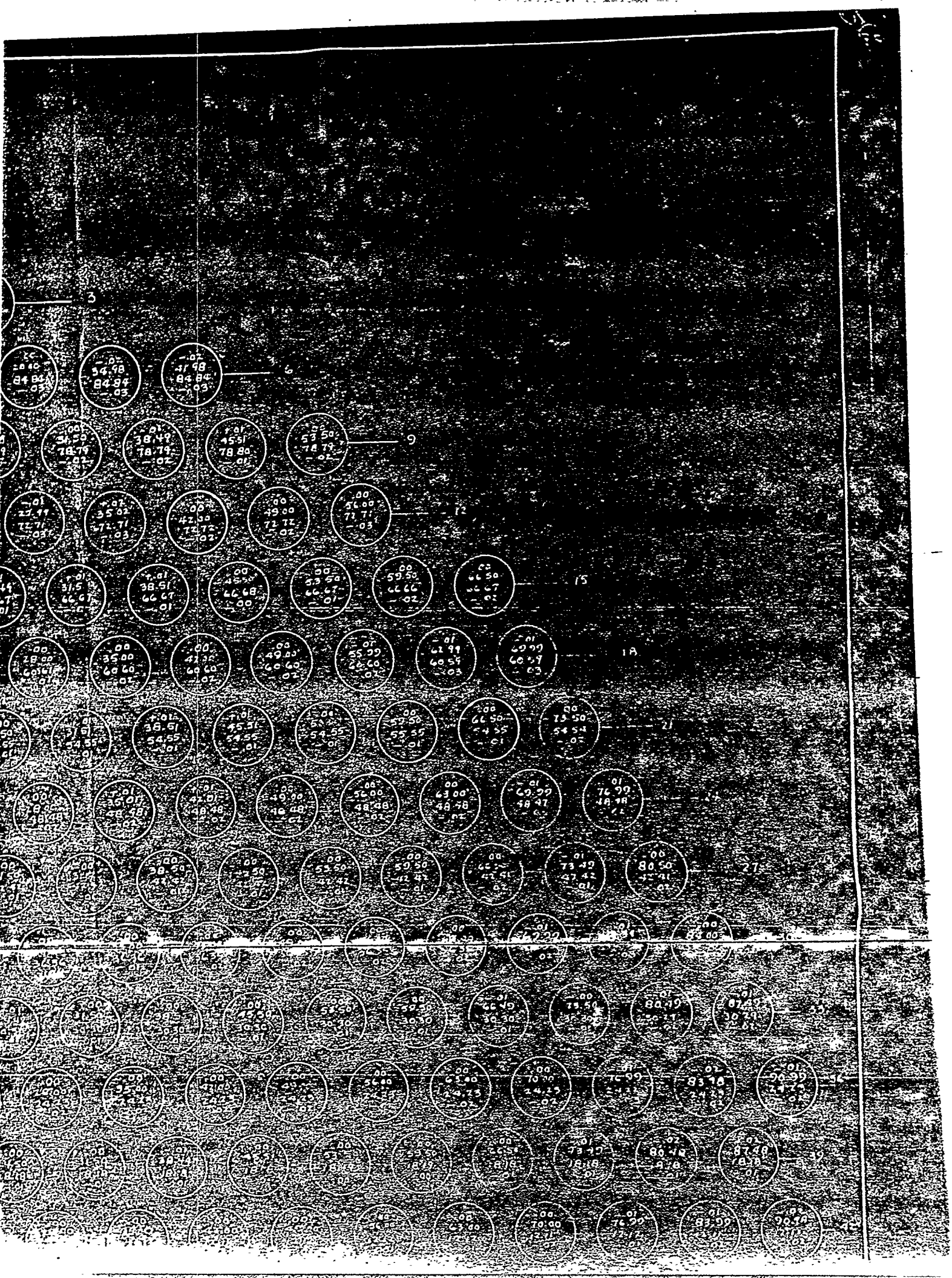
DRWG NO NYS 3-100452-B

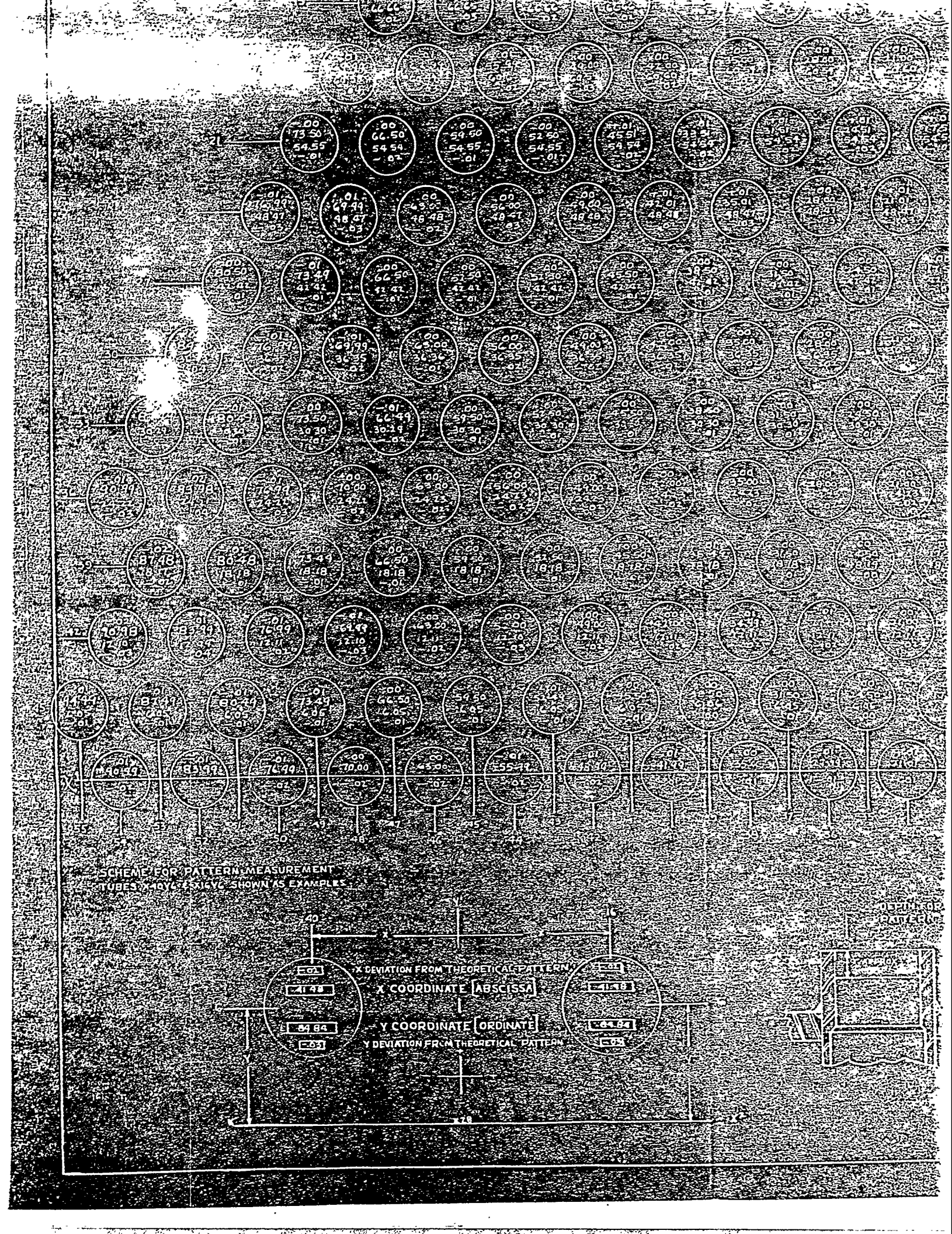


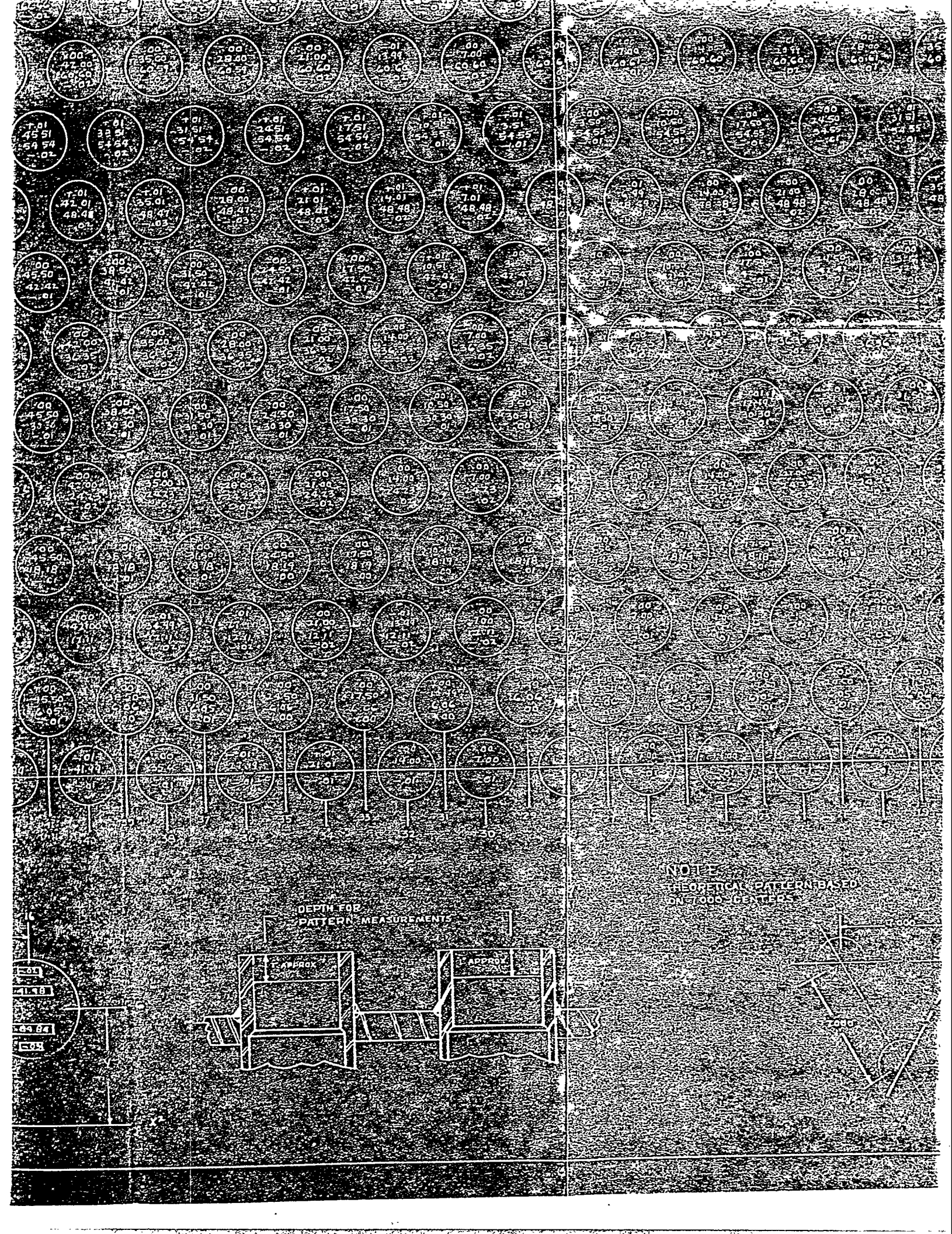


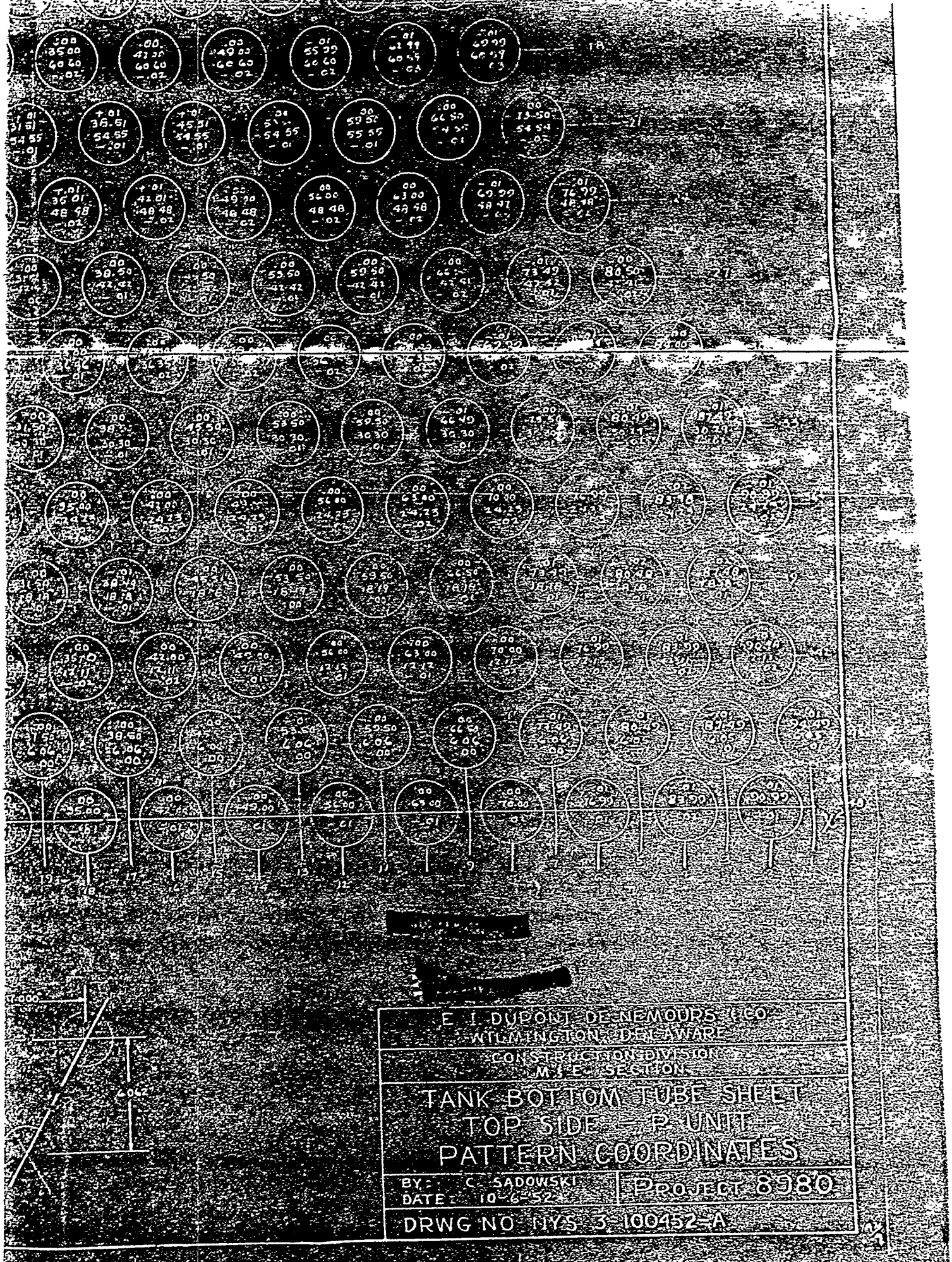







SCHEME FOR PATTERN MEASUREMENT
TUBES, ANODE AND GRIDS SHOWN AS EXAMPLES
X DEVIATION FROM THEORETICAL PATTERN
X COORDINATE (ABSCISSA)
Y COORDINATE (ORDINATE)
Y DEVIATION FROM THEORETICAL PATTERN


DEPTH FOR
PATTERN MEASUREMENTS
APPROX
APPROX
NOTE:
THEORETICAL PATTERN BASED
ON 1000 ITERATIONS



E I DUPONT DE NEMOURS & CO
WILMINGTON, DELAWARE
CONSTRUCTION DIVISION
M & E SECTION

TANK BOTTOM TUBE SHEET
TOP SIDE - P UNIT
PATTERN COORDINATES

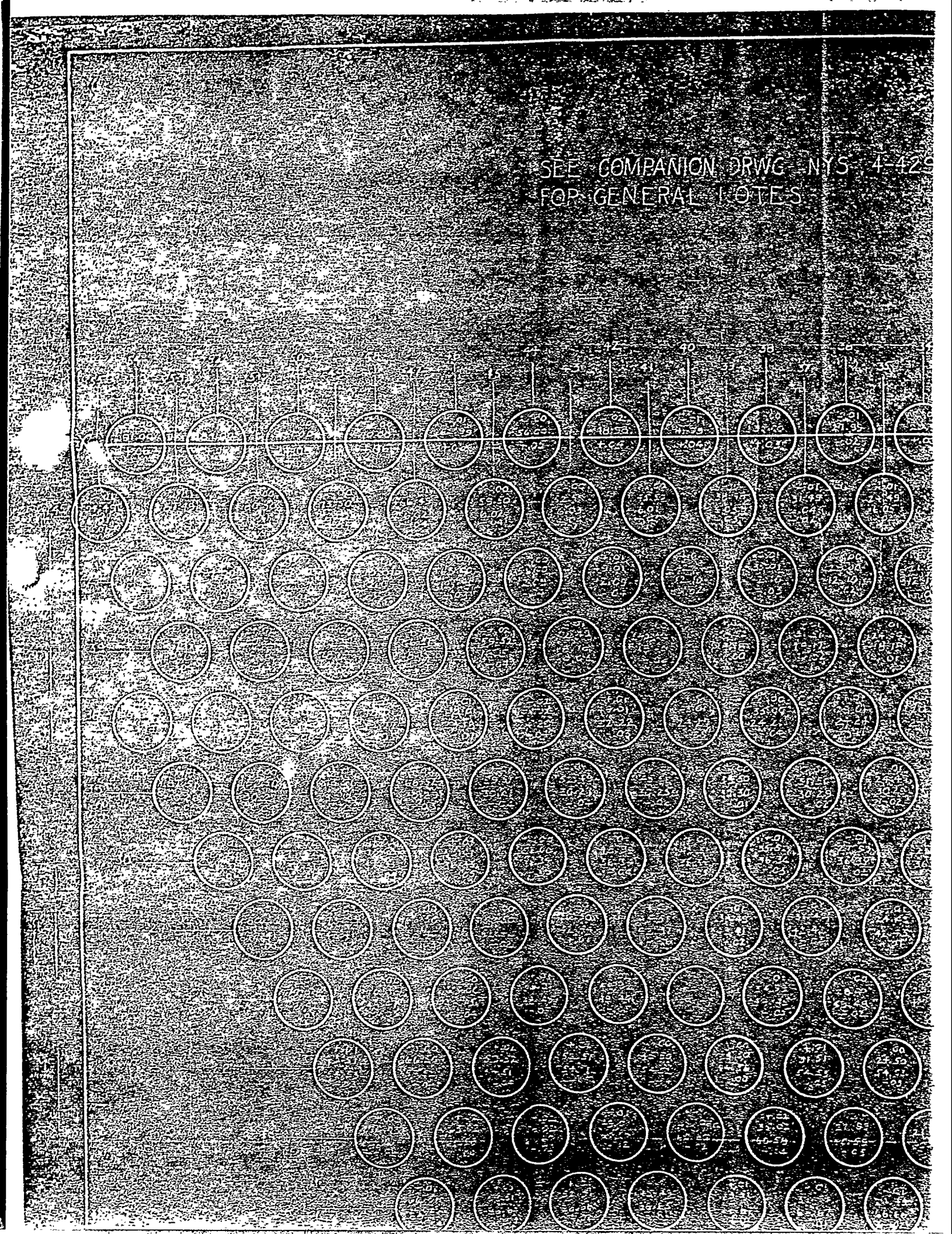
BY: C SADOWSKI
DATE: 10-6-52

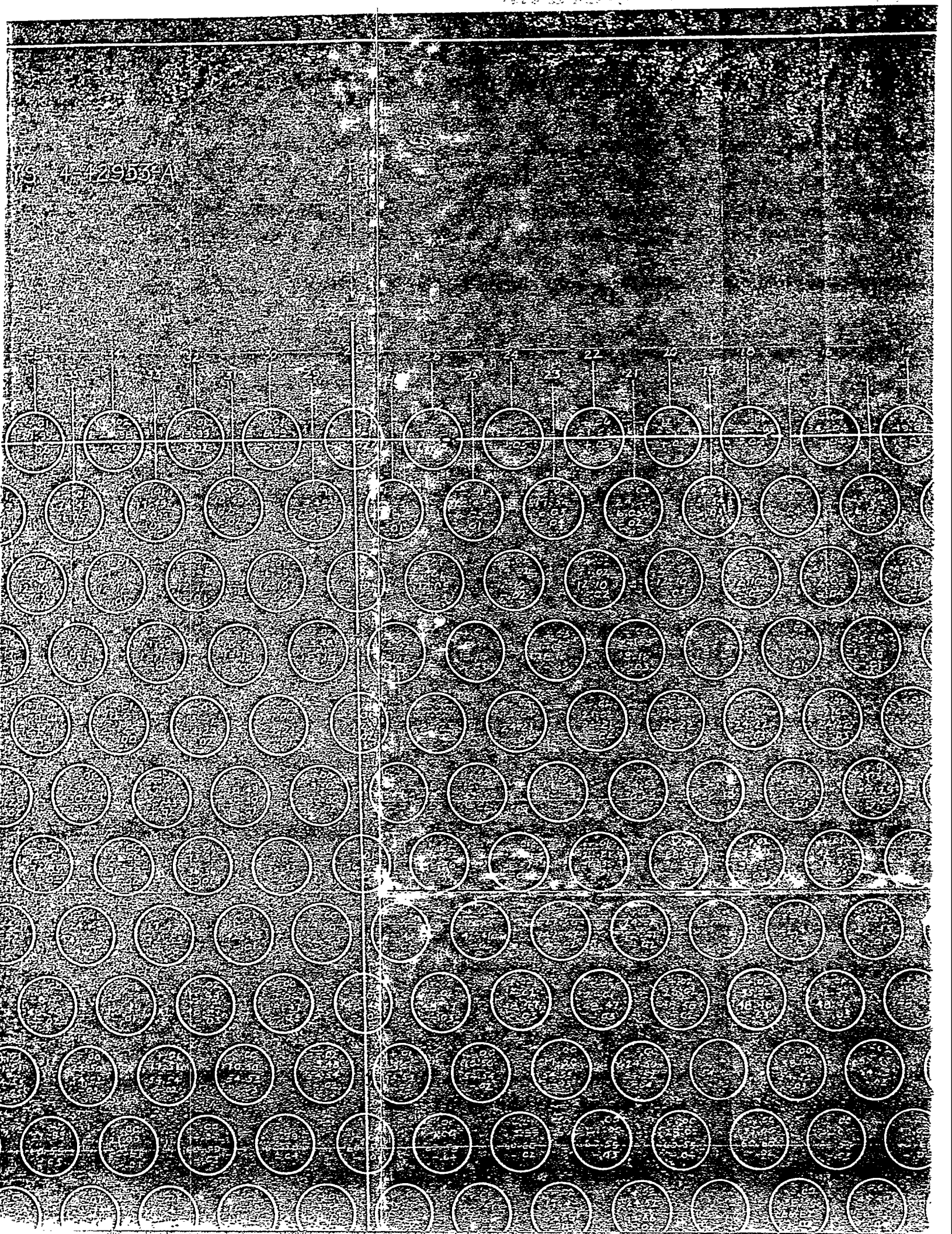
PROJECT 8980

DRWG NO NYS 3-100452-A

EXHIBIT #15

RESULTS OF PATTERN COORDINATES TAKEN ON TOP AND BOTTOM SIDES OF THE "L" BOTTOM TUBE SHEET ASSEMBLY.


SEE COMPANION DRWG NYS 4-42
FOR GENERAL NOTES



E. I. DU PONT DE NEMOURS & COMPANY
WILMINGTON, DELAWARE

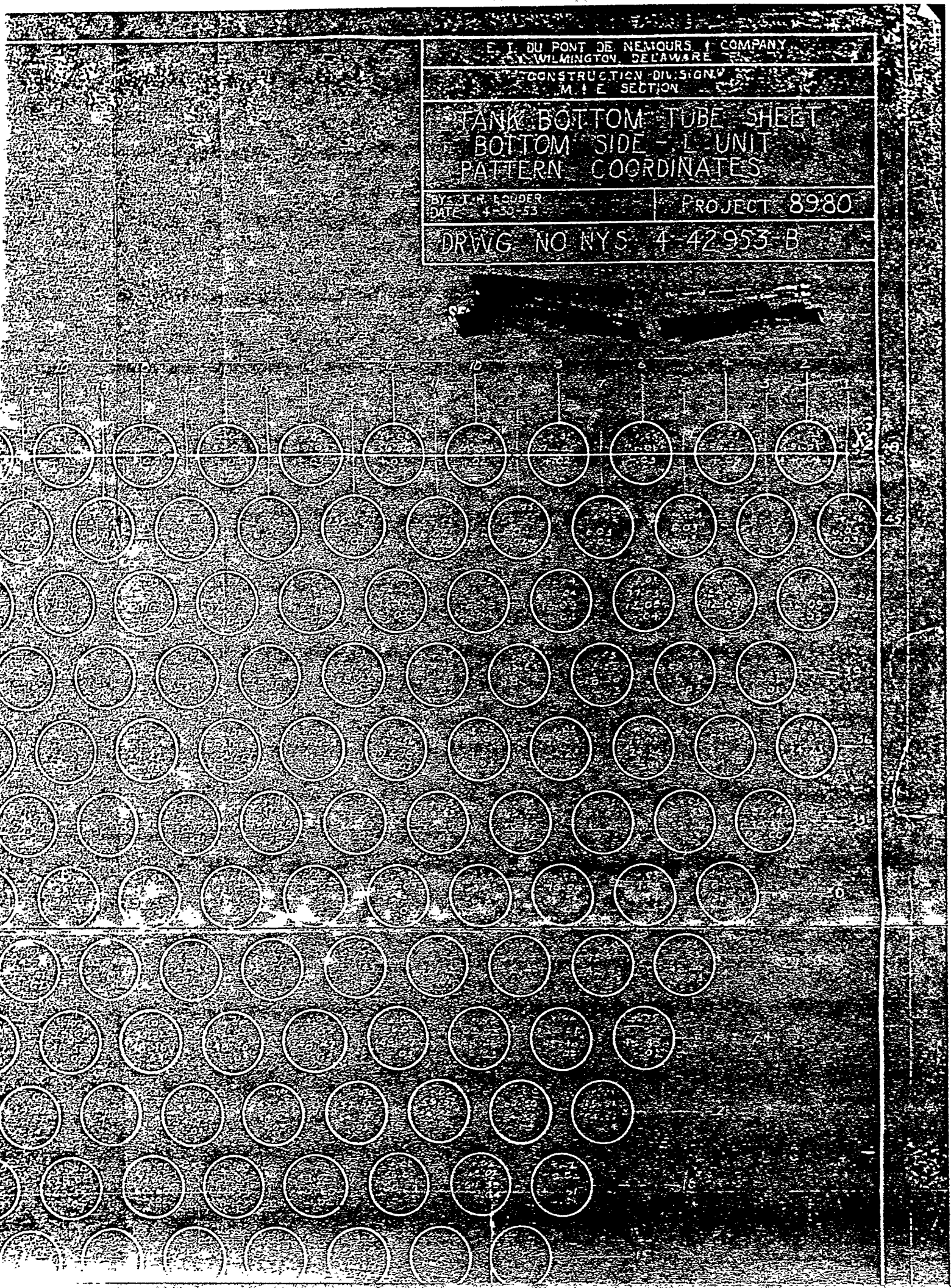
CONSTRUCTION DIVISION
M & E SECTION

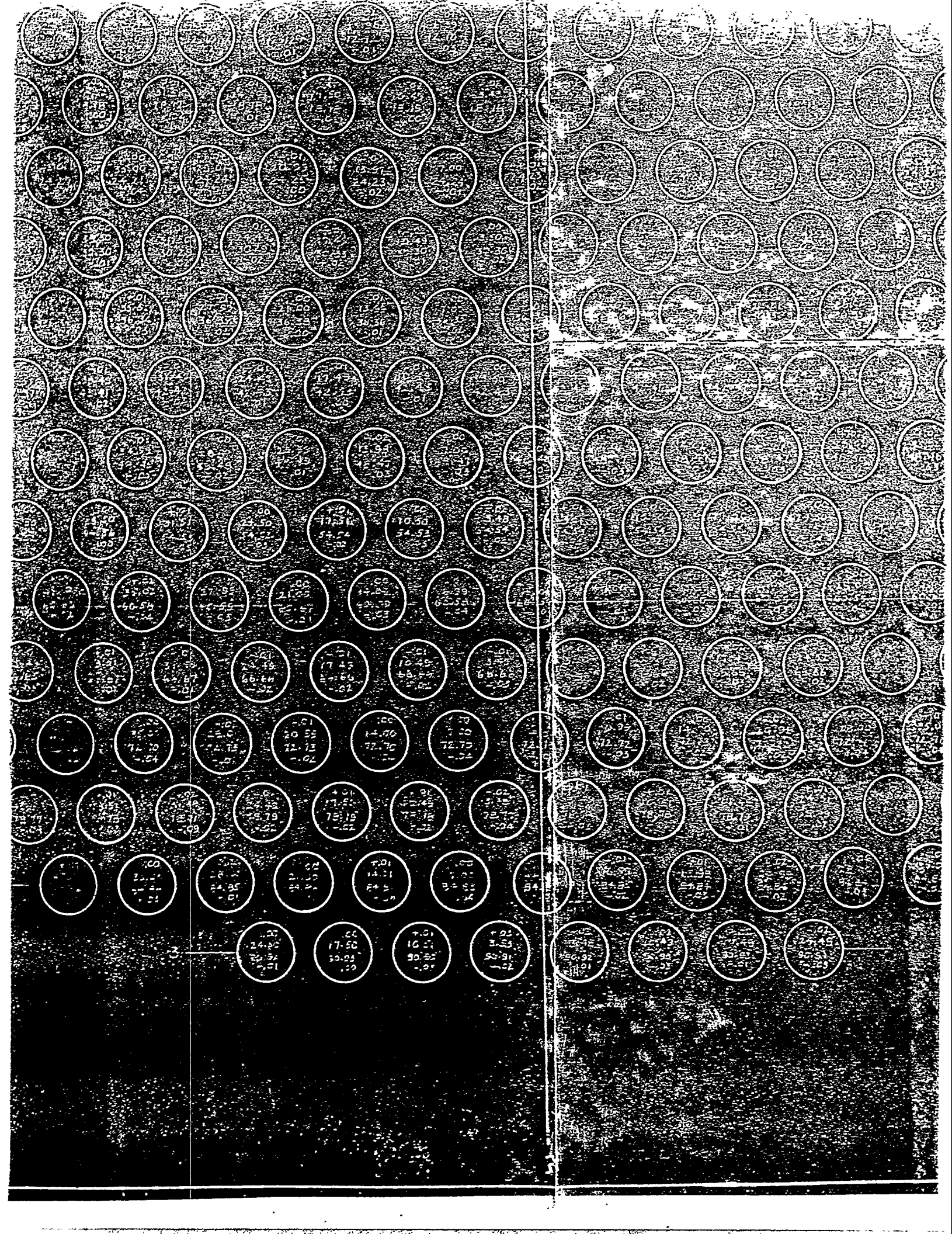
TANK BOTTOM TUBE SHEET BOTTOM SIDE - L UNIT PATTERN COORDINATES

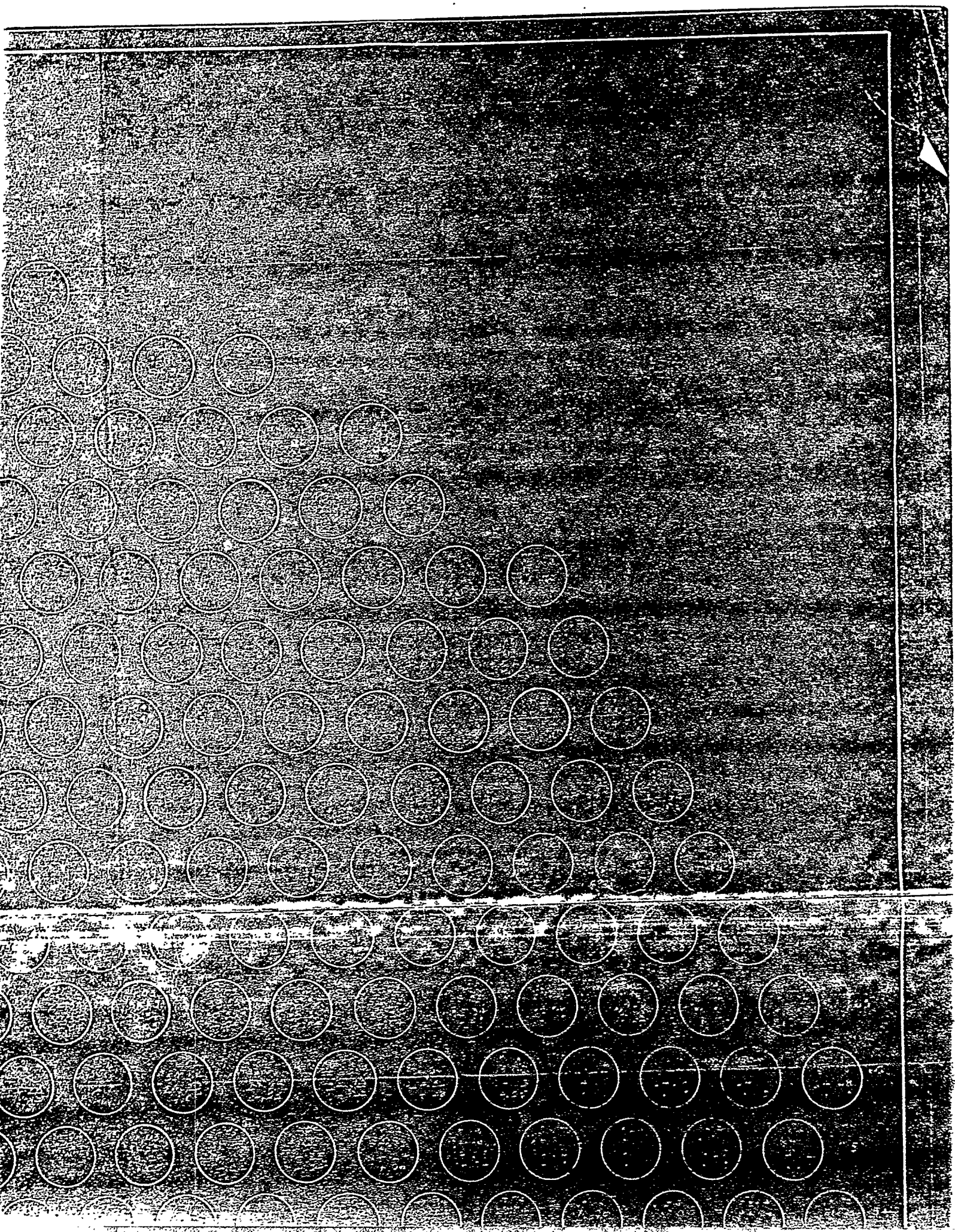
BY T.R. ROLDER
DATE 4-30-53

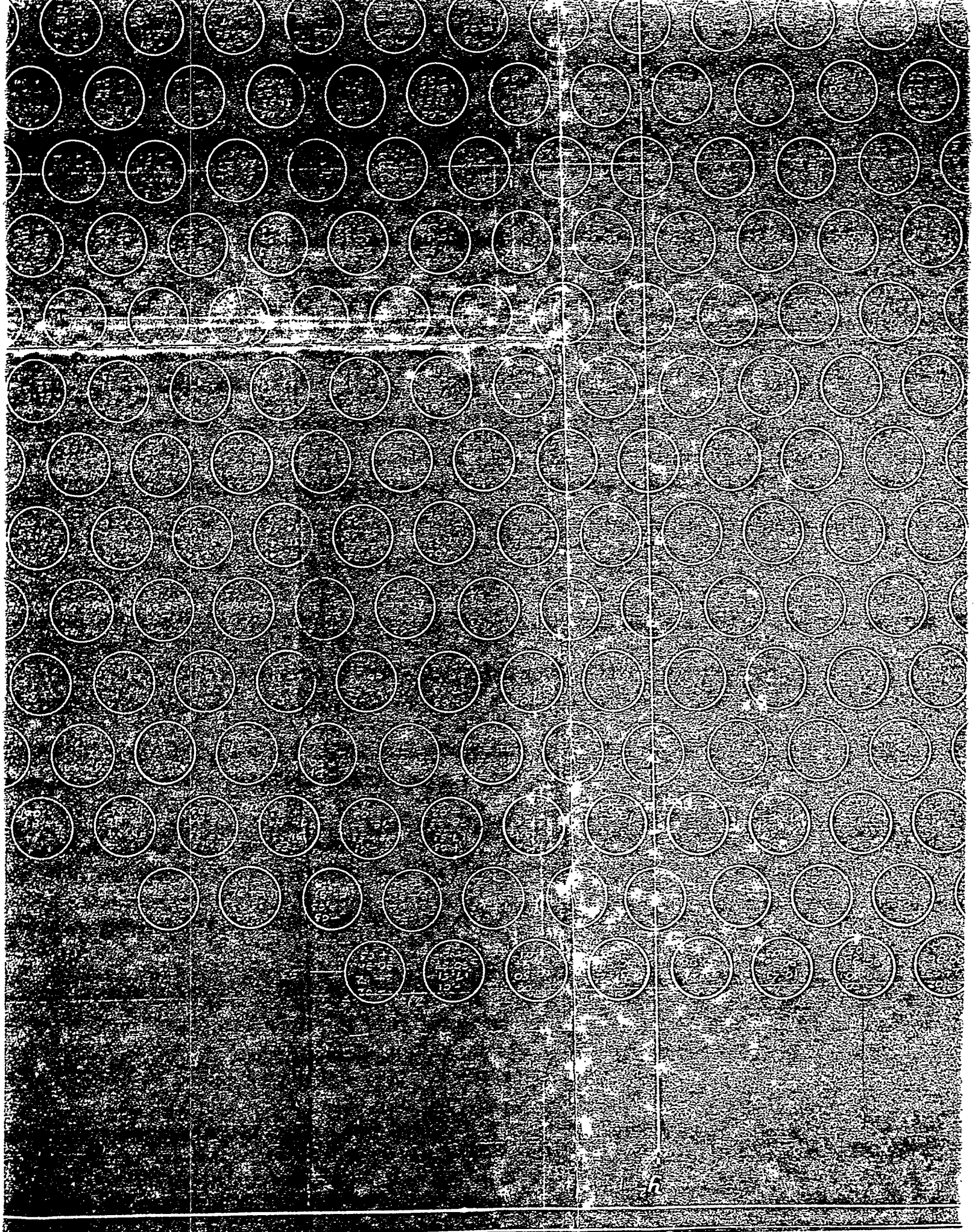
PROJECT 8980

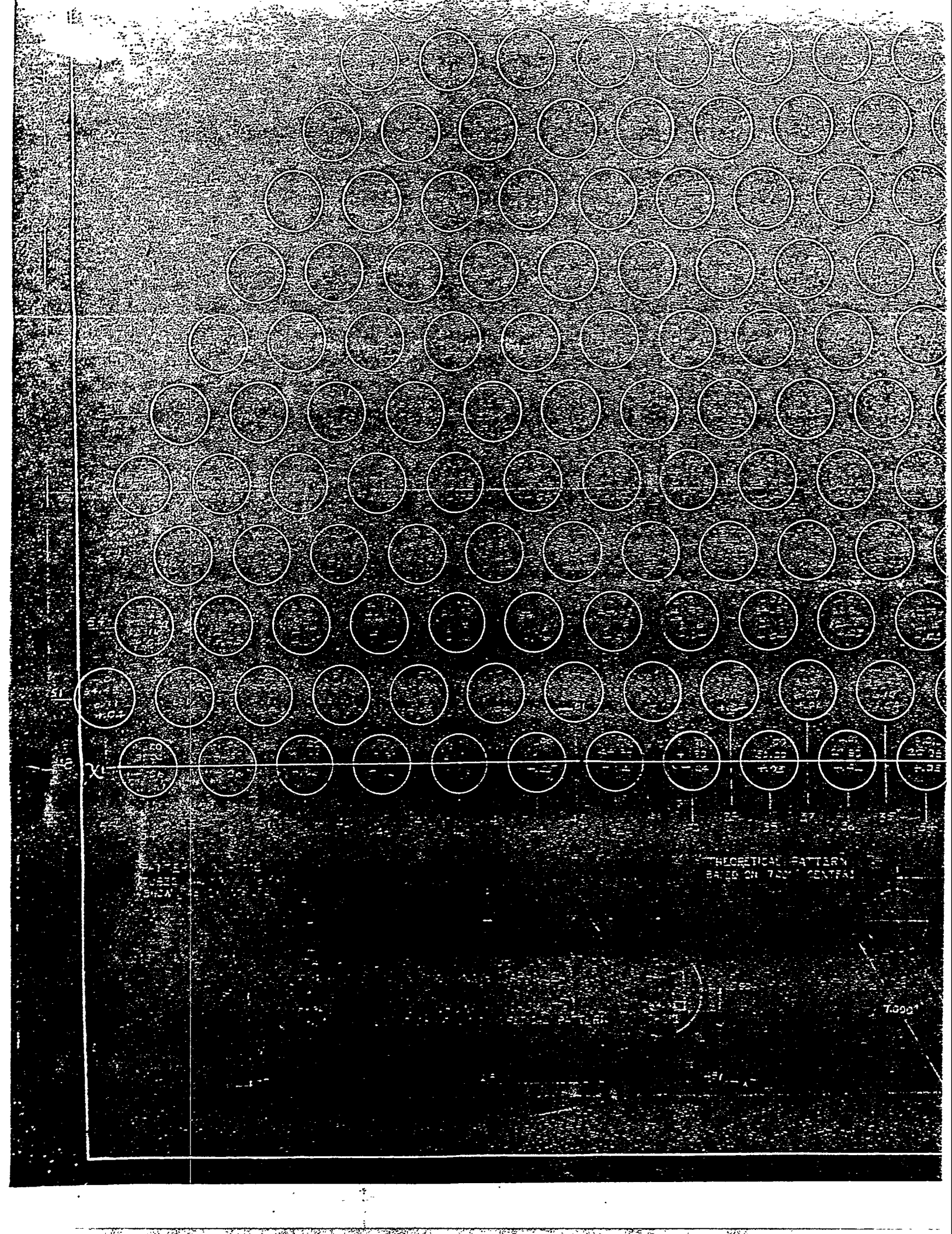
DRWG NO NYS 4-42953-B

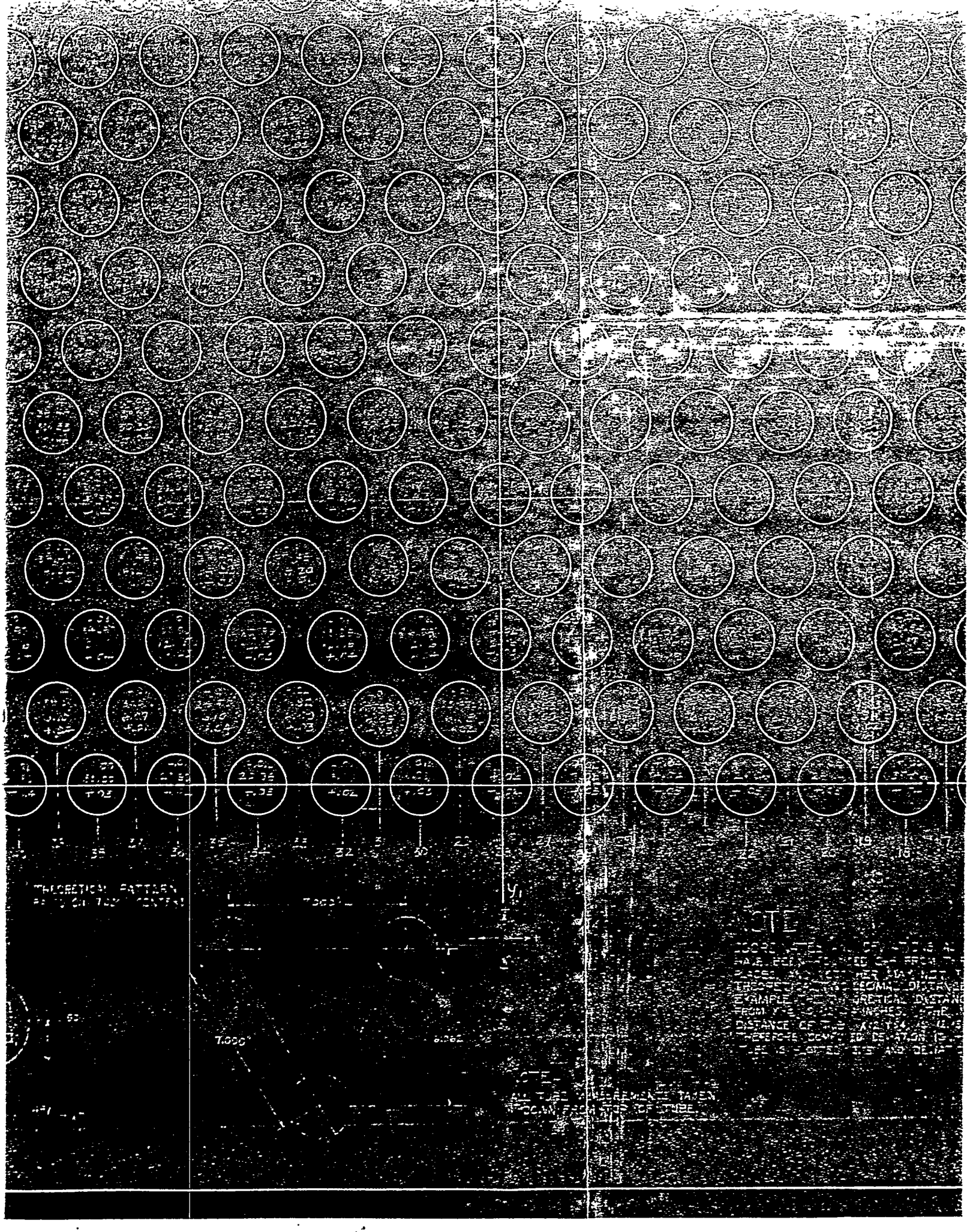


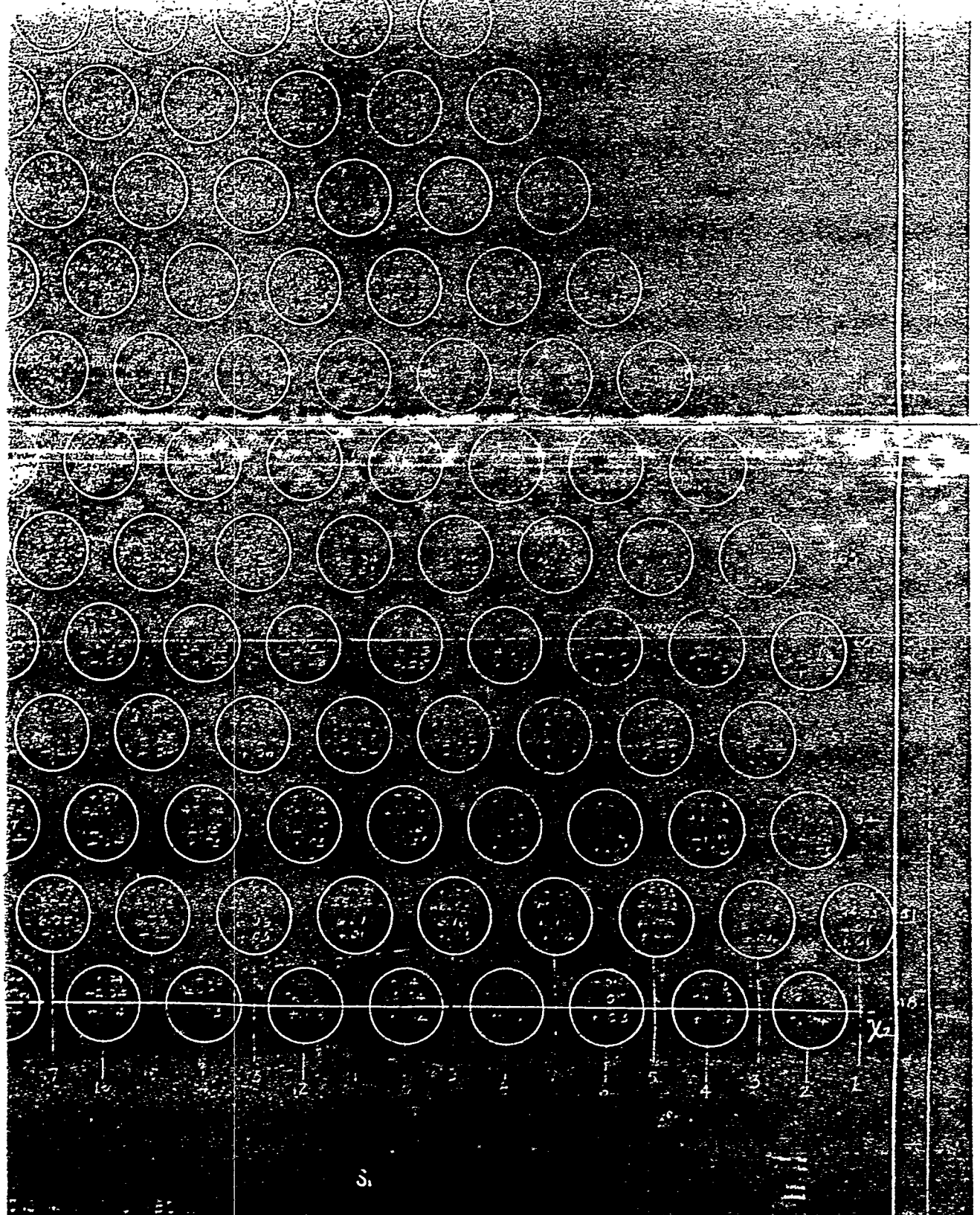












E. I. DU PONT DE NEMOURS & CO.
WILMINGTON, DELAWARE

ATOMIC ENERGY DIVISION
M & E SECTION

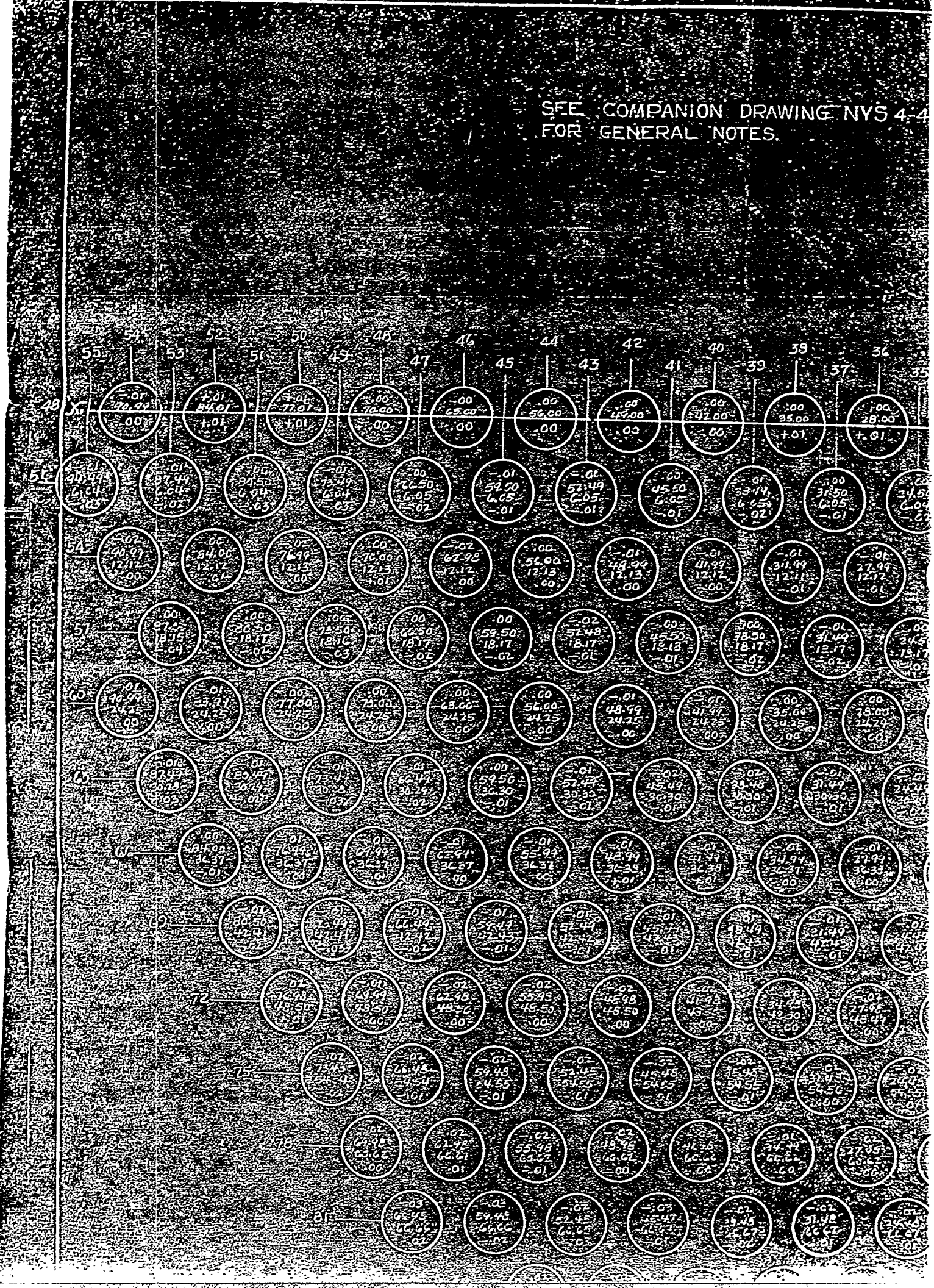
TANK BOTTOM TUBE SHEET
BOTTOM TUBE – L UNIT
PATTERN COORDINATES

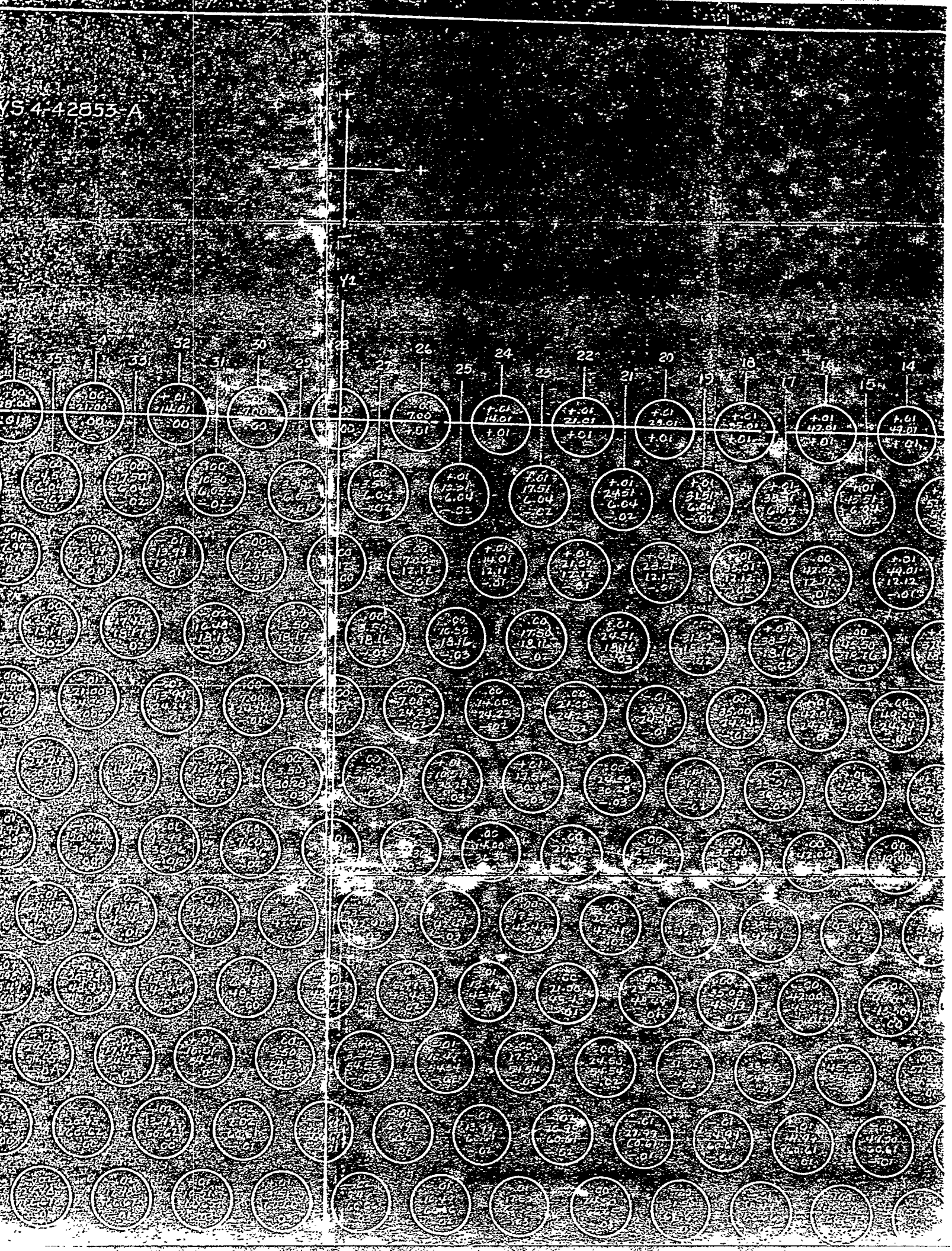
BY: L. M. LOUDER
DATE: 4-20-62

PROJECT 8980

DRWG. NO. M-3 4-42953-4

SEE COMPANION DRAWING NYS 4-4
FOR GENERAL NOTES.




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E. I. DUPONT DE NEMOURS & CO.
WILMINGTON, DELAWARE

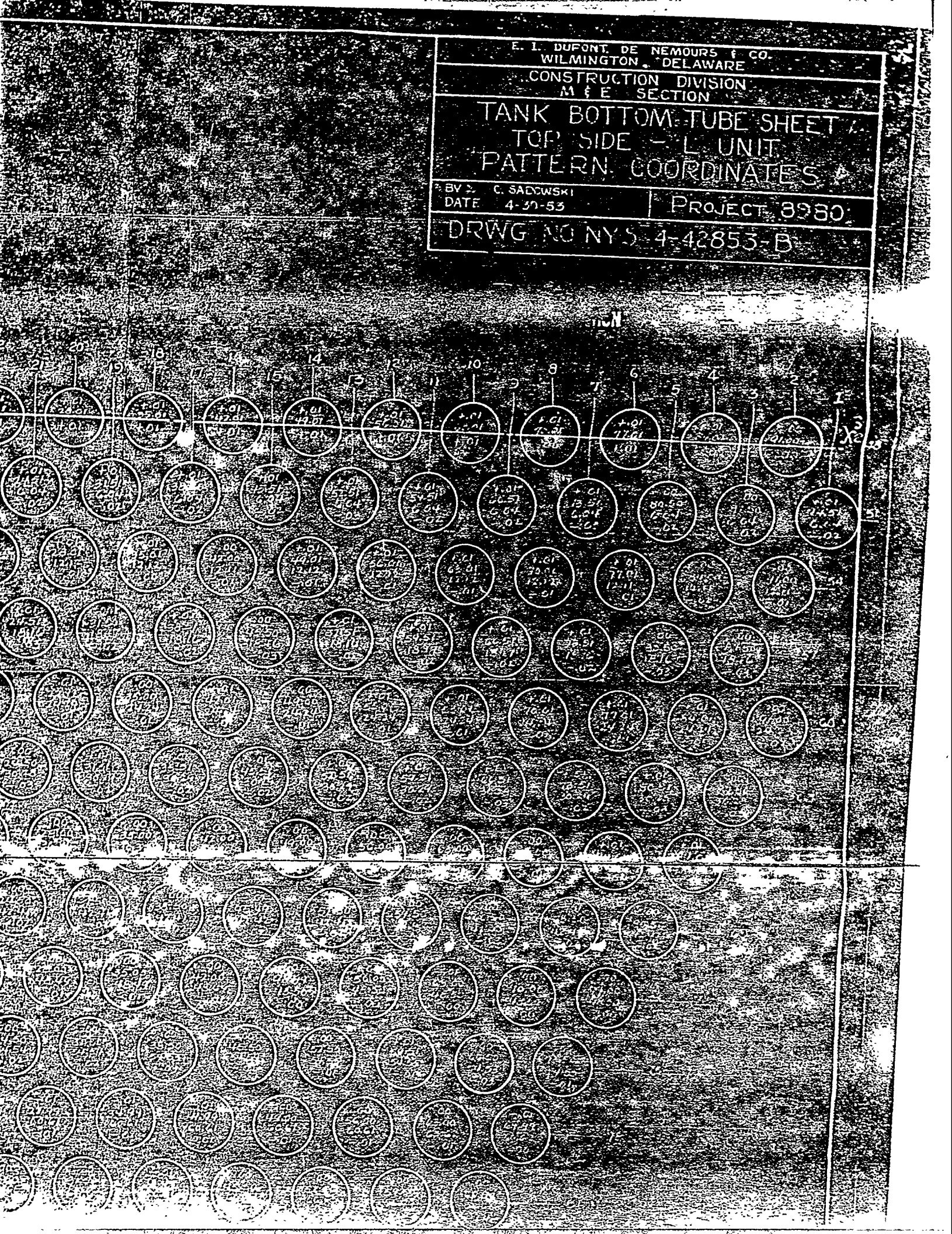
CONSTRUCTION DIVISION
M & E SECTION

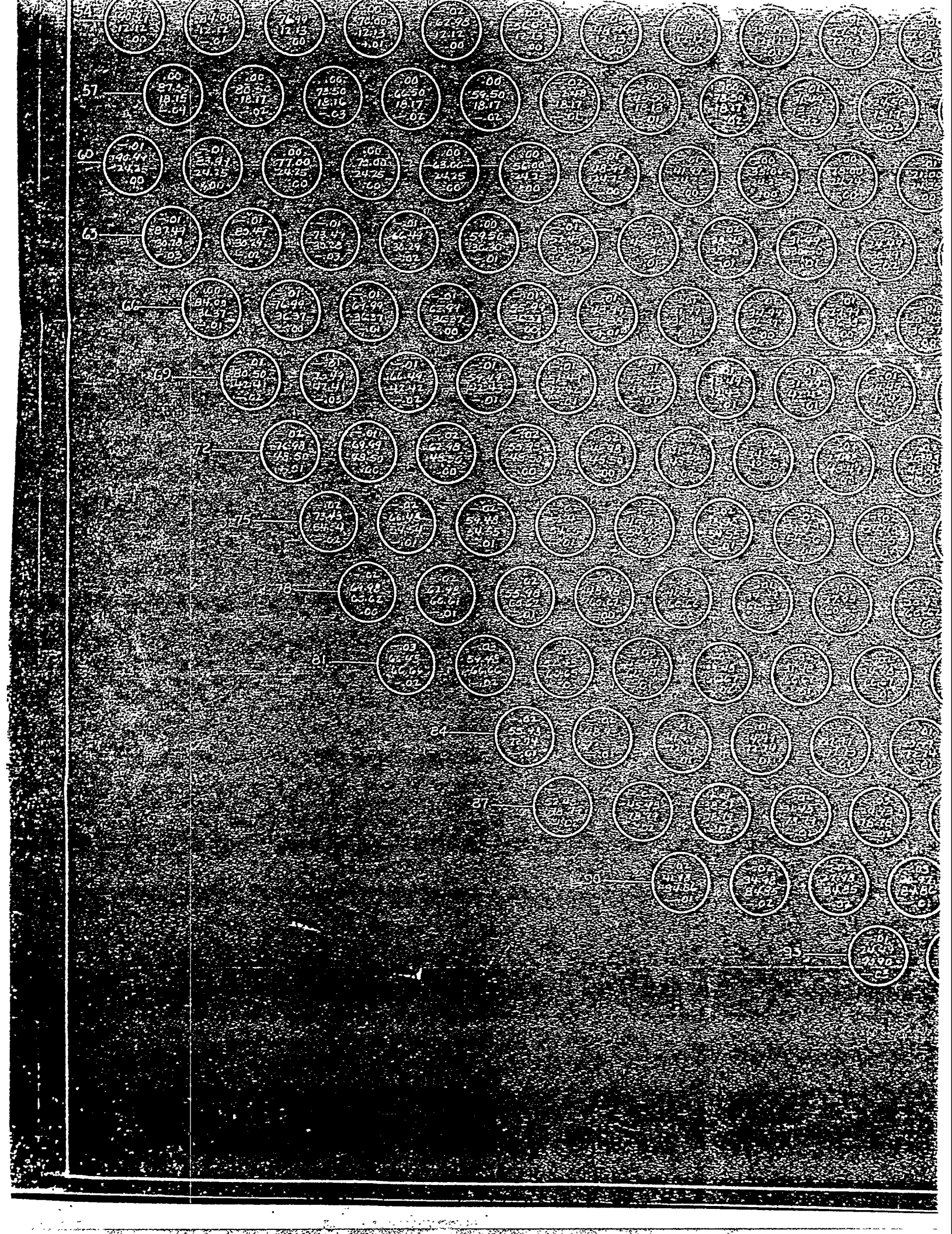
TANK BOTTOM TUBE SHEET
TOP SIDE — L UNIT
PATTERN COORDINATES

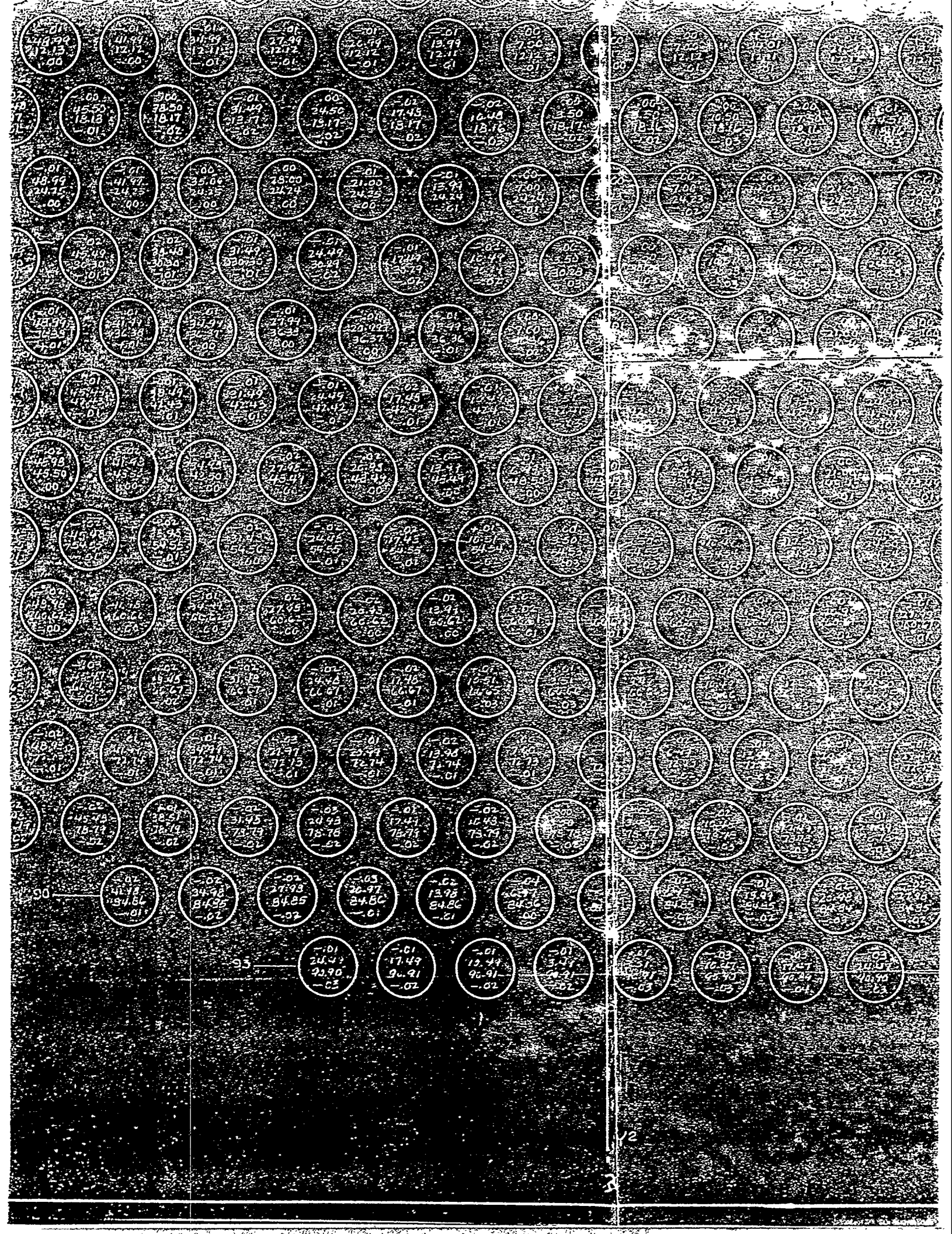
BY C. SADOWSKI
DATE 4-30-53

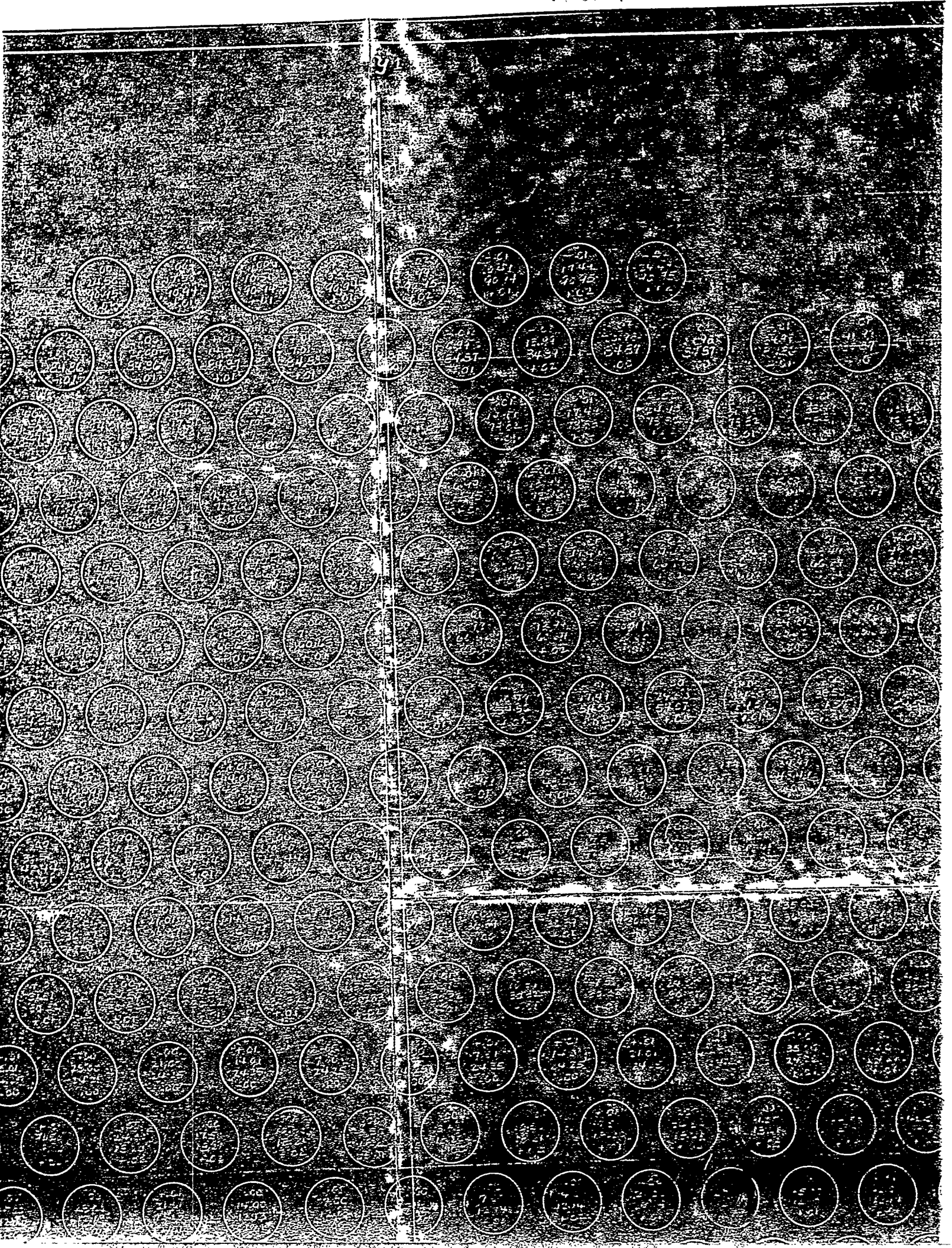
PROJECT 8950

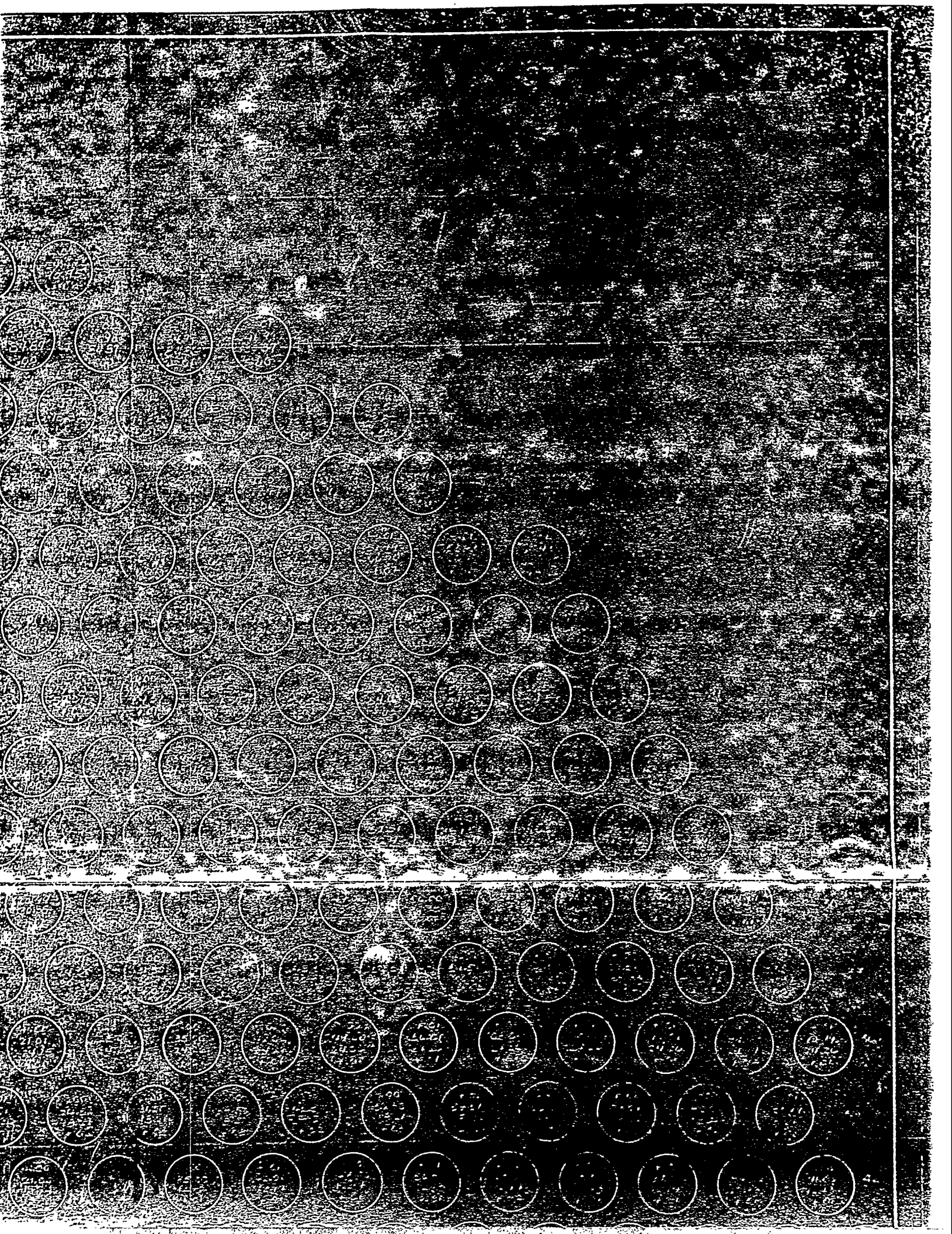
DRWG NO NYS 4-42853-B

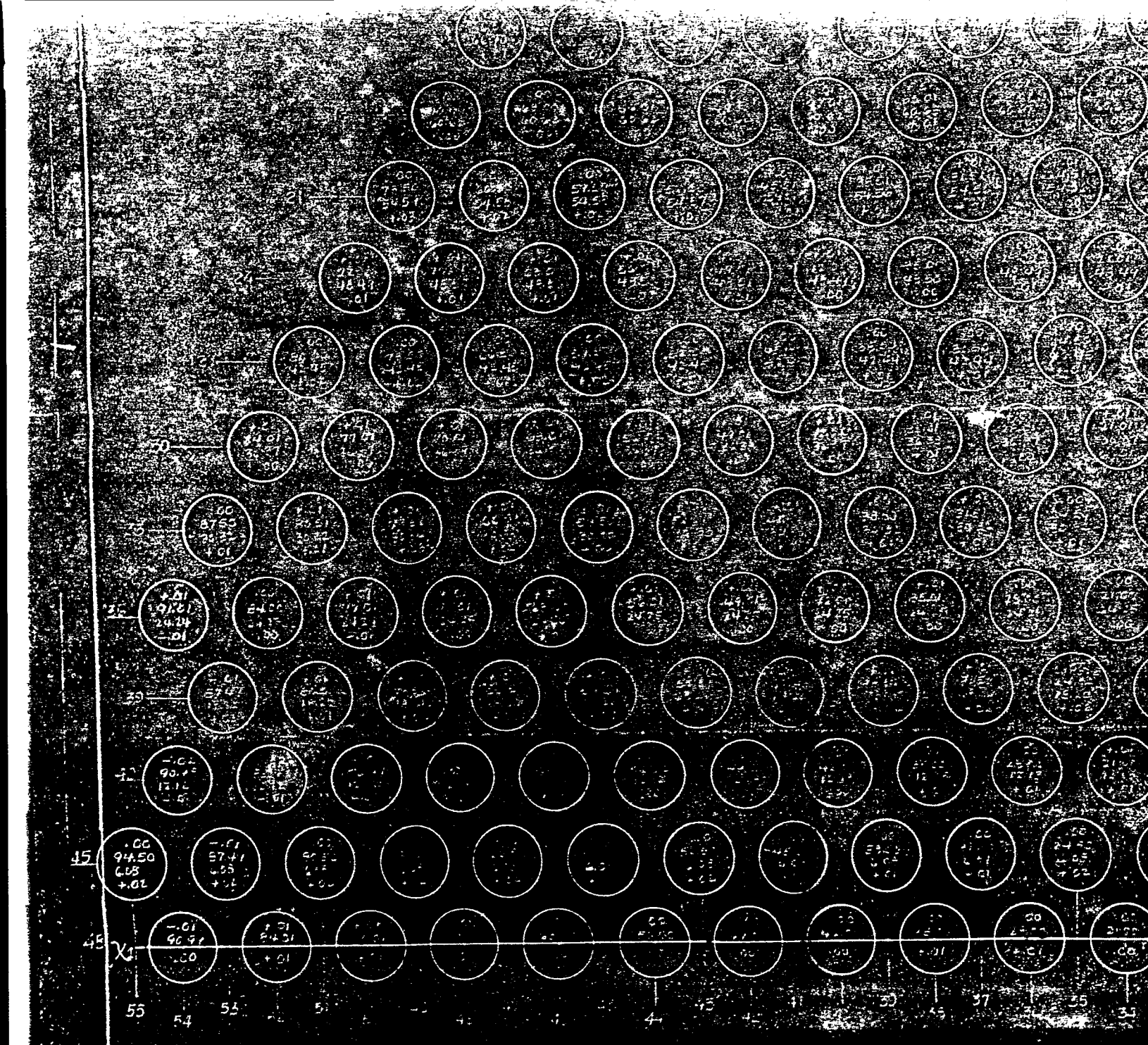


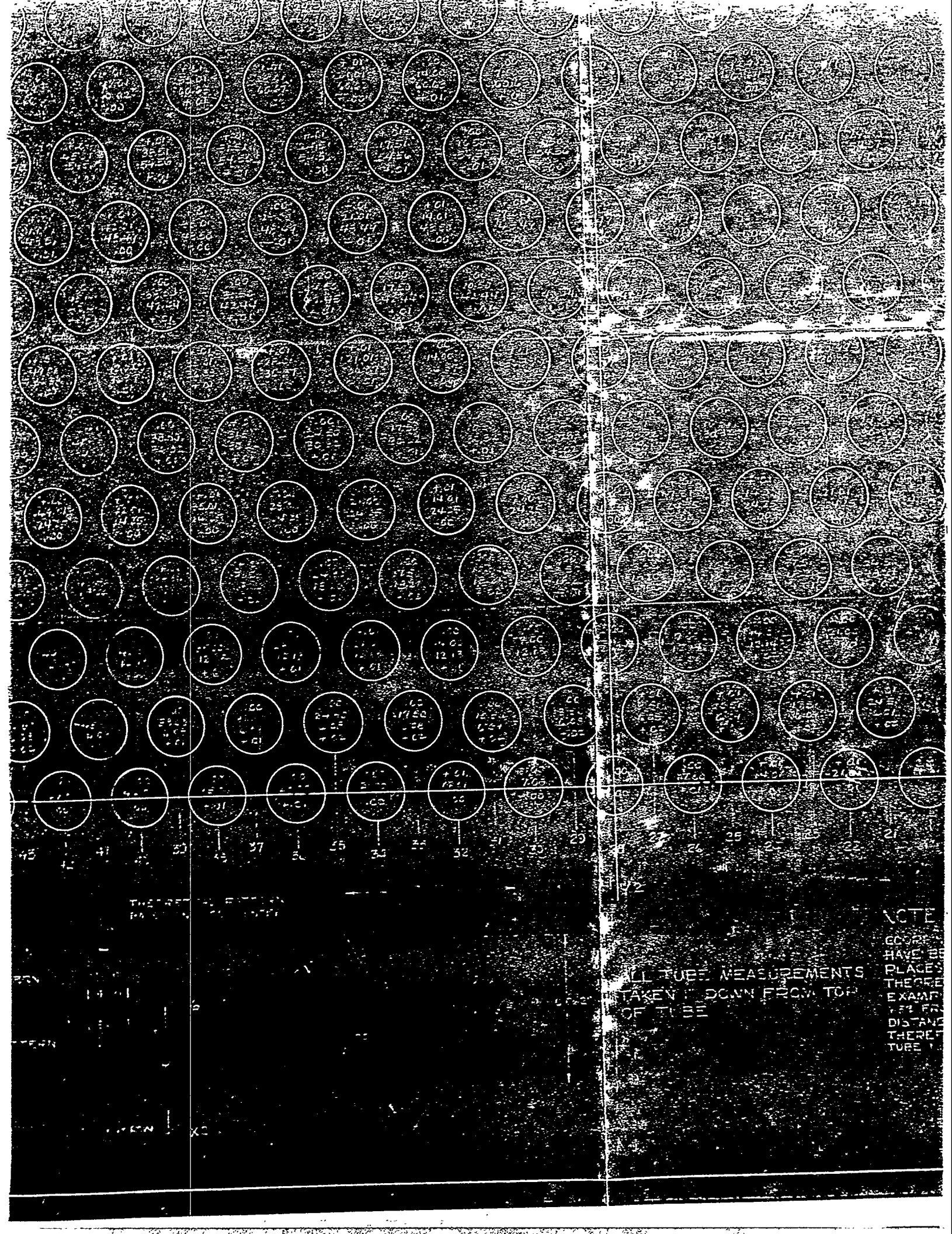


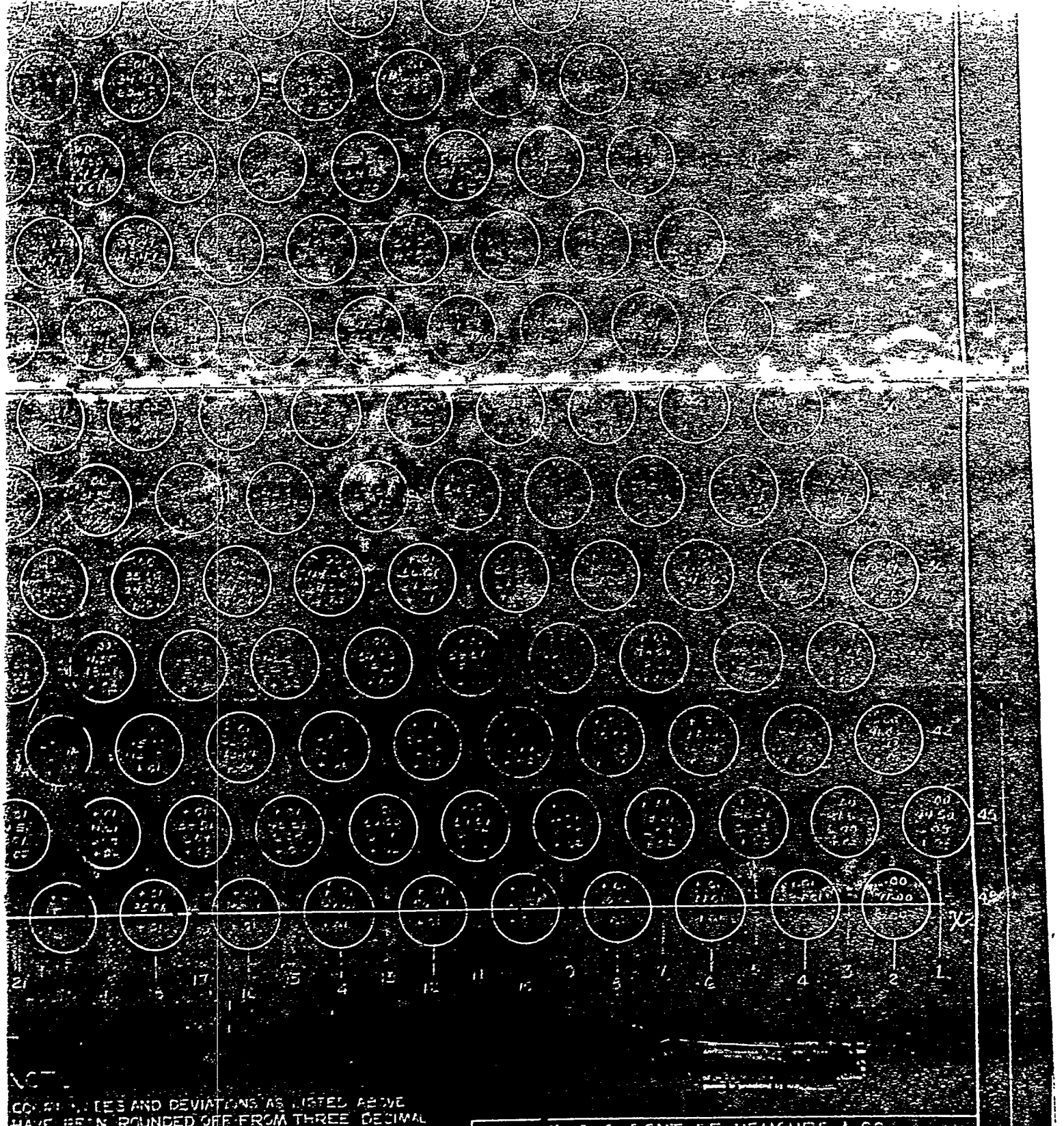









ALL TUBE MEASUREMENTS
TAKEN DOWN FROM TOP
OF TUBE



NOTE

COORDINATES AND DEVIATIONS AS LISTED ABOVE HAVE BEEN ROUNDED OFF FROM THREE DECIMAL PLACES AND TOGETHER MAY NOT TOTAL THE THEORETICAL TWO DECIMAL DISTANCE. FOR EXAMPLE THE THEORETICAL DISTANCE OF R... IS 12.186 INCHES THE MEASURED DISTANCE OF TUBE ... IS 12.213 INCHES THE COMPUTED DEVIATION ... TUBE ... LISTED IS ... AND DEVIATION ...

E. I. DUPONT DE NEMOURS & CO
WILMINGTON, DELAWARE
CONSTRUCTION DIVISION
M & E SECTION

TANK BOTTOM TUBE SHEET
TOP SIDE - L UNIT
PATTERN COORDINATES

BY: S. SARNOSKI
DATE: 4-28-53

PROJECT 8990

DRWG NO NVS 4-42253-A

cleaned the interior of the unit. The cleaning procedure established for this unit was formulated in a meeting held between du Pont Construction, du Pont Inspection Department, and Dowell Inc. The primary purpose of this meeting was to outline a cleaning procedure for the "R" plenum chamber during the "recleaning operations" (See Part VII Section I, item 15A-(5) of this manual for resume of this problem) which were currently under way in the shop to salvage this unit. Since at this time no definite procedure for cleaning any sub-assembly had been established, it was decided to include a cleaning precedure for "R" bottom tube sheet and top tube sheet in the overall cleaning program. However, due to the urgency of clearing up the problem encountered on the "R" plenum chamber, no definite step by step cleaning procedure was outlined for the "R" bottom tube sheet. In lieu of this, the cleaning procedure outlined for the "R" plenum chamber was used as a guide for the cleaning of the "R" bottom tube sheet and also the top tube sheet.

Essentially, internal cleaning of the "R" bottom tube sheet was the same as the "R" plenum chamber, except for the methods incorporated in the handling and getting the cleaning solution into and out of the unit for cleansing action. (See Part VII, Section I, Item 15A-(5) of this manual for the "R" plenum chamber cleaning procedure).

A resume of the internal chemical cleaning performed on the "R" bottom tube sheet was as follows: The raschig ring filling cradle was assembled on the unit and necessary pipe connections were made. The unit was then moved and placed in a vertical position on the raschig ring "rocking cradle bed" located next to a washing pit. A hot detergent supplied by Dowell was pumped into the unit with hot detergent, the solution on the inside was air agitated for one-half of an hour through air lines connected to the raschig ring inspection ports. These inspection ports were located around the bottom half of the unit in the wrapper plates. (Relatively speaking with unit in vertical position.) During this air agitating process, the raschig ring inspection ports located in wrapper plates around the top half of the unit were opened, thus allowing the hot detergent to be forced out through the ports under the air agitating pressure. The detergent remaining in the unit was drained through two 4" openings in the wrapper plates located in the bottom half of the unit while in a vertical position. The unit was then filled with warm distilled water from the bottom side and allowed to overflow through the raschig ring inspection ports located in the wrapper plates around the top half of the unit. This rinsing action was continued for 15 minutes. The "overflowing operation" was discontinued, and with the unit still completely full of warm distilled water, it was air agitated for approximately one-half hour. Within three minutes after air agitating, the unit was drained by opening up all port holes in the bottom half of the unit. During the draining operation, the unit was rocked in the cradle bed until the unit completely

drained. The draining operation was completed in 45 minutes.

The interior of the unit was then visually examined by du Pont Inspectors. This examination consisted of wiping clean paper towels on the inside surfaces of the unit. All paper towels revealed dark smudge marks; some black, others dark red. The unit was rejected by the du Pont Inspection Department on this basis; however, the Design Division reviewed the results and accepted the unit as being clean based on the supposition that the grime noted on the paper towels was not detrimental to the operation of the unit.

(2) Establishing X and Y Centerlines on Top and Bottom Side of the Bottom Tube Sheet

After cleaning the unit, X and Y centerlines were re-established on the top side of the unit. The method used for establishing these lines was similar to that described in Part II-A, Section 13. After this, the assembly was leveled using the Wild NIII Precision Level and target. (See Part III, II-J, for use of instrument in leveling of units.) Next, the X and Y centerlines on the top side were transferred to the bottom side of the unit using the Wild T-1 Theodolite. Sketch #14 pictorially illustrates how the transfer of X and Y axes was accomplished.

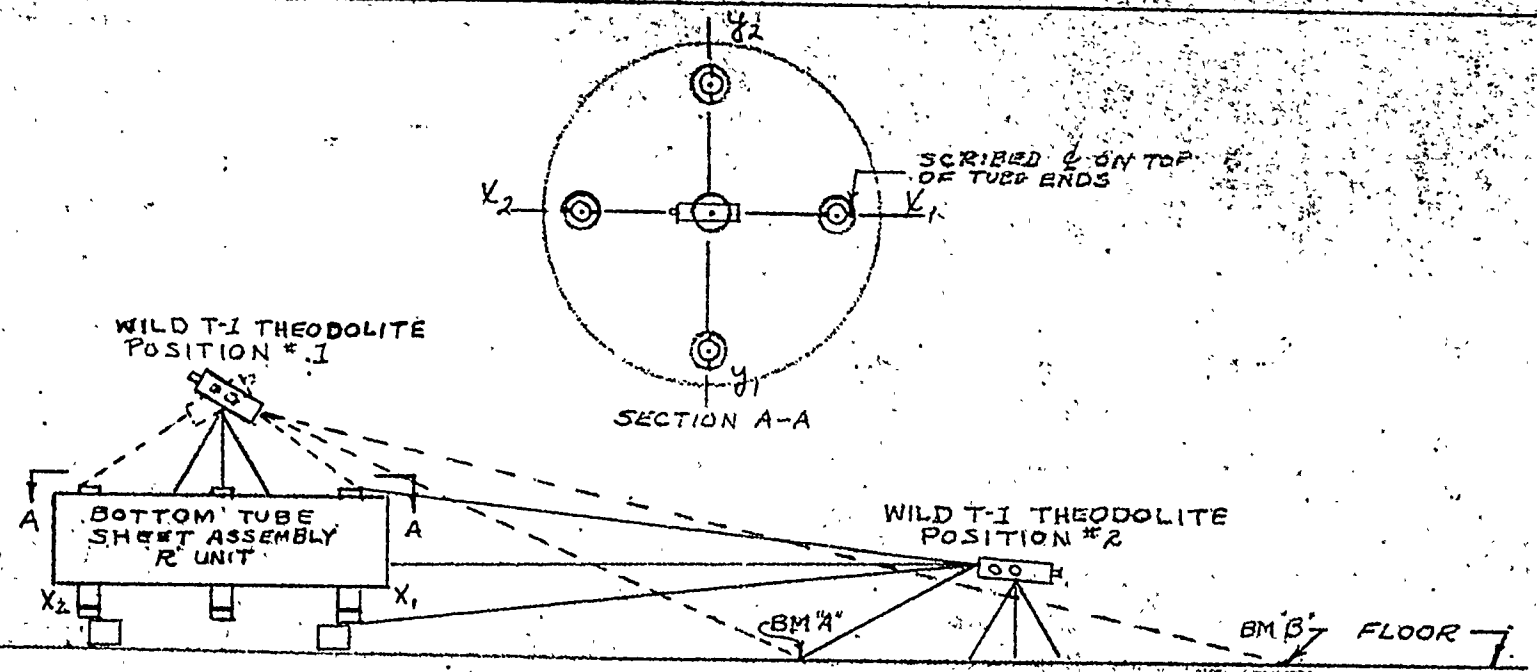
The unit was then turned bottom side up and a 18' straight edge laid along the X axes. The straight edge was then aligned to coincide with the two points previously transferred to the two tubes at the extreme ends of the X axis. A line was then scribed along the bottom ends of the tubes using the face of the straight edge as a guide. Before moving the straight edge, measurements were taken from the face of the straight edge to the inside diameter of each tube located on the X axis (row Y48). (See photo serial #53 in Part II-A, Section 13.) The straight edge was removed and the bore diameter of each tube was taken in the same direction using a standard dial indicator bore gage and ring gage. Next, the straight edge was laid along the Y axis (row X28) and the above procedure repeated. The measurements taken on the tube bores were used in tube pattern calculations for determining the location of a tube with respect to the X and Y axes.

B. "P" Unit

(1) Dowell Cleaning

Prior to loading raschig rings in the bottom tube sheet, Dowell Inc. of Wilmington, Delaware, chemically cleaned the interior of the unit. Cleaning of this unit was similar to that performed on the "R" bottom tube sheet, except for minor changes in the length of air agitation time and the number of times the unit was rinsed.

SKETCH #14



PROCEDURE FOR TRANSFERRING AXES FROM TOP OF B.T.S. TO BOTTOM OF B.T.S.

1. SET INST. ON TRIPOD IN CENTER OF B.T.S. WITH B.T.S. LEVEL.
2. LEVEL INST. USING CROSS SLIDE BORE TO ADJUST LINE OF SIGHT OF TELESCOPE TO COINCIDE WITH X" AXIS OF B.T.S.
3. REVOLVE INST. ON ITS VERTICAL AXIS & SIGHT ON FLOOR AT SUITABLE BENCH MARKS "A" & "B".
4. A CENTER PUNCH IS MOVED ACROSS BENCH MARK TO COINCIDE WITH TELESCOPES LINE OF SIGHT & A PUNCH MK. MADE ("A"). ANOTHER BM. IS ESTB. APPROX. 40' FROM "A" THIS PROCEDURE IS REPEATED ON BOTH ENDS OF BOTH AXES.
5. INST. IS REMOVED FROM B.T.S. & SET UP ON FLOOR BETWEEN ANY TWO BM'S. ON THE END OF AN AXIS.
6. THE LINE OF SIGHT IS AGAIN ADJUSTED TO LINE UP WITH THE BM ("A" & "B") & THEN THE SCOPE IS SIGHTED ON B.T.S. AT THE ENDS OF THE TUBE WHICH FALL ON THAT PARTICULAR AXIS.
7. A PUNCH MARK IS MADE ON THE END OF THE TUBE & THE WHOLE PROCEDURE REPEATED AT THE ENDS OF BOTH AXES.
8. UNIT IS TURNED BOTTOM SIDE UP & PUNCH MARKS ARE CONNECTED BY A SCRIBED LINE ON THE TOPS OF ALL TUBES IN THE PATTERN WHICH FALL ON THE AXIS. THE X & Y AXES ON THE BOTTOM OF THE BOTTOM TUBE SHEET ARE USED FOR LINING UP A 12" STRAIGHT EDGE AND MEASURING BORE DIAMETERS FOR TYING IN ALL TUBE PATTERN MEASUREMENTS.

A resume of the internal chemical cleaning performed on the "P" bottom tube sheet assembly was as follows: The raschig ring filling cradle was assembled on the unit and necessary pipe connections were made. The unit was then moved and placed in a vertical position on the raschig ring "rocking cradle bed" located next to a washing pit. A hot detergent supplied by Dowell was pumped into the unit until it was full. After filling the unit with hot detergent, the solution on the inside was air agitated for 2½ hours through air lines connected to the raschig ring inspection ports. These inspection ports were located around the bottom half of the unit in the wrapper plates. (Relatively speaking with unit in vertical position.) During this air agitating process, the raschig ring inspection ports located in wrapper plates around the top half of the unit were opened, thus allowing hot detergent to be forced out through the ports under the air agitating presure. The detergent remaining in the unit was drained through two 4" valve openings located in the bottom half of the unit while in a vertical position. After draining the detergent from the assembly, it was filled with warm rinse water and agitated by rotating the assembly as the rinse water was drained through the two 4" valve openings. The unit was rocked in the cradle bed until the unit completely drained. The above rinsing procedure was repeated two more times, and the unit was inspected internally for cleanliness. The inspection procedure consisted of a visual inspection of the interior through the 2" inspection ports and rubbing cotton swabs over the inner plate surfaces through the two 4" valve openings. The interior of the assembly was found clean and accepted for raschig ring loading.

(2) Establishing X and Y Centerlines on The Top and Bottom Sides of the Bottom Tube Sheet.

This inspection was performed in a similar manner to that described in Section 16A-(2) of this manual.

C. "L" Unit

(1) Sandblasting Top Side of Unit and Wrapper Plates

The top side and wrapper plates were sandblasted with iron-free silica sand to remove all surface impurities and weld oxidation from the exterior surfaces (top and wrapper plates only. Bottom side was not sandblasted) prior to final visual weld inspections and pressure tests. Since hydrostatic and freon testing follows the sandblasting operation, all openings in the bottom tube sheet were sealed with equipment suitable for both operations.

Before sandblasting this unit, approximately 15 psi of air was introduced into the interior to prevent fine grit from entering the assembly. After the sandblasting operation, loose sand and dust was blown off

using air hose.

Generally, all sandblasting was done outside the shop with the unit resting on a railroad flatcar; however, in the case of the "L" bottom tube sheet weather conditions did not permit this; therefore, the unit was sandblasted under the conical shaped hood used for the drying operation inside the building.

To prepare the bottom tube sheet for sandblasting, the unit was placed top side up on four (4) cast iron pedestals approximately 3' high under the conical shaped hood used for drying. All large tubes and instrument lead tubes were blanked off with wood caps of suitable size on both top and bottom ends of the tubes. Wood caps were held in place with a long 3/8" diameter rod threaded on both ends for 3/8" nuts, which were tightened on both ends to hold the caps tight. The two 8" x 8" main loading ports were sealed with 1/2" thick solid lap patch plates (S/S).

The 2½" diameter inlet and outlet openings in the wrapper plates were sealed with 1/2" lap patch plates which were drilled and tapped for 1/2" pipe plugs (for testing purposes). All 2" filling and inspection ports were sealed with a shoulder head screw plug and rubber ring gaskets. A retaining groove was machined in the screw type plug to hold the rubber gasket. The ten instrument wells were capped using S/S pipe plugs. All other machined surfaces were protected with cloth back masking tape.

After the unit had been completely sealed off as described above and placed under the conical shaped drying hood, the top side and wrapper plates were sandblasted. Upon completion of the sandblasting operation, du Pont Inspectors visually inspected the unit for cleanliness and performed ferroxyl test at random to determine if the areas sandblasted were iron free. All tests and visual inspections proved satisfactory and the unit was released for further fabrication.

(2) Establishing X and Y Centerlines on Top and Bottom Sides of Bottom Tube Sheet and Verticality Readings.

After sandblasting the "L" bottom tube sheet assembly, the unit was placed (top side up) on suitable cast iron pedestals; five (5) around the outer periphery of the unit and one in the middle to equally support the weight of the unit. Next, the unit was leveled using the Wild NIII Precision Level and target. (See Part III, II-J for use of instrument in leveling of units). When the unit was level within approximately .008" to .010", X and Y centerlines were established on the top side in a similar manner to that described in Part II-A, Section 13. After establishing the X axis, and with a 18' straight edge coinciding with the X axis, measurements from the face of the straight edge to the I.D. of tubes on this axis were taken in an identical manner to that

pictorially illustrated in photo serial #53, Part II. Also, bore diameters of these tubes were measured using a standard dial indicator bore gage in the same direction as those measurements taken from the 18' straight edge. The above procedure was repeated on the Y axis. Both sets of measurements were later used in calculating the position of large tubes in the tube pattern with respect to both the X and Y axes. For a discussion on pattern coordinate calculations, see Part III, II-G.

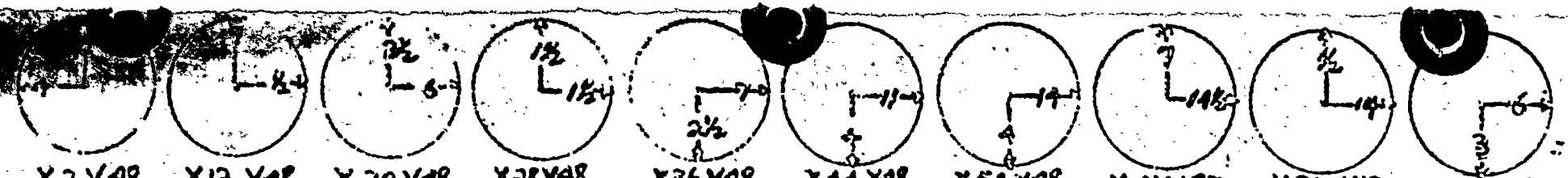
After X and Y axes were established on the top side of the unit, these axes were transferred to the bottom side of the unit in a similar manner to that shown in Sketch #14. The unit was turned bottom side up and a 18' straight edge was lined up with the transferred X axis. Next, measurements from the face of the straight edge to the I.D. of tubes on this axis were taken as described above. Then, bore diameters were measured in a similar manner to that also described above. Likewise all measurements taken on the bottom side were later used in calculating the positions of large tubes on the bottom side as discussed above.

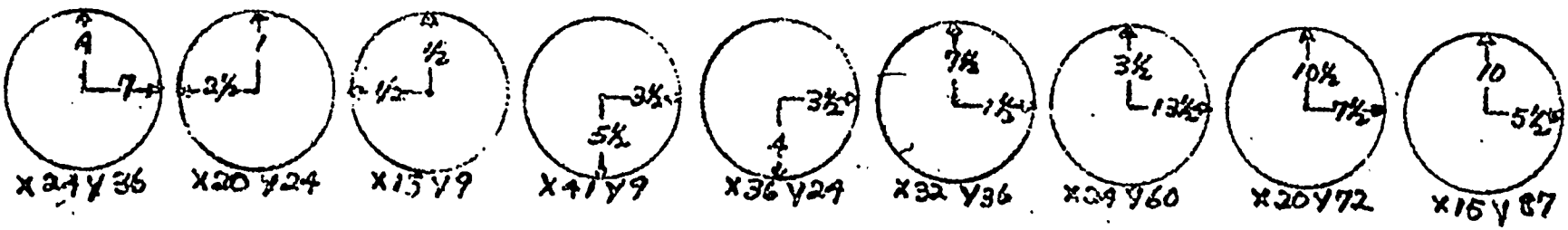
The unit was then turned top side up and re-leveled using the Wild NIII Precision Level and target. After the unit was leveled, verticalities of those tubes in the spider web tube pattern were taken and recorded. For results of this inspection see Sketch #15. The tubes in the "spider web" tube pattern have already been established in the past as being representative of all tubes in a unit. The verticality readings were then analyzed by du Pont inspectors to determine if tube verticality tolerance was being maintained after the unit was leveled. Verticality readings shown in sketch #15 were outside this limit, they were considered satisfactory by the du Pont Inspection Department and accepted.

(3) Dowell Cleaning

Internal Dowell cleaning of the "L" bottom tube sheet was performed in a similar manner to that described in Section 16B-(1) of this manual.

After cleaning, a visual inspection was made on the interior by looking thru two 5" pipe nipples using a flashlight. Samples for visual examination were taken by rubbing clean paper towels on those areas accessible by hand thru the 5" openings and not visible by eye. All samples taken and visual examinations made thru these two openings indicated no foreign material was present on the interior surfaces of the unit. Other visual inspections were made by looking thru the 2" inspection ports with the aid of a flashlight. Inspection ports were located in wrapper plates in a semi-symetrical pattern around the outer perimeter of the unit. All inspections exhibited a satisfactory surface cleanliness, although a slight residue of detergent was noted on some

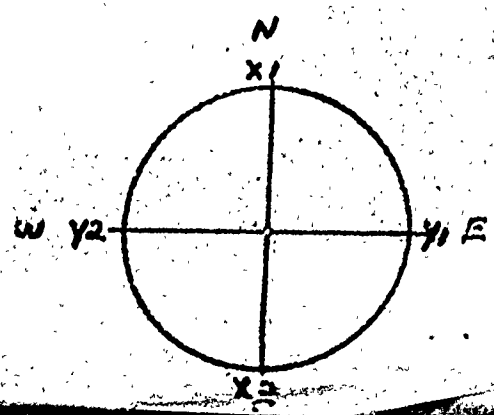




X	Y	N-S	E-W	X	Y	N-S	E-W	X	Y	N-S	E-W	X	Y	N-S	E-W	X	Y	N-S	E-W
2	48	9N	4W	12	48	9N	½E	20	48	2½N	6E	28	48	1½N	1½E	44	48	4S	11E
59	48	4S	14E	41	87	7N	14½E	36	72	½N	14E	32	60	3S	6E	24	36	4N	7E
20	24	1N	2½W	15	9	½N	½W	41	9	5½S	3½E	36	24	4S	3½E	32	36	7½N	1½E
29	60	3½N	13½E	20	72	10½N	7½E	15	87	10N	5½E	36	98	2½S	7E				

Note. All Above READINGS ARE IN thousands OF AN INCH. PER FOOT

Sketch at Right Shows: Location OF tubes IN TANK Bottom "L" UNIT



SKETCH #15

RESTRICTED

tubes. This gave the appearance of a white powder-like substance; however, this was not considered detrimental to the operation of the unit and was accepted by the du Pont Inspection Department. All other visual and mechanical examinations indicated that the unit was clean and the assembly was released for internal drying prior to loading of raschig rings.

(4) Internal Drying of Unit Prior to Loading Raschig Rings

For the internal drying procedure and the inspections performed by du Pont inspectors during this operation on the "L" bottom tube sheet, refer to Part VII, Section I, item 16C-(20).

17. Raschig Ring Loading Inspections

A. "R" Unit

A heavy loading cradle was designed and built by New York Ship to handle the top tube sheet and tank bottom assemblies for raschig ring loading during fabrication of the NYX unit. This same loading cradle was used to handle the unit during loading of raschig rings in the "R" bottom tube sheet. Part II-B, Section 14 describes the equipment used, and also illustrates pictorially the raschig ring loading methods.

The "R" bottom tube sheet assembly was loaded with raschig rings in accordance with the filler loading procedure and filler loading cleanliness procedure established by the Design Division and later adopted for subsequent units. Following this procedure, approximately 64 tons of raschig rings were loaded into the "R" bottom tube sheet. Du Pont inspectors observed all loading steps in the loading operation. Before loading rings they were visually inspected to see that no foreign matter was present and that the rings were clean. After all loading was completed, the loading port plugs were screwed in tight and later welded with the unit in a horizontal position.

The assembly was moved from the loading cradle bed and placed top side up. During the handling operations, raschig rings settled in the unit and it was necessary to add additional rings while the unit was in a horizontal position. This was done by opening auxiliary loading ports nearest the top side of the unit in wrapper plates and jetting additional rings into the unit. A spedial air jetting gun fabricated by New York Ship was used to blow the raschig rings into the unit. This operation was witnessed by a du Pont inspector.

After each auxiliary loading port was filled completely with raschig rings, plugs were screwed in the wrapper plates and then welded. All "A" and "B" filling port plug welding was then chipped, dressed and then visually inspected by du Pont inspectors for soundness and quality. This completed the raschig ring loading operation and the unit was released for further fabrication.

B. "P" Unit

A heavy loading cradle was designed and built by New York Ship to handle the top tube sheet and bottom tube sheet assemblies for raschig ring loading during fabrication of the NYX unit. This same loading cradle was used to handle the unit during loading of raschig rings in the "P" bottom tube sheet. Part II-B, Section 14 describes the equipment used, and also illustrates pictorially the raschig ring loading methods.

The "P" bottom tube sheet was loaded with raschig rings in accordance with the filler loading procedure and filler loading cleanliness procedure established by Design for the NYX unit and later adopted for subsequent units. Following this procedure a total of 61 tons, 1,485 lbs. or raschig rings were loaded into this unit.

The following is a resume of the loading operations as observed by a du Pont inspector. The unit was set in a vertical position and loading was done at first through two main loading ports. After each of the first 3 loading cycles of 10 tons each, the unit was rotated 45° right and left 3 times.

At this time inspectors discovered metal chips in a raschig ring container. A conference was held between New York Ship and du Pont and the chips examined. It was concluded by all that the chips found in the container was of no serious consequence.

The loading procedure was resumed and the fourth filling cycle of 4 tons, the fifth filling cycle of 5 tons, the sixth filling cycle of 10 tons and all other filling cycles that followed (9 filling cycles in all) were completed by rotating unit as described above. The loading of unit with raschig rings was done with a stainless steel hopper. Raschig rings were dumped from cardboard containers into a stainless steel hopper. (All rings were checked for cleanliness by inspectors before rings were dumped into hoppers.) The hoppers, with 1 ton of raschig rings in them, were lifted by crane to loading ports of unit. Unloading of hoppers was done through a valve controlled funnel-like extension on the hoppers. After main loading ports were filled to capacity, loading was continued by hand through "A" and "B" ports until they were filled to capacity. When loading was completed (in vertical position), the loading port plugs were screwed in tight and later welded with the unit in a horizontal position.

The assembly was moved from the loading cradle bed and placed top side up. During the handling operations, raschig rings settled in the unit and it was necessary to add additional rings while the unit was in a horizontal position. This was done by opening auxiliary loading ports nearest the top side of the unit in wrapper plates and jetting additional rings into the unit. A special air jetting gun fabricated by New York Ship was used to blow the raschig rings into the unit. This operation was

witnessed by a du Pont inspector.

After each auxiliary loading port was filled completely with raschig rings, plugs were screwed in the wrapper plates and then welded. All "A" and "B" filling port plug welding was chipped, dressed and visually inspected by du Pont inspectors for soundness and quality. This completed the raschig ring loading operation and the unit was released for further fabrication.

C. "L" Unit

Loading of the "L" bottom tube sheet with raschig rings was performed in a similar manner to that described in Sections 17A and B of this manual. No discrepancies were encountered.

A total of 321½ boxes of raschig rings weighting approximately 38 lbs per box, or approximately 61 tons, 170 lbs. was loaded into this unit. The entire loading operation was witnessed by the du Pont Inspection Department and accepted as being satisfactory.

Just prior to loading raschig rings, the bottom side of the bottom tube sheet was sandblasted in a similar manner to that described in Section 16C-(1) of this manual.

After sandblasting the unit was acid washed on the bottom side, visually inspected and found satisfactory.

18. Inspection of 8" Schedule 5 S Split Pipe Welded to Periphery of Bottom Tube Sheet.

A. "R" Unit

After completing the raschig ring loading operation, the bottom tube sheet was placed in a horizontal position (top side up on suitable cast iron pedestals) and leveled by du Pont inspectors using the Wild NIII Precision Level and target. Preparations were then made by New York Ship for assembling and welding two half round 8" schedule 5 S pipe sections to the periphery of the bottom tube sheet assembly. (See du Pont drawing W130947 for location of split pipe)

Before assembling and welding the half round sections to the unit, the butt welded joints in the piping were x-rayed 100%, radiographs examined by du Pont inspectors, and necessary repairs made. Next, each section was acid washed, ferroxyl tested and accepted by du Pont inspectors. Also, two half tee pipe connections were fabricated for the top and bottom circumferential pipe sections. One half tee pipe connection served as a inlet connector for the circumferential piping located nearest the bottom side of the unit. The other served as a outlet connector for the circumferential piping located nearest the top side of the unit. The butt welded joints that make up each of the two half tee pipe connections were visually inspected for cracks, porosity, undercutting and other mechanical defects. Repairs were made and then the butt joints were x-rayed 100%.

The half round pipe sections and half tee pipe connectors were assembled to the unit and welded using automatic aircomatic hand welding machines. After all welding was completed, a visual inspection was made to determine the soundness and quality of welding. Defects such as porosity, undercutting, cracks and other mechanical defects were chipped out, rewelded, ground smooth and re-inspected. After all repairs were made, the job was accepted subject to a final freon and hydrostatic test at a later date.

B. "P" Unit

Fabrication and inspection of 8" split circumferential pipe welded to the periphery of the "P" bottom tube sheet was similar to that performed on "R" bottom tube sheet, except as follows:

(1) New York Ship requested that the 8" schedule 5S split pipe (.109" wall thickness) be changed to 8" schedule 10S (.148" wall thickness). Design Division granted this request based on the following facts reported to them by the du Pont Inspection Department:

a. Difficulty in working and handling material due to thin thickness

b. Weld burn through frequently experienced in joining pipe segments together for making the transverse butt weld joint. In addition, much difficulty was experienced by New York Ship in getting the quality of weld to pass U-68 Code requirements. See Dwg. 5-2 presented herewith.

(2) Dy-cheking of top and bottom fillet weld joining split pipe to circumference of unit was incorporated on this assembly. For dy-cheking procedure, see Part VII, Section I, item 14B-(6).

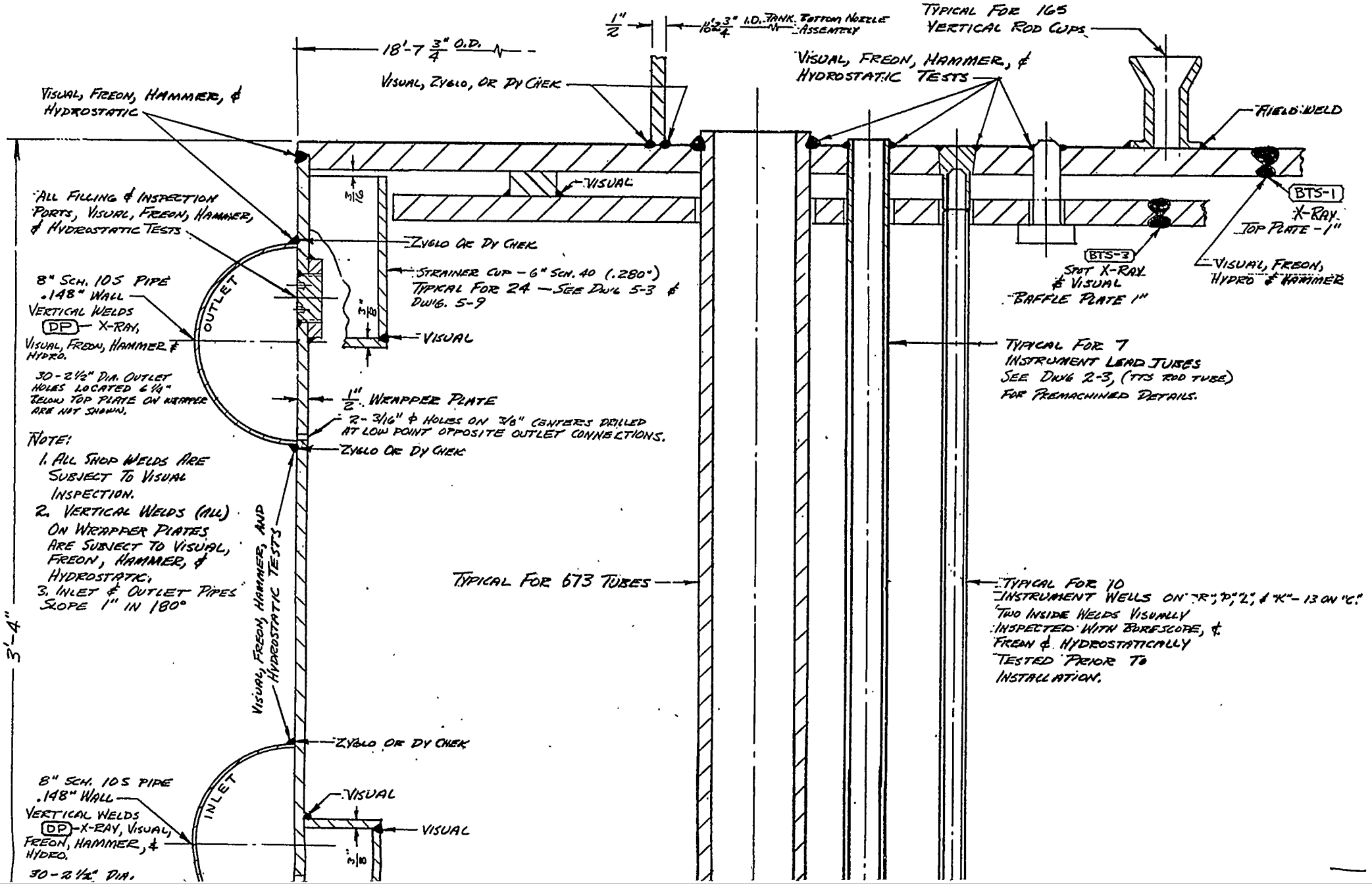
(3) Hydrostatic and freon testing of the 8" split circumferential piping and results are covered in Section 14B-(2) and (3).

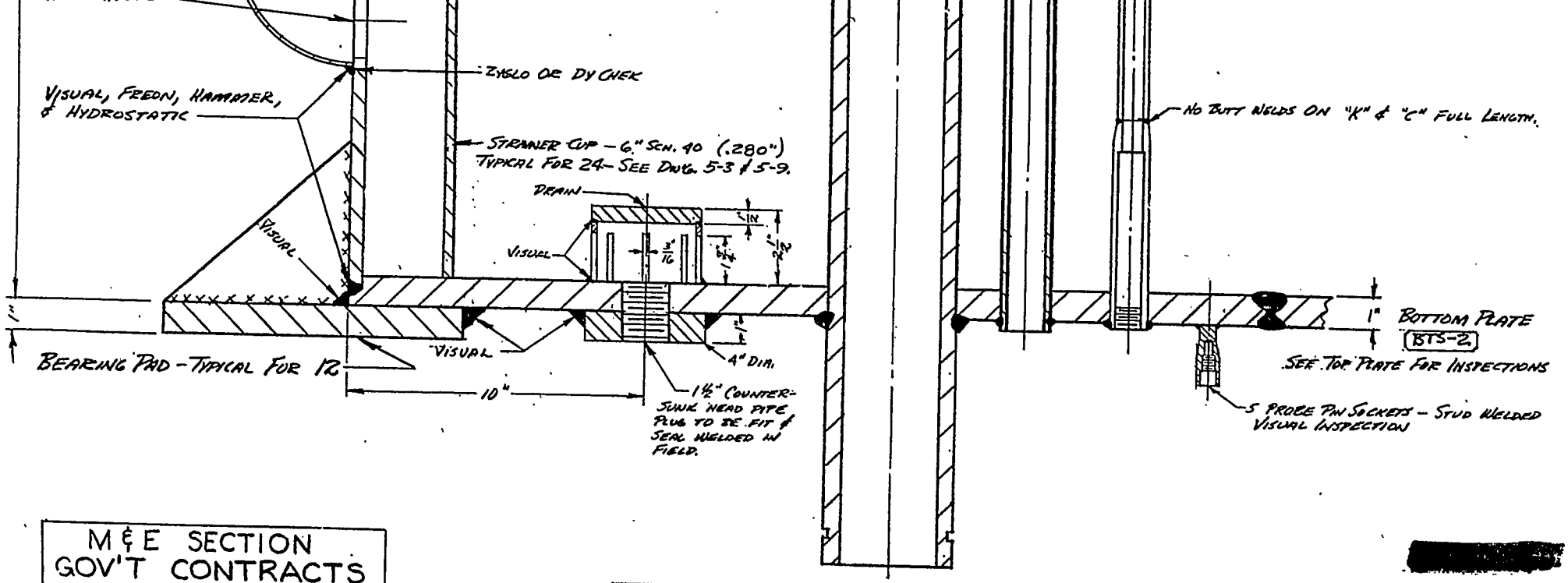
(4) Preparation of wrapper plate surface for receiving split circumferential piping.

Prior to assembling and welding of the split circumferential piping to the periphery of the B.T.S assembly, the location of the pipe was laid out on the wrapper plates to suit drawing dimensions. Next, the area enclosed by the piping as defined by layout lines was ground to remove any iron inclusions and all other mechanical defects present in the wrapper plate surfaces. After this, the ground areas were acid washed by New York Ship and then ferroxyl tested by the du Pont Inspection Department. Those areas that indicated the presence of free iron were re-ground and then cleaned with Safe-Tee Solvent (F.O. 128). All contaminated areas were re-ferroxyl tested and found satisfactory for assembling and welding the split circumferential piping to the unit.

[redacted]

SECTION THRU BOTTOM TUBE SHEET





M & E SECTION
GOV'T CONTRACTS

DWG. 5-2

[redacted]

BY: S.R. COCHRAN
JAN.-1958

C. "L" Unit

Fabrication and inspection of 8" schedule 10S split circumferential pipe welded to the periphery of the "L" bottom tube sheet was similar to those performed on the "P" bottom tube sheet except as follows:

(1) Changes in Welding Procedure

a. Secondary Argon Gas Shield

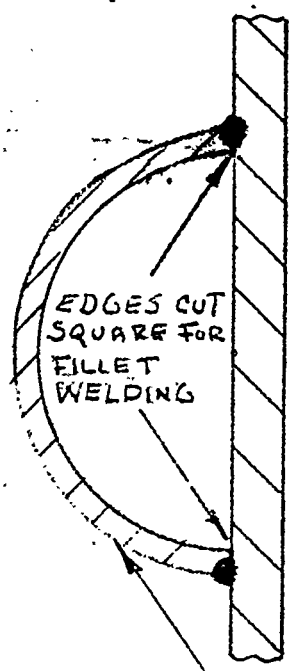
The top and bottom circumferential pipe sections (W132960) were fabricated, assembled and welded to the "L" bottom tube sheet using the welding procedure adopted for the "P" unit; however, an additional step was added to the latter and "L", "K" and "C" split pipe welding procedures. This step consisted of introducing argon gas into the interior of the split pipe sections at a pressure of 10#/cu ft after the pipe had been fit and tack welded to the unit. This argon pressure was maintained for one hour, then reduced to 5#/cu ft. and all welding fully completed using hand operated aircomatic welding machines.

The purpose for introducing argon gas into the interior of each pipe section and holding it there during final welding operations was to provide an internal or secondary gas shield to prevent oxidation of weld metal on the inside. Otherwise, weld metal that works its way to the inside during the final welding operation without the inert gas shield would be exposed to air with weld oxidation resulting. Oxidation causes pitting, porosity and other mechanical defects which cannot be repaired due to inaccessibility. (See Dwg. 5-2)

The introduction of argon gas at a pressure of 10#/cu ft and holding it at this pressure for one hour was necessary in order to insure that a homogenous mixture of the gas displaced nearly all oxygen. Fit-up of the split pipe and tack welding to hold it in place for final welding was a "metal to metal" joint between the unit and pipe with only a slight seepage of gas taking place when subjected to the argon pressure. Since it was only necessary to maintain a pressure slightly above atmospheric pressure to keep outside air from entering, the argon gas pressure was reduced to 5#/cu ft. to eliminate unnecessary escapage of gas.

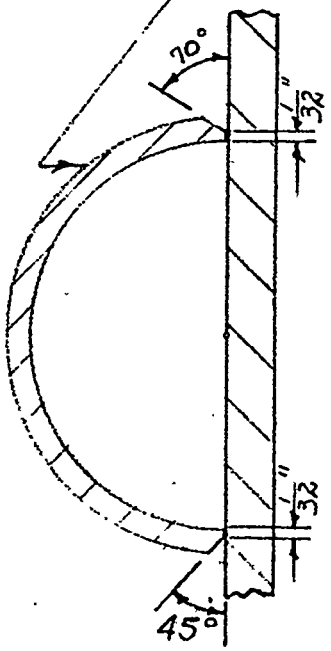
b. Weld Preparation Change From Fillet To Butt Weld.

On "R" and "P" units the weld preparation for joining the split pipe edges to the unit for final welding was cut square and then fillet welded to the circumference of the bottom tube sheet as shown in Sketch #16. Amember of the du Pont Inspection Department recognized that the quality of welding was



WELD PREPARATION ON SPLIT PIPE EDGES FOR "R" & "P" B.T.S.

8" SCHEDULE 10 S PIPE



WELD PREPARATION ON SPLIT PIPE EDGES FOR 'L" & K B.T.S.

SKETCH # 16

being sacrificed due to the above method of weld preparation on the split pipe edges for the "P" B.T.S. Also, it was found by welding samples of the split pipe to a 1" thick S/S plate that full weld penetration was not being maintained.

As a result of the above findings, it was suggested by New York Ship's welding engineer that a 70° bevel (weld preparation) be chipped on the top edge of the split pipe and a 45° bevel be chipped on the bottom edge. These weld preparation bevels were determined experimentally by New York Ship's welding school personnel. (See Sketch #16) Also, a 1/32" land with no root gap was left on all edges in order that"metal to metal" contact between the split pipe and unit be maintained for sealing off the argon gas during final welding operations as explained in Section (1) above.

The above weld preparation change from fillet weld to butt weld was incorporated into the fabrication procedure for "K" and "L" units.

(2) Split Pipe and Half-tee Wall Thickness Check

Starting with the "L" bottom tube sheets split circumferential piping, it was decided by the du Pont Inspection Department to check wall thickness of all 8" schedule 10S pipe (.148" thick), at the transverse butt weld joints after all welding repairs, grinding, etc., were completed, and before assembling and butt welding the split pipe to the bottom tube sheet assembly. In addition, a spot check was made on all pipe to see that wall thickness was not less than 0.125". Measurements were taken using a 12" outside micrometer with a dial indicator affixed to the micrometer spindle at one end of the frame. Clamped to the other end of the micrometer frame was a 1/4" steel rod. The dial indicator was set by placing a 2" block 0.1875" thick between the dial indicator plunger and the 1/4" steel rod tip. In this manner the dial indicator was set to read deviations plus or minus from the basic setting of 0.1875". The section of pipe to be checked was "sandwiched" between the pre-set dial indicator and 1/4" rod tip with both indicator and 1/4" rod perpendicular to the pipe. With the 12" micrometer frame in this position, the device was moved in a zig-zag manner over the surface of the pipe and thickness read directly in .001". In measuring the thickness of a transverse butt weld joint (one/section of pipe before welding to B.T.S.), the micrometer frame was positioned at the weld in a similar manner described above and thickness measurements of all points 1/2" each side of the butt weld was checked. All of the above thickness checks were performed on the split circumferential piping for the "L" and "K" bottom tube sheet assemblies. Final results indicated that the pipe was a minimum of .125" thick which was acceptable to the du Pont Inspection Department.

In addition to thickness checks made on the split pipe, these same measurements were repeated on the two half-tee pipe connectors before assembling and welding to the B.T.S. assembly. (See du Pont drawing W13290 for location) However, the minimum wall thickness for the half-tee connectors was set at .157". All thickness measurements made on the two tees for the "L" B.T.S. indicated that results ranged between .186" and .199" which was satisfactory.

All of the above thickness checks were made after x-raying and making all necessary repairs on the split circumferential piping and half-tee pipe connectors. After this, the pieces were released for welding to the bottom tube sheet assembly.

(3) Hydrostatic and Freon Test

Hydrostatic and freon testing of the 8" split circumferential piping and half-tee connectors is covered in Section 14C of this manual. For other inspections performed on the split circumferential piping, see Dwg. 5-2 in Section 18B of this manual.

(4) Checking Slope of Split Circumferential Piping and Location of Half-tees with Respect to "Y" Axis

Inspection of the split circumferential pipe slope and location of half-tees with respect to the "Y" axis is covered in Exhibit #16 presented herewith.

19. Alignment of Tank Bottom Nozzle Assembly on Top Side of Bottom Tube Sheet.

A. "R" Unit

The tank bottom nozzle assembly was fabricated as a unit before fitting and welding to the bottom tube sheet. Dwg. 5-5 illustrates pictorially all inspection made on this assembly.

Prior to fitting and welding the nozzle assembly to the bottom tube sheet, du Pont inspectors performed several jobs which aided New York Ship in lining up the assembly for welding.

As discussed in Section 16A-(2) of this manual, X and Y centerlines were established on the top side of the bottom tube sheet and then "wrapped" around the unit. From these lines New York Ship trammed 60° lines on the unit to correspond to each of the six nozzle centerlines on the nozzle assembly. The tank bottom nozzle assembly was superimposed on top of the bottom tube sheet and its nozzle radial centerlines (6 @ 60°) were matched to the six trammed 60° radial centerlines on the bottom tube sheet. After New York Ship aligned the nozzle assembly, it was fillet welded to the unit. Next, du Pont Inspectors made preparations to transfer the X and Y axes to the top outside edge of the nozzle assembly to be used later for lofting in of the main

EXHIBIT #16

CHECKING SCOPE OF SPLIT CIRCUMFERENTIAL PIPING

AND LOCATION OF HALF-TEES WITH RESPECT TO "Y" AXIS.

E. I..DU PONT DE NEMOURS & CO., INC.

Report Number 514-L

Construction Division

[redacted]

CC: H. W. Gosney, F.P.M.
R. K. Mason-D.A.Hauser-SRP (3
R. K. Mason-W.P.Duncan-SRP
H. L. Bunker - J.G.Brewer
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S. R. Cochran (2)
R. H. Barto - NYS (3)
J. B. Johnson - File

June 12, 1953
New York Ship - Camden, N. J.

FIELD INSPECTOR'S REPORT

This material contains information affecting the national defense of the United States within the meaning of the espionage laws, Title 18, U.S.C., Secs. 93 and 794, the transmission or revelation of which in any manner to an unauthorized person is prohibited by law.

TO C. J. VEITH - M & E FILE

FROM H. Dahlke - H. Neicen DATE May 4, 1953

PROJECT NO. 8980 PLANT Savannah River ORDER NO. AXC-167½

EQUIPMENT Tank Bottom - Half Round EQ.PC.NO. 153-L

DRAWING NOS. W-132760 R.18 JOB RATING

VENDOR New York Shipbuilding Corp. LOCATION Camden, N. J.

Inspection made 5/4/53

Scope: To check the slope of the half rounds as per specifications of drawing (slope 1" in 180° from inlet or outlet conn.). Also to check orientation of tees with respect to Y axis with 50' steel tape.

Procedure: The distance from top plate to center of top half round was checked at the outlet conn., 180° from this point, and at several other points. The distance at the outlet was 8" and 180° from here it was 9". The same procedure was used on bottom; measuring from bottom plate to lower edge of bottom half round. The distance at the inlet conn. was 13" and at 180° from this it was 12". The slope was uniform between these points.

The top tee was 4'10½" off the Y_2 axis toward the X_1 axis and the bottom tee was 4'10-9/16" off the Y_1 axis toward the X_2 axis. The drawing measurement is 4'10½".

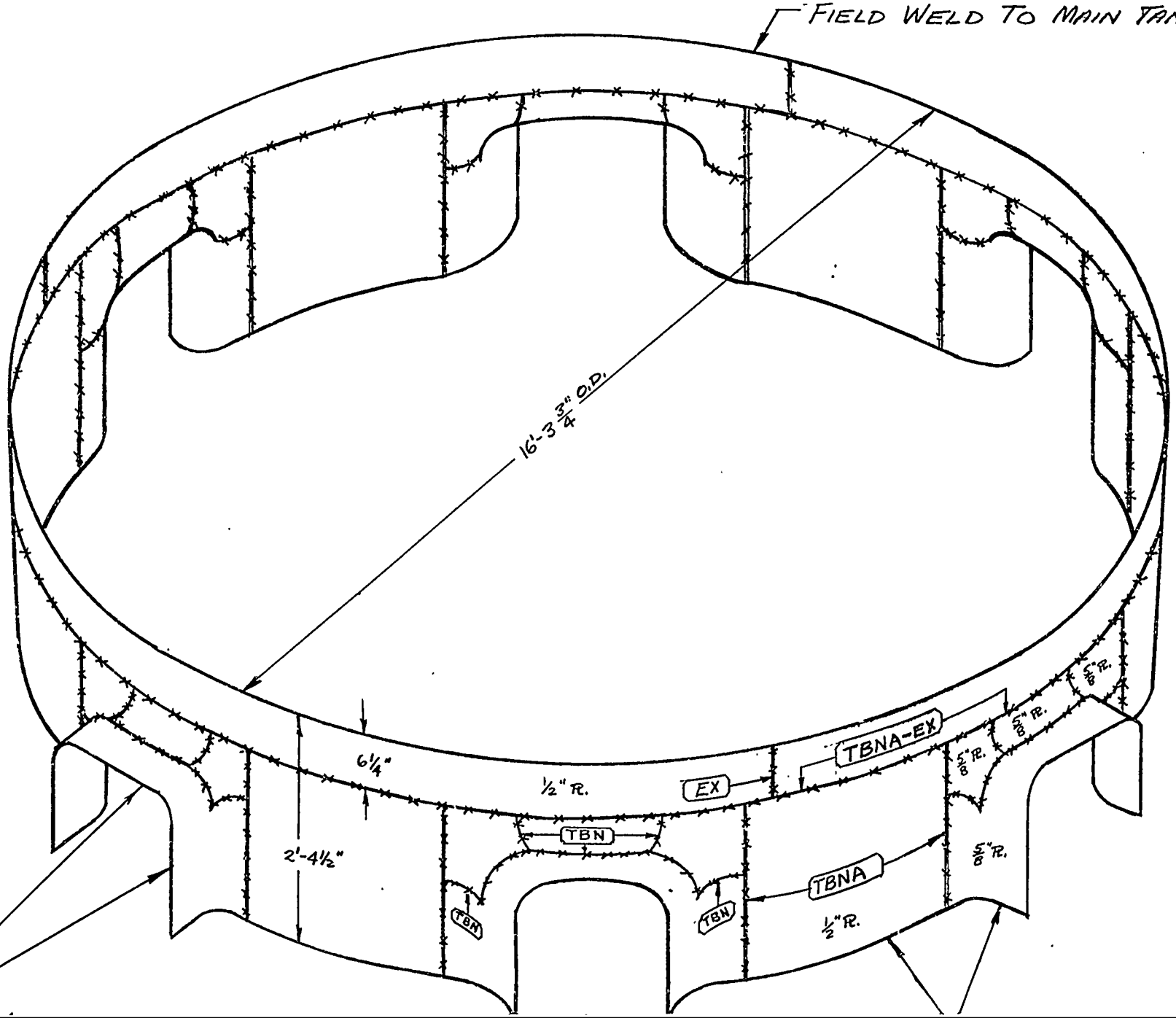
Note: All of the above measurements were considered acceptable.

lmw

[redacted]

TANK BOTTOM NOZZLE ASSEMBLY

[redacted]



WELD TO 20"-90° TANK OUTLET NOZZLE ELBOW

TBN-SE

VISUAL & X-RAY

WELD TO TOP PLATE OF BOTTOM TUBE SHEET.

NOTE:

1. ALL SEAMS VISUAL & X-RAY, EXCEPT:
   a. INSIDE FILLET TO BOTTOM TUBE SHEET
      1. VISUAL
      2. ZYGLO OR DYCHEK
   b. OUTSIDE FILLET TO BOTTOM TUBE SHEET
      1. VISUAL
      2. ZYGLO OR DY CHEK

M & E SECTION
GOV'T CONTRACTS

DWG. 5-5

tank section. The Wild T-1 Theodolite was used to transfer the X1-X2 and Y1-Y2 bottom tube sheet axis to the tank bottom nozzle assembly. Exhibit #17 presented herewith discusses the procedure used to transfer the axes and where the axes were located on the shell.

B. "P" Unit

This inspection was performed in a similar manner to that described in Section 19A of this manual, except the following additional inspections were made on this assembly:

(1) Measuring location of thermocouple clips on the bottom Tube Sheet Nozzle Assembly

The location of thermocouple clips as shown on du Pont dwgs. h-13981 and W133187 were checked to 1/8" accuracy using a stainless steel tape. All chips were located within tolerance except two which were located 30° counter-clockwise from Y1. Specified elevations on these clips were 3" and 5", respectively, above the top of the bottom tube sheet plate; however, measured elevations were 2-3/4" and 4-3/8" respectively. All thermocouple clip locations were satisfactory, except the two mentioned above and location of these was accepted by the Design Division.

(2) Final Inspection to Determine out-of-roundness of Bottom Tube Sheet Nozzle Assembly

A 100' stainless steel tape was used to measure four inside diameters of the nozzle assembly at the top edge. Results of this inspection was as follows:

Position	Result
X1-X2	195-1/32"
45° (CCW)	194-11/16"
Y1-Y2	194-19/32"
135° (CCW)	195-1/4"

Total out-of-roundness = 11/16"

The total out-of-roundness of the nozzle assembly was approximately 3/16" above the specified drawing tolerance. Due to the urgency of loading the above assembly for shipment, an immediate decision as to acceptability could not be obtained from the Design Division. However, this problem was discussed with a member of Design at a later date and the out-of-round tolerance was accepted.

(3) Measuring Height of Nozzle Assembly Referencing From Top Ends of Tubes and Circumferential Measurement

The distance from the tube ends (top side of B.T.S.) to the top edge of the tank nozzle assembly was taken at twelve positions around the outer periphery of the tube assembly. An eighteen foot straight edge was laid

EXHIBIT #17

TRANSFER OF X1-X2 AND Y1-Y2 BOTTOM TUBE

SHEET AXES TO THE TANK BOTTOM NOZZLE ASSEMBLY.

Ex 17-1

E. I. DU PONT DE NEMOURS & CO.

CONSTRUCTION DIVISION

[redacted]

Report Number 131-R

CC: C.E. Buckley, F.P.M.
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J.G. Brewer
H.B. Gage
F.C. Breuninger
A.H. Hughes
C.W. Dunn - File

July 17, 1952
New York Ship - Camden, N. J.

This material contains information affecting the national defense of the United States within the meaning of the espionage laws, Title 18, U.S.C., Secs. 793 and 794, the transmission or revelation of which in any manner to an unauthorized person is prohibited by law.

FIELD INSPECTOR'S REPORT

TO C. J.VEITH - M & E FILE

FROM GRAHAM - MIKELAIT — DATE JULY 13, 1952

PROJECT NO. 8980 PLANT SAVANNAH RIVER — ORDER NO. AXC-167½

EQUIPMENT TANK BOTTOM TUBE SHEET — EQ.PC.NO. 153-R

DRAWING NO. W-130947 — JOB RATING

VENDOR NEW YORK SHIPBUILDING CORP. — LOCATION CAMDEN, N.J.

Scope: Transfer of X1-X2, Y1-Y2 axes to tank shell section above tank bottom nozzles for tank shell alignment and assembly.

Procedure: At each of four areas opposite the ends of the axes, three (3) points were set on the inside and three (3) points on the outside of the shell section at approximately 1", 2" and 3" below the edge where the shell section and main tank shell will be joined. Points are outlined inside stenciled letter "O"'s and all are encircled with blue layout paint. (Paint is very soluble in alcohol.)

Procedure, which was contrary to that originally established in Memo #165 to A.H. Hughes from C.W. Dunn, was governed by existing conditions and was as follows:

1. Instrument (Wild T1 Theodolite) was set up on the tank bottom tube sheet axis at the extreme end opposite area on tank shell section to which the axis was to be transferred.

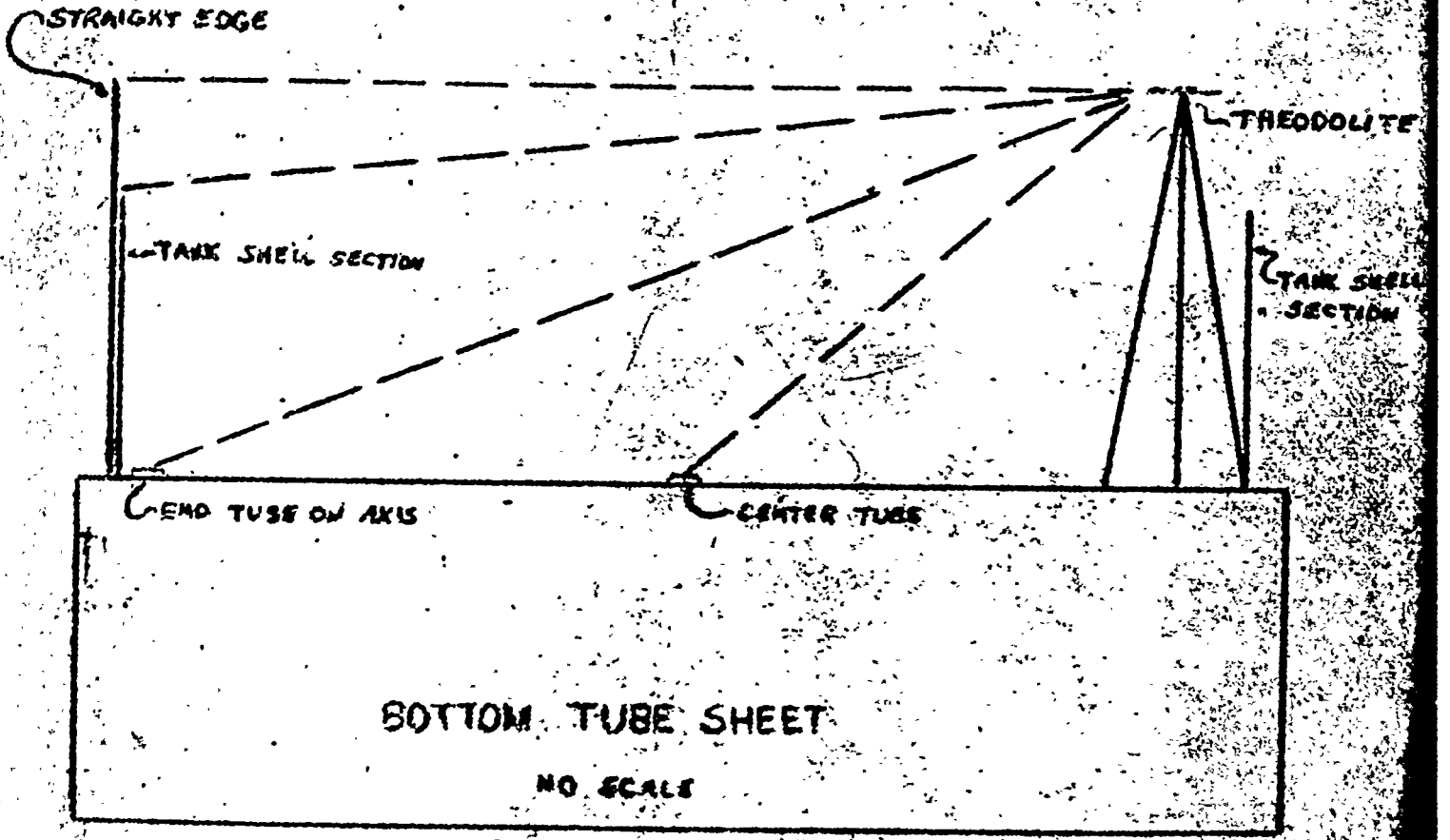
2. Instrument was walked-in on the axis and points were optically transferred to the shell section. Position of the instrument was checked by plunging and reversing it.

[redacted]

Ex-17-2

3. Points on inside of shell were set by direct observation.

4. Points on the outside of the shell were set by aligning the upper half of a clamped straight edge which was placed on the outside of the shell. After the upper half of the straight edge was sighted and aligned by the instrument, a line was scribed along the straight edge. Points were then set in the center of the scribed line. The points on this latter line are believed to be as accurate as those set by direct observation.



SKETCH SHOWING INSTRUMENT SET-UP

[redacted]

across the top of the tank nozzle assembly at the twelve positions to be measured. Vertical distances between the bottom edge of the straight edge and the top ends of the tubes were taken with a 3' scale graduated in 1/32". The points measured were taken at the middle of each nozzle and half-way between each nozzle.

Results of this inspection were as follows:

Position	Nozzle #1	Dimension
1	1	28-5/32"
1½	-	28-1/8"
2	2	28-3/16"
2½	-	28-3/32"
3	3	28-3/32"
3½	-	28-1/16"
4	4	28-3/16"
4½	-	28-1/8"
5	5	28-5/32"
5½	-	28-3/32"
6	6	28-5/32"
6½	-	28-3/32"

Drawing dimension was 28". The actual dimension ranged between 28-1/16" to 28-3/16". The above dimensions were final and accepted by du Pont Inspection Department.

Next, the outside circumference of the nozzle assembly was measured using 100' S/S tape graduated in 1/16". This measurement was taken approximately 1" below the top edge of the nozzle assembly. Final circumference measurement was recorded and 51'-3 1/8" which was accepted by the du Pont Inspection Department.

C. "L" Unit

All measurements and inspections performed on the "L" bottom tube sheet nozzle assembly were similar to those discussed in Sections 19A and B of this manual. Final results were satisfactory and accepted by the du Pont Inspection Department. Additional measurements taken on the nozzle assembly during main tank aligning operations are discussed in Part VII, Section IV.

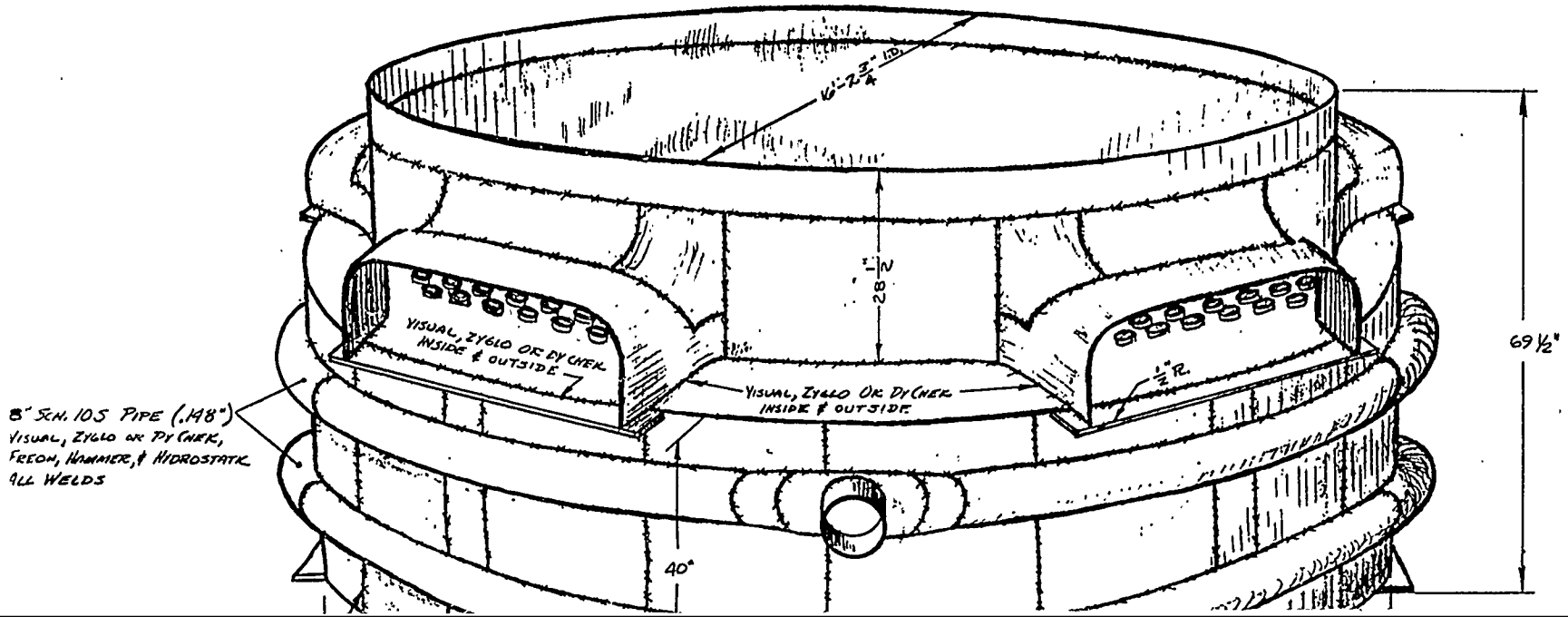
20. Welding Inspection and Zy-glo Testing of Fillet Weld Joining Nozzle Assembly to Bottom Tube Sheet

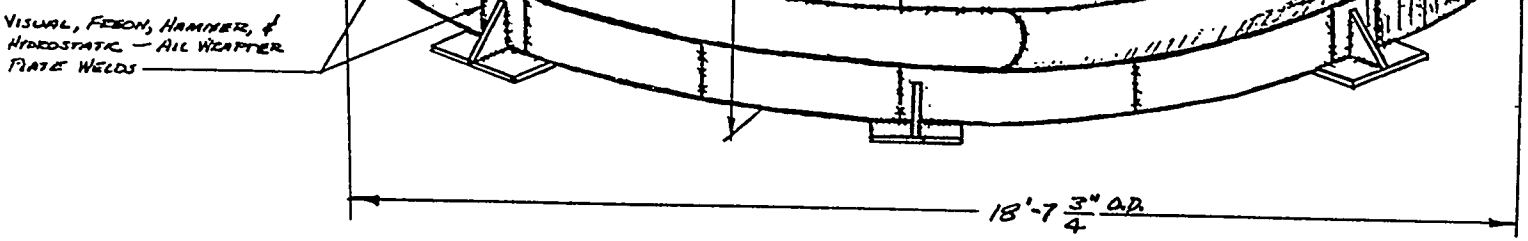
A. "R" Unit

After the nozzle assembly was welded to the top side of the bottom tube sheet, both sides of the double fillet welded joint between the two components were ground smooth and then visually inspected. Weld defects such as cracks, porosity, undercutting and other mechanical imperfections were chipped or ground out and then re-welded (if necessary), re-inspected and accepted. Dwg. 5-1 shows pictorially where these inspections and repairs were made.

[redacted]

BOTTOM TUBE SHEET





NOTE:

1. SEE TANK BOTTOM NOZZLE ASSEMBLY DRAWING FOR WELD INSPECTIONS & METAL THICKNESS.

M & E SECTION
GOV'T CONTRACTS

DWG. 5-1

[redacted]

BY S.R. COCHRAN
FEB.-1953

Next, the double fillet welded joint was zy-glo tested in a similar manner described in Section 14A-(3)a of this manual. Any cracks or imperfections found were chipped or ground out and re-welded where necessary. Final inspection revealed that all welding was of a sound nature and quality and accepted as being satisfactory.

B. "P" Unit

This inspection was performed in a similar manner to that described in Section 20A of this manual.

C. "L" Unit

Inspection of the fillet weld joining the bottom tube sheet nozzle assembly was performed in a similar manner to that described in Section 20A of this manual. However, in lieu of the zy-glo test, the dy-chek method was employed to check the quality of welding joining the above two components. For the procedure followed when the dy-chek method of inspecting welds is employed, see Part VII, Section I, item 14C-(9).

21. Measurements and Inspections After Loading Raschig Rings and Welding Bottom Tube Sheet Nozzle Assembly to Unit

A. "R" Unit

(1) Profile Measurements

After loading raschig rings into the unit, a profile in three directions across the top side tube ends was taken to determine if additional weight of raschig rings deflected the tube end plane. The profile was taken using a 18' straight edge and feeler gages. No appreciable distortion resulted.

(2) Inspection of 20"-90° Tank Outlet Nozzle Elbows

a. Inspections Performed Before Welding to Nozzle Assembly

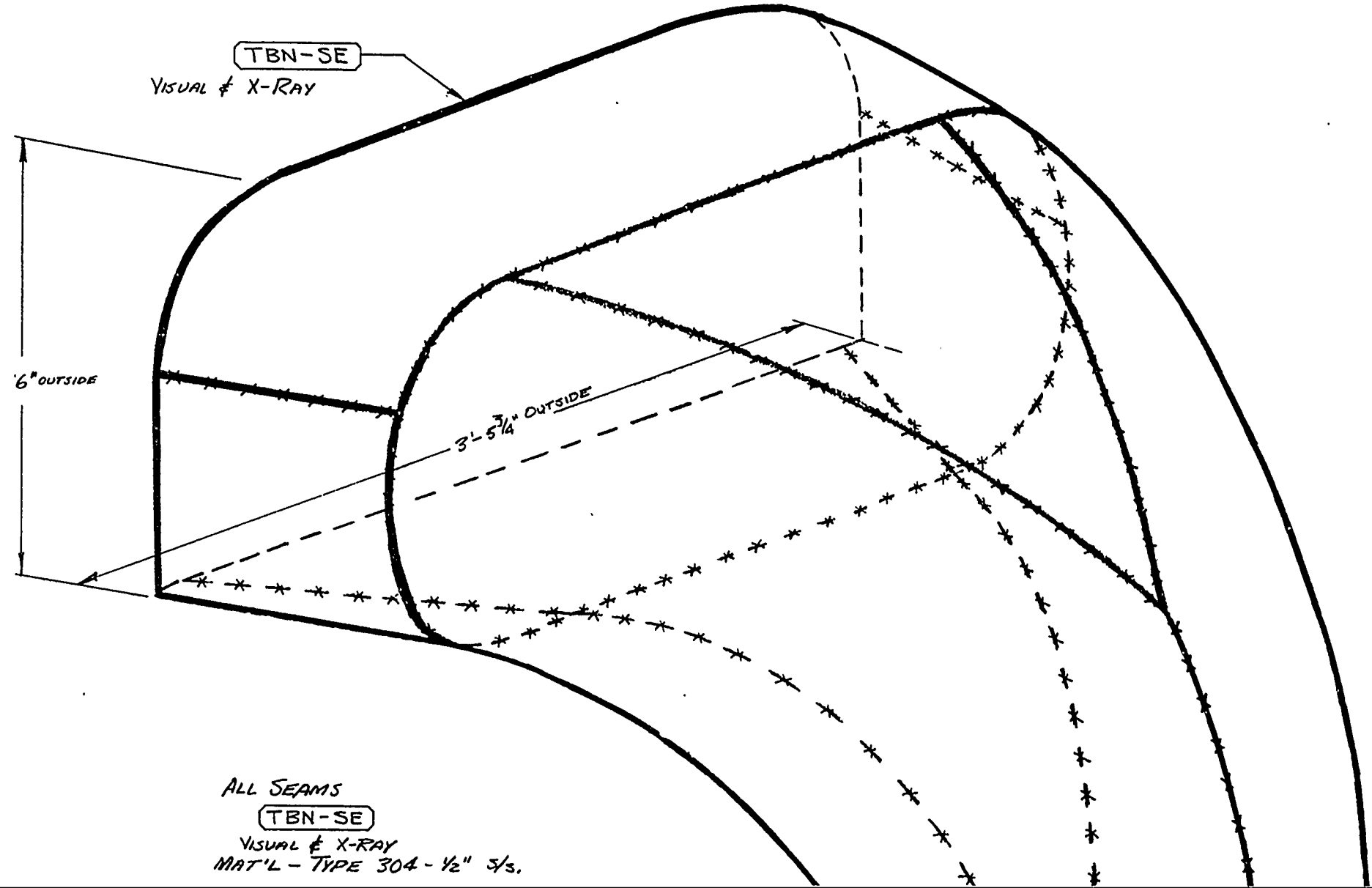
After fabricating six 20"-90° tank outlet nozzle elbows, all weld seams were visually inspected for cracks, porosity, undercutting and other mechanical defects. Necessary repairs were made, and then the nozzle elbows were released for x-raying (See Dwg. 5-6).

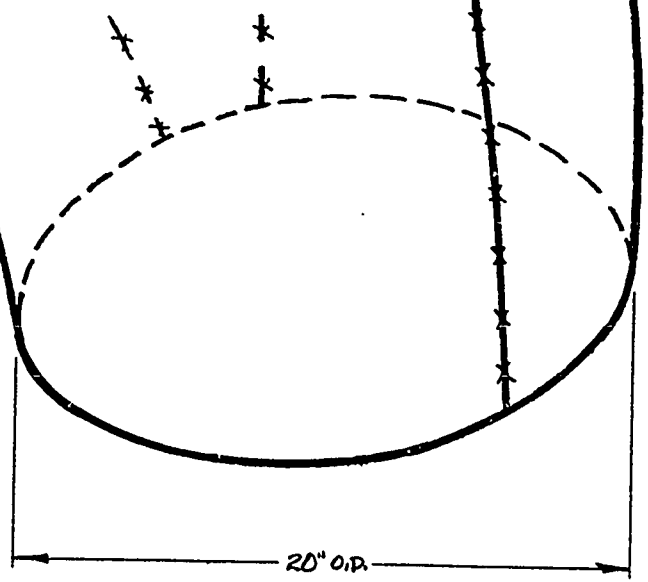
The above weld seams were x-rayed 100%, repairs made and then re-x-rayed.

Next, the six nozzle elbows were acid washed to remove "free iron" and other foreign material present on the nozzle surfaces. After this the nozzle elbows were ferroxyl tested by du Pont inspectors and accepted for welding to the bottom tube sheet nozzle assembly.

b. Inspections Performed After Welding Nozzle to Bottom Tube Sheet Nozzle Assembly

[redacted] 20"-90° TANK OUTLET NOZZLE ELBOW





M & E SECTION
GOV'T CONTRACTS

DWG. 5-6

[redacted]

BY: S.R. COCHRAN
FEB.-1958

[redacted]

Six 20"-90° tank outlet nozzle elbows were welded to the bottom tube sheet nozzle assembly. After grinding and dressing the butt welds joining the nozzle elbows to the nozzle assembly, they were inspected visually for cracks, porosity, undercutting and other mechanical defects. Repairs were made and then the butt welded joints were x-rayed 100%, repairs made, re-x-rayed and passed as being satisfactory.

c. Air test and final freontest for detection of leaks at tube welds and at fillet welds joining 8" split circumferential piping to B.T.S.

To prepare the "R" bottom tube sheet for freon testing, it was given an air-soap test by New York Ship personnel after welding the 8" split circumferintial piping to the unit.

Two stainless steel blanks were cut, fit, and welded to the half pipe tees. All openings were now sealed off. These blanks were fitted with pipe connections for supplying air into the unit and also for "bleeding" the unit after the air test. A special threaded pipe with pressure gage attached was coupled to one of the pipe connections located in the Tee blank. Compressed filtered air was pumped into the bottom tube sheet to raise the internal air pressure to 35 psi. With the aid of a standard type paint brush, a soap-glycerine water solution was applied to all weld surfaces. Thirteen leaks were found in the fillet welding joining the 8" split pipe to the wrapper plates. All negative areas were marked for weld repair. The pressure was released and these areas in welding where the leaks occurred were chipped out, dressed, re-welded and ground smooth.

The unit was again subjected to the air test, and all weld surfaces checked with soap-glycerine solution revealed that all repairs were satisfactory. No other leaks were found and the unit was considered air tight and released for further testing.

Next, twenty pounds (by weight) of freon #12 was introduced into the interior of the unit and then the internal pressure was increased to 35 psi with air. This condition was held for one hour before proceding with the test. All tube welding, 8" split pipe fillet and butt welding, and wrapper plate butt welds were tested for possible leaks using a General Electric Type "H" Halide Detector set on medium sensitivity. Photo serial #240 in Part VII, Section I, paragraph 14B-(5) illustrates the use of this instrument. No leaks were detected and the unit was accepted.

d. Final Hydrostatic Test

The bottom tube sheet assembly was given a final hydrostatic test with the top side of the unit up.

The unit was resting on four sets of pedestals approximately 6' high to allow workmen and inspectors to walk underneath the unit during the test. While in this position, the unit was shimmed on one side approximately 1" high from a level plane in order to properly vent the unit during filling of the interior with distilled water. After the unit was filled with distilled water, the internal pressure was raised to 52½ psi using a Watson-Stillman handpump. This pressure was held for two hours, and then du Pont inspectors checked all tube welding, 8" split circumferential fillet and butt welding for possible leakage. No leaks were found in this final hydrostatic test and the unit was accepted as being watertight.

B. "P" Unit

(1) Profile Measurements

This inspection was performed in a similar manner to that described in Section 21A-(1) of this manual. Results of this inspection indicated no appreciable distortion resulted after filling the unit with raschig rings.

(2) Inspection of 20"-90° Tank Outlet Nozzle Elbows

a. Inspections Before Welding to Nozzle Assembly

These inspections were performed in a similar manner to that described in Section 21A-(2) of this manual except as follows: As shown in photo serial #124 presented herewith, du Pont inspectors performed dy-chek tests on the edges of all 20"-90° elbows to determine if cracks or laminations were present in the edges of the nozzle. Defects found were chipped out, re-welded using the metallic-arc welding process, ground, and re-inspected. All six 20"-90° elbows for "P" B.T.S. were checked in this manner. This same inspection was performed on "L" B.T.S.

b. Inspections Performed After Welding Nozzles to Bottom Tube sheet Nozzle Assembly.

These inspections were performed in a similar manner to those discussed in Section 21A-(2)b of this manual. All results were satisfactory.

(3) Motion Measurement Pad Inspections

Three motion measurement pads were located and welded to the top edge of wrapper plates on the outer periphery of the unit 120° apart. To these pads were bolted stellited plates with a 40 Rockwell minimum hardness "C" scale. (See du Pont drawing W131395-Rev. 18). These were checked with a straight edge across the tops of the tubes and a precision square held across the face of the pads to see that they were perpendicular to the plane of the tube faces. The surface was checked with a profilometer and the hardness was checked by New York Ship's

[redacted]

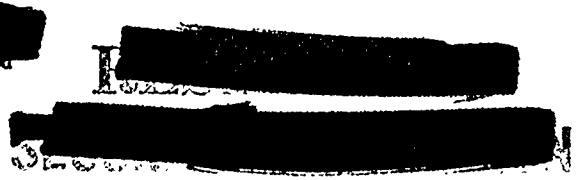
Serial Number 124

New York Shipbuilding Corporation
Camden, New Jersey
November 28, 1952

PROJECT 8980 - SAVANNAH RIVER PLANT

This view shows a du Pont inspector performing a dy-chek on the edge of a "P" unit tank bottom nozzle. Test is run to determine if cracks or laminations are present in the edge of the nozzle.






SER. #124
dyChek

Rockwell Hardness Tester. Both inspections were within drawing tolerance. Orientation was checked with a S/S tape. No discrepancies were found. Exhibit #17 presented herewith covers all the dimensional measurements taken on the three motion measurement pads located on the outer periphery of the unit.

To the bottom side of the unit three motion measurement pads of the type shown on du Pont drawing W131396 were located, bolted and welded to the bottom plate 120° apart. The procedure and results of the inspection performed on these motion measurement pads are covered in Exhibit #17-A item (2).

C. "L" Unit

(1) Profile Measurements

A profile of tube ends on the top side of the bottom tube sheet assembly was not taken after loading raschig rings and welding of the nozzle assembly to the unit. Previous inspections made on "R" and "P" bottom tube sheets indicated little or no change in the tube end plane; therefore, the du Pont Inspection Department considered it not necessary to repeat this inspection on the "L" B.T.S.

(2) Inspection of 20"-90° Tank Outlet Nozzle Elbows

a. Inspection performed before welding to nozzle assembly

Inspection of nozzle elbows for the "L" bottom tube sheet was performed in a similar manner to that described in Section 21A of this manual. The additional inspection discussed in Section 21B above was also performed on the nozzle elbows for this unit. No discrepancies were found and the six nozzle elbows were released for welding to the "L" bottom tube sheet's nozzle assembly.

b. Inspections Performed After Welding Nozzles to Bottom Tube Sheet Nozzle Assembly

These inspections were performed in a similar manner to those discussed in Section 21A-(2) of this manual.

(3) Motion Measurement Pad Inspections

Three motion measurement pads were located and welded to the top edges of wrapper plates on the outer periphery of the unit 120° apart. Du Pont drawing W132760, Section "H-H" and Detail "H" shows where these pads were located along with the required specifications and dimensions.

As shown on the above referenced drawing, one 2½" x 1/4" x 4" stellited plate was bolted to each of the three motion measurement pads. Prior to assembling of

EXHIBIT #17-A

(1) DETERMINE ACTUAL LOCATION WITH RESPECT TO MAJOR AXES AND VERTICALITY OF MOTION MEASUREMENT PADS ON SIDE OF UNIT.

(2) INSPECTION OF LOCATION AND LEVELNESS OF MOTION MEASUREMENT PADS ON BOTTOM SIDE OF BOTTOM TUBE SHEET.

E. I. DU PONT DE NEMOURS & CO., INC.

Construction Division

[redacted]

Report Number 287-P

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H. L. Bunker -J.G. Brewer
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H. B. Gage
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R. H. Potts
J. B. Johnson - File

October 29, 1952
New York Ship - Camden, N. J.

1032

FIELD INSPECTOR'S REPORT

This material contains information affecting the national defense of the United States within the meaning of the espionage laws, Title 18, U.S.C., Secs. 793 and 794, the transmission or revelation of which in any manner to an unauthorized person is prohibited by law.

TO C. J. VEITH - M & E FILE

FROM R. E. Chaney - R. W. Mease DATE October 29, 1952

PROJECT NO. 8980 PLANT Savannah River ORDER NO. AXC-167½

EQUIPMENT Tank Bottom Tube Sheet EQ.PC.NO. 153-P

DRAWING NOS. W-131395 JOB RATING

VENDOR New York Shipbuilding Corporation LOCATION Camden, N.J.

Scope: To determine actual location with respect to the major axes and the verticality of motion measurement pads.

Procedure:

1. Location - Each pad was measured using a tape (S.S. DuPont #2) extended around the shell from a major axis to the edge of the pad. The pad was measured and a centerline to centerline measurement calculated. The tape measure was then converted to degrees using .032" (of circumference) = one (1) minute of arc.
2. Verticality- Each pad was checked with a box level calibrated in .001"/9" and converted to .001"/12". Pads are numbered clockwise beginning with No. 1 off X1 axis.

Results:

1. Location - See attached sketch.
2. Verticality - No. 1 - .000"/12"
   No. 2 - .001"/12"
   No. 3 - .002"/12"

Note: The location and verticality of each pad was acceptable.

ach.

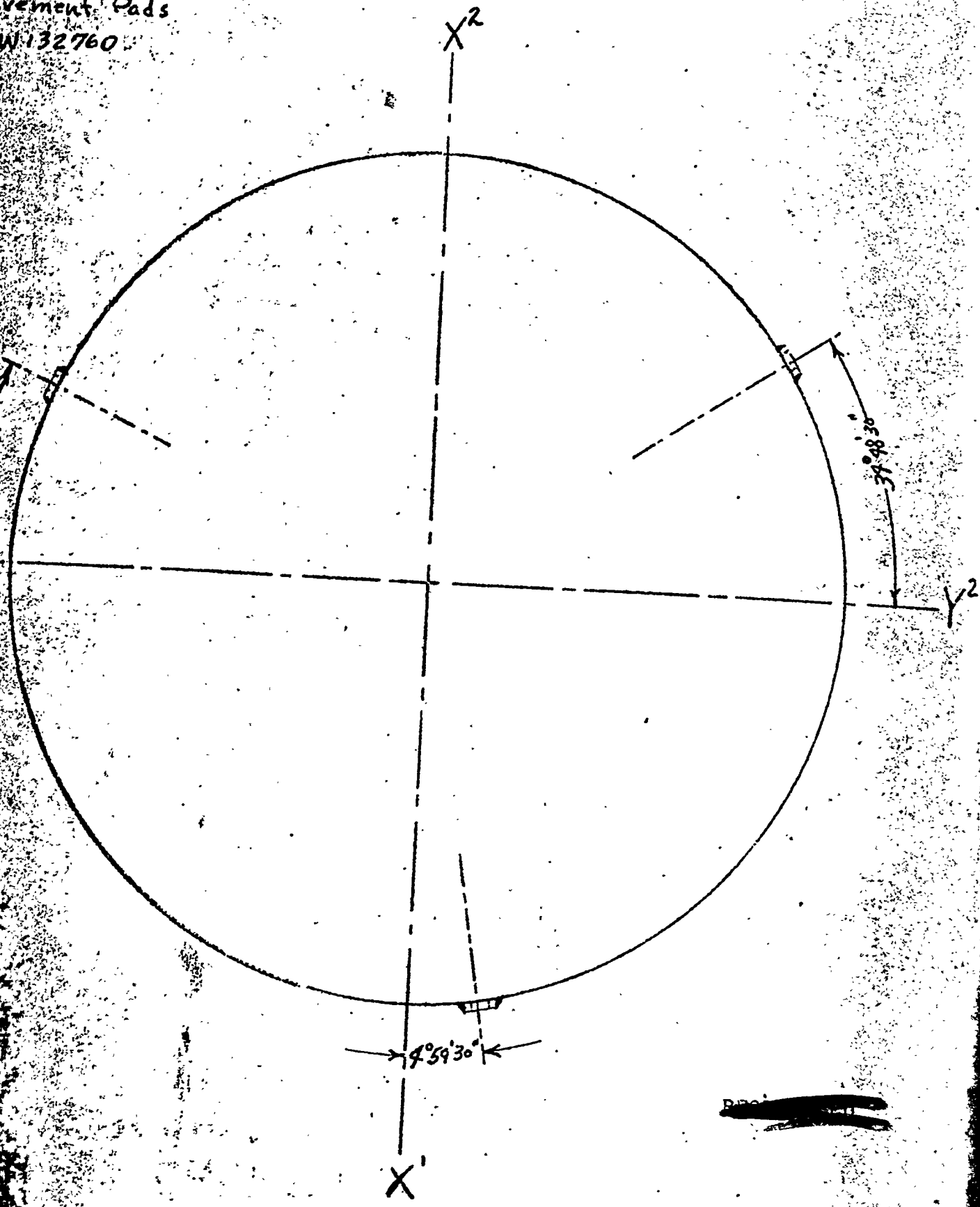
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Tank Bottom

Final Location of Motion Measurement Pads

Dwg W132760

10/28/52



E. I. DU PONT DE NEMOURS & CO., INC.

Report Number 294-P

[redacted]struction Division

[redacted]

CC: H. W. Gosney, P.P.M.
R. K. Mason, P.P.M.-SRP (3)
H. L. Bunker - J.G. Brewer
J. G. Brewer
H. B. Gage
F. C. Breuninger
R. H. Potts (2)
J. B. Johnson - File

November 3, 1952
New York Ship - Camden, N.J.

FIELD INSPECTOR'S REPORT

This material contains information affecting the national defense of the United States within the meaning of the espionage laws, Title 18, U.S.C., Secs. 793 and 794, the transmission or revelation of which in any manner to an unauthorized person is prohibited by law.

TO C. J. VEITH - M & E FILE

FROM D. M. Leland - R. R. Baker DATE October 28, 1952

PROJECT NO. 8980 PLANT Savannah River ORDER NO. AXC-1674

EQUIPMENT Tank Bottom Tube Sheet EQ.PC.NO. 153-P

DRAWING NOS. W-131396 JOB RATING

VENDOR New York Shipbuilding Corporation LOCATION Camden, N. J.

Scope:

Inspection of location and levelness of motion measurement pads on bottom side of tank bottom tube sheet.

Procedure:

A combination square and a level were used to check location and level respectively.

Results:

The pads were located properly with respect to the axes. The distances from the O.D. of the tube sheet to the center line of pads are shown on attached sheet.

Level is as follows:

Pad on Y1 axis was out of level .0015" per foot
Pad near X1 " " " " " .004" " "
Pad near X2 " " " " " .0025" " "

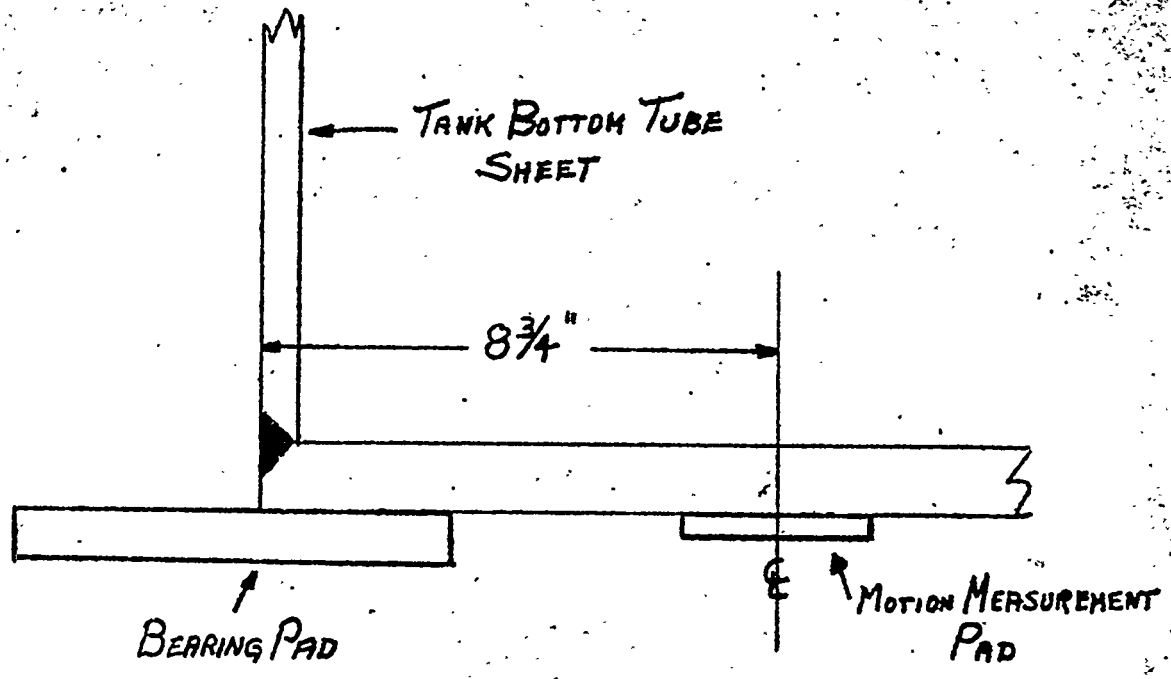
Note: The location and levelness of these pads were satisfactory.

lmw
Attach.

[redacted]

MOTION MEASUREMENT PADS P-UNIT

W-132763 OCT, 28, 1952



PAD ON Y1	AXIS	MEASURED	8 7/8"
PAD NEAR X1	"	"	8 15/16"
PAD " X2	"	"	8 15/16"

the stellited plates to the unit, each of the three plates were checked for Rockwell hardness, RMS finish and flatness. The hardness was checked on New York Ship's Rockwell Hardness Tester. Hardness was found to be Rockwell C-43 to 51 which was acceptable to the du Pont Inspection Department. RMS finish was checked with a profilometer and results indicated the finish to be 7 RMS which was well within the specified 32 RMS finish. The flatness of each plate was checked with a straight edge and .0015" thickness feller gage. The thickness gage would not enter between the straight edge and plate. The flatness check was considered accepted, the three plates were released for bolting to the motion measurement pad bases.

After the three stellited plates were bolted to the unit, the following inspections were performed by the du Pont Inspection Department:

a. Orientation of Blocks

(1) Block located by drawing at 5° from X1 was measured at 5.5°

(2) Block located between Y2 and X2 was measured at 119.91° from block in part a.

(3) Block between Y1 and Y2 was measured at 120.12° from block in part a.

(4) The above orientation measurements were located using a 100' S/S tape. Arc lengths were then converted to degrees. All three motion measurement pads were found to be oriented within tolerance.

(5) Size of Blocks

The size of all three motion measurement pads were measured using a 6" scale graduated in 1/64" and found within drawing tolerance.

(6) Field Complaint

After the "L" bottom tube sheet was received at the plant site, preliminary inspection by field personnel disclosed that the three stellited motion measurement pads were installed on the bottom edge of the unit instead of top edge. The field advised the du Pont Inspection Department at New York Ship of this oversight.

b. Motion Measurement Pads on Bottom Side of Unit

To the bottom side of the "L" bottom tube sheet three motion measurement pads of the type shown on du Pont drawing W132763, Section "R-R", Detail "Z", were located, bolted and welded to the bottom plate 120° apart. After the three blocks were finished

machined and prior to assembling to the unit, they were checked dimensionally using a 6" scale graduated in 1/64" and found within tolerance.

Next, the three blocks were then located, bolted and welded to the bottom side of the bottom tube sheet. Inspection of location and levelness of motion measurement pads after assembling to the unit were similar to those discussed in Section 21B, Exhibit #17-A, item 2. The location and levelness of these blocks were satisfactory and accepted by the du Pont Inspection Department.

22. Bearing Pad Inspection and Discrepancies

A. "R" Unit

(1) Bearing Pad Hole Discrepancies

As shown on du Pont drawing W-130949 and W-131265, twelve bearing pads were located and welded 30° apart on the bottom side of the unit. Into each of the bearing pads two elongated, tapered holes were milled. During the process of machining these holes in the bearing pads, numerous problems were encountered due to the original method of machining tried. In order to clarify the problem encountered, a step-by-step procedure covering the old and new method of machining and the steps taken to rectify the situation encountered on the "R" bottom tube sheet will be discussed in outline form as follows:

(a) Bearing pad holes on NYX bottom tube sheet were changed from round holes to elongated, tapered holes for "R" B.T.S. For this change in design, see du Pont drawing W-130949.

(b) Bearing pad centerlines (radial with respect to center of B.T.S.) were established using the large jig that was used for locating the same hole locations in the NYX BTS bearing pads. A template was made and used for layout of elongated bearing pad holes. This template was adjusted to the centerline of each bearing pad and elongation of holes scribed and center punched.

(c) Unit was set and leveled on cast iron padestals and elongated holes were milled in bearing pads using portable "Versa Mills."

(d) Du Pont inspectors examined the finished machined job and noted that the holes were not within tolerance. Visual inspection revealed that on all bearing pad holes milled there was evidence of "Tool chatter" on the wall of the holes, which was outside the layout lines. Also, no taper had been allowed for.

(e) In view of this problem, it was decided by New York Ship to drill out holes to a larger diameter and counter-bore holes (from top side) approximately

1/8" deep for insertion of a shoulder head bushing. These shoulder head bushings had an elongated, tapered bushing milled in them to finish size. This method of repair was agreed to by the du Pont Inspection Department with Design Division's concurrence and twenty-four bushings were fabricated (two/bearing pads).

(f) New bearing pad holes were laid out from existing centerlines on bearing pads.

(g) A small jig was made to clamp to the face of the bearing pad which lined its bushed holes up with layout of bearing pad holes.

(h) Round holes were drilled and reamed.

(i) A large field jig was set on bearing pads, lined up with centerlines and bearing pad holes scribed to jig. This jig was later sent to the plant site for locating, drilling and tapping holes in the units foundation.

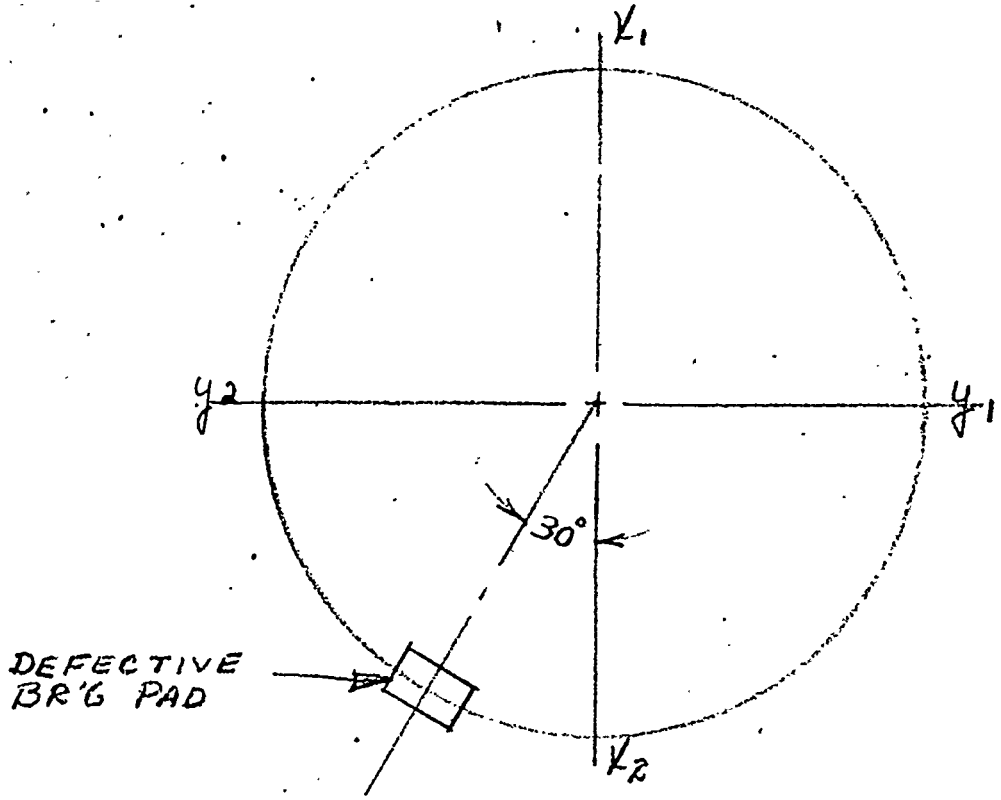
(j) Twenty-four shoulder head bushings (round O.D. and elongated, tapered I.D.) were press fit into the bearing pads. Care was taken to insure that elongated holes in shoulder head bushings were held parallel to the bearing pad centerline. A dummy plug that fit elongated, tapered holes in the bearing pad bushings had a flat strip across its face about 10" long for aligning the bushings (in bearing pad) to the bearing pad centerline. When bushings were in line, they were drilled, taped, and dowelled.

(k) Du Pont inspectors checked all work concurrent with New York Ship's personnel and found the job to be satisfactory.

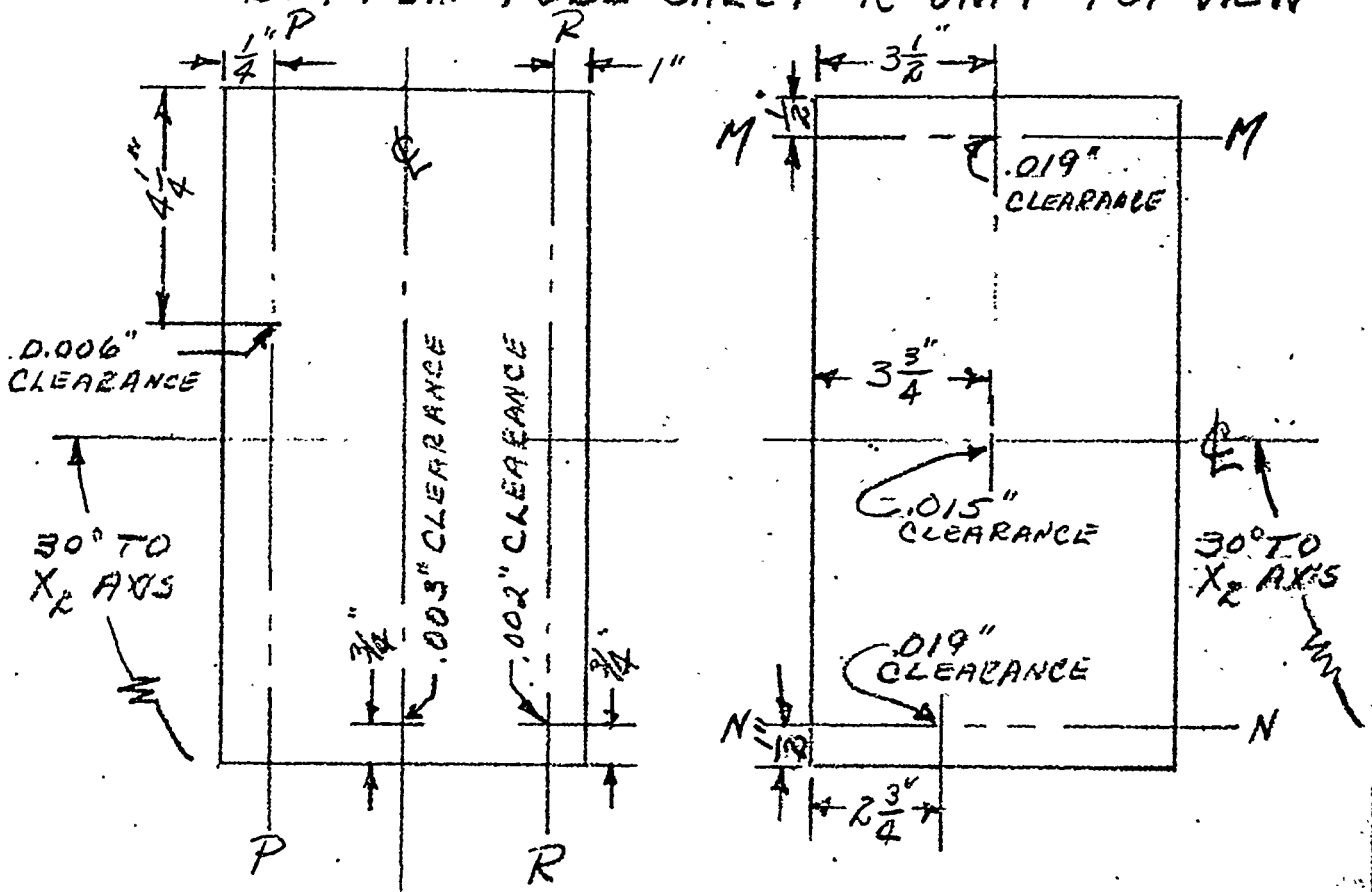
(2) Repair of Damaged Bearing Pad Face

During the process of handling the bottom tube sheet, one edge of a bearing pad located 30° off the X2 axis was hit and slightly bent. Du Pont inspectors measured the amount of distortion using feeler gages and a small straight edge. In Sketch #18 the lines P-P, R-R, centerlines, M-M, and N-N, show the position of the straight edge and maximum clearances. All clearances were to point marked.

The New York Ship mechanics repaired the damaged bearing pad, and re-inspection by du Pont inspectors in a similar manner to that discussed above was performed. Results indicated the bearing pad surface was $\pm$ .005" within the plane of tube ends and was 90° with the centerline of the large tubes. The repair job was accepted as being satisfactory and the unit was released for further fabrication.



BOTTOM TUBE SHEET "R" UNIT - TOP VIEW



BOTTOM VIEW OF BR'G PAD

SKETCH # 18

B. "P" Unit

(1) Bearing Pad Hole Discrepancies

The same discrepancies found on the twelve "R" bottom tube sheet bearing pads were encountered on the "P" B.T.S. assembly. The steps and inspections performed to rectify the problem on "P" unit were similar to those taken on the "R" B.T.S. assembly. For a discussion on this problem, see Section 22A-(1) of this manual. Also see du Pont drawing W-131396.

C. "L" Unit

As shown on du Pont drawing W-132763, twelve (12) bearing pads were located and welded 30° apart on the bottom side of the unit. The design of the bearing pads for this unit were somewhat different from those fabricated for the "R" and "P" bottom tube sheets. By referring to drawing W130949 and the above referenced drawing these differences can be readily seen. This design change came about as a result of the discrepancies encountered during machining of bearing pads in the "R" and "P" units discussed in Section 12A & B of this manual.

Along with the above change in design of the "L" bottom tube sheet bearing pads, the Design Division requested that the following tolerances be closely adhered to by New York Ship and checked by du Pont inspectors after all work on the pads had been completed:

(1) The 5" long guide surfaces shall be parallel to the radial centerline within 0.005" in their length (0.001"/")

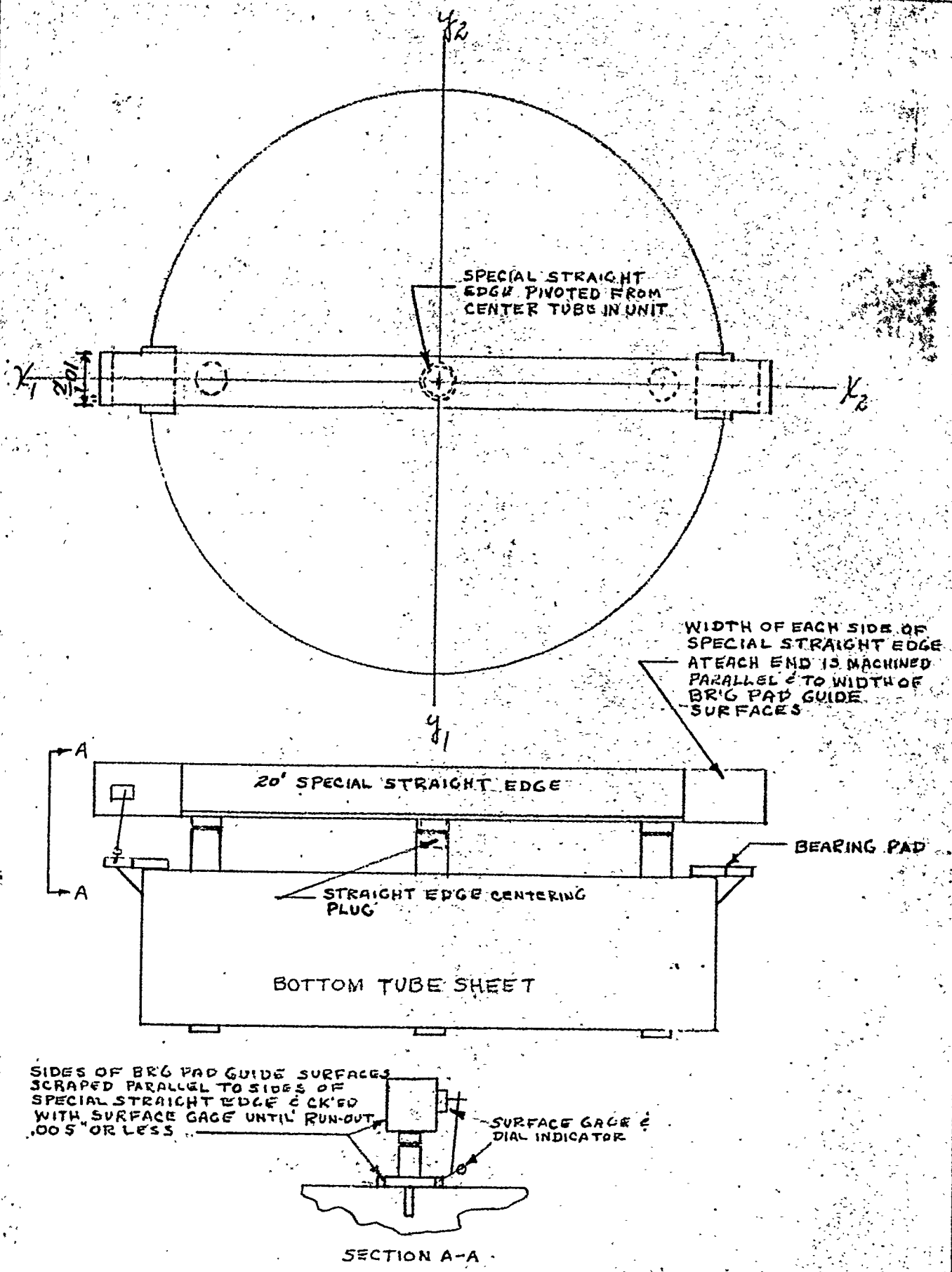
(2) The centerline of the 10½" wide section of the bearing pad shall be within 1/8"; one side or the other of the radial centerline on which it should fall.

(3) If the necessity to machine the guide surfaces for parallelism to the centerline arises after welding the pads, the 10½" dimension may be reduced to a minimum of 10-3/8". These tolerances were assumed sufficient by Design to counteract any welding distortion or possible error in fit-up.

To comply with the above bearing pad specifications requested by Design Division, the du Pont Inspection Department formulated the following inspection procedure for setting and checking the bearing pads:

(1) After the bearing pads have been installed and faced off, a 20' x 10½" wide straight edge, with a plug attached at the mid-point, is placed across the unit pivoting in the center tube. (See Sketch #19)

(2) The straight edge may be rotated so that the midpoints of the four guide surfaces of opposite bearing pads are the same distance from the edge of the straight edge.



TYPICAL SET-UP FOR CHECKING PARALLELISM OF BEARING PAD 5" GUIDE SURFACES

SKETCH # 19

(3) None of the mid-points of these four guide surfaces can be more than 1/8" from the edge of the straight edge.

(4) The four guide surfaces are then finished parallel to the edges of the straight edge within 0.005" over their entire length (0.001"/")

Following the above outlined procedure, the 20' straight edge was laid parallel to the centerline of the tube bundle, and then using a surface block and dial indicator, the run-out on the 5" guide surfaces were checked. Sketch #19 pictorially illustrates in detail how this inspection was performed. The other 10 remaining pads were inspected in a similar manner. The sides of all bearing pads checked on the "L" bottom tube sheet were found to be less than .001 in/in/5in. in length and were accepted.

Orientation and diametrical location of the 12 bearing pads were measured using a 50' stainless steel tape. All other bearing pad dimensions were measured with a 6" scale graduated in 1/64". For results of the above inspections, see DR. No. 6353-9 presented herewith.

A resume of all other measurements made on the 12 bearing pads is covered in Section 12C of this manual.

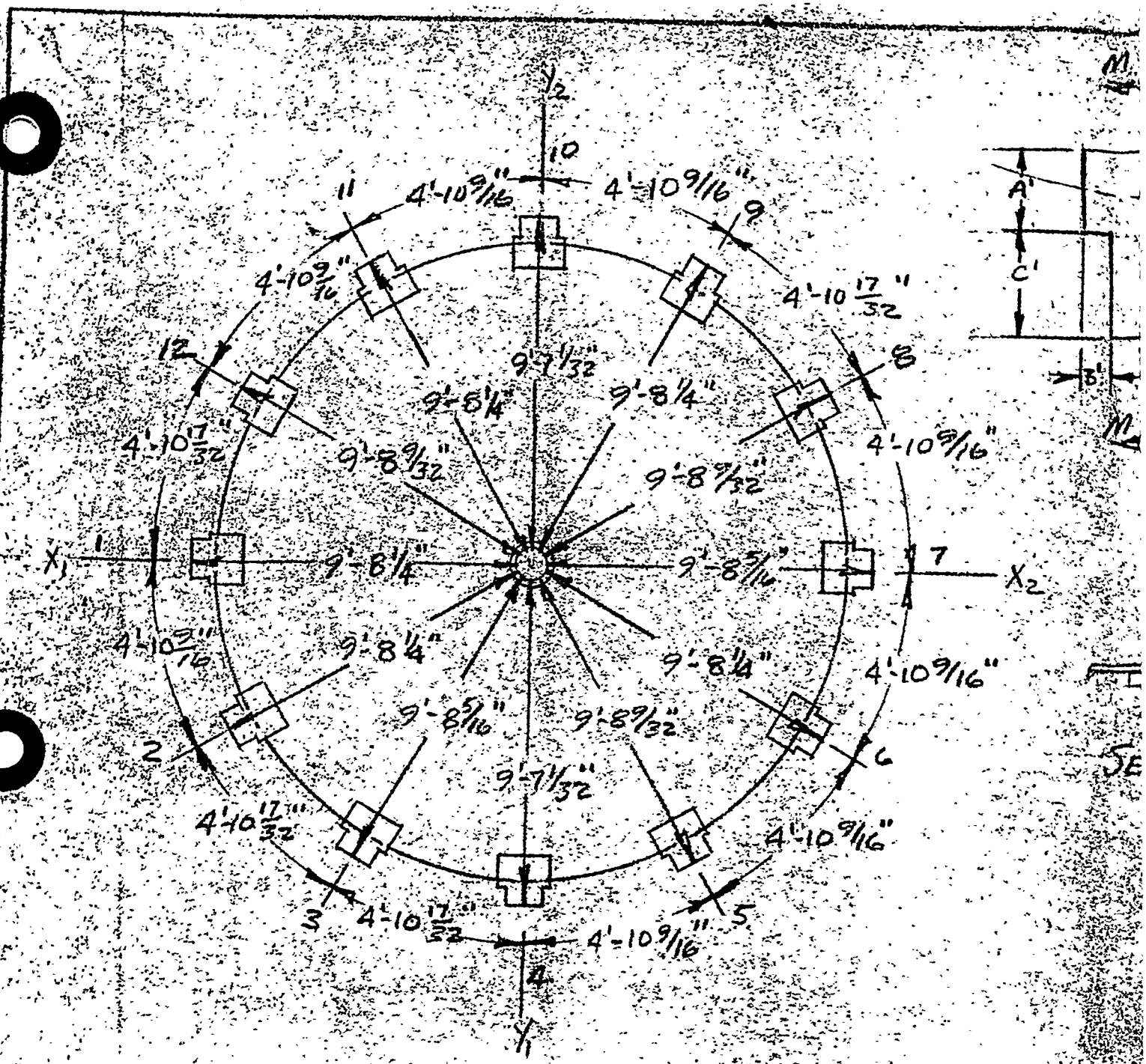
23. Rod Cups

A. "R" Unit

As shown on du Pont drawing D110129, one hundred sixty-five (165) rod cups were required for the "R" bottom tube sheet. These rod cups were to be cast from type 304 stainless steel (.08C Max.). A pattern of the rod cups was made by New York Ship and sent to an outside foundry for casting. Rod cups were cast and then shipped to New York Ship. Upon receipt of rod cups, they were inspected by du Pont inspectors for quantity and then released to New York Ship for finishing operations. All rod cups were ground and dressed on the outside, and then the bore, taper bore and length were machined to size and dressed.

Rod cups were acid washed, ferroxyl tested at random, and then visually and dimensionally inspected. The outside diameters were measured using 1-2" and 2-3" outside micrometers. Inside diameters were measured using a telescope gage and 1-2" outside micrometers. All other dimensions were scaled using a 6" machinist rule. Minor flaws and cavities were found in the finished rod cups, particularly in the rod cup base legs. These defects were ground out, spot welded and dressed. Repaired rod cups were re-acid washed, inspected and found satisfactory.

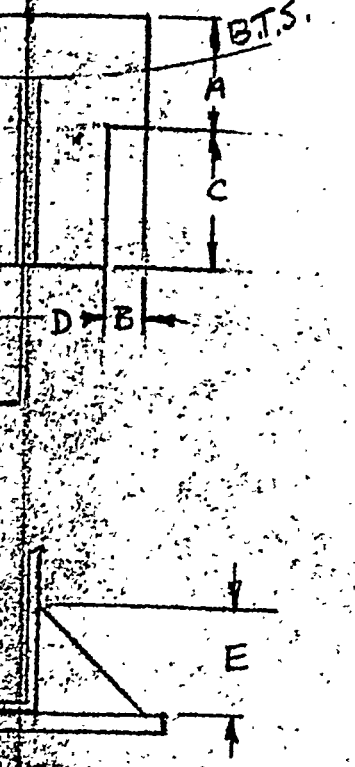
It was decided at this time that welding of rod cups to the top side of the bottom tube sheet would be done in the field rather than at New York Ship. This decision was based on the fact that rod cups welded to the unit at New York Ship would probably be bent or broken loose from the unit during



BOTTOM TUBE SHEET
BOTTOM VIEW

1. RADIAL MEASUREMENTS FROM BORE OF CENTER TUBE. B/P ON Y_1-Y_2 = 9'-7 1/16". B/P ON OTHERS = 9'-8 5/16"
2. CIRCUMFERENTIAL MEASUREMENTS TO CENTER OF BR'G PADS. B/P = 12 EQUALLY SPACED BR'G. PADS
3. ABOVE MEASUREMENTS BY R.E. CHANEY, A.N. PIATER, & O.P. FRANDSEN ON 5/11/53.

THIS DRAWING IS NOT TO SC



TION M-M

PAD No.	DIMENSION							
	A	A'	B	B'	C	C'	D	E
1	5	5	3/4	3/4	4 31/32	4 31/32	10 7/16	5 1/2
2	4 63/64	4 63/64	3/4	3/4	4 31/32	4 31/32	10 7/16	5 1/2
3	4 63/64	4 63/64	3/4	3/4	4 63/64	4 63/64	10 7/16	5 1/2
4	4 31/32	4 31/32	3/4	3/4	3 25/32	3 25/32	10 7/16	5 1/2
5	4 63/64	4 63/64	47/64	3/4	4 63/64	4 63/64	10 7/16	5 1/2
6	4 31/32	4 31/32	3/4	3/4	5	5	10 7/16	5 1/2
7	4 63/64	4 63/64	47/64	3/4	5	5	10 7/16	5 1/2
8	4 31/32	4 31/32	3/4	47/64	4 31/32	4 31/32	10 7/16	5 1/2
9	4 63/64	4 63/64	47/64	3/4	4 63/64	4 63/64	10 7/16	5 1/2
10	4 31/32	4 31/32	3/4	3/4	3 3/4	3 3/4	10 7/16	5 1/2
11	5	5	3/4	3/4	5	5	10 15/32	5 1/2
12	4 63/64	4 63/64	3/4	3/4	4 31/32	4 31/32	10 7/16	5 1/2
B/P	5	5	3/4	3/4	5*	5*	10 1/2	—

NOTES:

1. B/P FOR DIM'S. C & C' BECOME 3 3/4" ON Y1 & Y2
2. ABOVE MEASUREMENTS BY A.J. PIATEK & R.R. BAKER ON 5/10/53

REFERENCE DR. NO. W132763R17
W132760R14

"L" UNIT
BOTTOM TUBE SHEET
MEASUREMENTS ON BRG. PADS.

ALE —

DR. NO. 6353-9

handling operations before the unit was shipped. The finished rod cups were boxed and stored and later shipped to the field along with the main unit.

B. "P" Unit

Inspection of rod cups for the "P" bottom tube sheet was performed in a similar manner to that described in Section 23A of this manual.

C. "L" Unit

Inspection of rod cups for the "L" bottom tube sheet was performed in a similar manner to that described in Section 23A of this manual.

24. Inspection of Split Retaining Rings and Flanges for The Bottom Tube Sheet Large Tubes

A. "R" Unit

As shown on du Pont drawing D112637, six hundred and seventy-three (673) split retaining rings and flanges were required for the "R" bottom tube sheet. All machining and welding of split retaining rings and flanges was done by New York Ship and the finished parts submitted to the du Pont Inspection Department for final inspection. The discussion to follow will deal with the old and new type methods employed by inspectors for checking the machined parts and the discrepancies encountered and how they were rectified.

During the inspection of the split retaining rings for the "R" B.T.S., it was found through concurrent inspection that the rings shrunk out-of-round after the four studs were welded. It became necessary for New York Ship to fit the split retaining rings to B.T.S. scrap tubes to check the out-of-roundness. They were trued up by hammering, and then re-fitted to the tube for re-checking. This was repeated until all rings rotated freely on the tube. The rings were re-fitted for inspection in the same manner. This same method was used for checking split retaining rings for the "P" B.T.S.

The split flange assemblies for the "R", "P", and "L" B.T.S. were spot checked dimensionally using a 6" scale graudated in 1/64". In all cases this inspection proved satisfactory.

In the course of time, a du Pont Inspector noted that the above method of checking split retaining rings was time consuming and costly and in addition, the scrap B.T.S. tubes used for checking were not of maximum diameter, so it was possible that the rings would be tight on some of the B.T.S. tubes.

It was suggested by the inspector that a new method for checking the rings to be used, and after trying the new method, it was incorporated into the du Pont inspection procedure. This new method consisted of fitting the split rings to a functional plug gage which eliminated having to remove the

bolts to take the rings apart for fitting. The counter-bores of the rings were fitted over the end of a scrap tube for hammering to "round up" the ring from weld shrinkage without removing the bolts. The plug gage had a top diameter of 3.725" to gage for free rotation on the maximum diameter of the groove in the tube; a bottom diameter of 3.940" to gage for free rotation on the maximum O.D. of the tube and 0.206" shoulder between the two diameters to gage (by sight and feel) for free rotation in the minimum slot width on a tube. The quality of fitting and inspecting was improved because the plug gage represents the maximum diameters and minimum slot width which was not obtainable on a scrap tube. The tolerances allowed this plug gage were below drawing requirements, but was acceptable per the technical inspection group. This new method of inspecting split retaining rings was incorporated into the du Pont inspection procedure on "L", "K", and "C" B.T.S.

After the split retaining rings and flanges were visually and dimensionally inspected, they were acid washed, ferroxyl tested, and boxed for shipping to the plant site.

Upon receipt of the rings and flanges at the Savannah River Plant, and after the "R" bottom tube sheet had been set in place, split retaining rings and flanges were assembled to the bottom end of each large tube in the unit. Dwg. 2-5 presented herewith illustrates pictorially how a split retainer ring and flange was installed on the bottom end of a large tube. During the assembling operation four 7/16"-14NC-2 castilated hexagon nuts were used to clamp the "simulated insert" in the bottom end of a large tube. When tightening up the split flange the threads were not long enough and the nut froze on the body of the stud. This condition was not noted in the field, and as a result the studs were twisted off at the weld in an effort to tighten the flanges. The field concluded that the weld joining the studs to the retainer ring was not sound and notified the du Pont Inspection Department of the above discrepancy. Tests were then performed by du Pont inspectors at New York Ship to determine how much torque was required to break the stud weld loose, and also to further study the soundness of the welded joint. Results of this test indicated that the studs were properly welded to withstand the test torque applied. From this test it was concluded that the threaded studs were not long enough to securely clamp the "simulated insert" in the bottom tube sheet large tubes.

The above problem was rectified on "P", "L", "K" and "C" by lengthening the thread to 1 1/8" on each of the four retainer ring studs, thus lessening the possiblilty of nuts freezing to the stud body (when tightening) and breaking the weld joining the stud to the retainer ring.

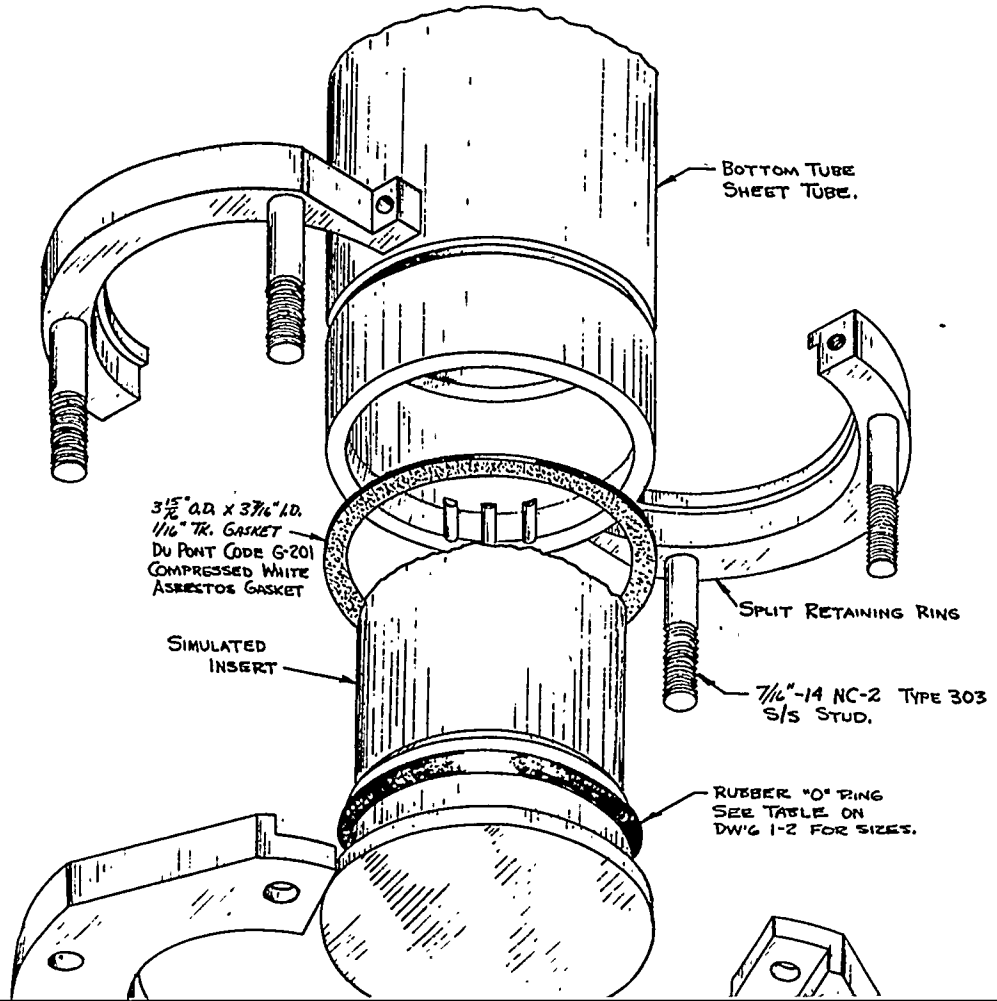
B. "P" Unit

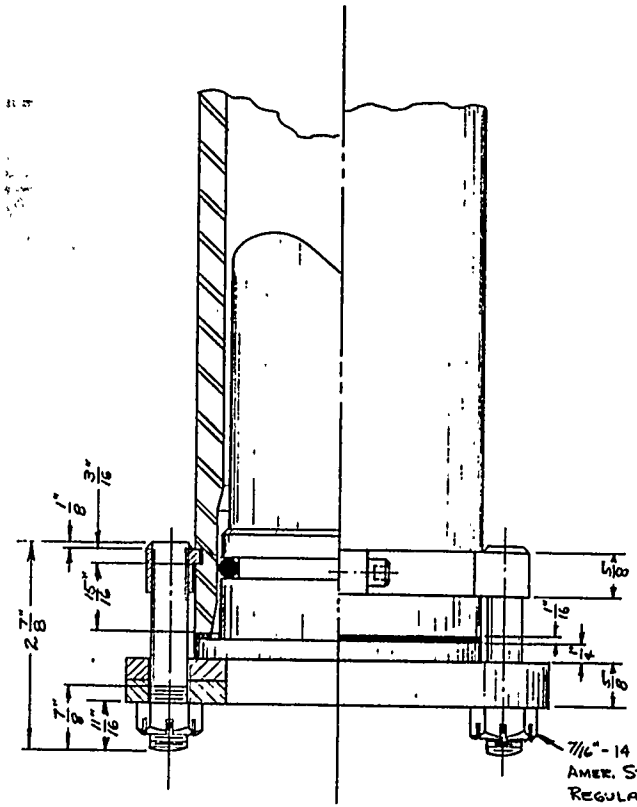
Inspection performed on split retainer rings and flanges for this units is discussed in Section 24A of this manual.

C. "L" Unit

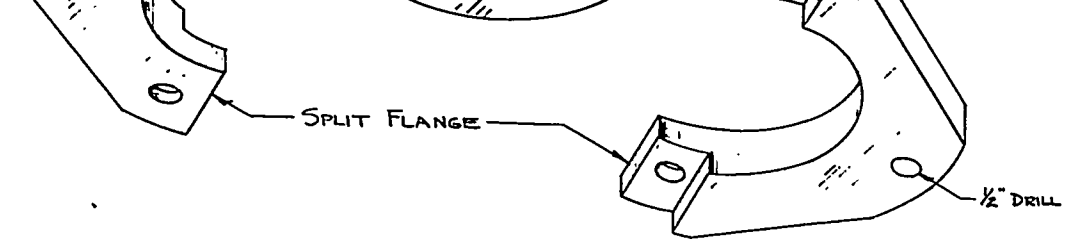
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SPLIT RETAINING RING & FLANGE

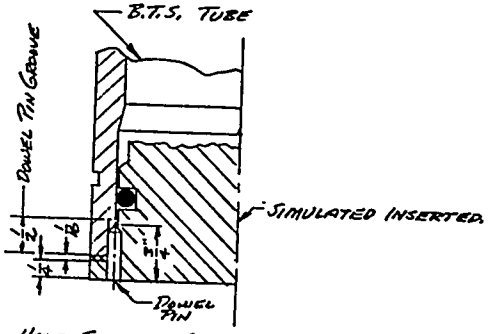




HALF SECTION SHOWING TUBE, SIMULATED INSERT, & SPLIT RETAINING RING & FLANGE



EXPLODED ISOMETRIC VIEW SHOWING INSTALLATION SEQUENCE.



HALF SECTION SHOWING DOWEL PIN & MATING GROOVE DIMENSIONS.

M & E SECTION
GOV'T CONTRACTS

DWG. 2-5

[redacted]

BY: S.R. COCHRAN
JUNE 1953

The inspections performed on split retainer rings and flanges for the "L" bottom tube sheet was performed in a similar manner to that discussed in Section 24A of this manual. In addition, a detail analysis of the actual inspection of the split retainer rings and flanges for "L" unit is presented herewith as Exhibit #18.

25. Nozzle Muff Assemblies

A. "R" Unit

As shown in Dwg. 5-7 and 5-8 presented herewith, six nozzle muff assemblies were required for the "R" bottom tube sheet nozzle assembly.

Material required for the fifty-four (54) muff leaf plates (9/nozzle) were inspected for laminations and other surface imperfections. Necessary repairs were made and then they were ferroxyl tested before releasing for fabrication. Muff plates were laid out, formed and machined to drawing size. The finished machined muff plates were then grouped in assemblies (9/nozzle) for the six bottom tube sheet nozzles and identified by a code number stenciled on the plate. The upper, center, and lower muff plates which required keyways were laid out and milled to size. Next, spacer bars, sleeves, dowel pins, keys, etc., were fabricated and machined to size. All component parts were then grouped and fit to their respective positions. The three top keys were located, ground and fit to the top inside of each bottom tube sheet nozzle. The top muff plates were then used as a jig for locating the final position of the three keys to the top inside of each bottom tube sheet nozzle. After positioning the muff plates to align the three (3) keys on the top inside of each nozzle, they were inspected for proper clearance by du Pont inspectors and approved. The keys were then tack welded. The upper muff leaf plates were removed from each of the six nozzles and all keys were fully welded and dressed. All welding was then visually inspected by du Pont inspectors for porosity, undercutting, cracks, and other mechanical defects. Necessary repairs were made, re-inspected and accepted.

Since the shipping date was near, and in order to expedite the completion on the "R" bottom tube sheet assembly to meet this date, it was decided that the three keys located on the top plate of the unit in each nozzle section would be located, fit and welded in the field.

The six nozzle muff assemblies were then sandblasted, acid washed, and ferroxyl tested by du Pont inspectors. All muff assemblies were accepted and boxed for shipment to the field where final assembling to the B.T.S. nozzles, fitting of center and taper drive keys was to be accomplished.

To assist in the location, fitting and welding of muff keys on the top plate of the "R" B.T.S., and final assembling of nozzle muffs into the unit in the field, a representative from New York Ship's Boiler Shop visited the Savannah River

EXHIBIT #18

INSPECTION OF SPLIT RETAINING RINGS AND

FLANGES FOR THE "L" BOTTOM TUBE SHEET ASSEMBLY

E. I. DU PONT DE NEMOURS & CO., INC.

Construction Division

[redacted]

Report Number 512-L

CC: H. W. Gosney, F.P.M.
R. K. Mason-D.A.Hauser - SRP (3
R. K. Mason-W.P.Duncan-SRP
J. G. Brewer
H. L. Bunker - J. G. Brewer
H. B. Gage
F. C. Breuninger
S. R. Cochran (2)
R. H. Barto - NYS (3)
J. B. Johnson - File

June 11, 1953
New York Ship - Camden, N. J.

This material contains information affecting national defense of the United States within the meaning of the espionage laws, Title 18, U.S.C., Secs. 793 and 794, the transmission or revelation of which in any manner to an unauthorized person is prohibited by law.

FIELD INSPECTOR'S REPORT

TO C. J. VEITH - M & E FILE

FROM D. J. Smathers & W. T. Laughlin DATE May 29, 1953

PROJECT NO. 8980 PLANT Savannah River ORDER NO. AXC-167½

EQUIPMENT BTS Split Retaining Rings EQ.PC.NO. 153-L

DRAWING NOS. D-112846 JOB RATING

VENDOR New York Shipbuilding Corp. LOCATION Camden, N. J.

Scope: Inspection of split retaining rings and flanges.

Procedure: After final machining and fitting, the rings were inspected for size with a co-axial functional plug gage (3.840" dia. x 1/2" long and 3.725" dia. x .206" long, the .206" being the shoulder depth between the two diameters). This plug permitted a tighter fit on the tube than the drawing tolerances would permit, but this was acceptable per Mr. A. A. Arthur (Design) and Mr. R.V. Graham (Technical Inspector).

Results: About 90% of the rings were found to be satisfactory and the remaining rings were corrected until the following conditions were met:

1. The large plug would start into the bottom of the counterbore.
2. The small plug would seat in the bore from the top side and the end of the plug would extend flush with the shoulder (by finger feel) or into the counterbore. This eliminated the possibility that the ring could bind in the slot width of a tube.
3. The cap screws were tight.

[redacted]

EX 18-2

[redacted]

It was noticed that a large percentage of the rings had sharp burrs on the I.D.'s at the joints which could possibly scratch the tube or foul the joint. It was planned to file these burrs when the rings were split for cleaning. About 50% of the rings were "lefts" and 50% were "rights"; that is, the stud-welds and counterbores were on the opposite sides of the rings to that shown on the drawing. This difference was considered umimportant by Mr. A. A. Arthur and Mr. R. V. Graham.

Two rings were scrapped because the counterbore was too small. The rings were split, wired together in pairs, and cleaned with FO. 128 solvent and then passivated to remove the oxides from the stud welds. The rings were visually inspected for cleanliness and were accepted.

The burrs at the I.D.'s of the joints were filed and visually spot-checked and accepted.

All dimensions except bore sizes and lengths (which were plug checked) were scale-measured and found within drawing tolerances.

After the rings were screwed together for shipping, 50% were spot checked by fitting them to the plug gage. It was noticed that a very small percentage of the screw threads were tight and about 10 rings of the 315 checked fitted very tight to the plug gage, but this was considered satisfactory and 670 rings were shipped to Savannah River.

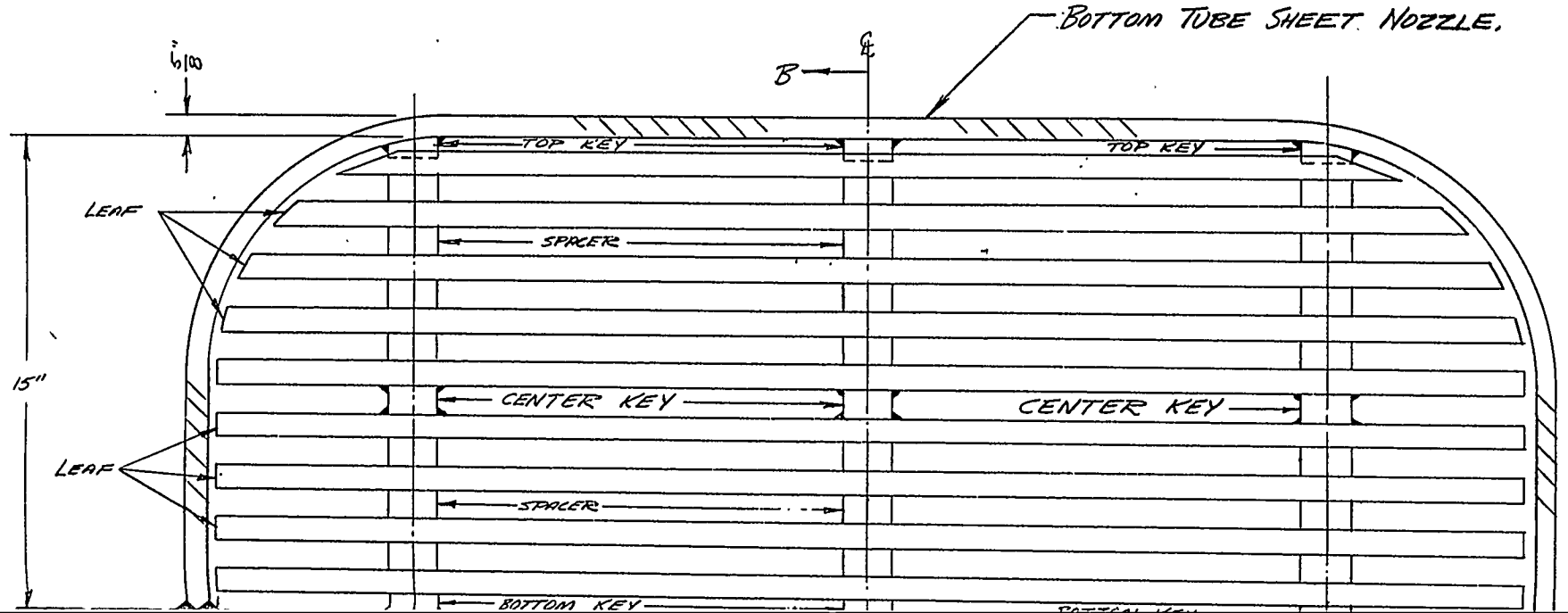
Six hundred eighty (680) split flanges were visually inspected after passivation and were found to be clean and free from burrs. These flanges were scale measured (spot check) and found to meet drawing requirements. They were shipped to Savannah River.

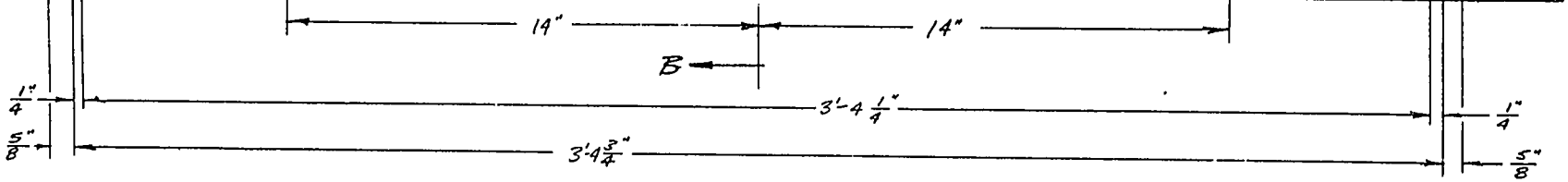
Note: Approximately 10% of each of the split flanges and retaining rings were ferroxyl tested after passivation and no free iron was evident. On this basis all flanges and rings were accepted.

mw

[redacted]

NOZZLE MUFF - BOTTOM TUBE SHEET
END VIEW





VIEW "A-A" (END VIEW OF NOZZLE & MUFF)

NOTE:

1. ALL SHOP WELDS - VISUAL INSPECTION.
2. FILLET WELDS AROUND TOP & BOTTOM KEYS, (WHEN WELDED IN SHOP), VISUAL & ZYGLO INSPECTION.
3. SEE DWG. 5-8 & 5-10 FOR SEC. "B-B."

M & E SECTION
GOV'T CONTRACTS

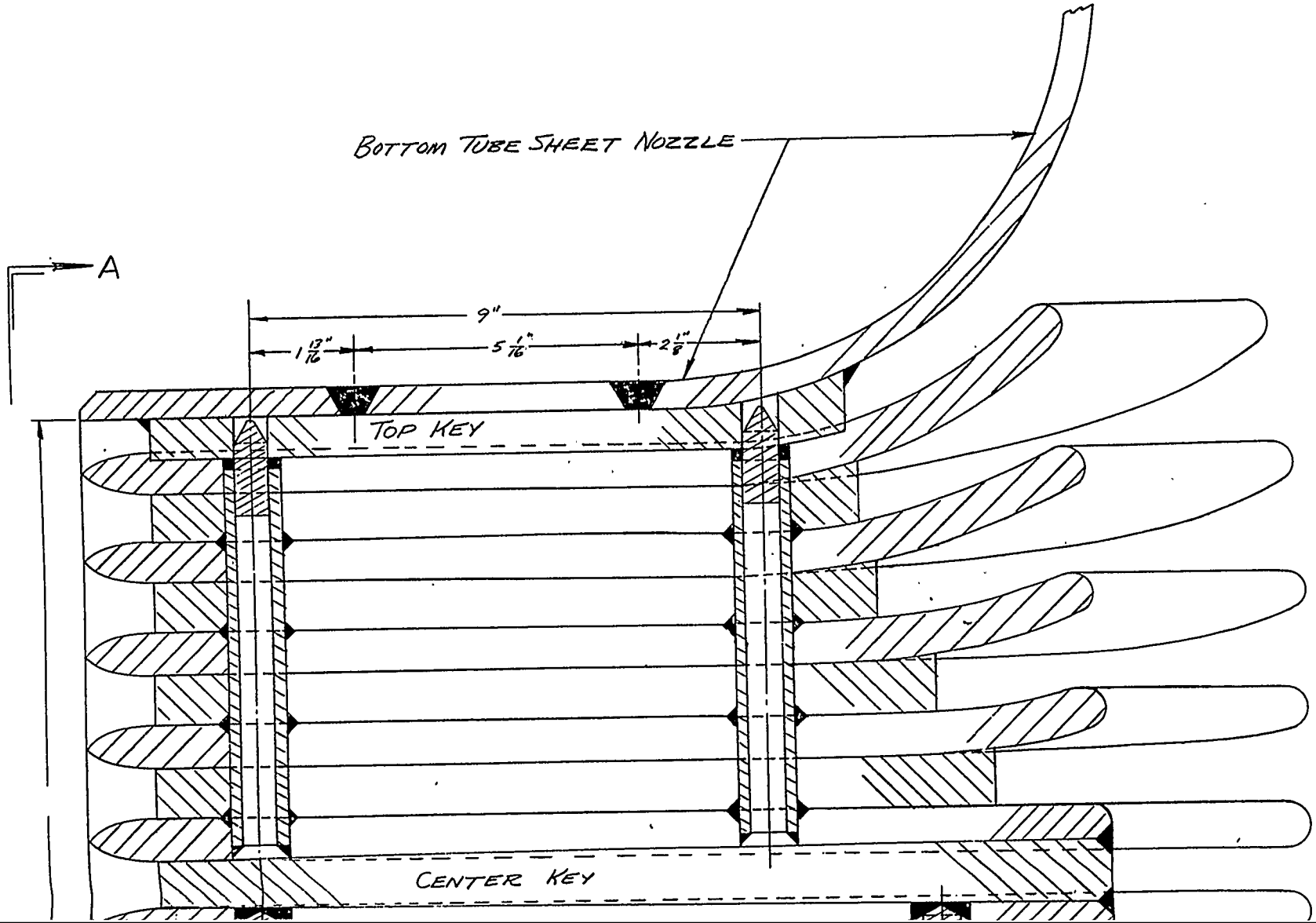
DWG. 5-7

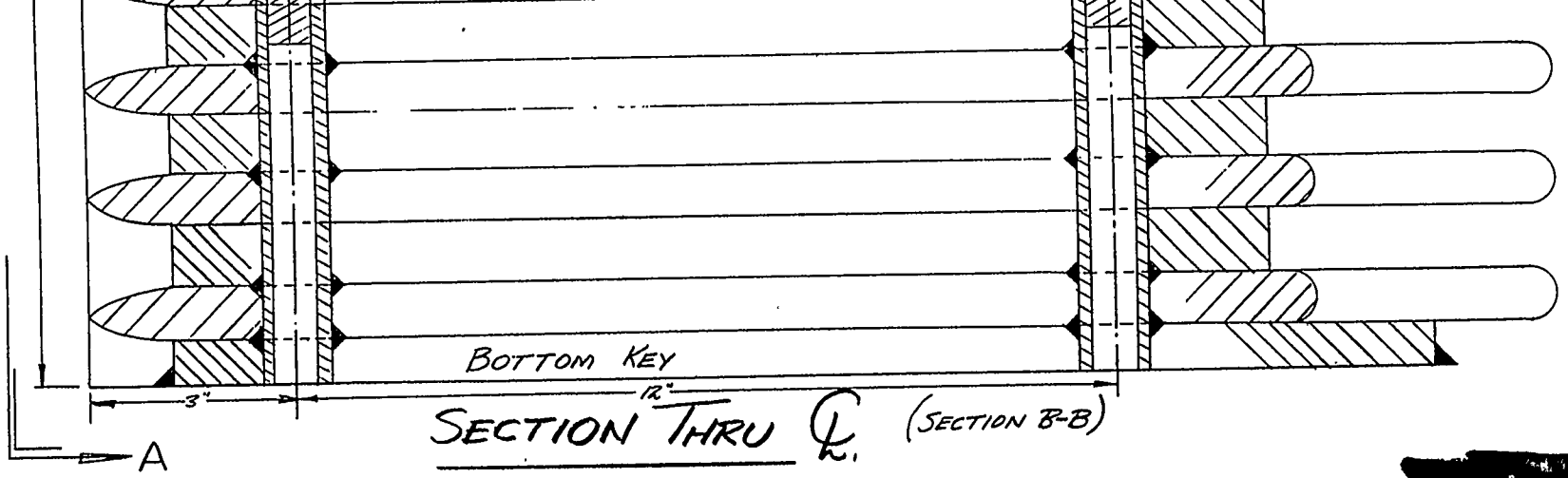
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BY: S. R. COCHRAN
JAN. - 1959

NOZZLE MUFF - BOTTOM TUBE SHEET

TYPICAL FOR "R" & "P" UNITS.





SECTION THRU ℄ (SECTION B-B)

SEE DWG. 5-7 FOR VIEW "A-A"

M & E SECTION
GOV'T. CONTRACTS

DWG. 5-8

[redacted]

BY: S.R. COCHRAN
JAN - 1953

Project to supervise the final nozzle muff assembling operations.

B. "P" Unit

The fabrication and inspection of the six nozzle muff assemblies for the "P" B.T.S. nozzle assembly was similar to that performed on the "R" B.T.S. described in Section 25A above except as follows: In addition to visual inspection of muff keys welded to the top inside section of each nozzle, they were also dy-cheked to further ascertain the quality of welding. Necessary repairs were made, key welding re-inspected and accepted by the du Pont Inspection Department. Also, on this unit the three keys located on the top plate of the unit in each nozzle section were not fit and welded at New York Ship. This work was left for the field to complete. To assist in the location, fitting and welding of muff keys on the top plate of the "P" B.T.S., and final assembling of nozzle nuffs into the unit in the field, a representative from New York Ship's Boiler Shop visited the SRP to supervise the final nozzle assembling operations.

C. "L" Unit

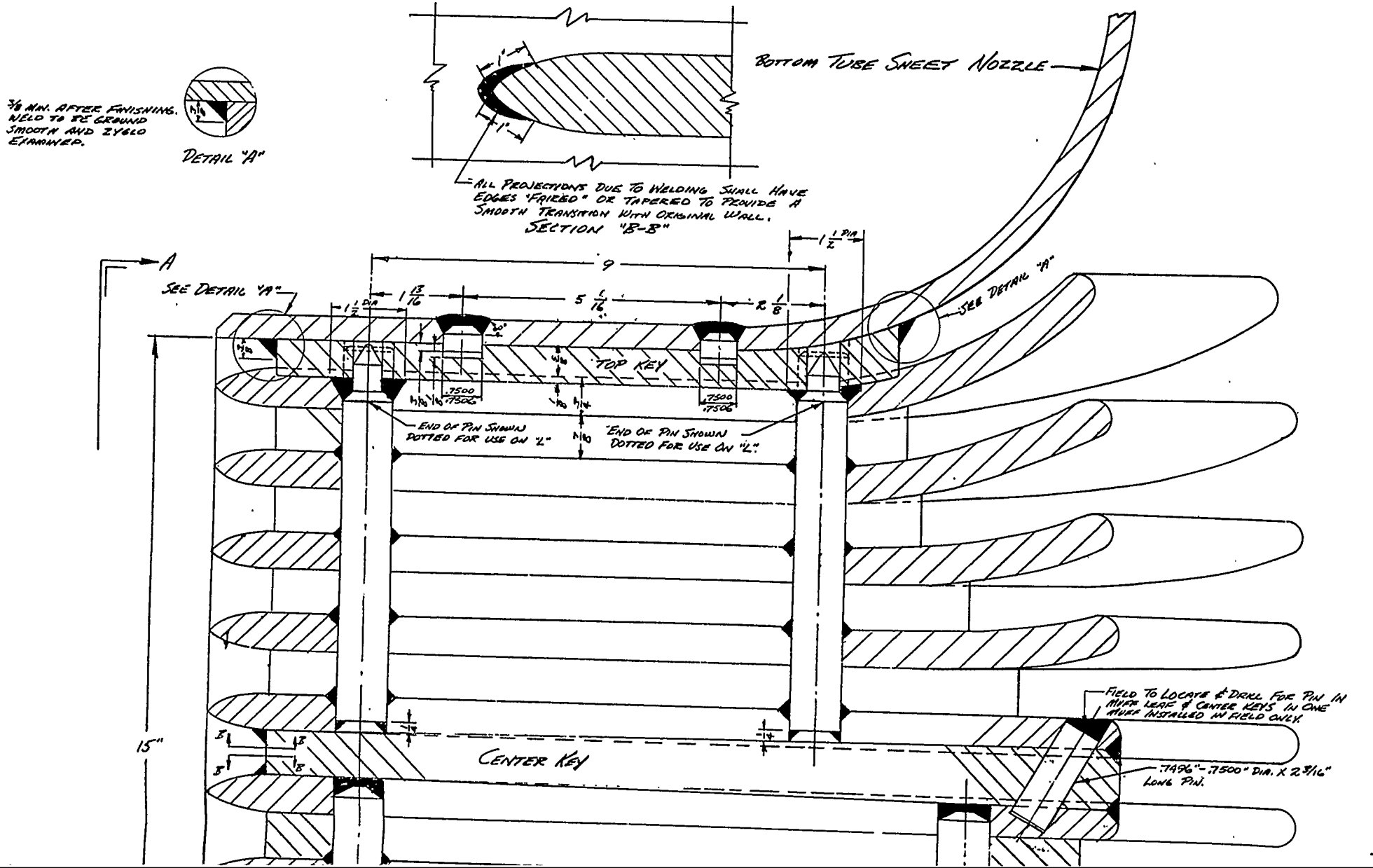
The design of the six nozzle muff assemblies for the "L" bottom tube sheet was somewhat different from "R" and "P". By referring to Dwg's. 5-10 and 5-8, these differences can be readily seen. Nevertheless, the fabrication and inspection of the muff assemblies for "L" was essentially the same as that performed on the "K" and "P" units, with one exception: The three keys located on the top plate of the "L" B.T.S. in each nozzle section were fit and their positions center-punched for later re-setting and welding in the field. The locations of the three keys in each of the six nozzles were visually and dimensionally checked by inspectors during the lay-out operations performed by New York Ship personnel and found satisfactory.

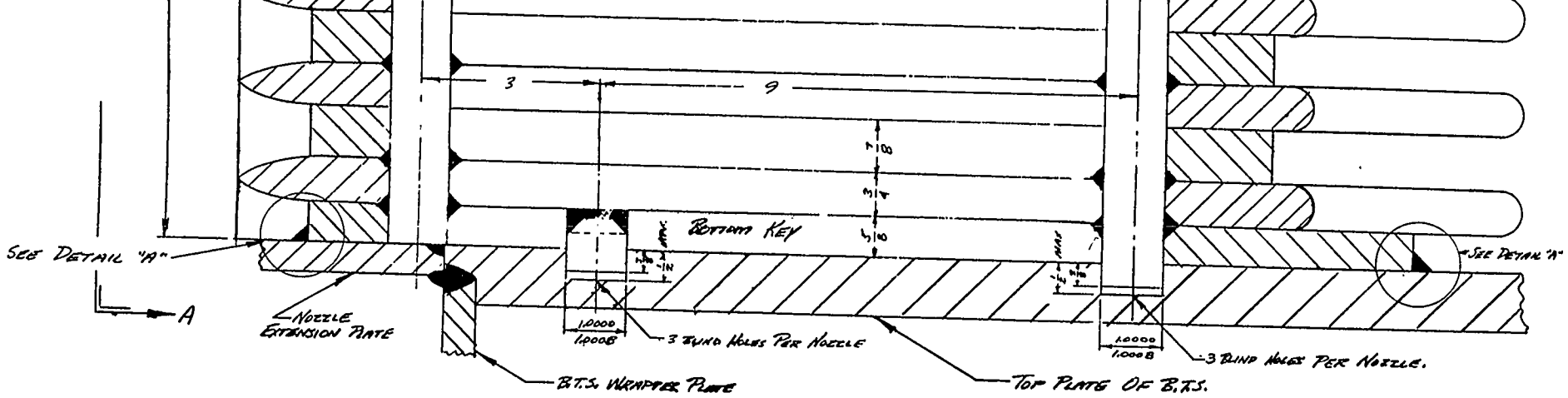
Prior to final dimensional inspections on the muff assemblies, a preliminary dimensional inspection revealed that the vendor had drilled 1 1/64" diameter sleeve holes in details D114662-A, R, K, and M on 9" centers instead of 12" centers as specified on drawing D114662 (also, see drawing W133304-R0). A plug with beveled edges was welded into sleeve hole drilled in wrong location, and a new sleeve hole was drilled in the proper location. The plug welds were then ground flush with the plate surface. All welding was visually inspected for soundness and quality and then dy-cheked to further ascertain the intergrity of the welding. All inspections were satisfactory and accepted by the du Pont Inspection Department.

The upper sections of each muff assembly were fit into the nozzle assembly before welding the latter to the top side of the B.T.S. The fitting of each nozzle muff bottom assembly was waived in order to "loft-in" the main tank section in the time remaining before the proposed shipping date.

NOZZLE MUFF – BOTTOM TUBE SHEET

TYPICAL FOR "L" & "K" UNITS





SECTION THRU ℄ (SECTION B-B)

SEE DW'G 5-7 FOR VIEW "A-A"

M & E SECTION
GOV'T CONTRACTS

DW'G 5-10

[redacted]

BY: S.R. COCHRAN
AUG-1959

All dimensional inspections confirmed that machining was within tolerance; welding and fit-up was satisfactory except as described above. Muff assemblies were then sandblasted, acid washed and ferroxyl tested by du Pont inspectors. All six muff assemblies were accepted and boxed for shipment to the field where final assembling to the B.T.S. was to be performed by field personnel.

After the "L" bottom tube sheet had been received at SRP and when the field was ready to assemble nozzle muff assemblies into the unit, a representative from New York Ship's Boiler Shop again visited the plant site to supervise and assist in nozzle muff assembling operations.

26. Heat Numbering System (All Units)

On January 6, 1953, a visit was made to NYS by a member of the Savannah River Plant AED. The purpose of his visit was to request that the Operations Group be furnished with chemical analysis and physical properties of each piece of steel used in the fabrication of the units at NYS.

Previous to this time no such record had been kept. However, when an incoming shipment of steel was inspected by du Pont inspectors at NYS the heat numbers were made a part of the inspection reports. In addition, it was possible to tie in the shop bills of material with purchase orders, and thus obtain heat numbers and analyses either from NYS' files or by requesting this information from the vendors. In some cases involving small quantities of steel the information was not available. In most instances physical properties were unobtainable since they were furnished only on request at the time of ordering.

Before this request was made by SRP, it had not been the practice at NYS to transfer heat numbers when a piece of steel was cut. The heat number transfer procedure was immediately instituted and has been followed since by NYS personnel with close check by the du Pont Inspection Dept. Since the "R" unit and the tank bottom of the "P" unit had already been shipped to the field, it was, of course, physically impossible to transfer heat numbers on these units. On the units in fabrication at that time, the Inspection Dept. visually examined each piece of steel possible for heat numbers. This was a double check on the information ascertained from bills of material and purchase orders. The latter source was not foolproof, since material purchased for one part of the unit would possible be used in another part for purposes of expediency. However, this rarely happened.

In the case of smaller pieces used in fabrication, it was normally the procedure to use cuttings from larger pieces of the same gauge material which bad been originally ordered oversize just for such a purpose. It was impossible to determine the heat numbers of these "cuttings" that were used prior to the time the transfer of heat numbers was initiated.

The rough tubing for the tube bundles was purchased from various vendors and then shipped to numerous other vendors for pre-machining. Due to the great amount of handling and intermixing involved, it would have been useless to attempt to pin

down the heat number of each specific tube. The Operations group was so informed and agreed that the heat numbers of tubes would not be supplied.

The above is a general picture of the heat numbering system. As for the individual units, the following is the status of the heat records:

"R" Unit:

The heat numbers, chemical analyses and in some cases the physical characteristics of 99% of the steel in the unit have been accumulated and tabulated and forwarded to S.R.P. In the tabulation, the unit was broken down into main assemblies, subassemblies and individual pieces of the subassemblies by name. The pertinent drawing number was recorded and also remarks if required. A typical entry in the record would be as follows:

MAIN TANK AND ENCLOSURE - "R" UNIT

E. P. 105 R - AXC 167½

Part Name	Drawing	NYS P.O.	Vendor	Gage	Heat	Slab	C	MN
Main Tank Shell	W-133252	8203-19	Carlson	1/2"	62089	3B	.055	.77

a. Upper Section

P	S	Si	NI	Cr	Yield in^2	Tensile in ^{2}	Elong 2"	Remarks
.026	.013	.58	9.28	18.34	41,800	82,300	60	

"P" Unit

Same as "R"

"L" Unit

Same as "R" and "P"

27. Final Inspection of Unit and Shipping Gear Installation

A. "R" Unit

The top side of the bottom tube sheet was jitted with air to remove all loose material present. Next, the top side of the tube sheet and the inside of the B.T.S. nozzle assembly was acid washed and then rinsed with clean city water. Ferroxyl tests were performed at random to determine if any "free iron" was present on the surfaces of the unit.

All tube bores were swabbed out using F.O. 128 (Fine Organics) and then followed up with a clean dry cloth to remove the excess F.O. 128 and any grime left in the tube bores. A visual inspection was made by du Pont inspectors and then wood plugs with an O-ring fitted to its diameter was inserted

into the bottom and top of all large tubes. These were similar in design to those shown in Sketch #38 in Part VII, Section 1 items 15 thru 16. A visual inspection was again made to determine if all large tubes were plugged on the top and bottom ends. All inspections proved satisfactory. Then New York Ship bolted an aluminum disc to each side of the large tube pattern to serve as a protective covering for the tube ends. Handling gear was installed and then the entire unit was "pillow-cased" with canvas and laced on the outer periphery and made ready for shipping. (See photo serial #71)

The "R" bottom tube sheet was shipped by tug boat and barge from New York Ship on August 2, 1952, to the Savannah River Plant located in the state of South Carolina.

B. "P" Unit

Final inspection of the unit prior to shipping to the field was performed in a similar manner to that described in Section 26A of this manual.

The "P" bottom tube sheet assembly was shipped by tug boat and barge from New York Ship on November 1, 1952, to the Savannah River Plant located in the state of South Carolina.

C. "L" Unit

Exterior cleaning of the bottom tube sheet prior to shipping was omitted at vendor's plant because of lack of time due to shipping date and other fabrication operations. However, the following cleaning operations were performed during the latter stages of fabrication: Prior to welding the 8" half-round distribution (inlet and outlet) pipes to the bottom tube sheet, the wrapper plates were cleaned with a solution of F.O. 128 (Fine Organics Saf-Tee Solvent) and then acid washed. A ferroxyl test indicated that cleaning was satisfactory. The interior surfaces of the 8" half-rounds were cleaned, acid washed, ferroxyl tested and the 8" pipes welded to the assembly.

After welding of the 8" half-round pipes, a freon and hydrostatic test was made on the assembly. Both tests indicated sound welds throughout the assembly after minor repairs.

The half-rounds were cleaned (internally) just prior to testing with a vacuum cleaner with 30 feet of hose in order to remove any metal or foreign matter. As the assembly was being filled with water for the hydrostatic test, water was permitted to flow through 1½" fitting in the top half of outlet tee cover for fifteen minutes to provide a cleaning action. That is, water was forced from assembly through the half-rounds and drained out through the 1½" opening whose top side was flush with the top surface of the tee. The outlet pipe was cleaned in this manner.

Shipping plugs with O-rings fitted to the diameter were not put in large tubes prior to shipping. It was found during repairing bottom land bores the insertion and removal of these

[redacted]

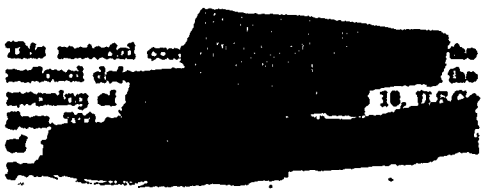
Serial Number 71

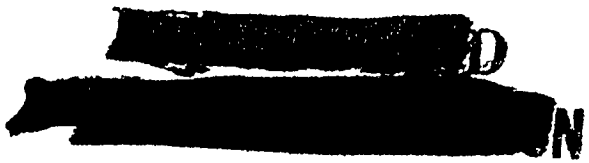
New York Shipbuilding Corporation
Camden, New Jersey
July 30, 1952

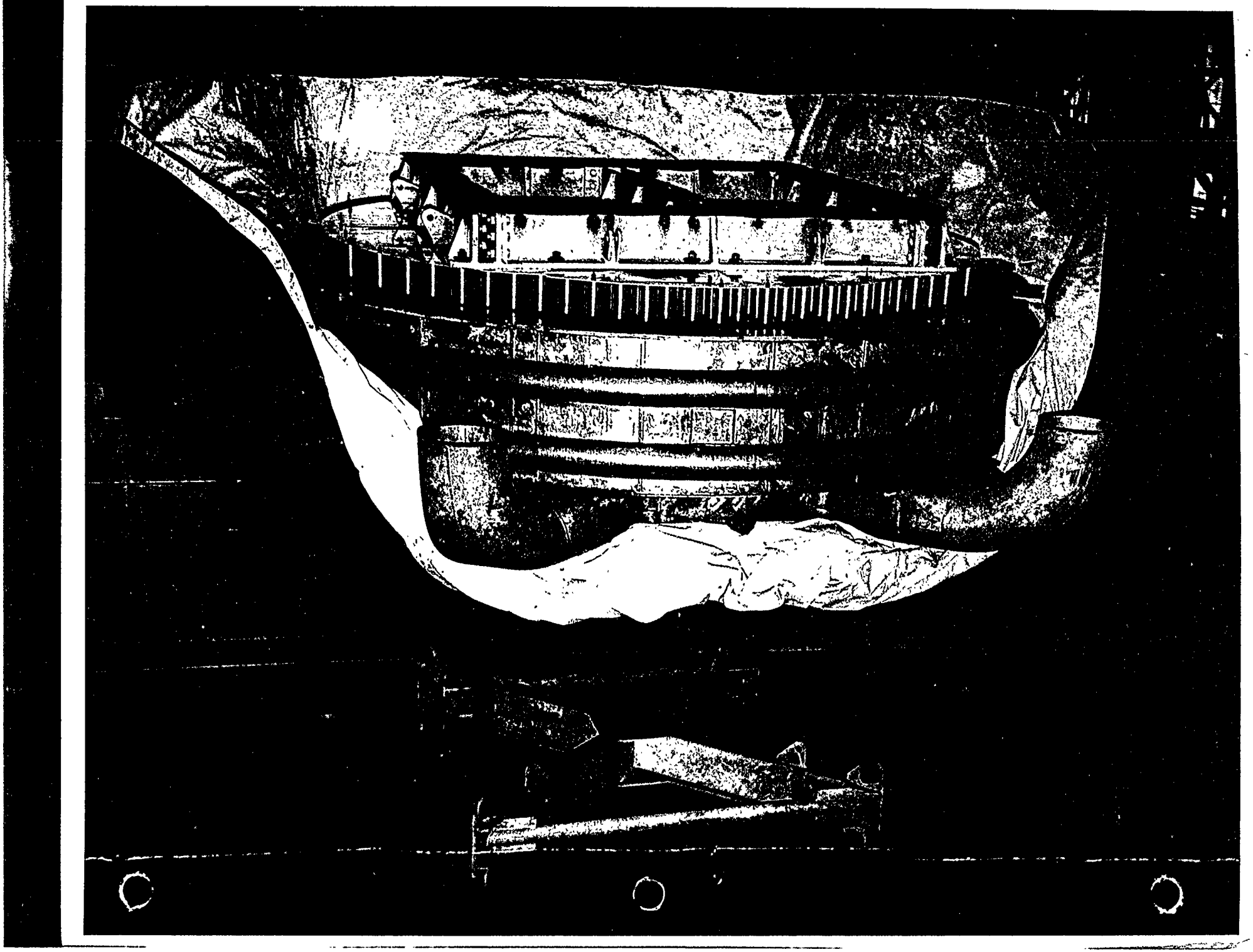
PROJECT 8980 - SAVANNAH RIVER PLANT

Loading and Shipment of "R" Unit Component Parts to the Savannah River Plant.

This view shows the removal of the "R" Unit Tank Bottom Assembly from Building Number 3, South Yard, New York Shipbuilding Corporation, to the barge for shipment to the field. Note the stainless steel disc between the bottom tube ends and the mild steel base to prevent contact of mild steel base with the stainless steel unit.







wooden plugs marred the surface finish in spots, and in most cases damaged the tubes O-ring seating zone.

A large aluminum disc was bolted to each side of the tube pattern to serve as a protective covering for the tube ends. Handling gear was installed and then the entire unit was "pillowcased" with canvas and laced on the outer periphery and made ready for shipping. (See photo serial #71)

The "L" bottom tube sheet was shipped by tug boat and barge on June 3, 1953, to the Savannah River Plant located in the state of South Carolina.

INSPECTIONS PERFORMED BY DU PONT

ON THE "R", "P", & "L" UNITS

PART VII
SECTION IV

"R","P" AND "L" MAIN TANK, BEARING RING,
EXPANSION JOINT AND TOP TUBE SHEET ENC.

REPORT

OF

MATERIAL & EQUIPMENT

SECTION'S

ACTIVITIES

AT

NEW YORK SHIPBUILDING CORP.

DURING FABRICATION

OF

AXC 167 1/2

STARTING MAY 18, 1951

PART VII - SECTION IV

BY: JAMES RAY STEWART

MAY 28, 1954

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34. Dwg. No. 6353-7	-	"L" Unit Main Tank Diameter Measurements

"R", "P" AND "L" UNIT DRAWING LIST BY SUB-ASSEMBLY

The following list covers all du Pont prints pertaining to fabrication released to the M & E Group located at New York Shipbuilding Corp.

This list was prepared from existing drawing files at the latter location on March 27, 1954. For reference purposes and convenience, drawings are listed by sub-assembly, drawing number, title and revision number.

A. "R" Unit

Drawing #	Title	Revision #
W-131104	Main Tank Top Shell - Plan & Section Arrgt.	0
W-131115	Main Tank Shell - Section of Details Arrgt.	17
W-131735	Nozzle Muff - Plan & Section Arrgt.	0
D-112625	20"-90° Tank Outlet Elbow	0
D-114417	Nozzle Muff	0

B. "P" Unit

Drawing #	Title	Revision #
W-131519	Main Tank Top Shell - Sections & Details Arrgt.	17
W-131542	Main Tank Shell & Bearing Ring - Plan of Sections Arrgt.	16
W-131543	Main Tank top Shell - Plan of Sections Arrgt.	1
W-131564	Main Tank Bottom Bearing Plates - Plan & Details Arrgt.	3
W-131981	Tank Wall Thermocouples - Arrgt., Plan & Section	12
W-133187	Tank Wall Thermocouples - Arrgt. Sections - Sheet2	5
W-132530	Tank Bottom Tube Sheet Nozzle Muff - Plan (Sections Arrgt.)	0
W-132536	Tank Bottom Tube Sheet Nozzle Muff - Plan (Sections Arrgt.)	1
D-112727	20"-90° tank outlet nozzle elbow	0
D-114474	Nozzle muff for tank bottom tube sheet	0

C. "L" Unit

Drawing #	Title	Revision #
W-133138	Main Tank Bottom Bearing Plates Plan & Detail Arrgt.	0
W-133252	Main Tank Shell & Bearing Ring Plan & Sections	7
W-133266	Main Tank Top Shell Plan & Sections Arrgt.	1
W-133270	Main Tank Top Shell Sections & Details Arrgt.	10
W-133271	Main Tank Top Bearing Ring Bearing Supports Plan & Sections Arrgt.	9
W-133303	Tank Bottom Tube Sheet Nozzle Cross & Section Arrgt.	3
W-133304	Tank Bottom tube sheet nozzle muff plan & Section	0
W-133879	Tank wall thermocouples arrgt. Plan & Sections Sheet #1	2
W-133880	Tank wall thermocouples arrgt. Sections Sheet #2	5
D-112875	20"-90° Tank Outlet Nozzle Elbow	0

PART VII - SECTION IV
MAIN TANK, BEARING RING, EXPANSION JOINT AND TOP TUBE SHEET ENCLOSURE INSPECTIONS PERFORMED BY DU PONT ON "R", "P", AND "L" UNITS

A. "R" Unit

(1) Main Tank

a. Plate Inspection, Fabrication and X-ray

The type 304 stainless steel material for the tank was inspected for surface condition, imbeddediron, mechanical defects and dimensions. All plates were checked with a magnet to determine if the material was austenitic. Ferroxyl tests were performed at random to determine if any free iron was imbedded. Free iron found was removed by grinding. All material was accepted after minor repairs and released for fabrication.

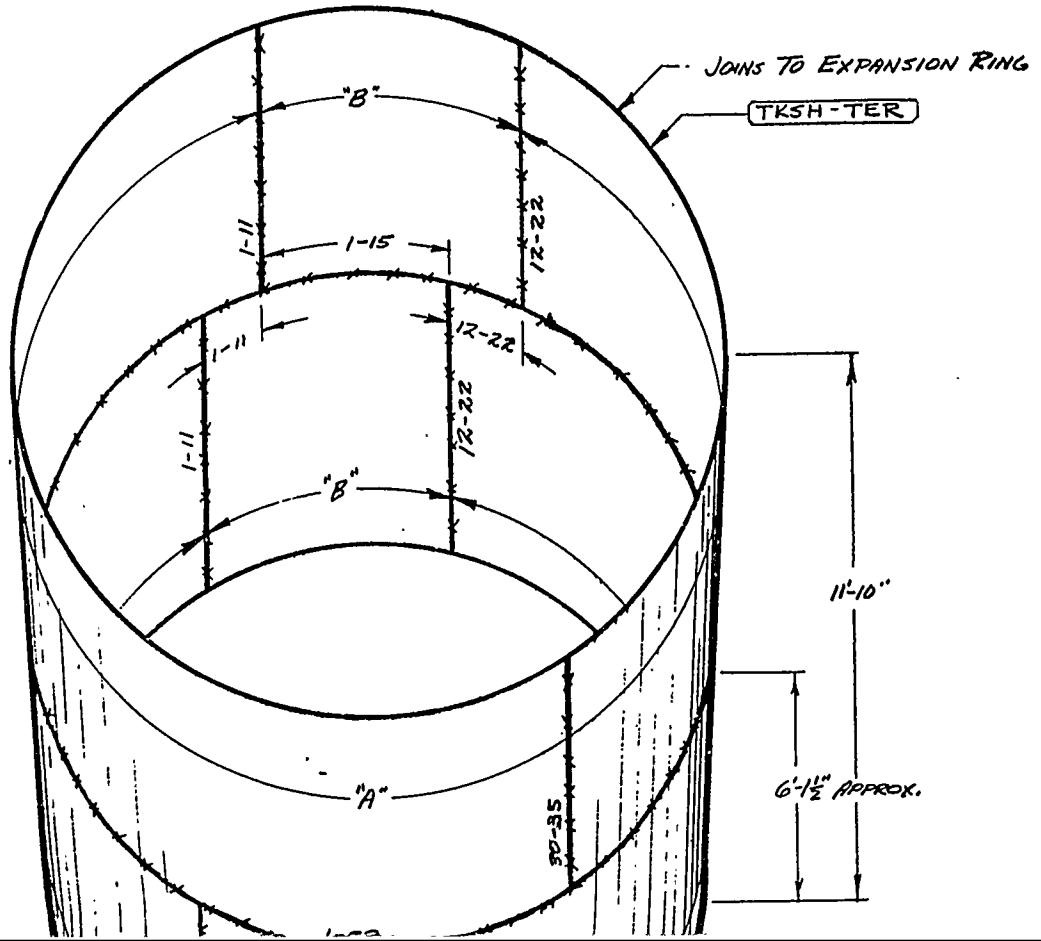
The tank was made up in the flat in two half-sections for later rolling on a set of 15 ft. horizontal rolls. (See Dwg. 6-5). The plates were then set together and fitted in two half sections with allowance for tank to be full on length. This was necessary since welding of the expansion joint and bottom tube sheet nozzle edge causes shrinkage. The "A" and "B" halves were fit and welded as shown in Dwg. 6-5. Before rolling, each half section joint was ground and then visually inspected for porosity, undercutting, cracks, and other mechanical defects. Repairs were made and then the joints were x-rayed in the flat. Radiographs were examined by du Pont inspectors and repairs made where necessary.

The tank differed from NYX in that it was shorter in height because of the addition added to lengthen the bottom tube sheet nozzle assembly and the incorporation of a new type expansion joint.

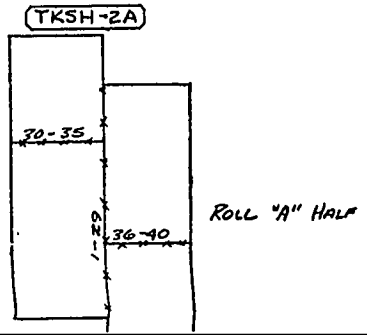
After the two half sections were x-rayed and accepted, the two half sections were rolled. The weight of the plate being rolled was held in position and moved as required by two balancing beams and two overhead cranes. (See photo serial #154 in Part II). During rolling the plate curvature was progressively checked with a radius template. After rolling each half-section was set with the bottom edges on a level slab. Final curvature was obtained by hammering with wooden mallets.

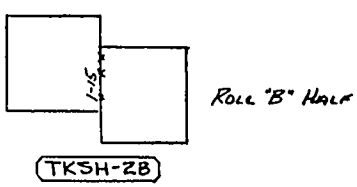
The two halves were then fitted to a mild wrought steel form made up of three drawing size rings (spiders) bolted together on stringers. (See photo serial #67 in Part II). The two half-sections were held to the jig with a cable and turn buckle around the mid-section of the tank for fitting the first vertical butt. After this the closing vertical butt was drawn together,

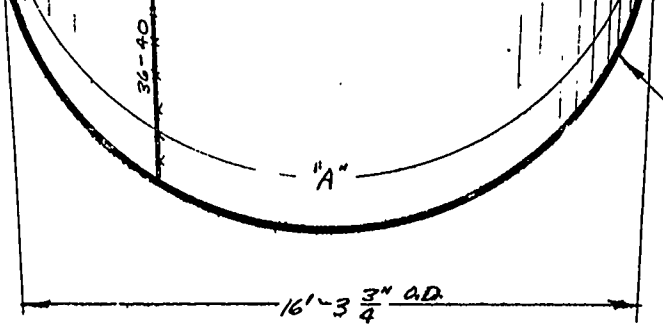
MAIN TANK SHELL "R"



VERTICAL SEAMS BOTH 1-22







Field Weld To Bottom Tube Sheet Nozzle Assembly

Fabrication Sequence
All Seams - Visual & X-Ray
Mat'l - Type 304 1/2" S/S

M & E SECTION
GOV'T CONTRACTS

DWG. 6-5

[redacted]

BY: S.R. COCHRAN
FEB. - 1953

fitted and tack welded. The tank was then set on a set of twin rollers for all welding in a down-hand position. (See photo serial #150 in Part II). The lower seam was step-welded from inside the tank using manual Aircomatic method adapted for this job. After each weld pass, they were chipped and dressed. After the lower seam was fully welded on the inside, the tank was rotated 180° and the same operation repeated on the other seam. The lower seam root bead which was now in the up position was back chipped from the outside, wire brushed, cleaned with solvent, and then fully welded from the outside in a downhand position according to the established welding procedure. The tank was again rotated 180° to bring the other seam on top for back chipping, cleaning, and welding. After all welding was completed, the two weld seams were ground flush and then the two vertical seams were x-rayed 100%. Radiographs were examined by du Pont inspectors and necessary repairs made. The circumferential weld previously x-rayed in the flat was not re-x-rayed after rolling.

The main tank shell was ground all over to remove iron imbedded in the plate surface, and then preparations were made for locating and welding thermocouple clips to the outside of the tank shell. Thermocouple clips were machined, dressed, fit and welded to the main tank. Welding was visually inspected and approved. Locations of the thermocouple clips were measured using a 6' tape referencing from the major axes and found to be within specified tolerances.

b. Tank Out-of-roundness

Before welding the main tank to the expansion joint, and with the "spider jig" removed, preliminary measurements on the I.D. of the tank were taken to determine out-of-roundness. Measurements were taken with a 16' pin gage set to a predetermined length using a steel tape graduated in 1/16". Measurements were taken at three elevations on the I.D. of the tank in the X and Y directions: namely, (1) top (2) middle and (3) bottom. Also, the height of the tank was measured at four positions (90° to each other), using a stainless steel tape graduated in 1/16". These dimensions were all within drawing tolerance.

Final measurements were also taken on the tank after welding to the top tube sheet enclosure assembly in a similar manner to that described above. These final dimensions were all within the required tolerance.

c. Inspections After Grinding and Acid Washing

The "spider jig" was removed from inside the tank and preparations were made for acid washing the inside and outside; however, after removing the jig, it was noted that the area where the three mild steel forming rings were pressed against the tank shell,

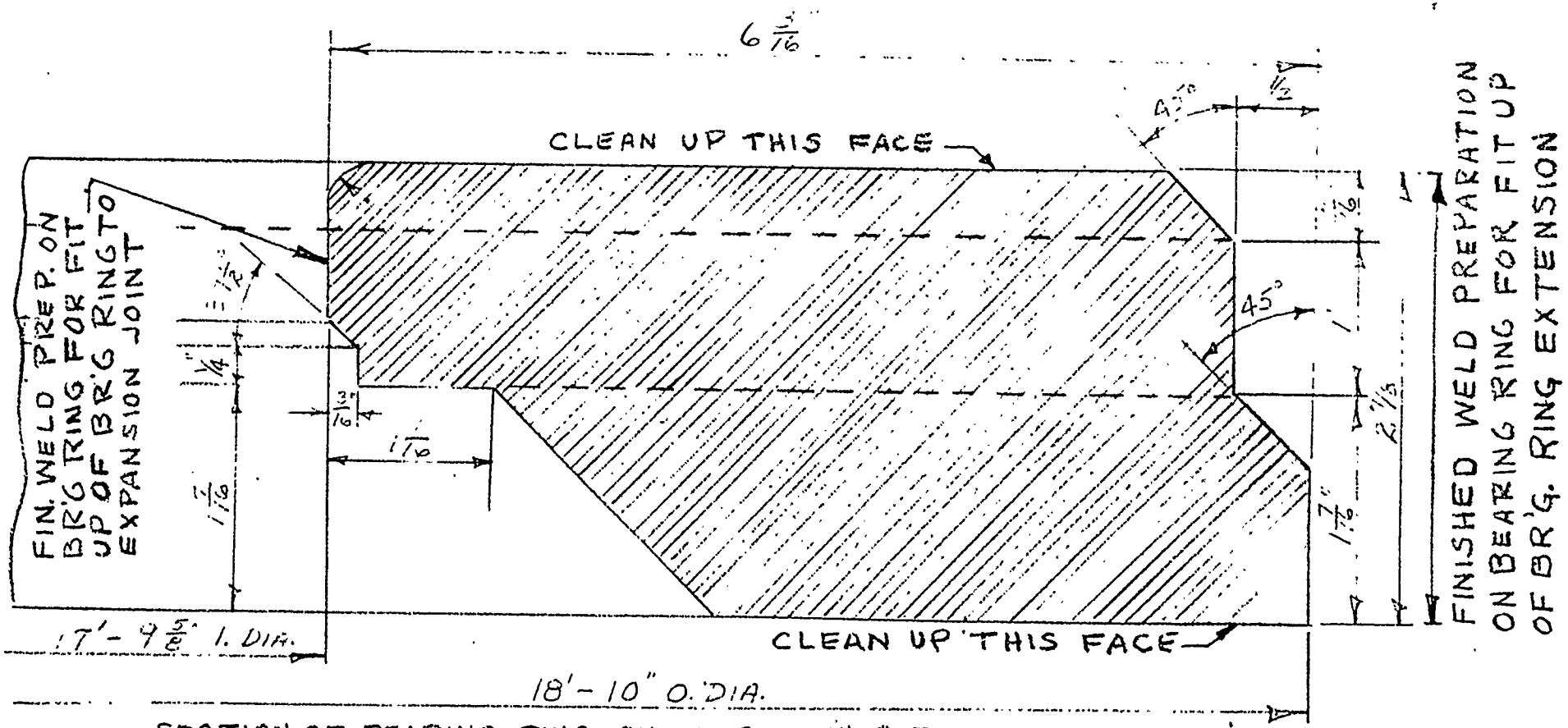
the rings had left deposits of free iron imbedded in the tank shell surface. Before proceeding with the acid washing operation, the iron imbeddedin the inside shell surface was removed by grinding. Next, the inside and outside surfaces of the tank shell were acid washed to remove any addition imbedded iron, dirt, scale, and weld smoke. The inside of the tank was then inspected for cleanliness and ferroxyl tested. However, the areas where the forming rings pressed against the inside of the tank were still contaminated. Additional grinding and acid washing finally eliminated this condition and the tank was accepted.

In the meantime it was decided to revise the three forming rings on the jig and add to it a stainless steel ring 3/4" thick and two inches wide to the O.D. of the three former rings. This was to eliminate any possibility of the former rings contaminating the tank shell. A stainless steel ring of the required diameter was welded to each of the three forming rings. Each forming ring was then set up on a 20' mill and the latters O.D. turned to the required inside diameter of the main tank shell. The addition of the stainless steel rings to the main tank "spider jig" former rings was also incorporated into the top tube sheet enclosure "spider jig". At a later date it was decided that these two "spider jigs" were to be put in the main tank section for shipping the assembly to the field. Since contamination of the main tank shell and top tube sheet enclosure could not be tolerated after final cleaning, the addition of the stainless steel rings to the O.D. of the former rings in the two jigs justified itself both in the shop and shipping the assembly to the field.

(2) Inspection of Bearing Ring, Expansion Joint and Top Tube Sheet Enclosure

a. Bearing Ring

Six bearing ring segments were burned from 3" thick type 304 stainless steel plates. These were chipped, ground, edges beveled, fitted, and butt welded into a ring. Butt joints were x-rayed, radiographs examined and necessary repairs made. It was then re-contoured, flattened and set-up on the 20' boring mill for rough machining. During rough machining, 3/16" thickness was left on both top and bottom of ring for final machining (following assembly of bearing ring to tank expansion joint). The I.D. and O.D. were turned to drawing dimensions plus 1/4" for weld shrinkage. (See Sketch B for inspections performed at this time). After this, the bearing ring was removed from the mill and set up on a layout table for locating and layout of 12 bearing slots or cut-outs on the bottom face of the bearing ring. For location of bearing slots, see du Pont drawing W-130953. After laying out the bearing slots, the bearing ring was set up on a Hydrotel Milling Machine for rough milling of the 12 slots. Next, the bearing ring was removed from the mill and preparations made for welding the bearing ring extension to the bearing ring.



SECTION OF BEARING RING SHOWING MACH. BEFORE WELDING TK. & EXPANSION RING

THESE DIMENSIONS GIVEN ALLOW 1/4" ON DIA. FOR SHRINKAGE & 3/16" ON TOP & BOTTOM FACE FOR MACHINING AFTER WELDING. ALL OF THE ABOVE DIMENSIONS WERE CHECKED @ 4 PLACES APPROX. 90° TO EA. OTHER USING A 6" SCALE. I. D. & O. D. WERE NOT MEASURED AT THIS TIME.

SKETCH # 8

Prior to fit-up and welding to bearing ring, the extension was made up in four sections, rolled and butt welded to form a ring. All butt joints were x-rayed. Radiographs were examined by du Pont inspectors and where necessary repairs were made. Excess material was left on top of extension for final machining (following assembly to tank expansion joint). The bottom edges of the extension was beveled for weld preparation joining it to the O.D. of the bearing ring. The bearing ring was clamped to a platen and the extension assembled and tack welded to the O.D. The bearing ring was removed from the platen and set up on a welding positioner in order that all welding be done in the downhand position. The outside circumferential joint joining the bottom edge of the extension to the bearing ring was butt welded according to the procedure adapted for this job. After this, the bearing ring was removed from the welding positioner and clamped to a platen for fillet welding the inner side of the extension to the bearing ring. (See Dwg. 6-3 for view of bearing ring and extension). Next, the fillet weld and outside circumferential weld were ground and then visually inspected for cracks, porosity, undercutting, and other mechanical defects. Necessary repairs were made and then the inside fillet weld was zy-glo tested to further ascertain the quality of welding. Additional repairs were made and all welding was accepted. The outside circumferential weld did not require zy-glo testing per du Pont specifications.

Finally, the vertical butts in the bearing ring were re-x-rayed for final disposition. Radiographs were inspected by du Pont inspectors and where necessary, repairs were made. No other work was performed on the bearing ring until the expansion joint and top tube sheet enclosure were completed. The following sections cover the final machining and inspection of the bearing ring.

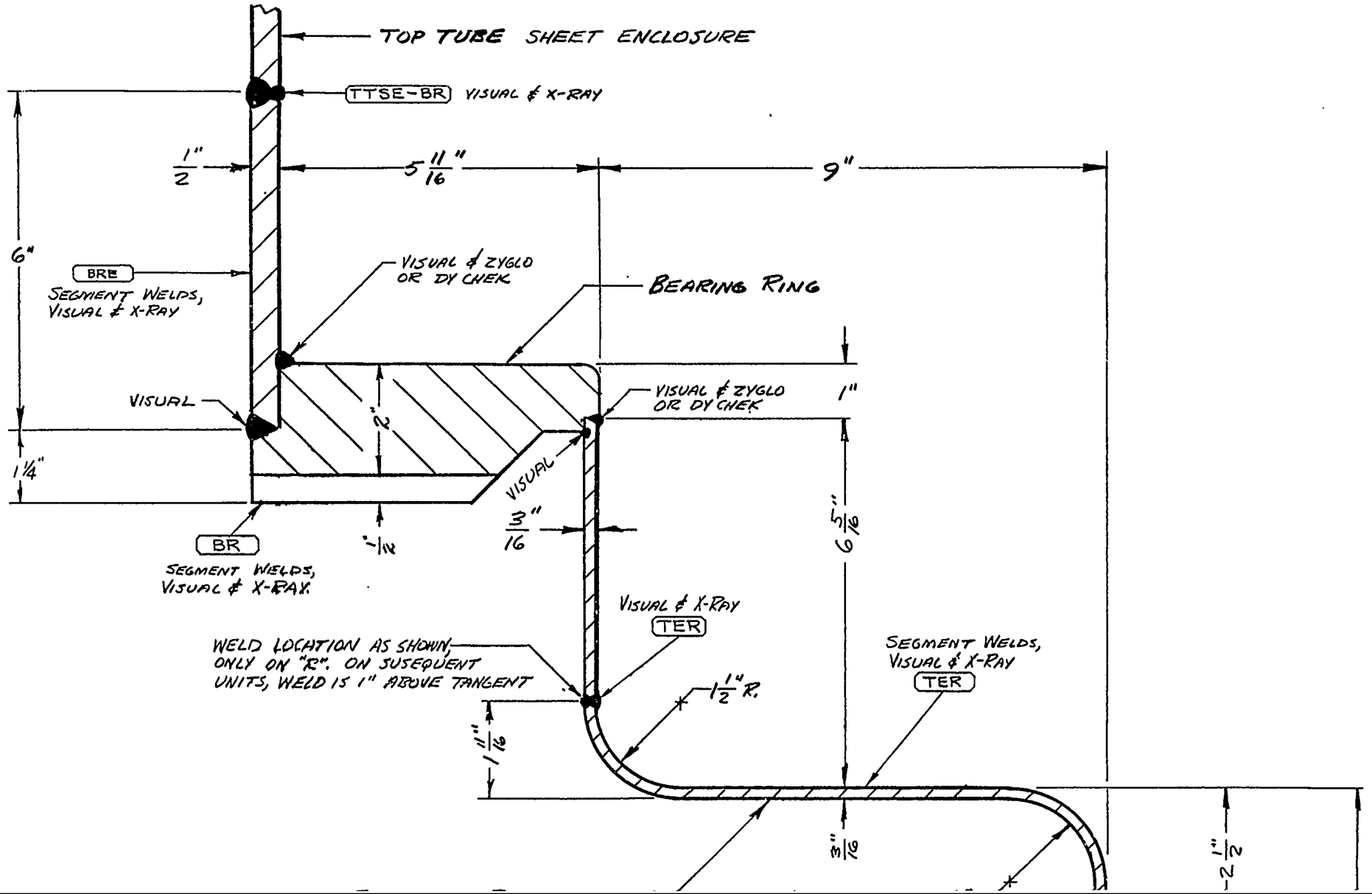
b. Tank Expansion Joint and Welding to Bearing Ring

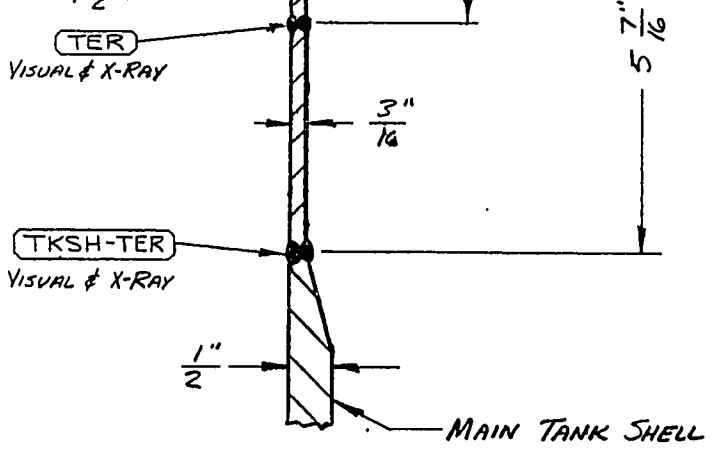
The "R" unit expansion joint was different from the design of the NYX. The difference can be seen by referring to Dwg. 6-4 presented herewith and to Sketch #18 in Part II.

Six expansion joint sections were formed from 3/16" thick 304 stainless steel using hammers and flatters against a die. Each of these main sections were contoured on the outside and inside edges to form an inside and outside 90° bend. To the top and bottom edges lip pieces (full in width) were formed, fitted and welded to each of the six main segments. After fabricating and welding the six main segments (each consisting of three pieces), the horizontal butt welds were ground flush with the 3/16" thick plate surface on both sides.

An assembling and handling jig had been fabricated for positioning and holding the six expansion joint segments to the correct diameter while fitting and welding the vertical joints to form the complete expansion joint. The six segments were fit to the jig by chipping the butt joints to form the complete expansion joint or ring. Care was taken to stagger the horizontal radial welds in the expansion joint with respect to the vertical welds. The butt joints were then beveled

SECTION SHOWING EXPANSION RING JOINED TO TOP TUBE SHEET ENCLOSURE & MAIN TANK





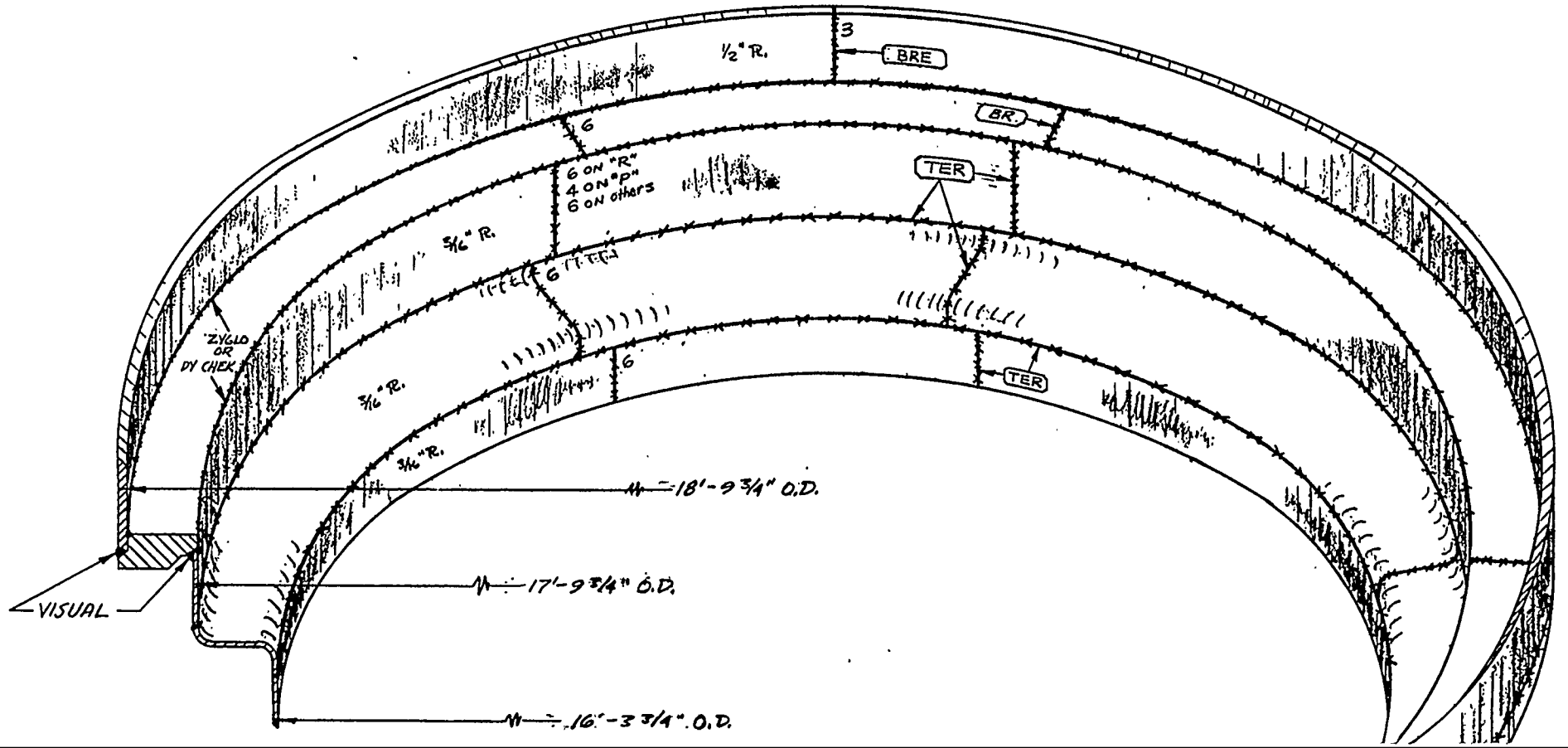
M & E SECTION
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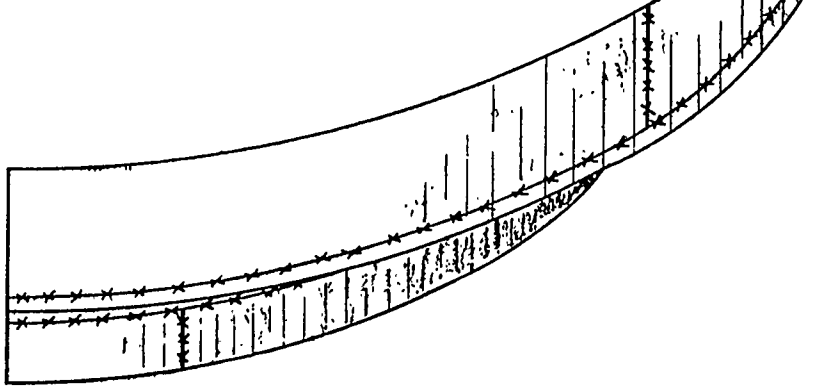
BY: S.R. COCHRAN
JAN.-1953

EXPANSION RING & BEARING RING



NOTE:

1. WELDS NOT NOTED ARE SUBJECT TO VISUAL & X-RAY INSPECTION.
2. "R" & "P" SEGMENTS FOR EXPANSION RING WERE NOT ANNEALED.
3. "L" & "K" SEGMENTS FOR EXPANSION RING WERE INDIVIDUALLY ANNEALED PRIOR TO ASSEMBLY.
4. "R" & "P" SEGMENT BUTT WELDS FORMING EXPANSION RING WERE STAGGERED AS SHOWN.
5. "L" & "K" SEGMENT BUTT WELDS FORMING EXPANSION RING WERE ALIGNED.



M & E SECTION
GOV'T CONTRACTS

DWG. 6-4

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JAN. - 1953

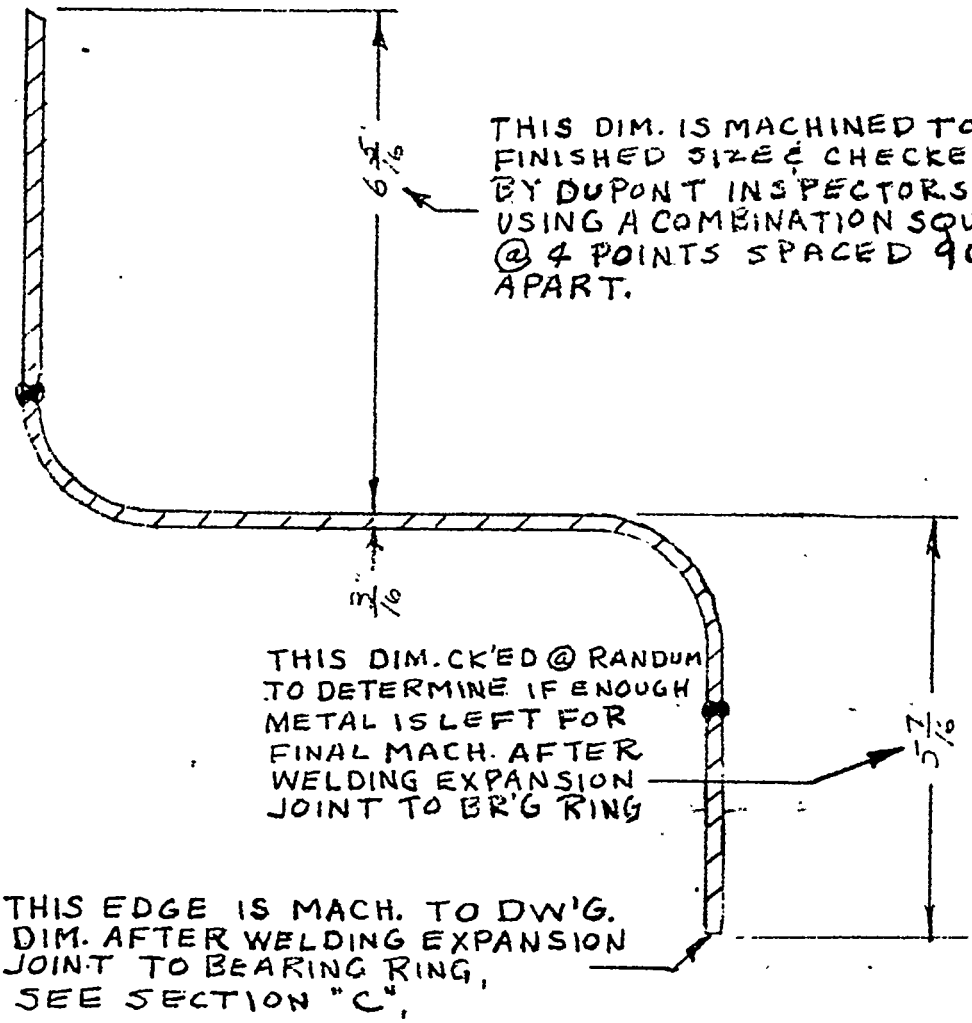
for welding, backing strips cut, fit and tack welded to each vertical joint.

With the complete expansion joint segments now fitted and clamped to the assembling and handling jig, the entire assembly was bolted to a welding positioner in order for all welding to be done in the downhand position. All welding was completed, backing strips chipped off, and then all vertical butt joints were ground flush with the plate surface on both sides of the weld. All buttwelding was visually inspected by du Pont inspectors for porosity, cracks, undercutting and other mechanical defects. Necessary repairs were made, re-inspected and accepted. All horizontal and butt welds were then x-rayed 100%. Radiographs were examined by du Pont inspectors and repairs made where necessary. Defects found were removed by chipping and then re-welding using metallic acid welding process and coated 304 S/S rods. All repaired areas were ground smooth and then x-rayed. (NOTE: expansion joint was raised slightly out of the jig for x-raying butt welded joints)

The expansion joint was re-clamped to the assembling and handling jig and preparations were made for machining the top edge joining the latter to the bearing ring. (The bottom edge is machined to size after welding expansion joint to bearing ring.) The expansion joint was moved and set up on a 20' boring mill for this operation. After the assembly was set up on the mill by New York Ship mechanics, the top edge of the expansion joint was machined to size and beveled for welding to the bearing ring. Before leaving the mill, this dimension was checked at random around the circumference of the expansion joint by du Pont inspectors. Referring to Sketch #9, the specified finished machined dimension was 6 5/16" from the top side of the expansion joint mid-section to the top edge of the weld preparation. This dimension was checked using a machinist combination square graduated in 1/64". Also, the distance from the mid-section segment to the bottom edge of the expansion joint was checked in a similar manner to determine if enough metal was left for final machining after welding to bearing ring at a later date. (See Sketch #9) All dimensions proved satisfactory, and the expansion joint was released for welding to the bearing ring.

The bearing ring was placed on a level platen bottom-side-up and clamped in place. Next, the expansion joint, which was clamped in the assembling and handling jig, was turned bottom-side-up and positioned over the bearing ring. The top edge (now in downhand position) was then fit and tack welded to the bore of the bearing ring. The assembly was then moved and bolted to a welding positioner for welding the inside joint between bearing ring and expansion joint in a downhand position. After all welding was completed on the inside, the joint was ground flush and then inspected for cracks, porosity, undercutting and other mechanical defects. Necessary repairs were made and then the

SECTION THRU EXPANSION JOINT



SKETCH #9

inside joint was zy-glo tested to further ascertain the quality of welding. Additional repairs were made, re-inspected and accepted by the du Pont Inspection Department.

The assembly was moved from the welding positioner, placed on a level platen, and clamped in place with the bottom side up. With the assembly in this position, a fillet bead was made on the outside joining the expansion joint to the bearing ring. After welding, the outside circumferential fillet weld was ground and then visually inspected for cracks, porosity, undercutting and other mechanical defects. Necessary repairs were made, re-inspected and accepted. The expansion joint and bearing ring was now welded into an assembly as shown pictorially in Dwg. 6-4 presented herewith.

c . Final Machining of Tank Expansion Joint and Bearing Ring

The bearing ring and expansion joint assembly was made ready to set bottom side up on a 20' boring mill with the assembling and handling jig assembled to hold it in shape. Before placing the bearing ring and expansion joint assembly on the 20' boring mill, twelve cast iron pedestals were positioned around the outer periphery of the mill table to correspond to each of the bearing ring cutouts on the bottom side of the bearing ring. The tops of these cast iron pedestals were then machined to a plane. These pedestals were purposely staggered in this manner in order to duplicate the actual set-up of the assembly when installed at the plant site. The assembly was positioned and clamped in place by New York Ship.mechanics, and preparations were made for machining the bottom side of the bearing ring to finish size. As shown in Sketch #8, 3/16" was left on this side after rough machining for final machining at this time. The bottom side of the bearing ring was machined to size and then checked by du Pont inspectors using a combination square graduated in 1/64". The distance from the finished machined bottom side of the bearing ring to the outside edge of the expansion joint mid-section was measured and found to be 5" $\pm$ 1/32". (See Dwg. 6-3 for location of this measurement). The bearing ring finish was then checked using a profilometer and found to be 32 RMS or less which met the specified finish requirement. Next, the bottom edge of the expansion joint was machined square and to drawing size for later fitting and beveling of weld preparation for joining it to the main tank section. This dimension was measured using a combination square and found to be within drawing tolerance. (SeeSketch #9)

Next, the bearing ring and expansion joint assembly was turned top side up for machining the top side of the bearing ring and bearing ring extension; however, during turning of the assembly, a cast iron support block used to support the assembly on the mill slipped and slightly bent the lower edge of the expansion joint. The bent portion was re-contoured by New York Ship mechanics using wooden mallets and flatteners. After straightening, the repaired area was inspected by du Pont inspectors and found satisfactory.

With the top side of the assembly up, the bottom side of the bearing ring was positioned on cast iron pedestals clamped and staggered to the mill table in order to support the bearing ring at each of the 12 bearing cutouts rough machined in the bottom side of the ring. (See paragraph 1 above) As shown in Sketch #8, 3/16" was left on the top side after rough machining for final machining at this time. The top side of the bearing ring was then machined to size. The inside fillet weld joining bearing ring extension to the bearing ring was radiused and blended in by machining. Next, the bearing ring extension was finished machined to size. Before removing the bearing ring and expansion joint assembly from the 20' boring mill, the following measurements were made by du Pont inspectors:

(1) The finish (RMS) was checked on the top side of the bearing ring using a profilometer. Results indicated that the finish was 32 RMS micro-inches or less which met required du Pont specifications.

(2) The outside diameter and circumference of the bearing ring extension were checked. These measurements were taken near the top edge of the extension to determine if fit-up of bearing ring extension to the top tube sheet enclosure will be satisfactory. The O.D. measurement was taken across the assembly in three positions equally spaced using a stainless steel top graduated in 1/16". The circumferential measurement was taken using a special stainless steel tape graduated to read the actual diameter (average) of the bearing ring extension when placed around the girth. All measurements indicated that satisfactory fit-up could be accomplished between the bearing ring extension and bottom edge of the top tube sheet enclosure. Results were recorded and given to New York Ship.

(3) The same measurements listed in (2) above were repeated on the bottom edge of the top tube sheet enclosure to verify fit-up between the latter and bearing ring extension. (See Dwg. 6-3)

(4) Circumference of bearing ring was measured using a special stainless steel tape graduated to read the average diameter to the nearest 1/16".

(5) Inside diameter of bearing ring was measured at 0°, 45°, 90°, and 135° using a pre-set pin gage of suitable length.

(6) The 5 11/16" dimension across top surface of bearing ring was checked. (See Dwg. 6-3) This was measured using a 6" scale.

(7) Thickness of bearing ring between each of the twelve bearing pad cutouts on the bottom side of the bearing ring was checked. (Drawing thickness - $2\frac{1}{2}$"; see Dwg. 6-3). This measurement was taken using a 18" "C" micrometer frame with a dial indicator attached to a

adjustable spindle for recording thickness to the nearest .001". This gage was pre-set using a standard pin gage of suitable length.

(8) The distance from the bottom surface of bearing ring to weld preparation on bottom edge of expansion joint (Drawing size - $10\frac{1}{4}$") was checked with a 12" scale graduated in 1/64".

(9) The distance from top surface of bearing ring to weld preparation on bottom edge of expansion joint was measured using a small straight edge and combination square. (Drawing size - 12 3/4"; see Dwg. 6-3)

(10) The distance from the top surface of bearing ring to the top of the mid-section in the expansion joint was taken at 12 locations equally spaced around the periphery of the assembly (drawing size - 7 5/16"; see Dwg. 6-8)

(11) The O.D. and circumference of the expansion joint edge that fits to the top edge of the main tank was checked in a similar manner outlined in item (2) above.

(12) At this time New York Ship lay out men established and scribed X and Y axes on the bearing ring assembly. Du Pont inspectors re-trammed these lines in an identical manner used by New York Ship to determine if axes were 90° apart and in their correct position. Also, the accuracy of the axes transferred to the inside and outside of the bearing ring was checked.

All of the above measurements were found satisfactory by the du Pont Inspection Department and the assembly was released for further machining.

Three indexing slots were layed out 120° apart on the top side of the bearing ring by New York Ship layout men. (See du Pont drawing W-130953 for location and layout of three indexing slots). The assembly was then set up on a hydrotel milling machine and the three indexing grooves machined to drawing sizes. The slots were then inspected for size, orientation and diametral location. Orientation and diametral locations were taken using a stainless steel tape graduated in 1/16" and referencing from the previously established X and Y axes. The length, width and depth of each slot was measured using a 6" scale graduated in 1/64".

The above measurements were satisfactory and the assembly was turned bottom side up for finish machining the twelve rough machined bearing pad cut-outs on the bottom side of the bearing ring. The twelve bearing

cut-outs were machined to drawing size, dressed, and then the assembly was released to the du Pont Inspection Department for inspection. The following inspections were performed on each of the twelve bearing pad slots:

(1) Machined surfaces of slot were checked for finish (RMS) using a profilometer. All machined surfaces required 125 RMS micro-inch finish.

(2) Depth of the two "steps" in the slots was checked using a pair of depth micrometers. All measurements were referenced from the bearing ring face (top side). These measurements were held within $\pm$ .005".

(3) Orientation of each bearing pad slot was checked with respect to each other referencing from the X and Y axes. These measurements were taken using a stainless steel tape graduated in 1/16" and estimated to the nearest 1/64". For location of bearing pad slots with respect to the X and Y axes, see du Pont drawing W-130953.

(4) All other measurements were checked with a 6" scale graduated in 1/64".

The above measurements proved satisfactory and the assembly was released for fitting and welding to the top tube sheet enclosure.

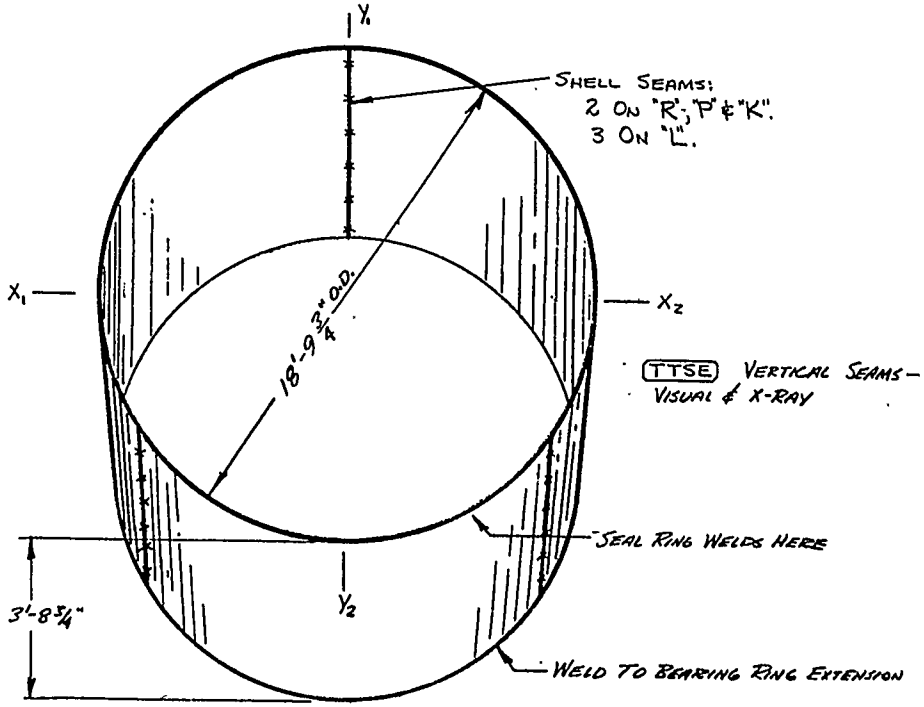
d. Fabrication and Inspection of Top Tube Sheet Enclosure

The type 304 stainless steel material for the top tube sheet enclosure was inspected for surface condition, embedded iron, mechanical defects, and dimensions. All plates were checked with a magnet to determine if the material was austenitic structure. Ferroxyl tests were performed at random on the plates to determine if any free iron was imbedded in the surface. Any indication of free iron was removed by grinding. All material inspected was accepted after minor repairs and released for top tube sheet enclosure fabrication.

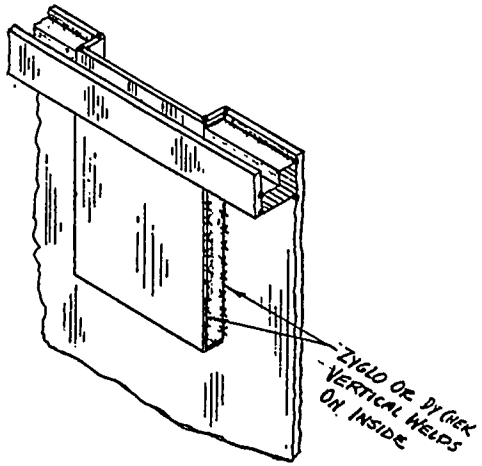
Two plates were flame cut, chipped, machined and rolled to make up the top tube sheet enclosure shell. Excess material was left on the top and bottom edges for final machining. The rolled half shell plates were then fit to a form or "spider jig" whose O.D. ($18' - 9\frac{1}{4}$") was the same as the I.D. of the tank shell. After fitting the two plate sections to the "spider jig", the two vertical seams were tack welded. For view of top tube sheet enclosure shell, see Dwg. 6-2.

Next, four lifting lug openings were laid out on the top portion of the shell. These openings were cut and chipped to layout. (See Dwg. 6-2 for view of lifting lug cutout in enclosure shell). For location of top tube sheet lifting lug cut-outs, see Dwg. 6-1. In addition, two overflow pockets and two nozzle openings were laid out on the shell. These were cut and chipped to layout. (See Dwg. 6-2, section B-B and C-C).

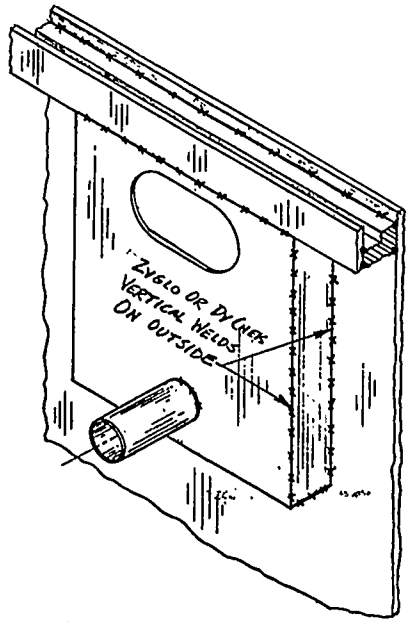
TOP TUBE SHEET ENCLOSURE - SECTIONS



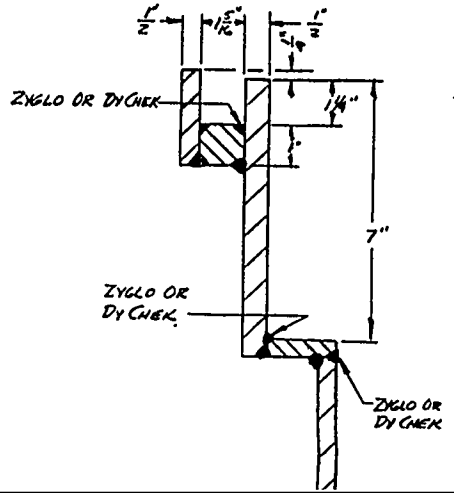
TOP TUBE SHEET ENCLOSURE - MAIN TANK - TOP SHELL

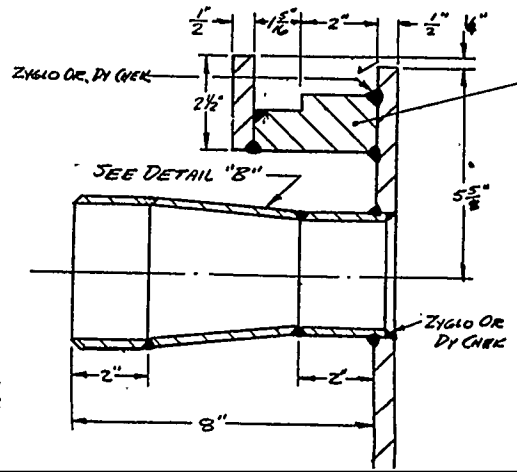


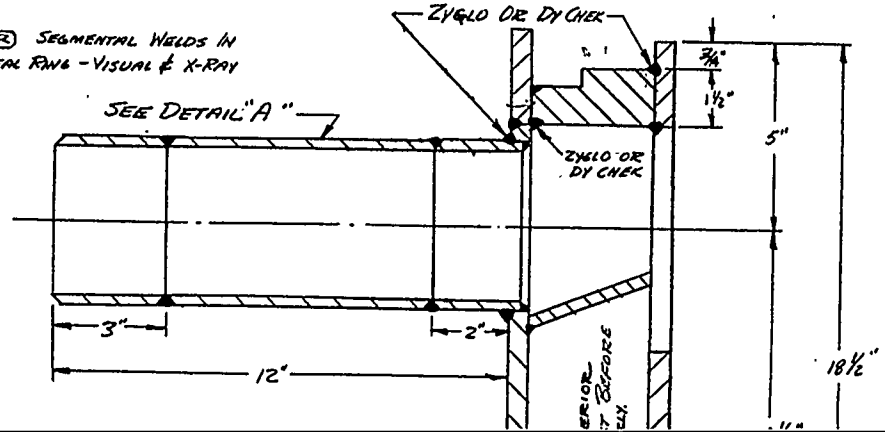
ISOMETRIC VIEW OF LIFTING LUG CUTOUT

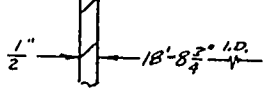


ISOMETRIC VIEW OF LARGE NOZZLE CUTOUT (LARGE NOZZLE REMOVED)

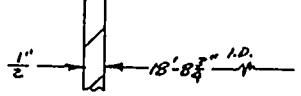








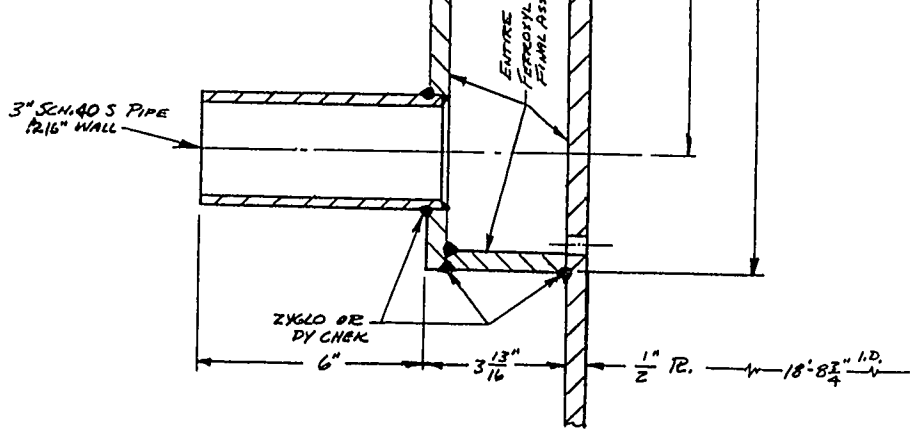
SECTION A-A
AT
LIFTING LUGS
SEE ISOMETRIC VIEW



SECTION B-B
AT
SMALL NOZZLES

NOTE:

1. ALL WELDS SUBJECT TO VISUAL INSPECTION, ADDITIONAL INSPECTIONS ARE LISTED.



SECTION C-C
AT
LARGE NOZZLES
SEE ISOMETRIC VIEW

M & E SECTION
GOV'T CONTRACTS

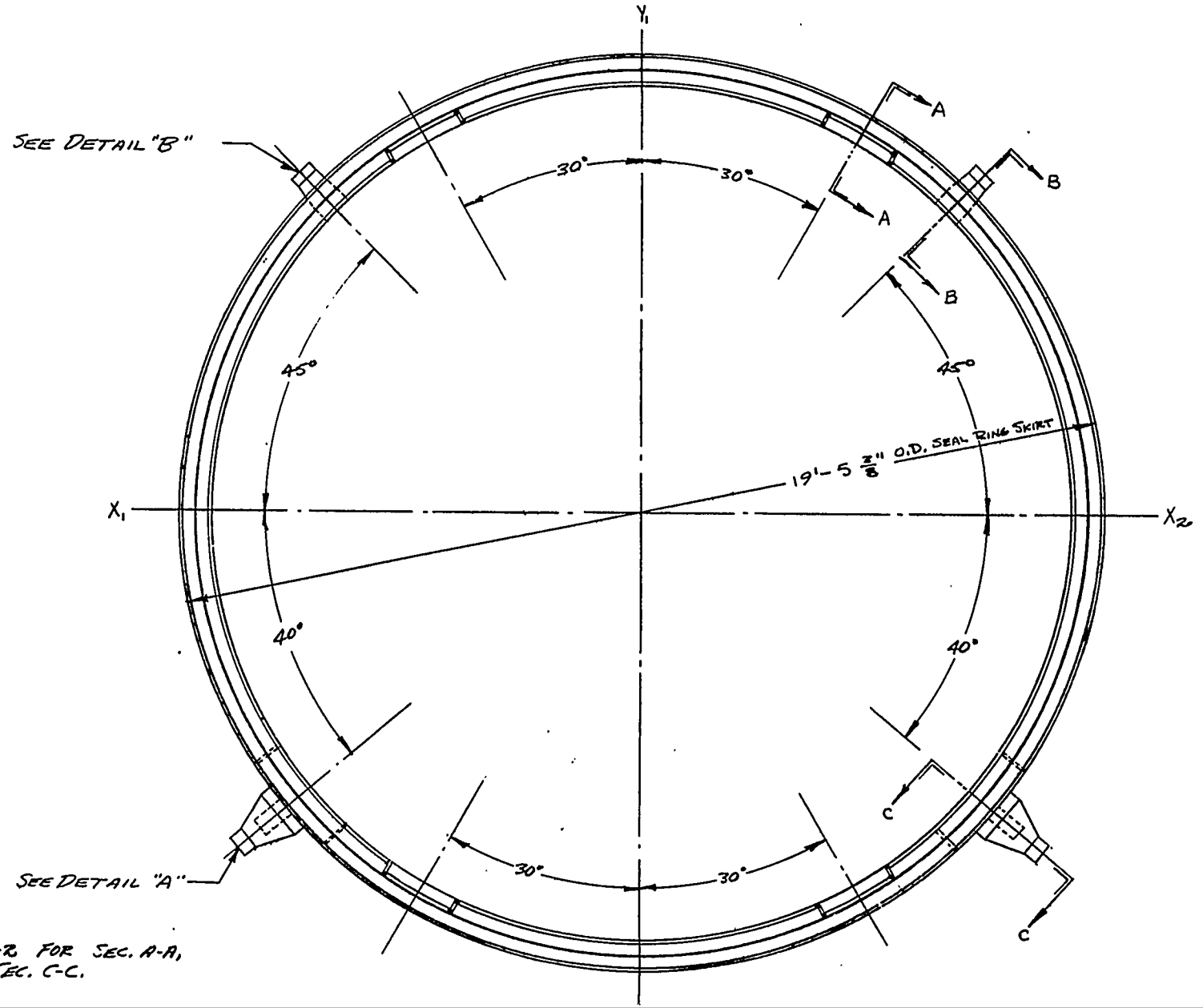
DWG. 6-2

[redacted]

BY: S.R. COCHRAN
FEB.-1958

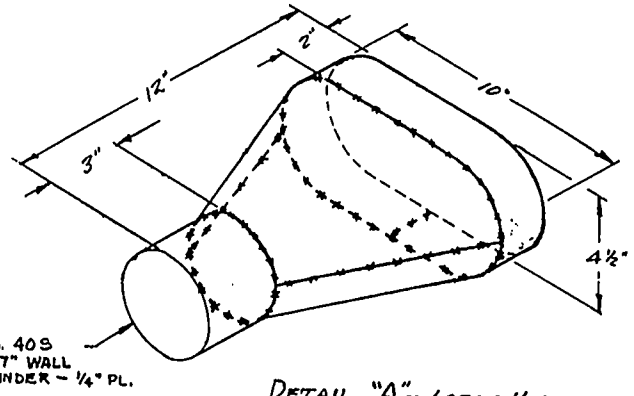
[redacted]

TOP TUBE SHEET ENCLOSURE



NOTE:
SEE DWG. G-2 FOR SEC. A-A, SEC. B-B, & SEC. C-C.

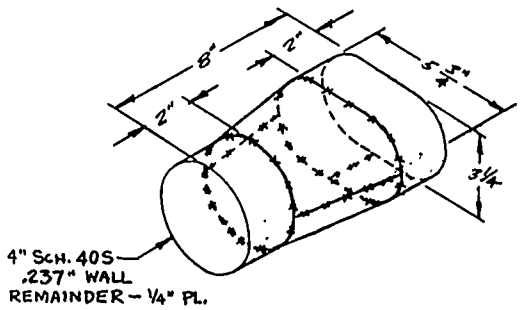
PLAN VIEW



DETAIL "A" – LARGE NOZZLES

TTSENL

ALL SEAMS – VISUAL & X-RAY



DETAIL "B" – SMALL NOZZLES

TTSENS

ALL SEAMS – VISUAL & XRAY

M & E SECTION
GOV'T CONTRACTS

DWG. 6-1

[redacted]

BY: S.R. COCHRAN
FEB.-1953

Four lifting lug assemblies and two overflow pockets were laid out on plate, pieces cut, fitted, and welded to form "pocket assemblies." Two large nozzles and two small nozzles were laid out from developed templates, material cut, formed to template and welded with pipe sections to form the four nozzles. (For isometric view of large and small nozzles, see Dwg. 6-1, details "A" and "B". For sectional view of large and small nozzles, see Dwg. 6-2, sections B-B and C-C). All welding on the inside and outside of the four nozzles were ground and then visually inspected for cracks, porosity, undercutting and other mechanical defects. Necessary repairs were made, re-inspected and released for x-raying. Nozzle seams were x-rayed, radiographs examined, and necessary repairs made. Next, the nozzles were sand-blasted, acid washed and ferroxyl tested. All inspections proved satisfactory and the nozzles were released for assembling to the top tube sheet enclosure.

The four lifting lug assemblies were fit and tack welded in their proper position. Also, the two overflow pocket assemblies were fit and tack weldedin place.

The top tube sheet enclosure was then bolted to an 18' welding position in order that all welding be done in a down-hand position. Tack welds were chipped, wire brushed, and ground as required, and all joints were manually "aircomatic" step welded according to the welding procedure adapted for this job. During the above operations, a visual inspection by du Pont inspectors was maintained to insure quality in welding.

After all welding had beencompleted, it was ground and then visually inspected. Dwg. 6-2 illustrates pictorially where all visualy inspections were made. Cracks, porosity, undercutting and other mechanical defects were chipped or ground out of the defective welding, re-inspected and accepted. (NOTE: No dy-cheking or zy-glowing of welding as shown in Dwg. 6-2 was performed on "R" TTS enclosure. This was started on "P" and subsequent units). Next, the two vertical shell seams were x-rayed, radiographs examined and necessary repairs made.

The top tube sheet enclosure was removed from the welding positioner and placed on a level platen until the seal ring was fabricated. The following paragraphs cover this phase of fabrication and inspection.

Before the seal ring was laid out and fabricated to size, the circumference of the top tube sheet enclosure was measured to determine what size to machine the bore of the seal ring.

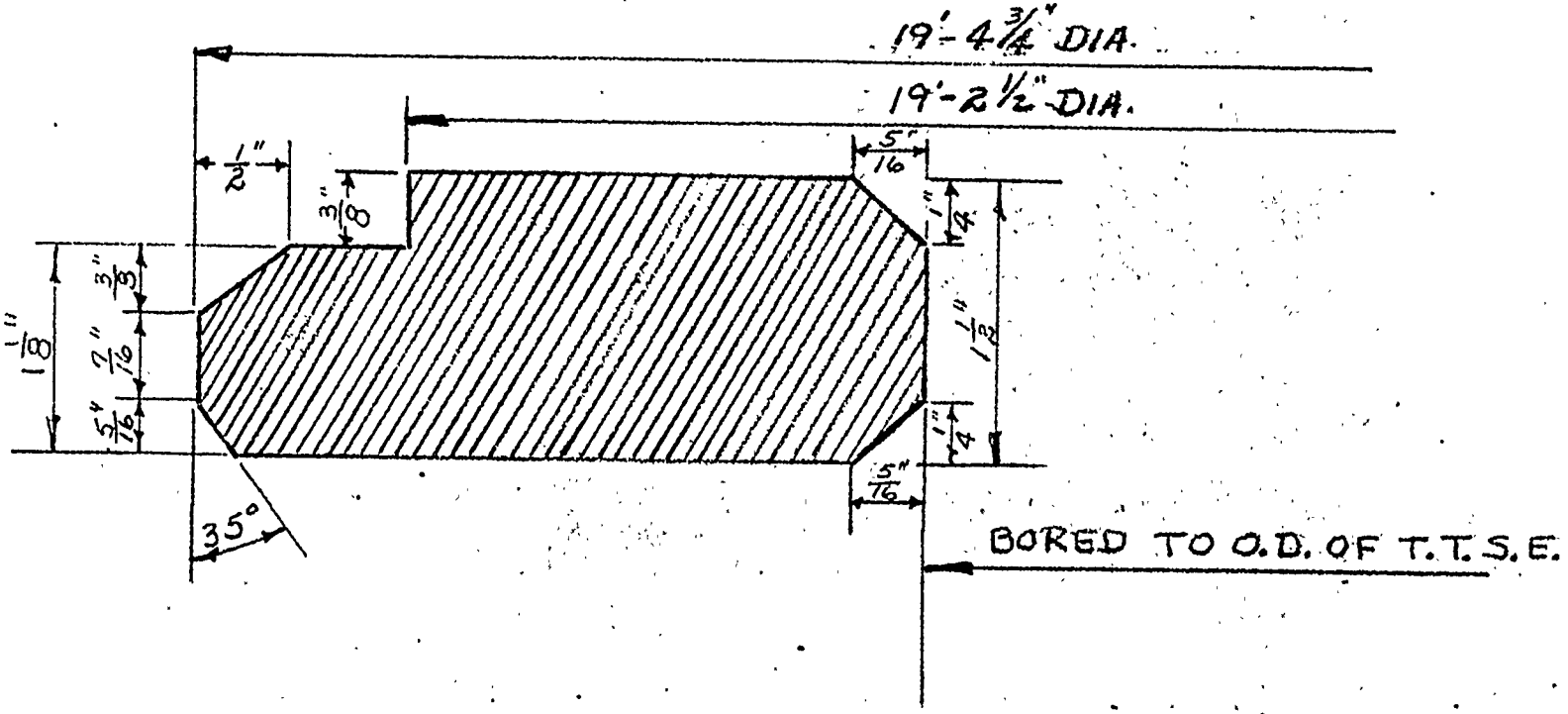
This measurement was taken just below the large and small nozzle cutouts using a special tape to read the O.D. of the shell when wrapped around the shell circumference. This O.D. was recorded and given to a New York Ship machinist for boring the seal ring to size for fitting and welding around the O.D. of the enclosure shell.

Six lengths of 1½" x 4" bar stock were chipped on the ends for double Vee butt joints. A section was made by clamping and fitting two lengths to a level platen and butt welding the two together. Two additional sections were made in a similar manner. All welding was done using manual Aircomatic welding machines. After this, the butt joint in each of the three sections was chipped, ground, and weld defects repaired. The three sections were then heated to a cherry red and formed to a semi-circular layout using moon bars and pins on a furnace slab. After forming the sections, the curvature was checked with a radius template. Next, both butt joints on one section were chipped and then clamped to layout on a slab. The two other sections were fit to layout in a similar manner.

After fitting the three sections to form a ring, the three double Vee butt joints were welded using manual Aircomatic welding machines. The butt joints were chipped, ground and then x-rayed. Radiographs were examined by du Pont inspectors and necessary repairs made. It was then recontoured, flattened and set up on the 20' boring mill for rough machining. The O.D. of the seal ring was machined ¼" full on diameter to allow additional metal for shrinkage caused from welding the gasket retaining bar to the O.D. of the ring at a later time. Next, the inside fillet weld preparation on the top edge of the seal ring (where the gasket retainer bar was to be welded) was finished machined to size. Also, the fillet weld preparation on the opposite edge of seal ring (where the ring was welded to the O.D. of the top tube sheet enclosure) was machined to finish size. Weld preparations on the top edge of the seal ring were machined to drawing sizes at this time in order to insure that a full 1/4" fillet weld would be left after finish machining the top face of the seal ring. (See Sketch #10) The seal ring was then removed from the 20' boring mill and set aside until the gasket retainer bar was fabricated.

Four segments were formed from plate, fitted, and welded to make up the gasket retainer bar. The

SECTION OF SEAL RING



SEAL RING FOR TOP TUBE SHEET ENCLOSURE
SHELL - MACHINING BEFORE WELDING

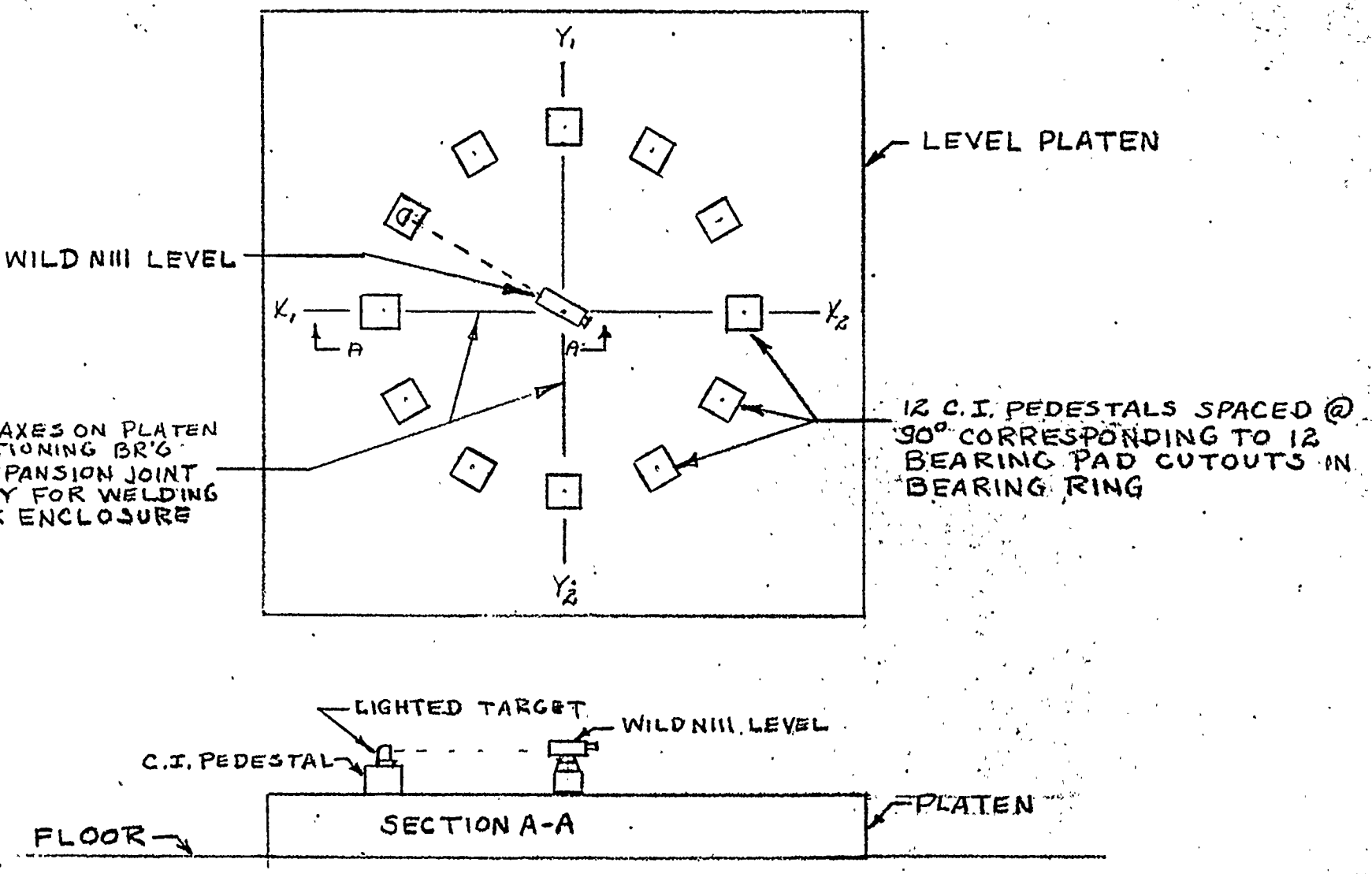
SKETCH #10

seal ring was then clamped to a level platen, and then the gasket retainer bar was fit and tack welded to the outside diameter of the seal ring. The gasket retainer bar was then fully welded to the seal ring; turning the assembly was required to balance welding. Dwg. 6-2 illustrates pictorially where these welds were made. The assembly was placed back on the 20' boring mill and the I.D. of the seal ring was bored to the diameter of the top tube sheet enclosure (The diameter of the top tube sheet enclosure was previously measured by inspectors, and the results were given to a New York Ship machinist for boring the seal ring to fit the TTS enclosure. This was covered in an earlier paragraph in this section). After boring out the seal ring to the correct I.D., du Pont inspectors checked the I.D. at three locations equally spaced with respect to each other. The seal ring assembly was removed from the 20' boring mill and set up on a level platen. At this time, four cutouts in the seal ring assembly were laid out to clear the lifting lug cutouts welded to the top tube sheet enclosure. (See Dwg. 6-2, Section A-A) After this, the seal ring assembly was set up under drill presses and the cutouts drilled to layout. Next, the assembly was removed from the drill presses, set up on a level platen and the four lifting lug cutouts chipped to layout, dressed and beveled for weld preparation. The top tube sheet enclosure was set up on a level platen and the seal ring assembly was tried for fit. After the seal ring was properly fit to the O.D. of the T.T.S. enclosure, it was removed and set aside until the TTS enclosure was welded to the bearing ring and expansion joint assembly.

e. Welding of Top Tube Sheet Enclosure to Bearing Ring and Expansion Joint Assembly

The top tube sheet enclosure and bearing ring were moved to a level platen where preparations were made for welding the two assemblies together.

First, twelve cast iron pedestals which had been previously machined parallel were arranged in a circle on a platen and bolted down in such a fashion that they would support the bearing ring directly under its bearing ring cutouts. (See Sketch #11) The pedestals were shimmed on the bottom side until all were in the same plane. The relative height of the cast iron pedestals with respect to each other were checked with the Wild NIII precision level and target before and after all shimming was completed. In addition, the top of each machined pedestal was checked to insure that all points were in the same plane. This was checked by placing a target at the four corners and middle of the pedestal and noting any differences in elevation using the Wild NIII precision level.



LAYOUT FOR SUPPORTING BR'G RING ASS'Y. & TANK ENCLOSURE DURING WELDING

SKETCH #11

After the twelve pedestals were leveled, the bearing ring and expansion joint assembly was placed (top side up) on the pedestals and the X and Y centerline on the latter matched to a similar set of axes scribed on the platen. When this alignment was satisfied, the bearing ring was clamped in position. Next, the top tube sheet enclosure was lowered in position and its X and Y axes (previously established by NYS for alignment purposes only) were matched to a similar set of axes on the bearing ring and extension. After this, the top tube sheet enclosure was locked in position to the bearing ring with welded stainless steel clips. The TTS enclosure seal ring was then lowered in position and set parallel and to its correct height from the bearing ring. Next, it was tack welded to the circumference of the tank enclosure shell.

The bottom edge of the top tube sheet enclosure was tack welded to the bearing ring extension. Before fully welding this joint, the following inspections were made by du Pont inspectors:

[1] Verticality of the TTS Enclosure. This was measured using a box level held against the tank enclosure shell. This check was made at four places equally spaced around the circumference of the tank enclosure shell and found satisfactory.

[2] The clearance between the bearing ring and pedestals was checked using feeler gages. The maximum size feeler gage that can be inserted should be 0.003". All results indicated that this requirement was maintained.

The joint between the bearing ring extension and bottom edge of the tank enclosure shell was fully welded. After this, another check with the Wild NIII precision level was made. The instrument was set up in the middle of the tank enclosure shell and level readings were taken. Readings were taken at 12 points on the top side of the bearing ring. These twelve points were directly over the areas where the bearing ring was resting on the 12 cast iron pedestals. All measurements indicated that the top face of the bearing ring was still in the required plane.

The butt weld where the bearing ring extension and bottom edge of the tank enclosure shell join was dressed, x-rayed, radiographs examined and repairs made. In addition, the distance from horizontal welds on bearing ring

and horizontal and vertical welds on expansion ring to bearing pad slots in bearing ring were measured. (See Exhibit 6 for results)

Next, the height of the seal ring was checked referencing from the top surface of the bearing ring, and it was found to be 3/32" low. The tack welds joining it to the TTS enclosure were chipped loose and the ring was positioned and leveled to its correct height with respect to the bearing ring. After this, the seal ring was fillet welded on both sides joining it to the tank enclosure shell. (See Dwg. 6-2, Section B-B for location of circumferential fillet welds)

After all welding was completed, the following inspections were again repeated:

[1] The level of the bearing ring was checked at the designated 12 points with the assembly unclamped from the platen.

[2] TTS enclosure was checked for verticality at twelve locations equally spaced around the circumference of the tank enclosure using a box level.

[3] The clearance between the bearing ring and cast iron pedestals was checked using feeler gages. (See Exhibit #7).

The following weld inspections were made after welding the seal ring to the tank enclosure shell.

[1] Inside top circumferential weld. Visually examined for porosity, cracks, undercutting, and other mechanical defects. Final condition of weld - as welded with some grinding to remove defects.

[2] Remaining three circumferential welds; visual examination only. Final condition of welds: (a) inside bottom - as welded; some grinding to remove defects. (b) Outside top - ground flush. (c) Outside bottom - as welded; some grinding to remove defects. (d) Segmental seams in seal ring - machined flush; visual and x-ray examination.

With the TTS enclosure, bearing ring and expansion joint assembly still resting on the 12 machined blocks on a level platen, the previously established X and Y axes on the bearing ring were transferred to the outside of the assembly. Sketch #12 illustrates pictorially how this was accomplished. The theodolite was set up near the center of the assembly underneath the tank enclosure's supporting spider (not shown in sketch). As shown in the sketch, sight lines were

EXHIBIT #6

E. I. DU PONT DE NEMOURS & CO., INC.

Construction Division

[redacted]ON

Report Number 123-R

CC: C. E. Buckley, F.P.M.
R. K. Mason, F.P.M. - SRP (3
H. L. Bunker - J.G. Brewer
J. G. Brewer
H. B. Gage
F. C. Breuninger
A. H. Hughes
C. W. Dunn
File

July 11, 1952
New York Ship - Camden, N.J.

FIELD INSPECTOR'S REPORT

TO C. J. VEITH - M & E FILE

FROM A. J. Piatek - C. H. Heist DATE July 9, 1952

PROJECT NO. 8980 PLANT Savannah River ORDER NO. AXC-167½

EQUIPMENT Bearing Ring and Expansion Ring EQ.PC.NO. 150-R

DRAWING NOS. W-130953 JOB RATING

VENDOR New York Shipbuilding Corporation LOCATION Camden, N. J.

Scope: To measure the distance from horizontal welds on bearing ring and horizontal and vertical welds on expansion ring to bearing pad slots in bearing ring. (Measurements taken July 9, 1952).

Procedure: Measurements were taken with an 8 ft. steel tape. The distance, the horizontal weld is from the slot, is a chord measurement taken from outer edge of weld to the outer edge of the center of the bearing pad slot. The distances, the horizontal and vertical welds on expansion ring are from the slots are ARC measurements taken on the outer circumference of bearing ring. from welds to center of slots.

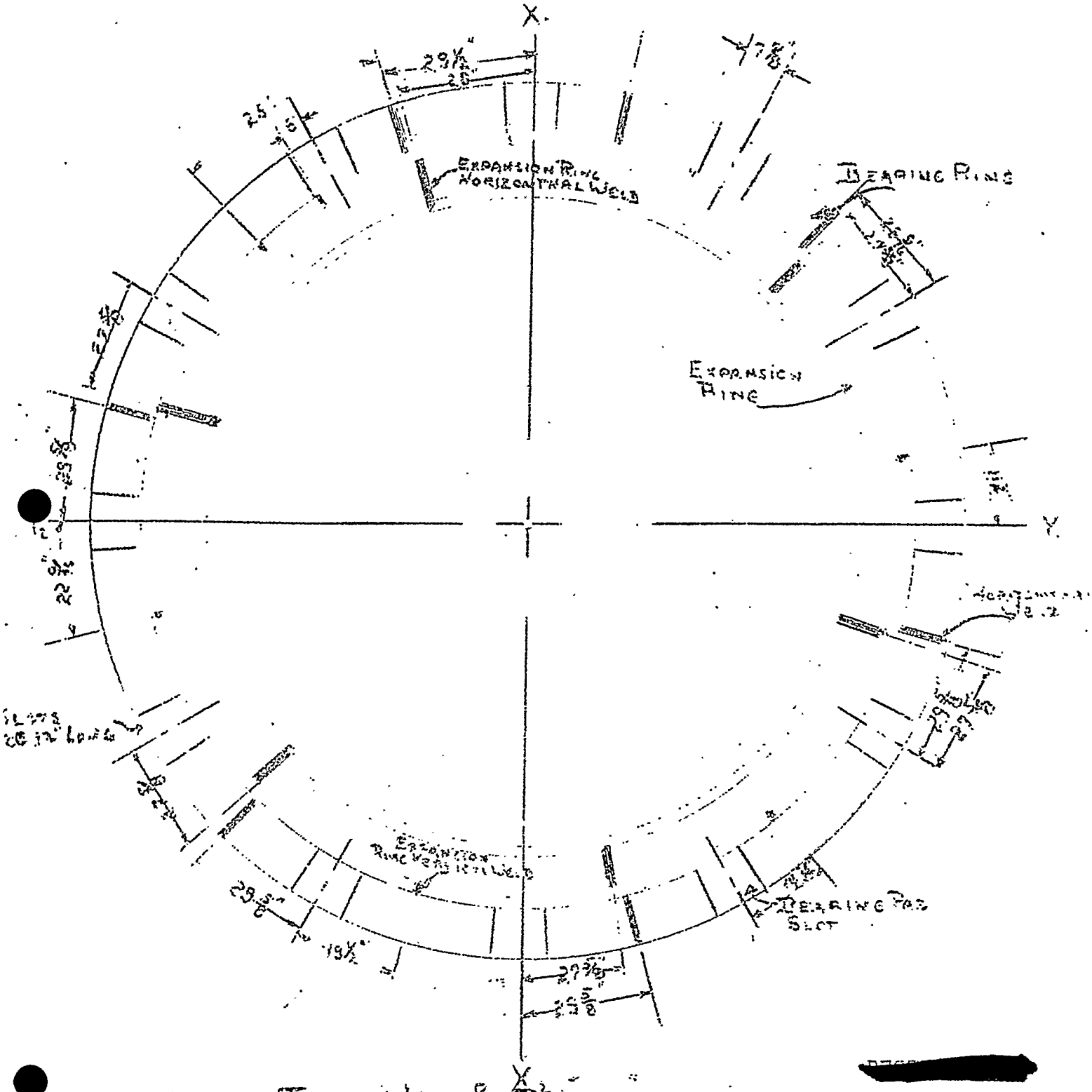
Results: Results on attached sheet.

lmw
Attach.

[redacted]

"R" Unit Bearing Ring & Expansion Ring

Patented Heist
Taken 7-9-52



Measurement Taken With Steel Tape

Horizontal Weld On Bearing Ring Is Circumference Measurement From Outer Edge Weld To Outer Edge Of Center Of Bearing Pad Slot

Welds (Horizontal & Vertical) On Expansion Ring Are Arc Measurements On Outer Circumference Of Bearing Ring Taken From Weld To Center Of Bearing Pad Slot

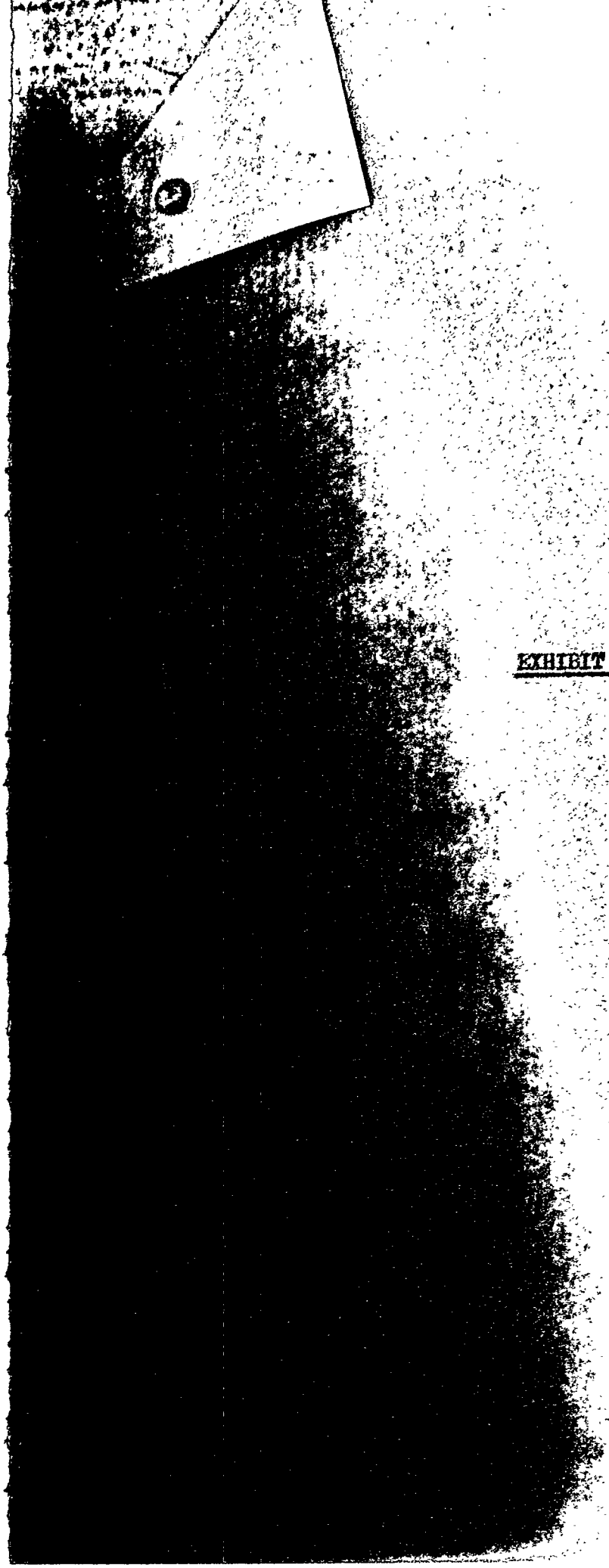


EXHIBIT #7

E. I. DU PONT DE NEMOURS & CO., INC.

Construction Division

[redacted]

CC: C. E. Buckley, F.P.M.
H. L. Bunker - J. G. Brewer
J. G. Brewer
H. B. Gage
F. C. Breuninger
R. K. Mason, F.P.M.-SRP (3)
~~A. H. Hughes~~
C. W. Dunn - File

(New York Ship - Camden, N.J.)

7-1

This material contains information affecting the national defense of the United States within the meaning of the espionage laws, Title 18, USC, Secs. 793 and 794, the transmission or revelation of which in any manner to an unauthorized person is prohibited by law.

FIELD INSPECTOR'S REPORT

TO C. J. VEITH - M & E FILE

FROM S. R. COCHRAN DATE May 28, 1952

PROJECT NO. 8980 PLANT SAVANNAH RIVER ORDER NO. AXC 167½

EQUIPMENT BEARING RING EQ.PC.NO. 150-R

DRAWING NOS. W-130953 JOB RATING

VENDOR NEW YORK SHIPBUILDING CORPORATION LOCATION CAMDEN, N. J.

Purpose: The following report pertains to measurements made on the twelve (12) bottom bearing surfaces of the bearing ring. Measurements were taken to determine if all twelve bearing surfaces were in the same plane.

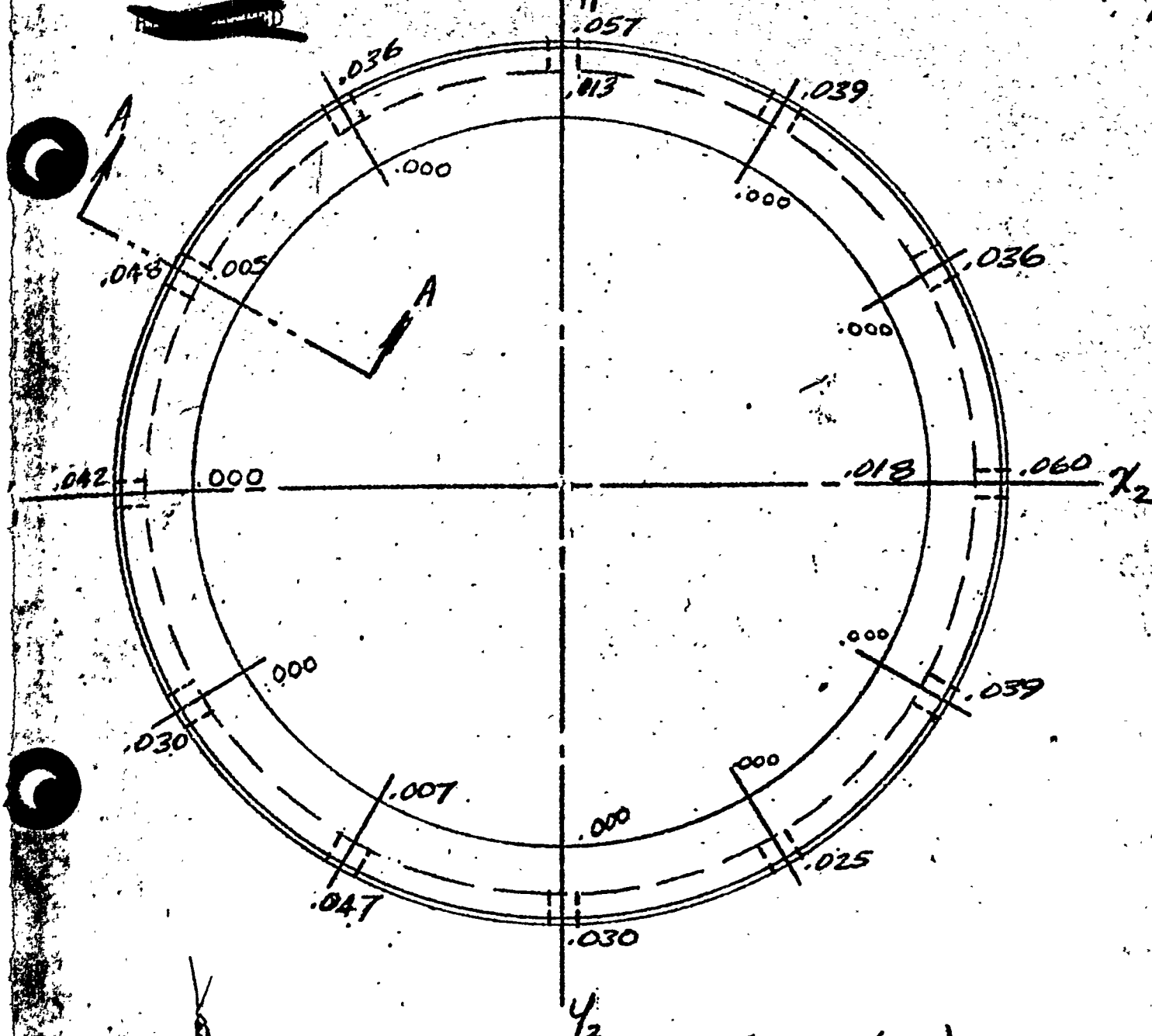
Procedure: Measurements were made after machining of the bearing surfaces and the following weldments had been made:

1. Bearing ring to expansion ring.
2. Bearing ring to top special enclosure sheet.

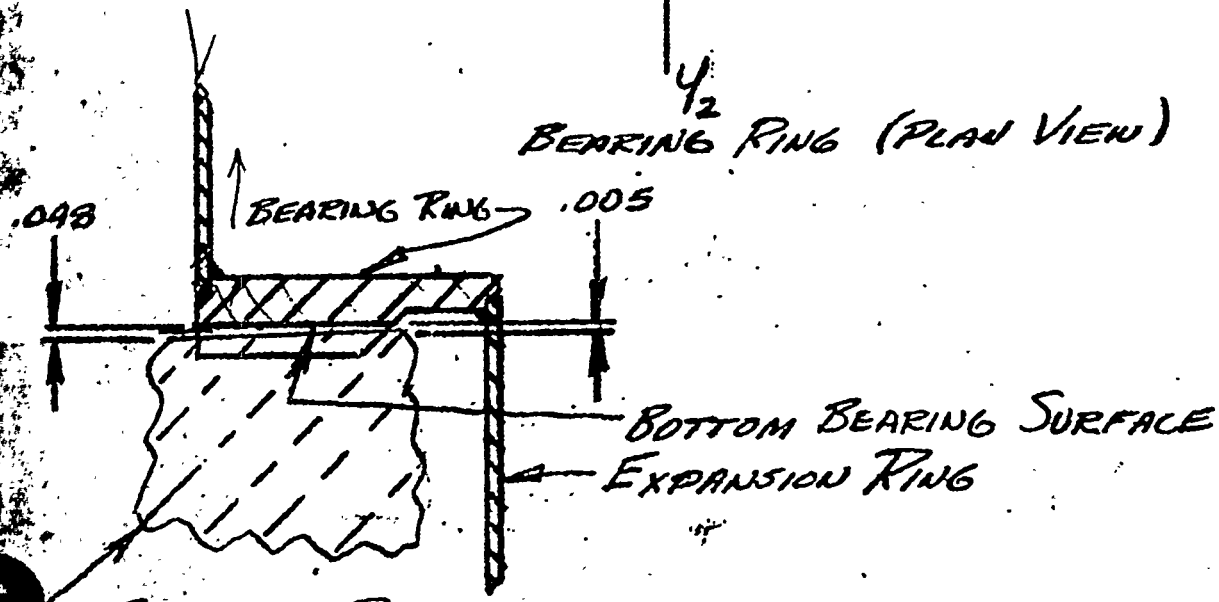
With the above fabricated as a unit and the whole supported on machined parallel blocks, which in turn were resting on a level, flat, platen, feeler gages were inserted between the parallel blocks and bottom bearing surfaces to determine the clearance as shown on the attached sketch.

Results: See attached sketch.

[redacted]

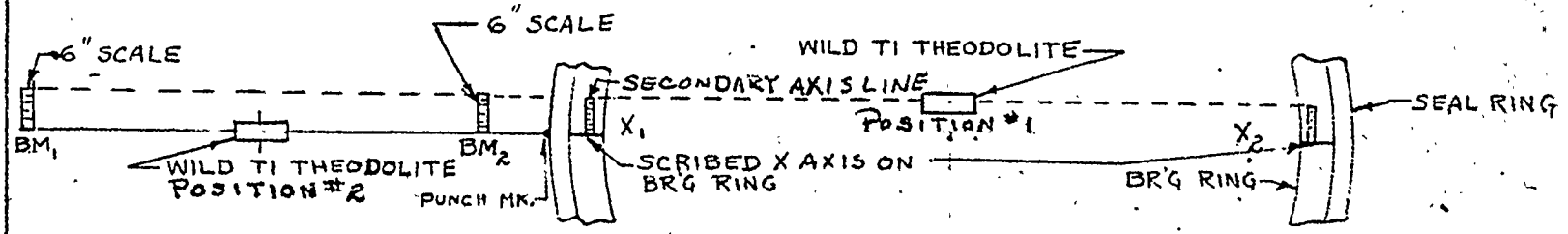


BEARING RING (PLAN VIEW)

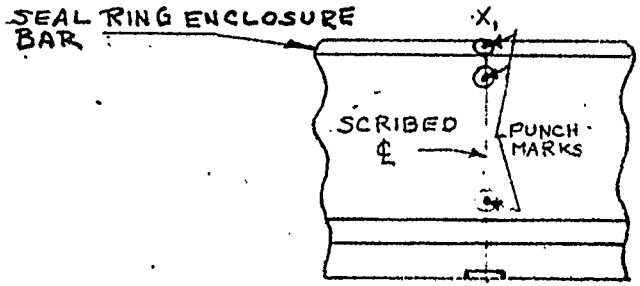


SECTION A-A

SET UP FOR TRANSFERRING CENTERLINES FROM BR'G. RING TO OUTSIDE OF TANK ENCLOSURE

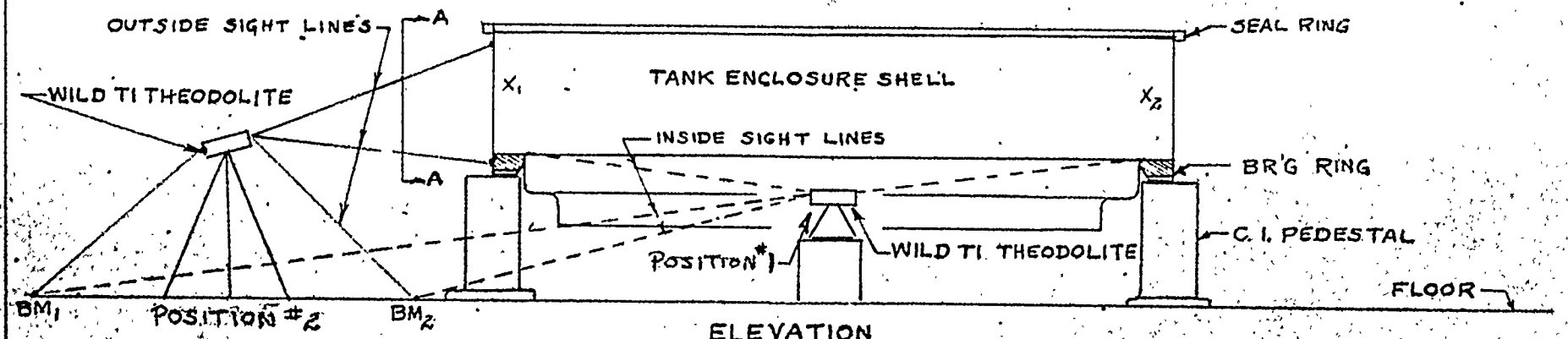


TOP VIEW



SECTION A-A

PEDESTALS WERE SET DIRECTLY UNDER AXIS LINES ON BEARING RING. PEDESTALS OBSTRUCTED SIGHT LINES FROM INSIDE TO OUTSIDE, THEREBY MAKING IT NECESSARY TO OFF-SET X & Y AXES FOR TRANSFERRING AS SHOWN IN TOP VIEW. SAME PROCEDURE WAS REPEATED ON X_2, Y_1 & Y_2.



ELEVATION

SKETCH #12

J.R Stewrat

obstructed from the inside, thereby necessitating the set-up illustrated in the sketch. The instrument was "walked in" on the X-X axis by sighting on the edge of a 6" scale and then plunging the instrument and sighting a 6" scale 180° opposite the first point. This procedure was followed until the instrument was adjusted exactly on the secondary axis. With the instrument aligned with the secondary axis on the bearing ring (position #1), the latter's axis was transferred to the floor at two points, BM_1 and BM_2 (Sketch #12). These points were center punched in the floor. Extreme care was taken to insure that the bench marks (BM) were established on an area in the floor foundation that was permanent so that no possible movement of the bench marks could take place. When this procedure was completed on the X and Y axes, du Pont inspectors moved to position #2 outside the assembly and "picked up" the points that had just been put in the floor. The theodolite was "walked in" on these points in a similar manner outlined above. Next, these points were transferred to the outside of the seal ring enclosure bar and a point center punched near the top edge of the enclosure bar. (See Sketch #12, Section A-A) Also, two additional points were established on the tank enclosure shell. After this, a line was scribed from the top point to the bottom point on the tank enclosure shell. New York Ship layout men then transferred the bottom point on the tank enclosure shell to the tank expansion joint. This procedure was repeated at X_2, Y_1 and Y_2 (NOTE: When axis lines are transferred and punched marked on the outside of the seal ring and tank enclosure, extreme care should be taken to insure that these marks are encircled with an "O" stencil mark. This is necessary so that there can be no mistaken identity of the axis lines)

f. Machining of Seal Ring

After axis lines had been established on the outside of the tank enclosure, it was placed on a 20' boring mill (top side up) for finish machining of the seal ring. The assembly was set up on the mill in an identical manner shown in Sketch #11. It was known that welding had warped the bearing ring to such a degree that the outer part of the bearing ring face on the bottom side was approximately .050" higher than the inner face. Exhibit #7, Section A-A, illustrates this condition. This same condition existed when the assembly was in position and resting on the 12 pedestals clamped to the 20' boring mill table. A meeting was held by the du Pont Inspection Department and New York Ship in regards to this problem. It was decided to pull the bearing ring face flush (or as near as possible) to the top faces of the 12 cast iron pedestals using large staybolts to hold the bearing ring in a level plane. Since the bearing ring when in an operating position in the field would be subjected to the weight of the top tube sheet assembly and plenum chamber, it was postulated that the warped bearing ring would straighten itself with this additional weight added. The out-of-plane condition of the bearing ring was accepted by the du Pont Inspection Department and the bearing ring was pulled down as close as possible to the plane of the 12 machined cast iron pedestals. The tank enclosure gasket seal ring

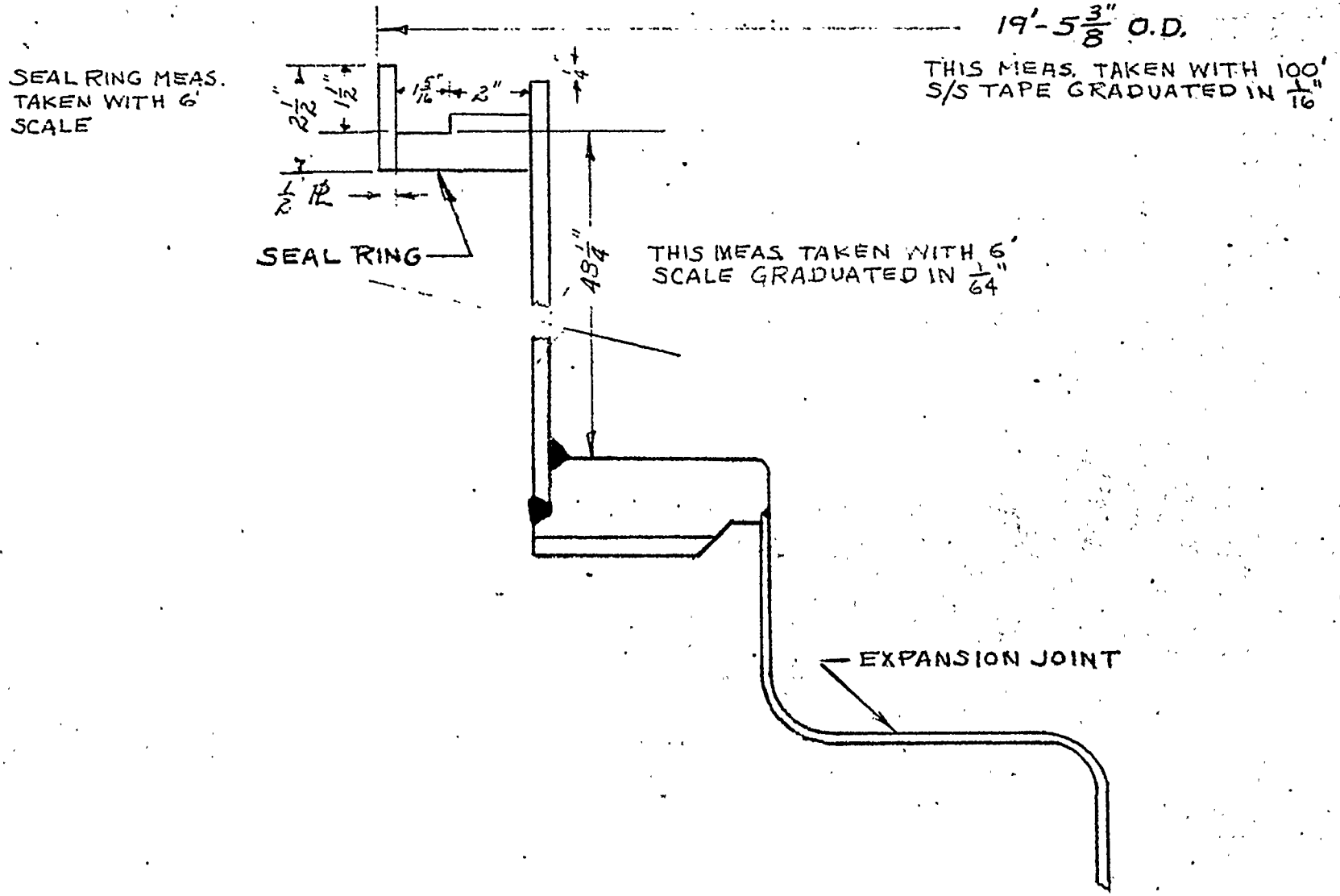
was machined to drawing size. After machining, the dimensions shown in Sketch #13 were checked by du Pont inspectors and accepted.

Next, the tank enclosure was removed from the 20' boring mill and preparations were made for cleaning the assembly. First, the "spider jig" on the inside of the tank enclosure was removed and the inside and outside of the assembly was ground and dressed. After this the assembly was acid washed and then ferroxyl tested by du Pont inspectors. Some places in the surface of the enclosure were found to have iron inclusions and other mechanical defects. These spots were re-ground, acid washed, re-inspected, ferroxyl tested and found satisfactory. The "spider jig" was re-installed and preparations were made for welding the assembly to the main tank section.

g. Fitting and Welding of Expansion Joint to Main Tank Shell

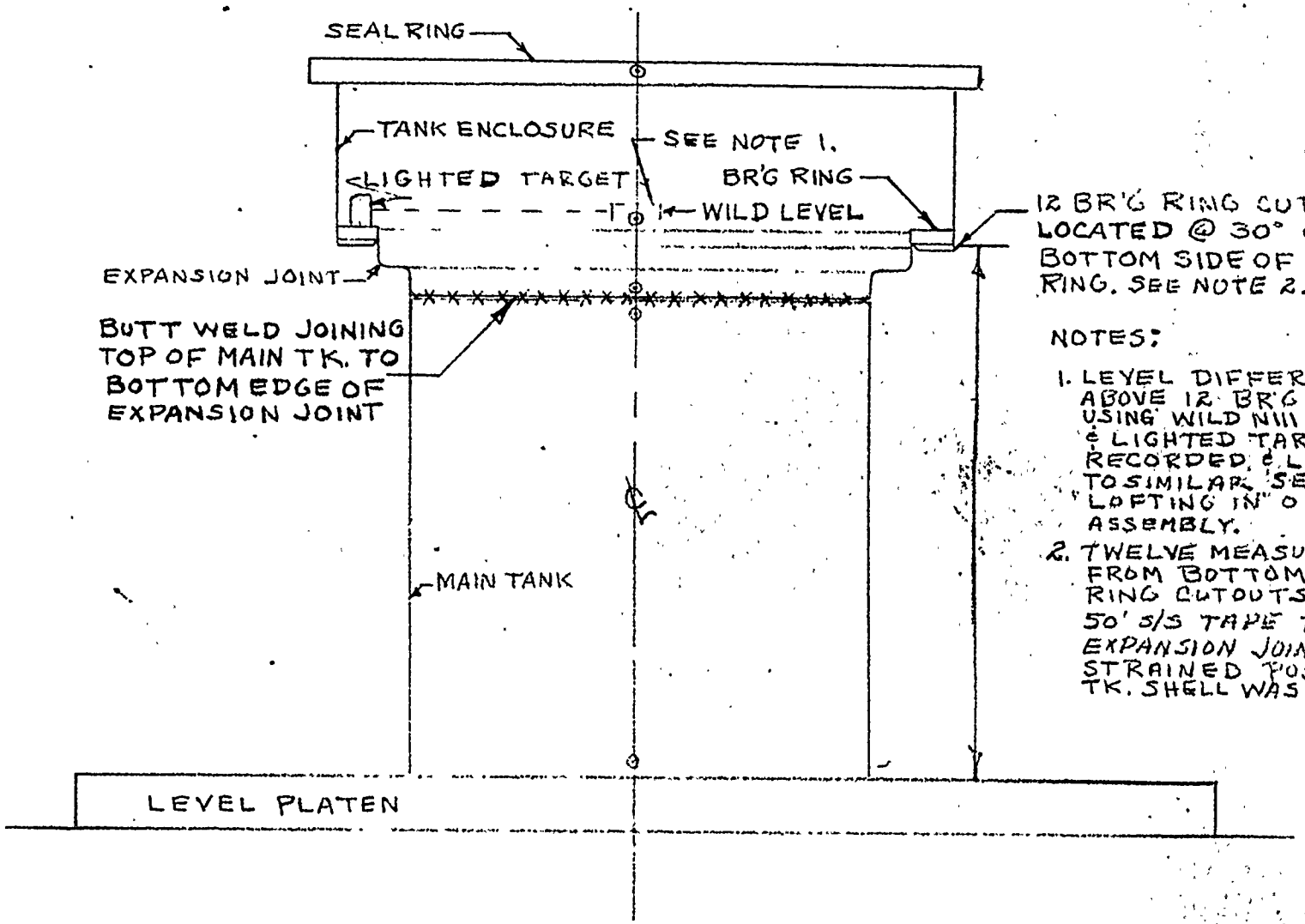
The O.D. and centerlines of the main tank shell were laid out on a level platen by New York Ship layout men. The main tank shell was then placed over the layout lines and its X and Y axes lined up with those on the platen. After aligning the tank shell axes to correspond to platen axes, eight stainless steel blocks were tack welded to the O.D. 2" from the bottom of the tank for clamping the tank to the platen. Next, the position of the vertical butts of the tank shell, expansion joint and bottom tube sheet assembly were laid out on the platen and rotation of the weld butts checked to conform to the A.S.M.E. code. After this, the tank enclosure was placed on top of the tank shell for orienting, fitting and tack welding of the expansion joint to the tank shell's top edge. The X and Y axes on the tank enclosure and expansion joint were matched to the tank shell X and Y axes. With the tank enclosure properly aligned and level, the expansion joint was tack welded to the tank Shell's top edge. Before fully welding the joint, level readings were taken on the bearing ring as previously described in this section to determine if the bearing ring was reasonably level. Also, the distance from the bottom side of the twelve bearing ring cutouts to the platen was measured with a 50' S/S tape to determine if the expansion joint was in an unstrained position. (See Sketch #14) After all measurements were found to be satisfactory, the butt joint between the expansion joint and tank shell was fully welded using manual Aircomatic welding machines in accordance with the welding procedure adapted for this job. All welding on the inside and outside was ground, visually inspected for cracks, porosity, undercutting and other mechanical defects. Necessary repairs were made and then the joint was x-rayed 100%. Radiographs were examined by du Pont inspectors and necessary repairs made.

After all welding was completed, the level of the bearing ring was again checked to determine if it had moved as a result of welding. Also, the distance from the 12 bearing ring cutouts to the



BEARING RING - EXPANSION JOINT - TANK SHELL ASSBL.

SKETCH #13



NOTES:

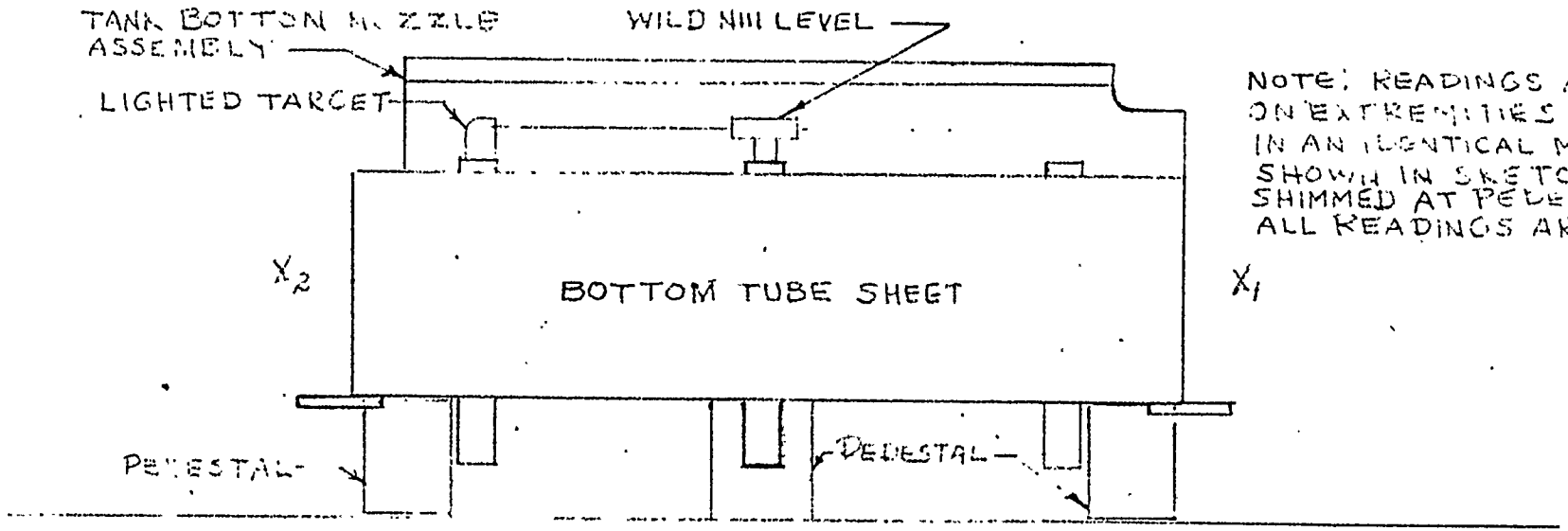
1. LEVEL DIFFERENTIALS TAKEN ABOVE 12 BR'G RING CUTOUTS USING WILD N111 PRECISION LEVEL & LIGHTED TARGET. LEVEL READINGS RECORDED & LATER COMPARED TO SIMILAR SET TAKEN AFER "LOFTING IN" OF MAIN TK. TO B.T.S. ASSEMBLY.
2. TWELVE MEASUREMENTS TAKEN FROM BOTTOM SIDE OF BR'G RING CUTOUTS TO PLATEN USING 50' S/S TAPE TO DETERMINE IF EXPANSION JOINT WAS IN AN UN-STRAINED POSITION. LENGTH OF TK. SHELL WAS CUT TO FIN SIZE.

SKETCH #14

platen was again checked to determine if the proper tank shell elevation was still maintained and if the bearing ring was in an unstrained position. The above level differentials taken on the bearing ring and the distances taped from the bearing ring cutouts to the platen were recorded and later used for fitting and leveling up the assembly to the bottom tube sheet. The assembly was then released for fitting to the bottom tube sheet assembly.

h. Orientation and Fit-up of Main Tank and Enclosure to Bottom Tube Sheet

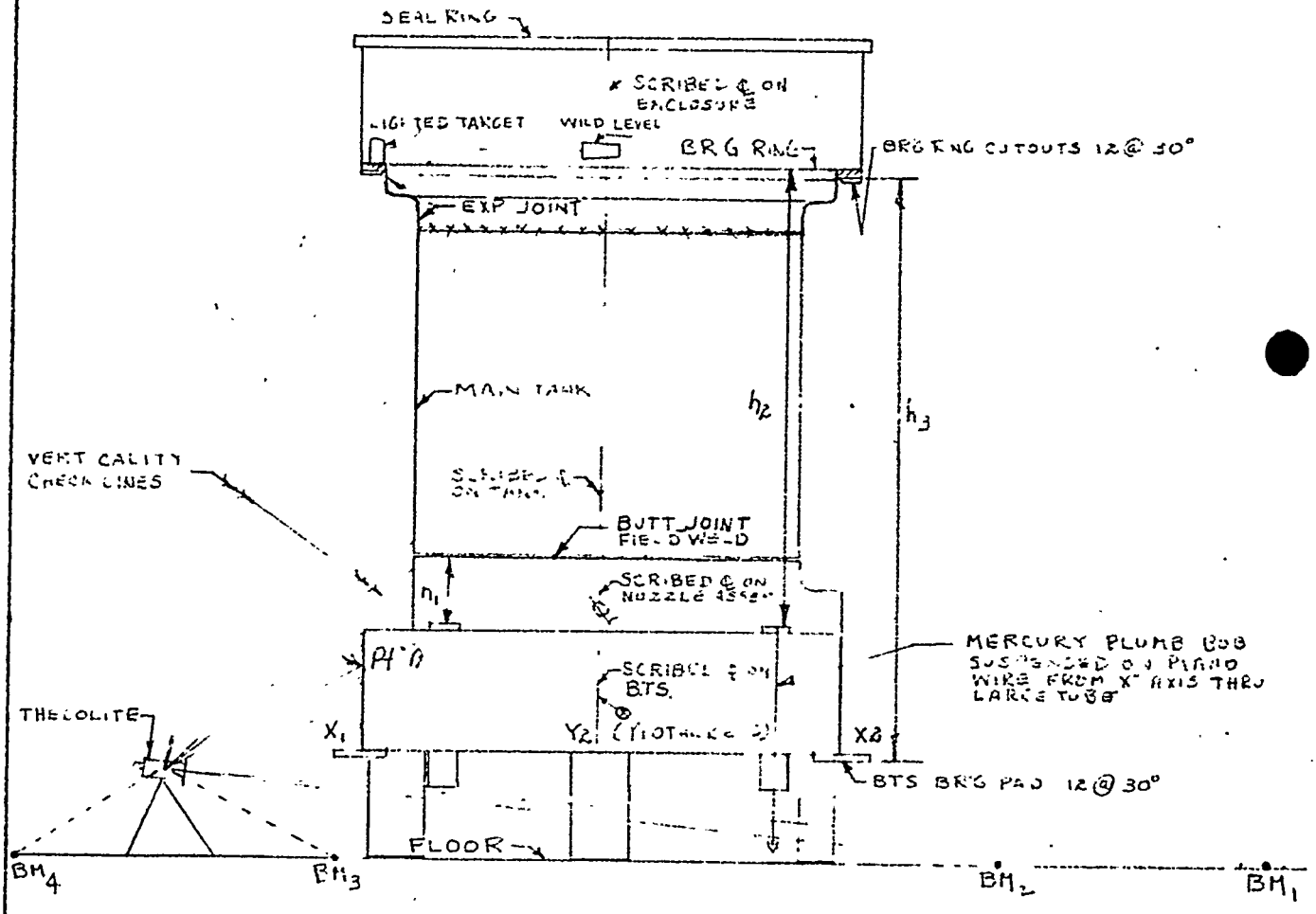
The bottom tube sheet assembly was leveled within 0.008" using the Wild NIII precision level and lighted target. (See Part III-IIJ) Sketch #15 illustrates pictorially how this was accomplished. Next, the tank shell assembly was positioned over the bottom tube sheet and the X and Y axes on the bearing ring expansion joint, and tank shell were matched to the X and Y axes scribed on the tank bottom nozzle assembly. (See Sketch #16) (See Part VII, Section III, item 19). This was accomplished by rotating the main tank clockwise or counter-clockwise until the two sets of axes coincided. After the two sets of axes were properly matched, the wild level was used to check the level differentials on the inside top face of the bearing ring. This was accomplished in a similar manner illustrated in Sketch #11. (See Section A-(1)e of this manual) Level differentials were adjusted to correspond to those discussed in Sketch #14. These level differentials were adjusted by use of a spider frame mounted on the inside of the tank shell for vertical adjustment. After level differential readings were closely duplicated, the expansion joint was considered to be in an unstrained condition. Then the distance from the 12 bearing ring cutouts to the bottom edge of the tank shell (where field weld was to be made) was measured using a 50' S/S tape graduated in 1/16". (See Sketch #16). To these measurements allowance for weld shrinkage and root opening were added to obtain the drawing dimension. The tank shell was then scribed around the circumference using a scribe and surface gage "riding" on the tank bottom nozzle assembly where the field butt weld was to be made. The bottom edge of the main tank was then chipped to layout and the two assemblies butted together. Next, the X and Y axes located on the bearing ring were lined up with the X and Y axes scribed on the bottom tube sheet using four plumb bobs, (one at the extremity of each axis). After adjusting the bearing ring axes to coincide with the bottom tube sheet axes, clearance at the butt joint joining the main tank shell and tank nozzle assembly was checked using feeler gages. Clearance between the joint was found to vary between .000" and .025" which was acceptable. However, during the course of changing shifts, the four plumb bobs suspended



NOTE: READINGS ALSO TAKEN ON EXTREMITIES OF Y AXIS IN AN IDENTICAL MANNER SHOWN IN SKETCH. UNIT IS SHIMMED AT PEDESTALS UNTIL ALL READINGS ARE WITHIN .008

LEVELING BOTTOM TUBE SHEET ASSEMBLY IN PREPARATION FOR LOFTING IN OF MN. TK.

SKETCH #15



ORIENTATION & FITUP OF MAIN TANK & ENCLOSURE TO BOTTOM TUBE SHEET

SKETCH #16

from the bearing ring and coinciding with the bottom tube axes were accidentally moved, thus destroying the alignment check between the two assemblies. Since the verticality of the tank shell, final bearing ring level readings and overall elevation measurements had not been taken, it was decided to use the Wild T1 theodolite for final tank alignment operations in lieu of re-establishing the location of the four plumb bobs.

The first problem was to establish bench marks (BM) on the floor for use in aligning the Wild T1 theodolite on the X and Y axes. (See Sketch #16) To accomplish this, the theodolite was set up on the X_1 side of the assembly. Next, a mercury plumb bob, suspended on a piece of piano wire, was passed thru a large tube on the X_2 side of the unit and aligned to the X axis. The instruments line of sight was adjusted to line up with the piano wire and scribed X axis line on the wrapper plates (PT."A") The theodolites line of sight now coincided with the bottom tube sheet's "X" axis. BM_1 and BM_2 were then established on the X_2 side of the unit in the floor as shown in Sketch #16. BM_3 and BM_4 were established in a similar manner. The theodolite was moved to the Y_2 side of the assembly and the above procedure repeated. (For detail use of the Wild T1 theodolite, see Part III-II K). As shown in Sketch #16, the theodolite was returned to the X_1 side of the unit, "walked in" on BM3, BM4, and PT "A". Then the verticality of the scribed ℄ on the enclosure, scribed ℄ on tank and scribed ℄ on the nozzle assembly were checked for vertical alignment by sighting thru the instrument. This procedure was repeated on the three other axes, orienting the tank assembly where necessary, until all centerlines were plumb and coincided with each other. After this, the bearing ring was again checked at the twelve bearing pad cutouts using the Wild NIII Level and lighted target in a manner previously described in this section. Finally, measurements were again taken at H3, H2 and H1 (Sketch #16) using a 50' S/S tape graduated in 1/16". All measurements were within drawing tolerance and accepted. This completed all measurements taken during and after lofting in of the main tank assembly to the bottom tube sheet. The main tank assembly was removed from the bottom tube sheet and made ready for shipping to the plant site.

B. "P" Unit

(1) Main Tank

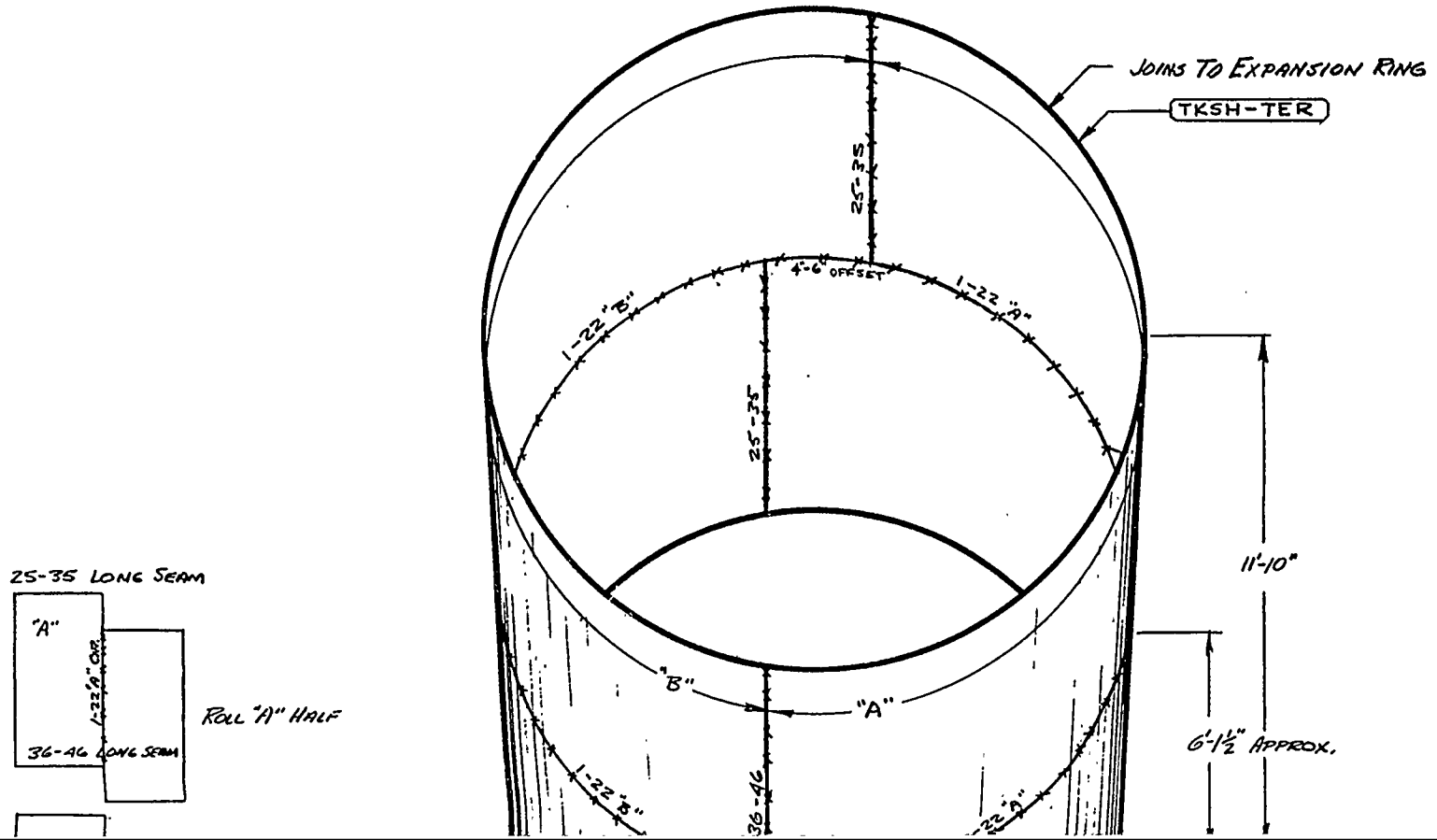
a. Plate Inspection, Fabrication and X-ray

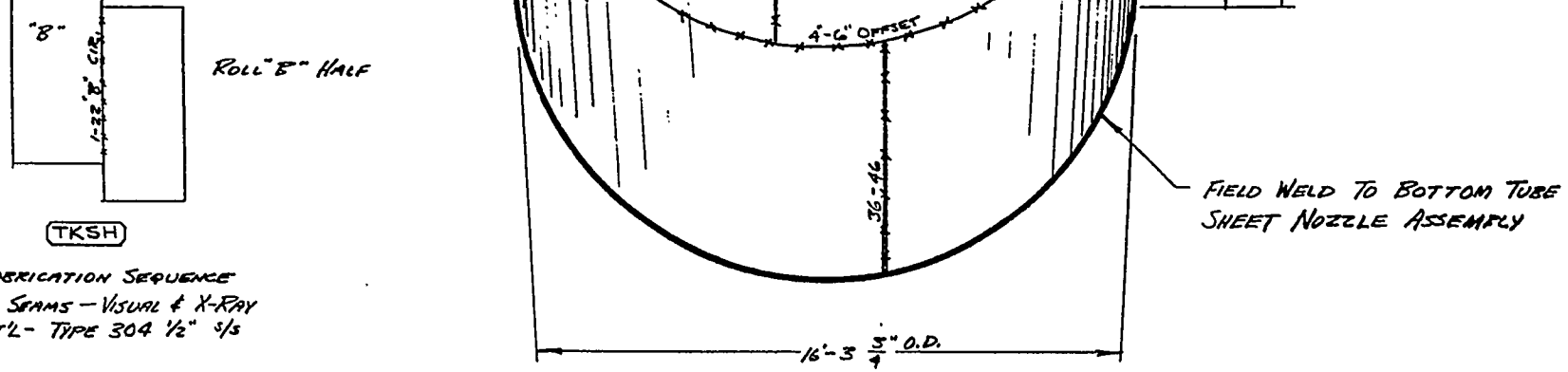
The fabrication, machining and inspection of the "P" main tank shell was similar to that discussed in Section A(1)-a of this manual, except as follows:

[1] Plate Arrangement and Fabrication Sequance

The main tank shell was fabricated from four ½" thick type 304 stainless steel plates. For fabrication sequence, see Dwg. 6-6 presented herewith.

MAIN TANK SHELL "P"





FABRICATION SEQUENCE
ALL SEAMS — VISUAL & X-RAY
MAT'L - TYPE 304 1/2" S/S

M & E SECTION
GOV'T CONTRACTS

DWG. 6-6

[redacted]
BY: S.R. COCHRAN
FEB.-1953

[2] Radiograph Inspections

It was discovered by the du Pont Inspection Department that New York Ship x-rayed butt welded joints in "R" tank shell's two half-sections before rolling the plates to form the tank. These radiographs were presented to du Pont as final pictures. Since x-raying butt welded joints in the flat and before rolling did not represent the final condition of welding, and in addition, did conform to U-68 code requirements, it was requested that all final x-raying be done after the tank half-section plates were rolled and butt welded together to form the main tank shell.

New York Ship complied with the above request and x-rayed all "P" tank welding after the shell had been fabricated. This change in x-ray technique was immediately incorporated into the tank fabrication procedure for "L", "K" and "C" Units.

b. Tank Out-of-Roundness

Same as Section A (1)-b of this manual.

c. Inspections After Grinding and Acid Washing

Same as Section A(1)-c of this manual.

(2) Inspection of Bearing Ring, Expansion Joint, and Top Tube Sheet Enclosure

a. Bearing Ring

Fabrication, machining and inspection of the "P" bearing ring was performed in a similar manner to that described in Section A(2)-a of this manual. No major problems were encountered at this stage of fabrication.

b. Tank Expansion Joint and Welding to Bearing Ring

Fabrication, machining and inspection of the "P" tank expansion joint and welding it to the bearing ring was performed in a similar manner to that described in Section A(2)-b of this manual. No major problems were encountered at this stage of fabrication.

c. Final Machining of Tank Expansion Joint and Bearing Ring

This machining operation and the inspections performed were similar to that discussed in Section A(2)-c of this manual. No major problems were encountered at this stage of fabrication.

d. Fabrication and Inspection of Top Tube Sheet Enclosure

All inspections performed during and after fabricating and machining the top tube sheet enclosure were similar to that discussed in Section A(2)-d of this manual, except as follows: Design Division

requested that the following inspections be performed on the "p" top tube sheet enclosure and on all sub-assemblies of the "K", "L" and "C" units.

1 Apply Zy-glo or dy-chek inspection to all important weld seams which cannot be x-rayed or pressure tested. Design classified all important welds whose failure would permit leakage and those subjected to possible hydraulic vibration. Typical of those welds not requiring Zy-glo or dy-cheking are welds attaching external motion measurement pads.

2 Grind smooth all welds exposed to the process fluids. This is desired to help maintain cleanliness standards and to aid inspection of welds. This does not mean that all such welds must be ground flush with the surface. In all cases care must be exercised to avoid "thinning" the metal on each side of the weld.

The above several inspection specifications were added to obtain further assurance of weld soundness in the fabricated units.

Dwg. 6-2 presented in Section A(2)-d of this manual pictorially illustrates where Zy-glo or Dy-cheking was performed on the "p" top tube sheet enclosure. Exhibit #18 presented herewith covers the the results of this inspection along with other visual, x-ray and miscellaneous inspections performed on the "p" unit tank assembly prior to shipping.

e. Welding of Top Tube Sheet Enclosure to Bearing Ring and Expansion Joint Assembly

The welding of the top tube sheet enclosure to bearing ring and expansion joint assembly was done in a similar manner to that described in Section A(2)-e of this manual. No major problems were encountered at this stage of fabrication.

f. Machining of Seal Ring

The machining of the top tube sheet's seal ring was done in a similar manner to that described in Section A(2)-f of this manual. No major problems were encountered at this stage of fabrication.

g. Fitting and Welding of Expansion Joint to Main Tank Shell

This operation was performed in a similar manner to that described in Section A(2)-g of this manual. Inspection concurrent and after welding of the expansion joint to the main tank shell was also similar to those discussed in the above referenced section. Exhibit #19 presented herewith summarizes the dimensions taken on this assembly which affect field assembly at the construction site.

EXHIBIT #18

VISUAL, X-RAY AND DY-CHEK INSPECTION OF ALL WELDS ON THE "P" UNIT TANK ASSEMBLY

E. I. DU PONT DE NEMOURS & CO., INC.

Report Number 392-P

Construction Division

[redacted]

CC: H. W. Gosney, F.P.M.
R. K. Mason-K. R. Leifermann
Savannah River Plant (3)
H. L. Bunker - J. G. Brewer
J. G. Brewer
H. B. Gage
F. C. Breuninger
S. R. Cochran (2)
J. B. Johnson - File
R. H. Potts

January 19, 1953
New York Ship - Camden, N. J.

167

FIELD INSPECTOR'S REPORT

TO C. J. VEITH (2)

FROM H. E. Dills DATE January 19, 1953

PROJECT 8980 PLANT Savannah River ORDER NO. AXC-167½

EQUIPMENT Tank Assembly EQ.PC.NO. 150-P

DRAWING NOS. W-131542 - W-131543 JOB RATING

VENDOR New York Shipbuilding Corporation LOCATION Camden, N. J.

This report covers the visual, X-ray and dy-chek inspection of all welds on the "P" Unit Tank Assembly which includes the Top Tube Sheet Enclosure, Bearing Ring, Expansion Ring, and Tank Shell. This inspection was completed and the assembly was shipped unfinished on January 15, 1953 at the request of Construction Division Management.

All welds were visually inspected for soundness, undercuts, even crown contour on the outside of 1/2" material and flush with parent metal on both sides of 3/16" thick material and the inside of 1/2" material.

All inside welds that are subjected to pressure and are not x-rayed were inspected for surface defects such as cracks, pin holes, etc. by using the dy-chek method. This dy-chek method consists of the following steps:

(1) A red dye is applied to the surface of weld which penetrates any cracks or holes that are in the weld.
(2) Dye is cleaned off the surface with a cleaning solvent, leaving a deposit of dye in any cracks or holes in the weld.
(3) Apply a white developer to the cleaned surface and allow it to dry. Any defects will then show up through this white developer as red lines or spots. A few defects were found, repaired and rechecked. These welds were then accepted as sound and free of surface defects.

[redacted]

All butt welds, both vertical and circumferential, were x-rayed according to the A.S.M.E. Boiler Code for 1949, Par. U.68. These x-rays were examined for defects and found acceptable with the exception of the three circumferential and sixteen (16) vertical seams on the expansion ring. There are a total of sixty (60) films on the expansion ring that require weld repair. In all cases defects consist of a single spot or several spots per film.

The defects on these sixty (60) films were circled with ink and also comments were written for each film. These defects were located on the expansion ring and marked on the outside surface with prussian blue. Surface defects were circled while sub-surface defects were marked with a solid line. The defects in the expansion ring to tank shell seam and films 40-41, 10-11, 11-12, 94-X, and 75-76 on the other seams are not located or marked on the expansion ring surface due to the fact that repairs were made just prior to shipping and the films were not available for examination until after the assembly had been loaded for shipment. For further information concerning weld identification and defects see attachment.

Films covering expansion ring, bearing ring extension to top tube sheet enclosure, and expansion ring to tank will be brought to the Savannah River Project along with comment sheets by a representative of the M & E Section. He will assist in the location of defects and setting of the tank.

After the expansion ring was assembled, surface fissures were discovered on the tension side of the 90° bends. These fissures were in groups and of various lengths at a 45° angle to the vertical and were approximately .005" deep. These fissures were removed by polishing the surface with 50 and 150 grit emery paper. The condition was examined by J. A. Collins, J. G. Brewer and J. B. Johnson and considered acceptable.

The distortion in the expansion ring, particularly at the vertical seams, was inspected by C. J. Veith, J. G. Brewer and J. B. Johnson and accepted. This distortion took place during the process of weld repair. It is of gradual contour and blends with the original expansion ring contour leaving no sharp corners. To remove this distortion would have meant additional cold working of the material accompanied by stretching and thinning of the metal.

A separate report will be issued describing thickness check of expansion ring by the Audi - Gage Method.

lmw
attach.

[redacted]

Weld Seam	Identification	Number of films	No. of films accepted	No. of films rejected
Top Tube Sheet Enclosure vertical	TTSE-3 1 thru 6	6	6	0
Top Tube Sheet Enclosure to bearing ring extension	TTSE3-BR3 1 thru 51	51	51	0
Large Nozzles All Welds	TTSENL4-1) TTSENL3) TTSENL2)	13 13	13 13	0
Small Nozzles All Welds	TTSENS-2	26	26	0
Seal Ring Segmental Seams	TESR3 1 thru 6	6	6	0
Bearing Ring Segmental Seams	BR3 1 thru 6	6	6	0
Main Tank Shell Circumferential	TKSH3A (1-22) TKSH3B (1-22)	44	44	0
Main Tank Shell Vertical	TKSH3 25-46	22	22	0
Bearing Ring Extension Vertical	RRE3 1-X, 2-X & 3-X	3	3	0
Expansion Ring Top Circumferential	TER3 1-48	48	27	21
Expansion Ring Bottom Circumferential	TER3 49-92	44	27	17

Weld Seam	Identification	Number of films	No. of films accepted	No. of films rejected
Expansion Ring	TER3	4	2	2
Verticals	93-X, 94-X,			
Top Section	95-X & 96-X			
Center Section	TER3	6	0	6
	103-X, 104-X			
	105-X, 106-X			
	107-X & 108-X			
Bottom Section	TER3	6	5	1
These appear only on circumferential bottom seam film				
Expansion Ring to Tank Shell	TKSH3-TER3 1 thru 44	44	31	13

EXHIBIT #19

SUMMARY OF DIMENSIONS MEASURED ON THE "P" UNIT PLENUM CHAMBER, TOP TUBE SHEET, BOTTOM TUBE SHEET AND MAIN TANK ASSEMBLY

E. I. DU PONT DE NEMOURS & CO., INC. Report Number 482-P

Construction Division

[redacted]

CC: H. W. Gosney, F.P.M.
R. K. Mason - D. A. Hauser
Savannah River Plant (3)
R. K. Mason - E.M.Vass- SRP
H. L. Bunker - J. G. Brewer
J. G. Brewer
H. B. Gage
F. C. Breuninger
S. R. Cochran (2)
R. H. Barto - NYS (3)

April 27, 1953
New York Ship - Camden, N. J.

FIELD INSPECTOR'S REPORT

TO C. J. VEITH - M & E FILE

FROM S. R. Cochran DATE January 16, 1953

PROJECT NO. 8980 PLANT Savannah River ORDER NO. AXC-167½

EQUIPMENT P.C., T.T.S., B.T.S., Main Tank EQ.PC.NO. 155P, 154P, 153P, 150P

DRAWING NOS. W-131155, W-131365 W-131395, W-131543 JOB RATING

VENDOR New York Shipbuilding Corp. LOCATION Camden, N. J.

This report summarizes dimensions measured on subject equipment which affect field assembly at construction site.

Inspections were made by du Pont inspection during various phases of fabrication at vendor's plant.

Most of the inspections listed herein are covered by previous field inspection reports; therefore numberous references will be noted. (This is to enable one to obtain more specific details as to procedure and method of inspection if necessity warrants such action.)

A. Plenum Chamber (see sketch #1)

1. Length of tubes

a. Dimension: h_1
b. Number of measurements made:

Thirtyone on tubes on outer periphery of tube area.

c. Measurements were made by L. W. Mergenthaler on 12-10-52 using 24" vernier calipers.

[redacted]

2. Distance from bottom edge of hood to bottom face of tubes.

   a. Dimension: h_2
   b. Number of measurements made:

      Eight - (at X_1, X_2, Y_1, Y_2 and at diameters 45° CW & CCN from X axis)

   c. Measurements were made on 12/5/52 by L. W. Mergenthaler.

3. Outside diameter of bottom edge of hood.

   a. Dimension: D_4
   b. This measurement will be made at a later date as present stage of fabrication will not permit this measurements. (Refer to report number 451-P.)

B. Top Tube Sheet (see sketch #1)

1. Distance from bottom edge of bearing pads to top face of tubes.

   a. Dimension : h_3
   b. Number of measurements made:

      One at each bearing pad.

   c. Reference Report Number 204-P

2. Outside diameters of top tube sheet

   a. Dimension: D_1 & D_2
   b. One measurement at each elevation made. Diameters were calculated from circumference measurements.
   c. Measurements were made on 1/9/53, by D. J. Smathers using a 100' s/s tape with 10# tension

   Note: Actual diameter measurements to determine out-of-roundness, if any, will be taken at a later date. (See report #407-P)

3. Outside diameters at top edge of lifting lugs.

   a. Dimension: D_3
   b. Measurements were same for both pair of lifting lugs.
   c. Measurements were made on 1/9/53, by D. J. Smathers using a 100' s/s tape with 10# tension.

C. Bottom Tube Sheet (see sketch #2)

1. Inside diameters of tank bottom nozzle assembly at field weld preparation.

   a. Dimension: D_1, D_2, D_3, & D_4.
   b. Reference Report Number 320-P

2. Outside circumference of tank bottom nozzle assembly at 1" below field weld preparation.

   a. Dimension: C_1
   b. Reference Report Number 352-P

3. Distance from top face of tubes to top edge of field weld preparation.

   a. Dimension: h_1
   b. Twelve measurements were made as shown
   c. Reference Report Number 347-P

4. Distance from bottom surface of bearing pad to top face of tubes.

   a. Dimension: h_2
   b. Twelve measurements made as shown
   c. Reference Report Number 195-P

5. Length of tubes

   a. Dimension: h_3
   b. Reference Report Number 195-P

D. Main Tank (see sketch #3)

1. Distance from seal surface of seal ring to top surface of bearing ring.

   a. Dimension: h_1
   b. Reference Report Number 397-P

2. Inside diameters and outside circumference of Main Tank bottom section

   a. Dimension: D_1, D_2, D_3, & C_1
   b. Reference Report Number 341-P

E. Main Tank - Top Section (see sketch #4)

1. Various diameters
2. Reference report number 396-P

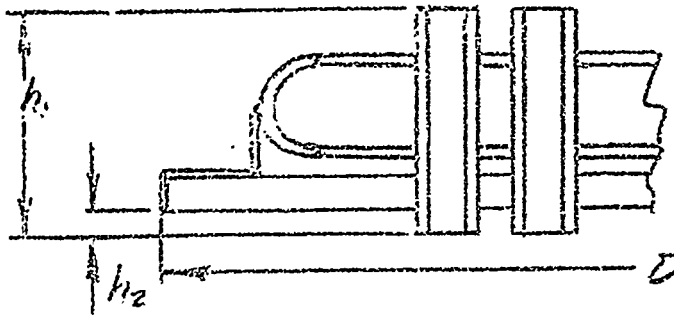
F. Main Tank - Bottom Section (see sketch #5)

1. Various elevations
2. Reference report number 398-P

lmw
attach. 5

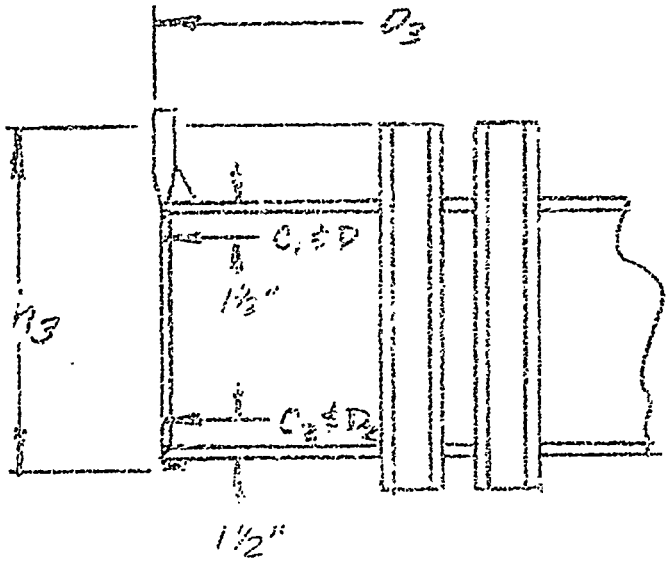
SKETCH #1

PLENUM CHAMBER – EQ. PC. # 155-P



DIM.	BLUE PRINT SPECIFICATIONS	"AS BUILT" MEASUREMENTS	
		MAXIMUM	MINIMUM
h_1	19.125" ± .015"	19.129"	19.124"
h_2	1.5625" ± .015"	1.562"	1.553"

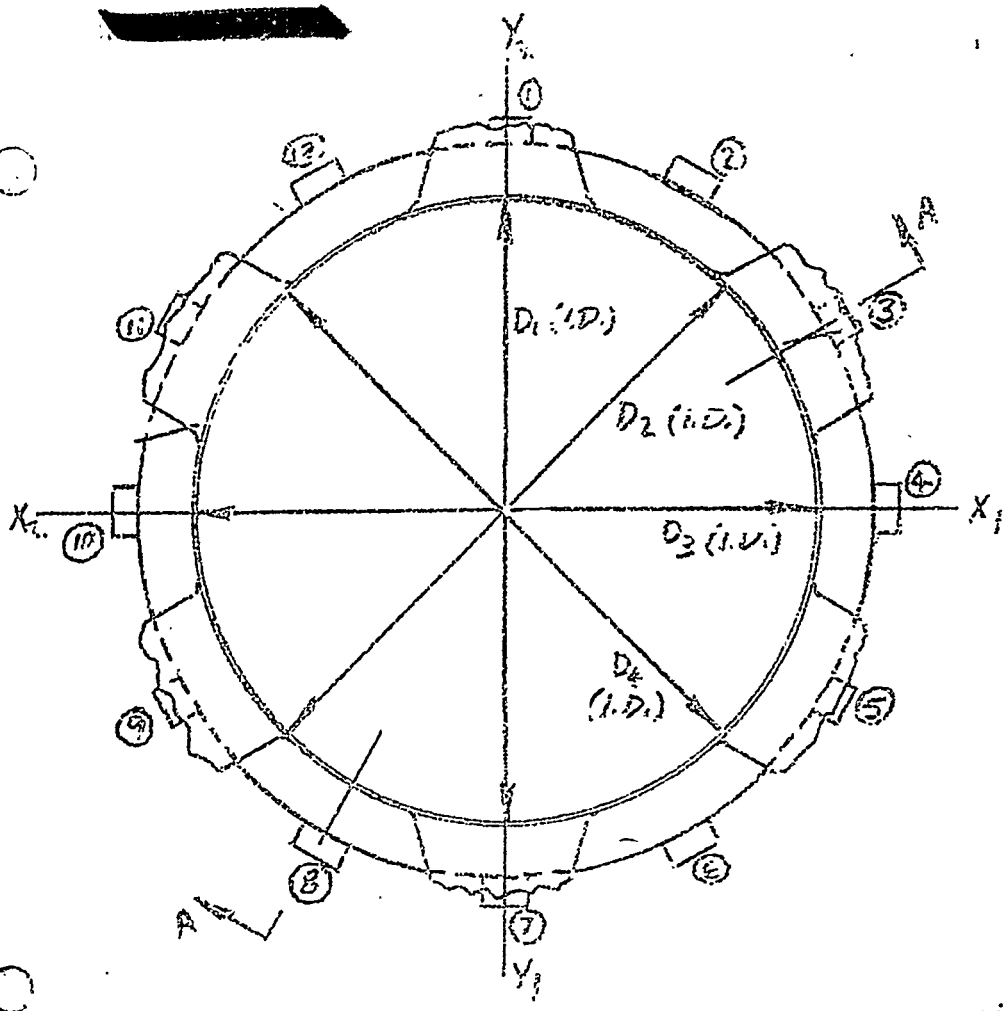
TOP TUBE SHEET – EQ. PC. # 154-P



NOTE: D_1 & D_2 ARE OUTSIDE DIAMETERS CALCULATED FROM OUTSIDE CIRCUMFERENCES C_1 & C_2 RESPECTIVELY. D_3 WAS THE SAME DIM., (18'-8½"), FOR BOTH PAIR OF LIFTING LUGS.

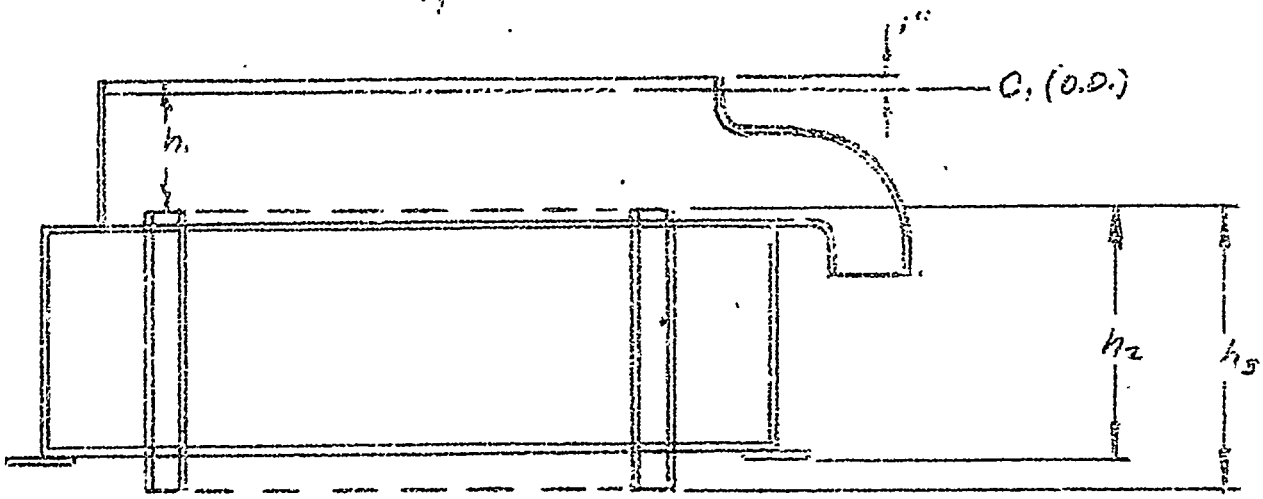
DIM.	BLUE PRINT SPECIFICATIONS	"AS BUILT" MEASUREMENTS	
		MAXIMUM	MINIMUM
h_3	47.125" ± .008"	47.117"	47.117"
C_1	SEE D_1	58'-8 1/4"	——
D_1	18'-8 1/4"	18'-8 1/64"	——
C_2	SEE D_2	58'-8 1/4"	——
D_2	18'-8 1/4"	18'-8 1/64"	——
D_3	18'-10 3/8"	18'-8 1/2"	——

SKETCH #2



NOTE:

1. P_1, P_2, P_3, & P_4 TAKEN AT TOP OF TANK BOTTOM NOZZLE ASSEMBLY.
2. h_1 TAKEN AT OUTER PERIPHERY OF TUBE ROWS.



SECT. A-A

BOTTOM TUBE SHEET — Co. PC. # 153 P

NOTE: SEE FOLLOWING PAGE FOR TABULATION OF DIMENSIONS.

DIMENSIONS FOR SK. #2
Report #482-P

"AS BUILT" MEASUREMENTS
BOTTOM TUBE SHEET - EQ. PC. #153P

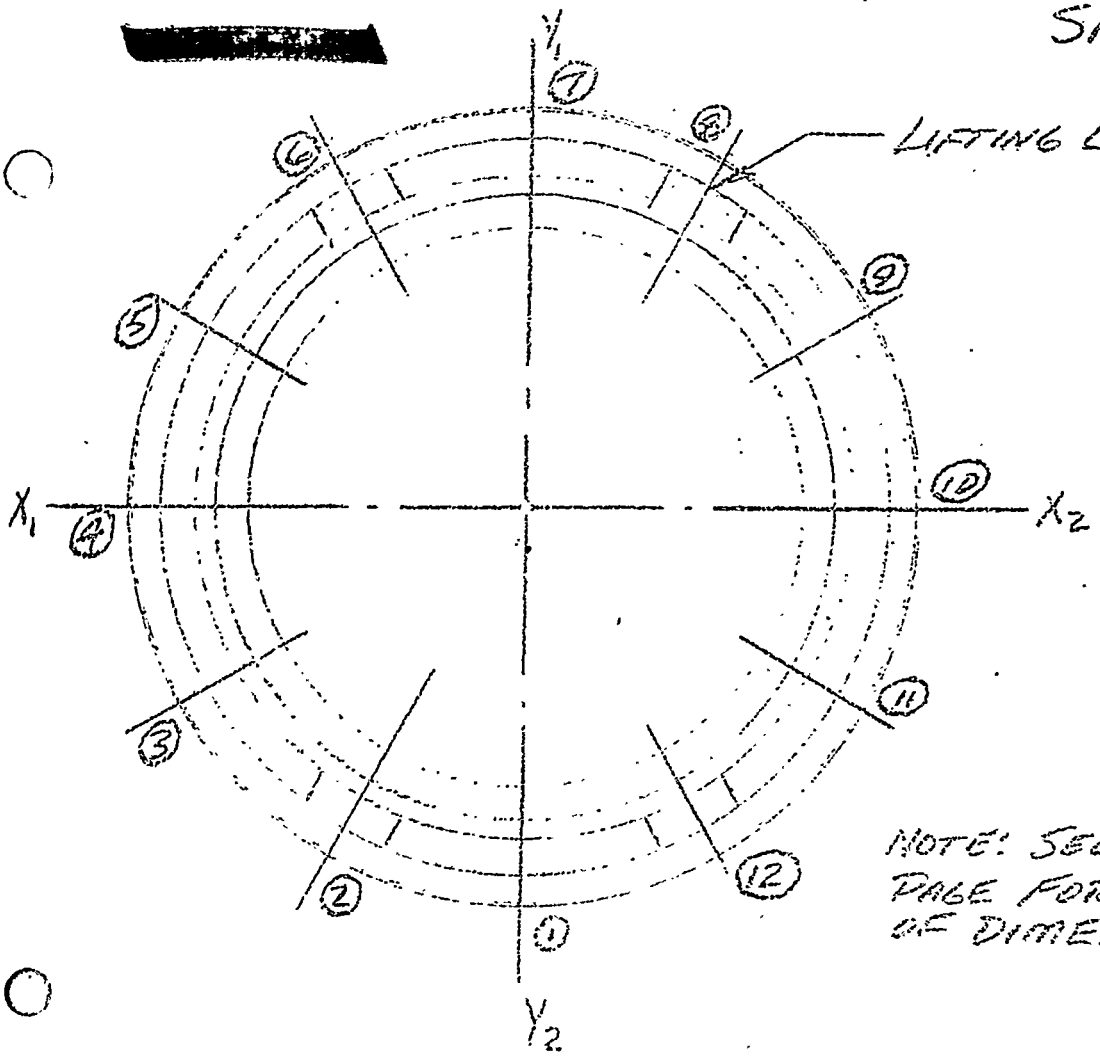
DIM.	POSITION	BLUE PRINT SPECIFICATIONS	"AS BUILT" MEASUREMENTS	
D_1	—	16'-2 3/4"	16'-2 19/32"	
D_2	—		16'-2 11/16"	
D_3	—		16'-3 9/32"	
D_4	—		16'-3 1/4"	
C_1	—		51'-3 1/8"	
h_1	1	28"	28 5/32"	
	2		28 1/8"	
	3		28 3/16"	
	4		28 3/32"	
	5		28 3/32"	
	6		28 1/16"	
	7		28 3/16"	
	8		28 1/8	
	9		28 5/32"	
	10		28 3/32"	
	11		28 1/32"	
	12		28 3/32"	
h_2	1	41.500 ± .012"	41.503"	
	2		41.5015"	
	3		41.501"	
	4		41.502"	
	5		41.498"	
	6		41.501"	
	7		41.4945"	
	8		41.500"	
	9		41.501"	
	10		41.503"	
	11		41.500"	
	12		41.502"	
			MAXIMUM	MINIMUM
D_3	—	49.4375" ± .030"	49.442"	49.405"

SYMBOLS:

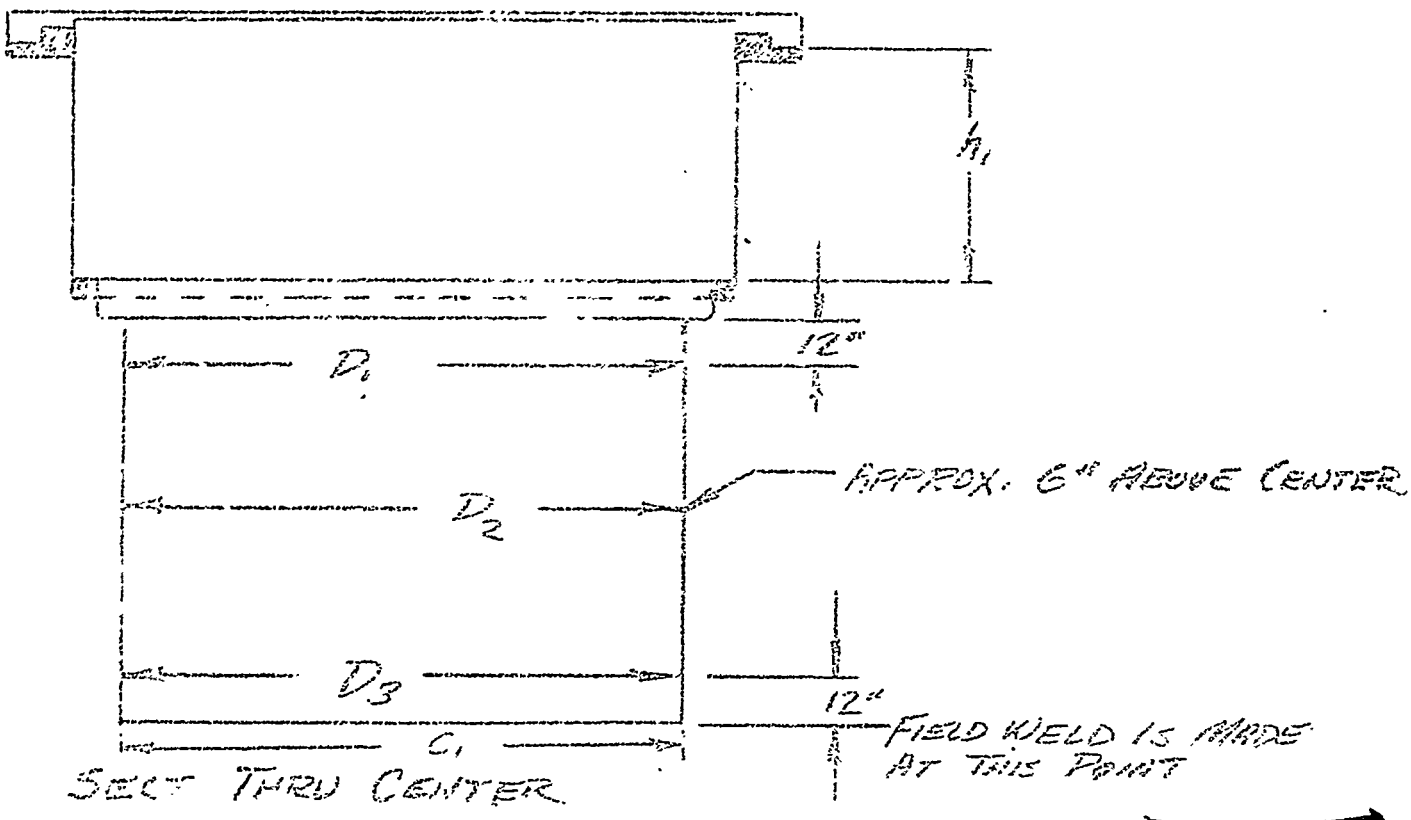
D — DIAMETER
C — CIRCUMFERENCE
h — ELEVATION - DIFFERENTIALS

SKETCH #3

Report #482-P



NOTE: SEE FOLLOWING PAGE FOR TABULATION OF DIMENSIONS.



SECT THRU CENTER

[redacted]

DIMENSIONS FOR SKETCH #3
Report #482-P.

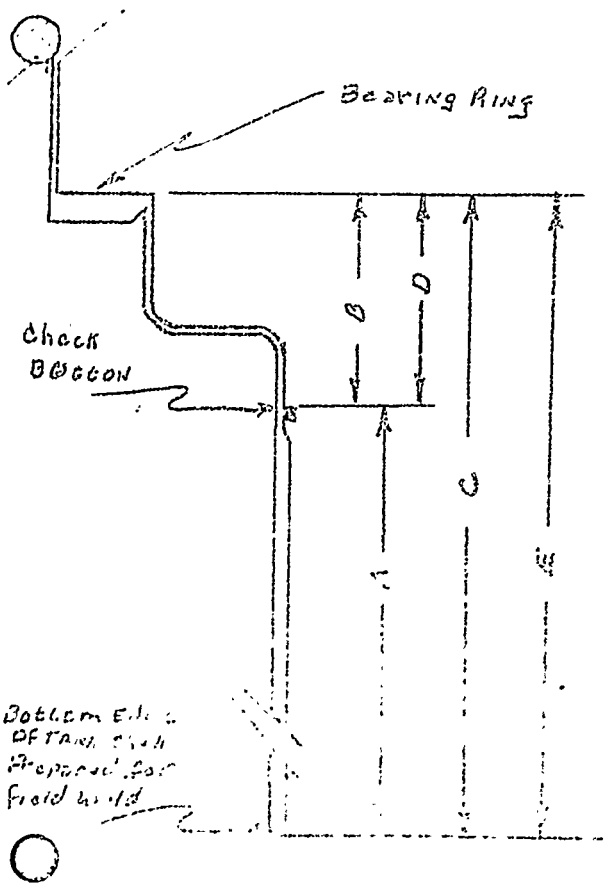
DIM.	POSITION	BLUE PRINT SPECIFICATIONS	"AS BUILT." MEASUREMENTS
h_1	1	*SEE FOOTNOTE #1	48.235"
	2		48.245"
	3		48.228"
	4		48.230"
	5		48.222"
	6		48.230"
	7		48.242"
	8		48.251"
	9		48.235"
	10		48.229"
	11		48.217"
	12		48 236"
D_1	$X_1 - X_2$	16'-2 3/4"	16'-2 7/8"
D_1	$Y_1 - Y_2$		16'-2 15/16"
D_2	$X_1 - X_2$		16'-2 7/8"
D_2	$Y_1 - Y_2$		16'-3 1/8"
D_3	$X_1 - X_2$		16'-3 1/16"
D_3	$Y_1 - Y_2$		16'-3 3/32"
C_1	1	51'-2 5/8"	51'-3 9/16"

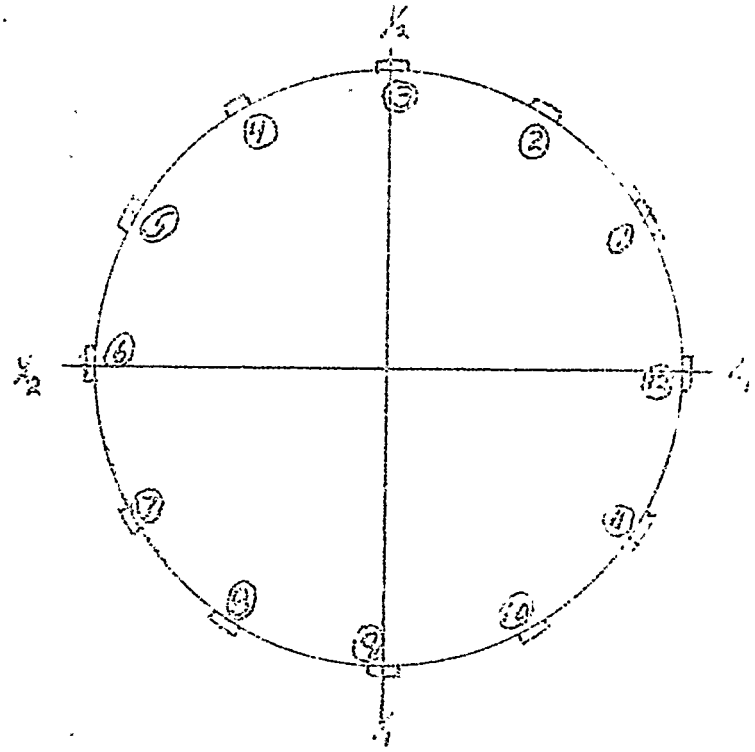
1" ABOVE FIELD WELD PREPARATION

1.* THIS DIMENSION IS NOT CLEARLY DEFINED ON DRAWINGS. BY CALCULATION THE DIMENSION IS 48 1/4"

[redacted]

[redacted]

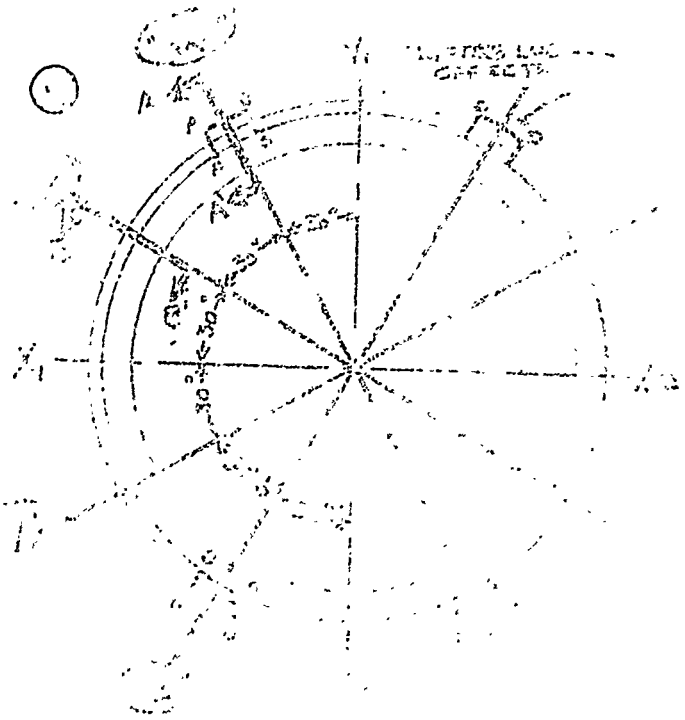


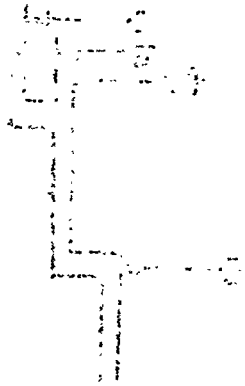


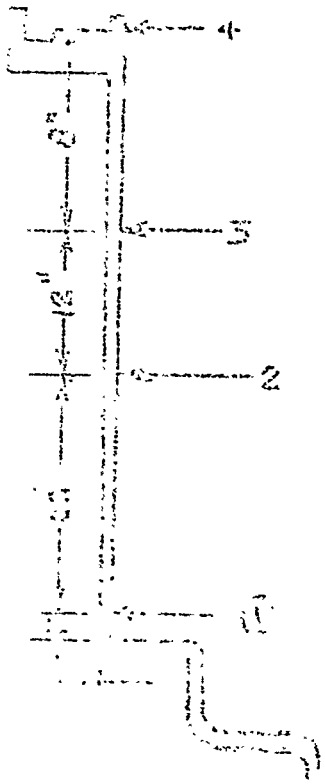
Note: Measurement 'C' is only
to be used if
Measurement 'D' is the
measurement when the Bearing
Ring is in the unstrained position
Measurement 'D' is to be used
when Bearing Ring is strained
to [illegible]

Course Dimensions					
Measurement No.				L	
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12	*				

* [illegible]






4
3
2
1

h. Problems and Difficulties Encountered on the "P" Main Tank Assembly

During the final stages of fabricating and inspecting the "P" main tank assembly, field complaints were received pertaining to defects in "R" Unit's expansion joint. As a result of field difficulties, the x-ray technique and fabrication methods used on the "P" main tank were re-studied and in several cases improved.

A chronological discussion of the field complaints and corrective action taken at New York Ship appears in the following paragraphs.

A report from the field stated that the "R" Unit's expansion joint had seven (7) small cracks in parent metal perpendicular to the upper girth weld on the expansion joint itself. During the field hydrostatic test, two (2) of these seven (7) cracks leaked. The defects in the expansion joint were evident after re-examination of the radiographs; however, they were originally interpreted by du Pont inspection personnel at New York Ship as lead marks and accepted. Further investigation by the du Pont Inspection Department lead them to believe that these cracks were caused from the forming dies used to fabricate the segments of the expansion joint. The forming dies used to form the "R" and "P" expansion joints had originally been used to fabricate the NYX expansion joint. The original die (for NYX) was converted and utilized for forming the "R", "P", "L" and "K" expansion joint segments; however, in order to use the original expansion joint dies, a skirt plate had to be removed. The skirt plate was cut off, but New York Ship didn't fill in depressions on the edges and smooth in the working segment areas on the dies. When the expansion joint segments for "R" were formed, it was postulated that these rough edges in the skirt plate caused cracks to form in the expansion joints parent metal perpendicular to the upper girth weld during the process of hammering (cold) the expansion joint to shape.

As a result of the above field complaint, the following steps were taken by the du Pont Inspection Department to alleviate the re-occurrence of the above problem on "L" and "K" unit expansion joints and to apply these steps wherever possible to the "P" main tank before shipping to the field.

[1] The expansion joint forming dies were completely re-worked by filling in all depressions in the skirt plate and grinding all sharp corners to a smooth contour. The dies were inspected and accepted for fabricating the "L" and "K" expansion joints.

[2] Fine grain x-ray film was substituted for coarse grain film used previously on NYX, "R" and "P" units. All of "P" main tank was re-x-rayed using the fine grain x-ray film.

[3] A new x-ray film reading procedure established for "P" tank, "P" top tube sheet, "P" plenum chamber, "L", "K" and "C" units. The x-ray film reading procedure was as follows:

(a) All welds must be inspected visually prior to x-ray for defects and surface condition, and repairs made. This produces better pictures and saves x-ray time and film.

(b) Film too dark for adequate vision on viewer must be examined on the intensifier. Film too light for interpretation must be re-taken.

(c) Look at entire film-not just weld area-you are looking for defects in parent metal, too.

(d) Take advantage of film overlap on consecutive pictures and film overlap at joint intersections for identical images; this may help separate x-ray technique defects from work defects.

(e) Images Resulting from Condition of Work:

1. Porosity
2. Slag inclusions or tungsten inclusions
3. Undercuts
4. Cracks
5. Lack of fusion
6. Incomplete penetration
7. Grinder or chipping marks
8. Excessive weld crown
9. Thinning of base metal
10. Weld splatter

(f) Images Resulting from X-ray Technique:

1. Scratches & abrasions
2. Water marks
3. Color contrast
4. Static marks
5. Penetrameter & identification letters
6. Lead & intensifying marks

(g) On those defects that cannot be interpreted, the film is taken to weld joint for location of affected area and physical examination of weld.

(h) If visual examination shows nothing, another x-ray is taken for comparison of one film against the other for similar markings.

(i) Chip out and reweld if same marks appear.

(j) Chip out and reweld all defects identified as beyond code acceptibility.

(k) Re-x-ray repairs

(l) Reading of film and repair of defects by New York Ship is to be done before film is presented to du Pont for final examination.

(m) All film is to be read by at least two inspectors at different times. Radiograph inspection is to be confined only to shift leaders and supervisors.

(n) Du Pont is to examine only x-rays representing final condition of plate and welds (forming, grinding, etc., all done)

(o) X-ray ledger in du Pont Inspection Department established for better control over visual examination and x-raying of welding.

(p) Purchased x-ray viewer and x-ray intensifier. X-ray viewer to be first used for examining all radiographs. Suspicious defects that don't show up too clearly on x-ray viewer are to be re-examined on x-ray intensifier for final disposition.

(q) For easier location of defects in welds that showed on x-ray film, holder numbers were established so that steel stencil numbers in parent metal were not covered by the holder number. This method allowed the steel numbers that were stamped in the parent metal near the weld seam that was x-rayed to show clearly on the film; therefore, when defects showed on the film, they could be easily located on the assembly by matching these numbers on the film to corresponding steel stenciled numbers stamped in area x-rayed. (See Sketch #17)

[4] Preparation of Welded Joints Prior to X-ray

The following procedure for preparation of welded joints prior to x-ray was incorporated into the fabrication sequence for "P", "L", "K", and "C" Units:

(a) Preliminary X-ray

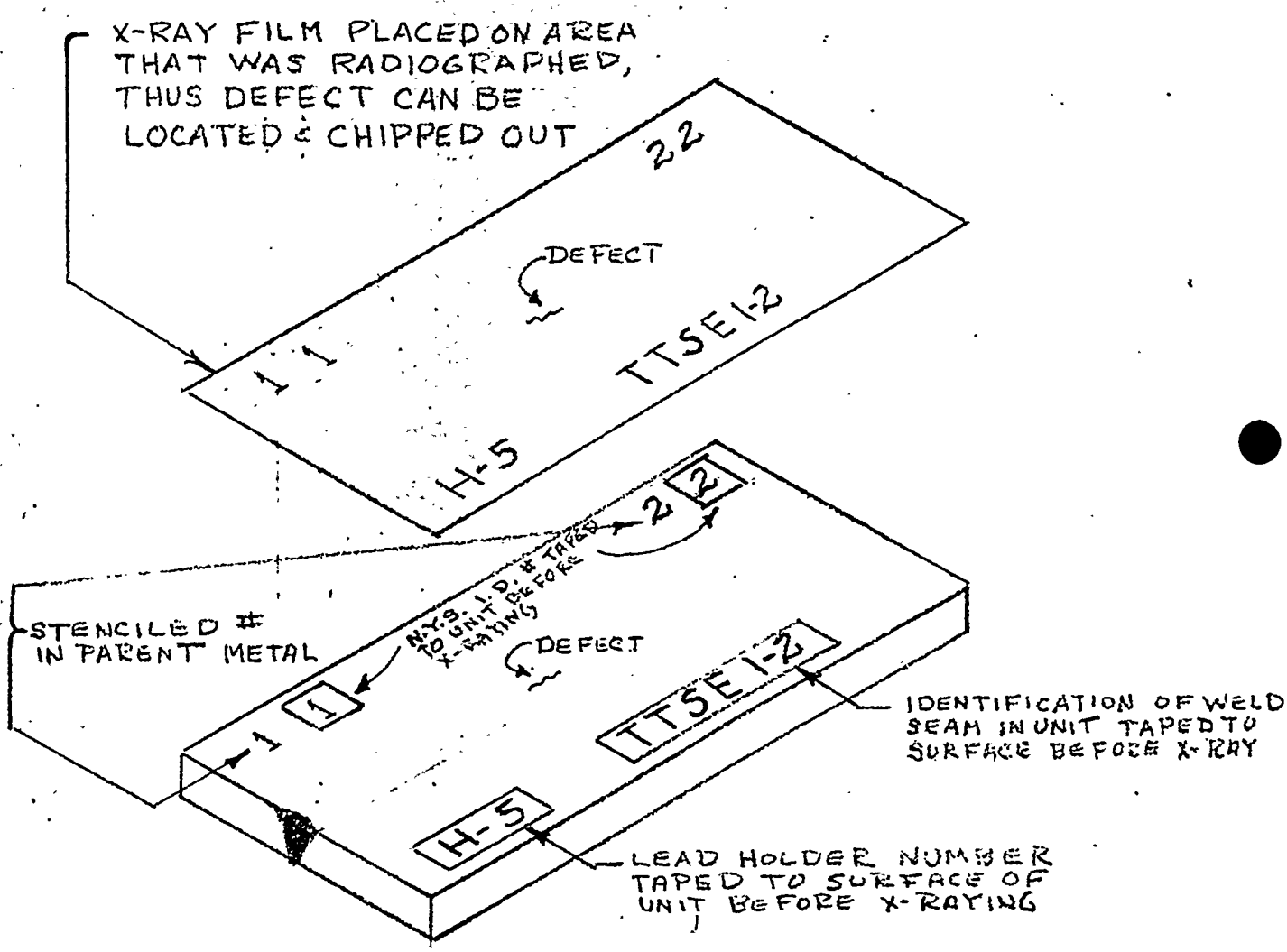
Where it is desirable to check welds for major defects prior to further working such as rolling of plate assembly that has been welded flat or expansion ring joints, etc., preliminary x-ray is to be made in as welded condition or with rough grind only.

(b) Final X-ray

Flat butts - where finished joints are to be ground flush, bond line is to be removed or ground, so no bond line can be found by feeling with hand. Visual inspection to be taken for undercut, gouge marks, grind marks, etc., and repairs to be made. If straightening is to be done, it should be made at this time. All centerppunch marks in the expansion ring are to be ground out, welded and ground flush. Exceptionally deep center punch marks in any thickness of plate are to be repaired.

Where butts are not to be ground flush, reinforcement is to be 1/32" to 1/8", uniform and smooth. Grind high spots as required and build up low spots. Where multiple bead finish is used, bead lines are to be ground out to improve x-ray interpretation.

Where weld metal is too high to grind and chipping is done to flush welds, enough metal is to be left on to insure ripped area from chipping to be ground out.



METHOD FOR LOCATING DEFECT IN WELDING USING X-RAY FILM

SKETCH # 17

Where one-sided welds into backing strips are used, backing strip is to be removed (where possible) and chipped out to good clean metal, if necessary, welded and ground smooth. The side on which the backing strip is - is to be held flush. Any differential in thickness of plates to run on opposite side.

All grinding to be done perpendicular to welded joints where possible.

"T" or fillet welds that require zy-glo, to be ground smooth and slightly radiused, so cross section is not smaller than designed fillet size. Other fillets to have uniform contour.

Where welding is done on irregular contours and different thickness plates, welds are to be blended to give best possible appearance.

Where possible and practical, sandblast prior to surface examination and x-ray. This is to be done after all repairs are made.

Unit to be x-rayed, to be checked by Dept. 46 fitter and welded supervision prior to release to Dept. 19 for examination and x-ray.

When ready for final x-ray, as determined by NYS, du Pont inspectors to make visual examination for approval of surface.

[5] Tank Expanion Joint: Before final x-ray, grind welds flush and polish entire joint to approximately #4 finish. This applies to "P" and subsequent units.

[6] Grind smooth and zy-glo or dy-chek the upper weld joining the expansion joint to the bearing ring. This applies to "P" and subsequent units.

[7] Anneal 6 segments of expansion joint after forming but before welding together. This applies only to "L" and "K" units.

i. Remaining Inspections Performed on the "P" Main Tank Prior to Shipping

As a result of the change over from coarse grain x-ray film to fine grain film, the entire "P" main tank assembly was re-x-rayed using fine grain x-ray film. Most of the major defects were found to exist in the expansion joint. Those in the main tank shell were minor and repaired here at New York Ship.

After all x-raying was completed, surface fissures were discovered on the tension side of the 90° bends in the expansion joint. These fissures were in groups and of various lengths at a 45° angle to the vertical and were approximately 0.005" deep. These fissures were removed by polishing the surface with 50 and 150 grit emery paper. This condition was examined after repair and accepted by members of Design Division and the du Pont Inspection Department.

After all grinding and weld repairs were completed on the expansion joint, it was decided to check the thickness of the joint to determine how much "thinning" of the material resulted after the grinding operation. Since no mechanical method of measuring the expansion joint thickness after it had been assembled into the main tank was feasible, it was necessary to have it checked electronically using an "Audi-gage". A representative of Branson Instruments, Inc., Stanford, Conn., was called in to perform the job.

The scope, procedure and results of this inspection is presented herewith as Exhibit #10.

During the time that the surface fissures were being repaired, extensive weld repair work to the expansion joint was under way. Inert gas shielded arc welding, e.g., "Heli-arc", on the main tank and its parts were used to repair defects in welding on this sub-assembly. Experience obtained during part of the repair welding on the "P" main tank expansion joint proved the superiority of coated electrode metal-arc welding for work of this kind on light gauge stainless steel.

A significant advantage of the coated electrode metal-arc method as used for repair welding lies in the fact that the heat input is less than involved in "Heli-arc", hence less shrinkage and distortion occurs.

As a result of the above problem and the use of coated electrode metal-arc welding, the Design Division granted permission to use this type rod in the repair of expansion joints and in repair of tube-to-tube sheet welds.

As the shipping date of November 1, 1952, for "P" bottom tube sheet and "P" main tank approached, it became apparent that "P" tank would not be ready due to the considerable amount of welding repairs necessary on the expansion joint. Also, the "P" main tank assembly had not been "lofted in" to the "P" bottom tube sheet at New York Ship because of the above welding problem. Therefore, the following decisions were made and followed to expedite the completion and shipment of the aforementioned units to the field.

EXHIBIT #10

EXPANSION JOINT THICKNESS MEASUREMENTS BY AUDI-GAGE METHOD

E. I. DU PONT DE NEMOURS & CO., INC.

Construction Division

[redacted]

Report Number 395-P

CC: H. W. Gosney, F.P.M.
R. K. Mason, - K.R. Leifermann
Savannah River Plant (6)
H. L. Bunker - J. G. Brewer
J. G. Brewer
H. B. Gage
F. C. Breuninger
S. R. Cochran (2)
R. H. Potts
J. B. Johnson - File

January 20, 1953
New York Ship - Camden, N. J.

FIELD INSPECTOR'S REPORT

TO C. J. VEITH - M & E FILE (2)

FROM W. J. Laughlin DATE January 16, 1953

PROJECT NO. 8960 PLANT Savannah River ORDER NO. AXC-167½

EQUIPMENT Expansion Ring EQ.PC.NO. 150-P

DRAWING NOS. W-131542 JOB RATING

VENDOR New York Shipbuilding Corporation LOCATION Camden, N. J.

Scope: This report covers the thickness check on the above unit expansion ring. This check was made on 1-6 to 1-7-53.

Procedure:
The thickness of the ring was checked at spots designated by the writer with an "Audi-gage" thickness tester model FMSS-5 which was operated by Mr. K. P. Hayes of Branson Instruments, Inc., Stamford, Connecticut. In the operation of the tester, the standard crystal was used wherever possible; however, due to surface irregularities it was necessary to use a 1/2" dia. crystal in some spots. The majority of the spots checked were immediately adjacent to the welds.

Results:
The thinest section found was .174"; the average thickness was about .183". It should be noted that the original material was .198" - .214" thick and was received as 3/16" material.

The results of the test are tabulated on the following sheets.

lmw
attach.

[redacted]

[redacted]

FIELD INSPECTOR'S REPORT
FROM: W. J. Laughlin

Report Number 395-P
Page 2 of 4

Column 1 denotes location of check located on Page
Column 2 denotes thickness in .001"

1	2	1	2	1	2	1	2	1	2	1	2
1	198	27	199	53	190	79	194	105	189	131	192
2	201	28	196	54	181	80	193	106	195	132	202
3	196	29	194	55	201	81	190	107	199	133	192
4	193	30	202	56	199	82	200	108	200	134	202
5	195	31	194	57	194	83	195	109	186	135	207
6	194	32	184	58	196	84	199	110	194	136	202
7	203	33	204	59	200	85	184	111	192	137	203
8	202	34	200	60	186	86	189	112	201	138	203
9	202	35	199	61	187	87	190	113	194	139	203
10	199	36	197	62	196	88	190	114	183	140	197
11	199	37	194	63	188	89	181	115	191	141	187
12	178	38	194	64	195	90	201	116	192	142	189
13	201	39	190	65	199	91	191	117	197	143	183
14	202	40	189	66	196	92	193	118	194	144	198
15	198	41	194	67	197	93	188	119	181	145	202
16	188	42	194	68	200	94	194	120	196	146	201
17	197	43	197	69	174	95	202	121	197	147	195
18	194	44	190	70	179	96	199	122	194	148	194
19	191	45	196	71	194	97	188	123	194	149	191
20	191	46	194	72	190	98	198	124	193	150	183
21	194	47	190	73	184	99	200	125	191	151	209
22	203	48	193	74	192	100	197	126	194	152	182
23	184	49	179	75	196	101	189	127	186	153	208
24	196	50	188	76	201	102	185	128	196	154	206
25	203	51	204	77	194	103	200	129	198	155	207
26	210	52	194	78	189	104	194	130	186	156	201

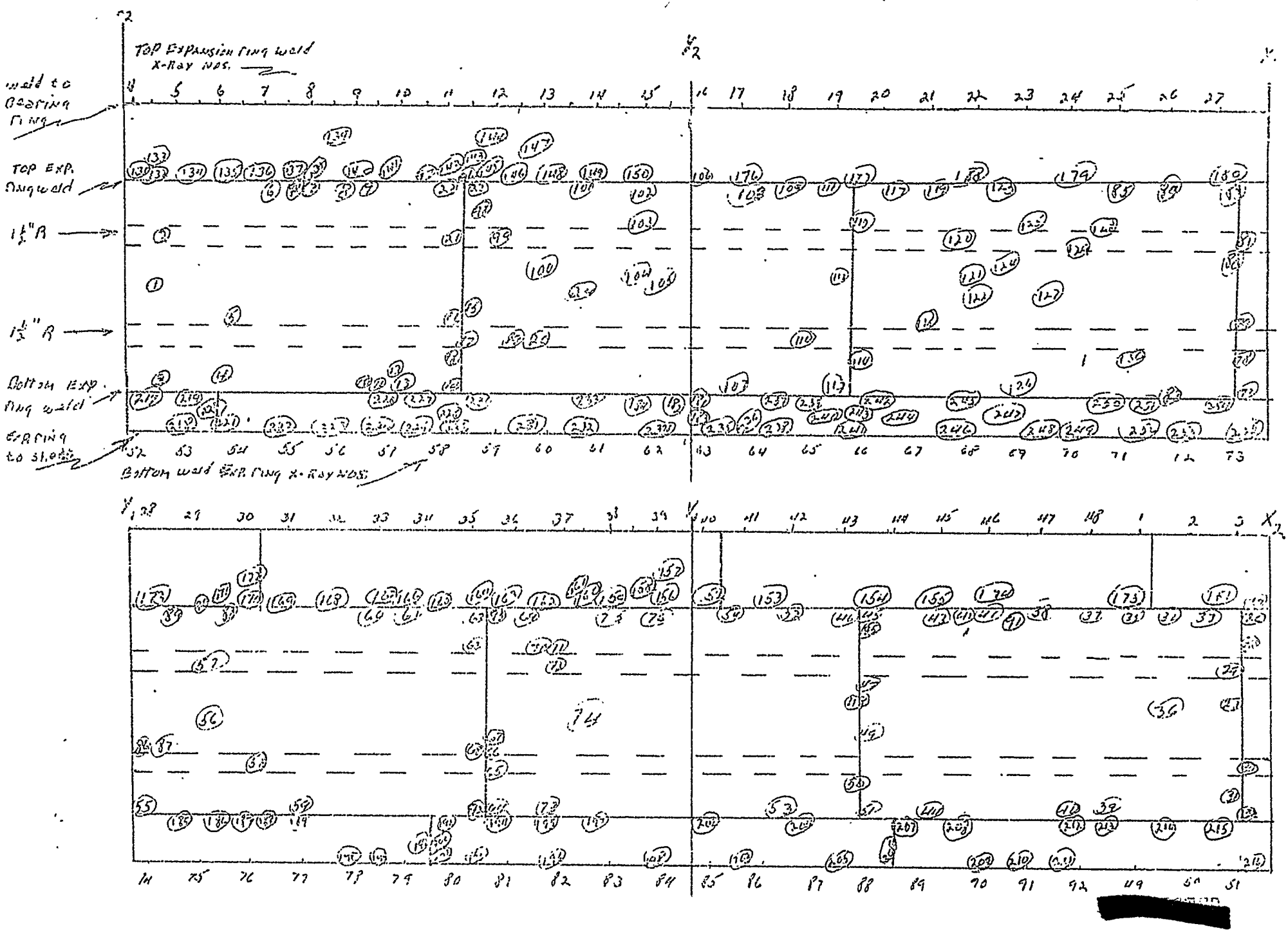
[redacted]

Column 1 denotes location of check located on Page 4
Column 2 denotes thickness in .001"

1	2	1	2	1	2	1	2	1	2	1	2
157	194	172	206	187	208	202	206	217	191	237	202
158	193	173	192	188	206	203	207	218	188	238	199
159	180	174	200	189	211	204	200	219	201	239	196
160	184	175	192	190	207	205	209	220	196	240	188
161	203	176	188	191	207	206	207	221	186	241	201
162	194	177	186	192	184	207	181	222	194	242	194
163	184	178	191	193	201	208	201	223	201	243	192
164	201	179	189	194	202	209	197	224	188	244	188
165	194	180	187	195	202	210	194	225	186	245	194
166	200	181	206	196	204	211	199	226	198	246	200
167	207	182	201	197	203	212	196	227	194	247	192
168	194	183	214	198	203	213	192	228	207	248	199
169	202	184	201	199	199	214	206	229	196	249	201
170	190	185	202	200	192	215	192	230	190	250	203
171	189	186	198	201	189	216	198	231	204	251	191
								232	196	252	184
								233	204	253	201
								234	200	254	180
								235	202	255	204
								236	198		

[redacted]

[redacted] Location of Thickness Measurements on "P" Expansion Ring



[1] All repairs not made to the expansion joint at New York Ship were done at the plant site. X-ray film showing defects in expansion joint welding was marked on the film at NYS for easy location at the field site for making the necessary repairs. To assist the field in locating the defects in the expansion joint, a du Pont inspector was sent to SRP with the marked film.

[2] Also, a New York Ship representative accompanied the inspector to SRP to assist the inspector and field personnel in the lofting in of the "P" main tank section. The decision was made to loft in the "P" main tank to the bottom tube sheet at the plant site based on the fact that time remaining before the shipping date could not be utilized to perform this operation.

C. "L" Unit

(1) Main Tank

a. Plate Inspection, Fabrication and X-ray

Same as Section B(1)-a of this manual, except for fabrication sequence, see Dwg. 6-7 presented herewith.

b. Tank Out-of-Roundness

Same as Section B(1)-b of this manual except as follows:

During handling the "L" main tank shell was dropped in Bldg. 3 causing slight damage to the shell plates. Sketches #18, #19 and #20 show where caved in spots and dents occurred. All cave in spots and dents were taken out by using a 450 ton cold press and large wooden hammers. As shown in Sketch #18, one scar was welded and ground smooth.

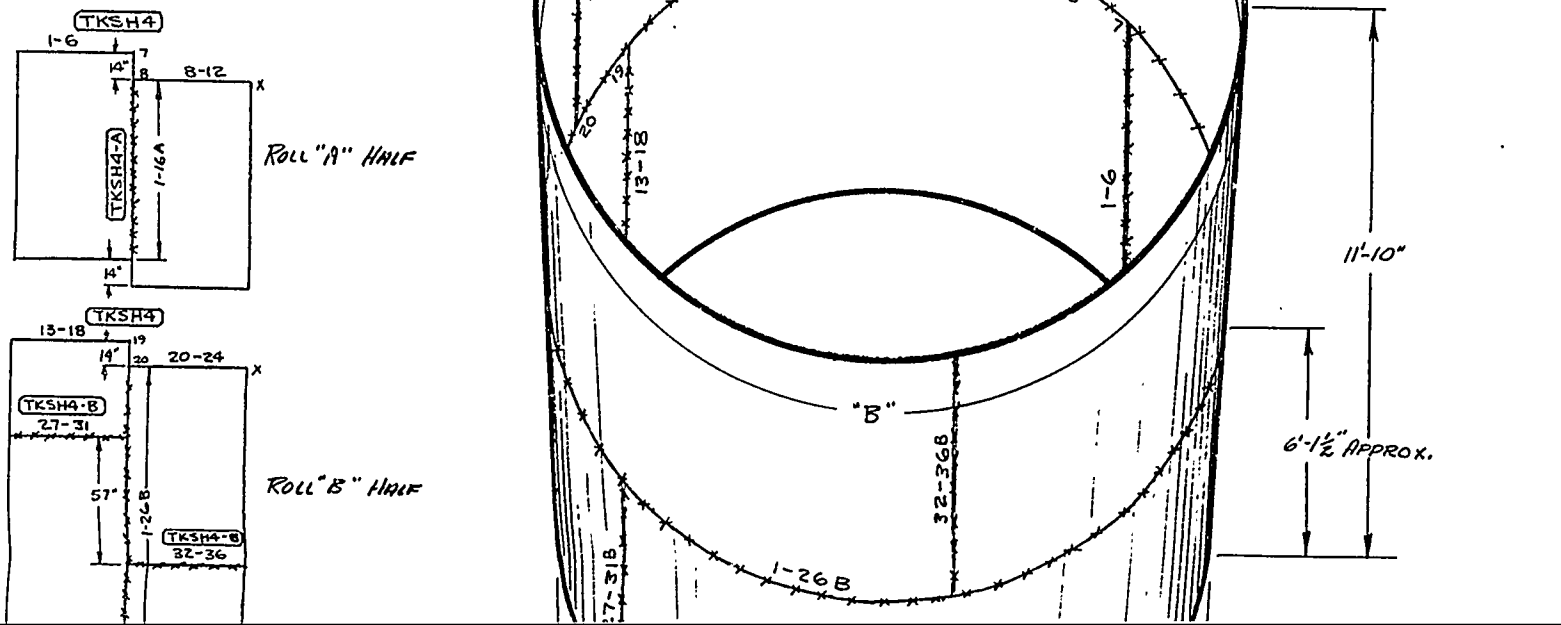
After all repair work was completed, the welding in the immediate vicinity of damaged areas were re-x-rayed and necessary repairs made. In addition, the top and bottom circumference measurements were re-taken and found satisfactory. Sketch #19 lists the results.

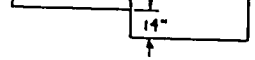
All repairs to the tank were successful, and it was released for further fabrication.

c. Inspections After Grinding and Acid Washing

Same as Section A(1)-c of this manual.

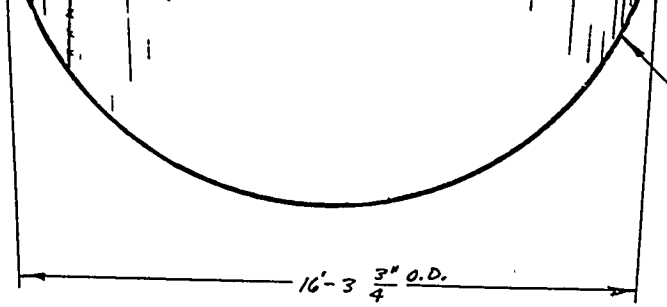
MAIN TANK SHELL "L"





TKSH

FABRICATION SEQUENCE
ALL SEAMS - VISUAL & X-RAY
MAT'L - TYPE 304 - V2" - S/S



FIELD WELD TO BOTTOM TUBE SHEET NOZZLE ASSEMBLY

16'-3 3/4" O.D.

TKSH

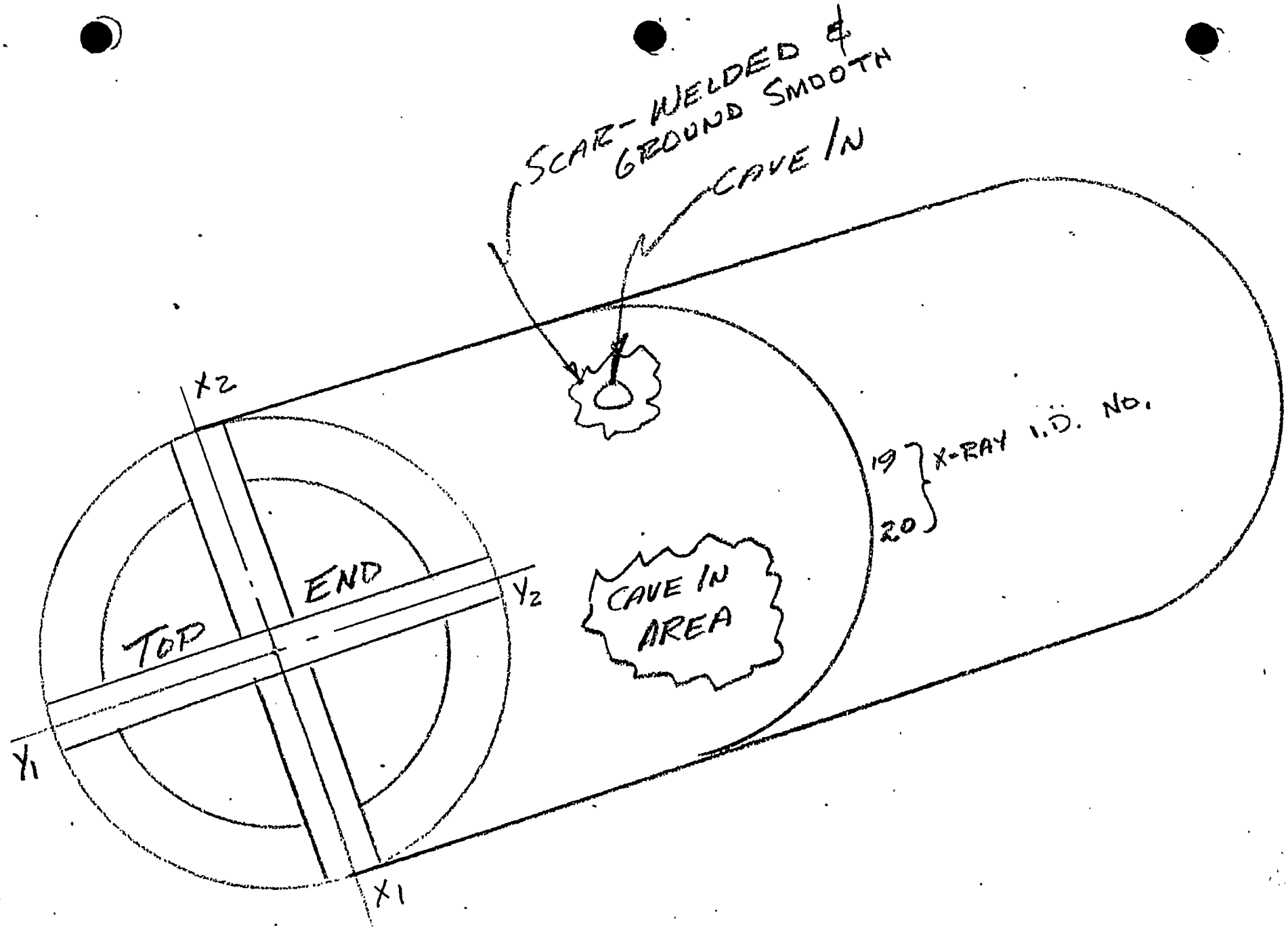
ALL SEAMS - VISUAL & X-RAY
MAT'L - TYPE 304 V2" S/S.

M & E SECTION
GOV'T CONTRACTS

DWG. 6-7

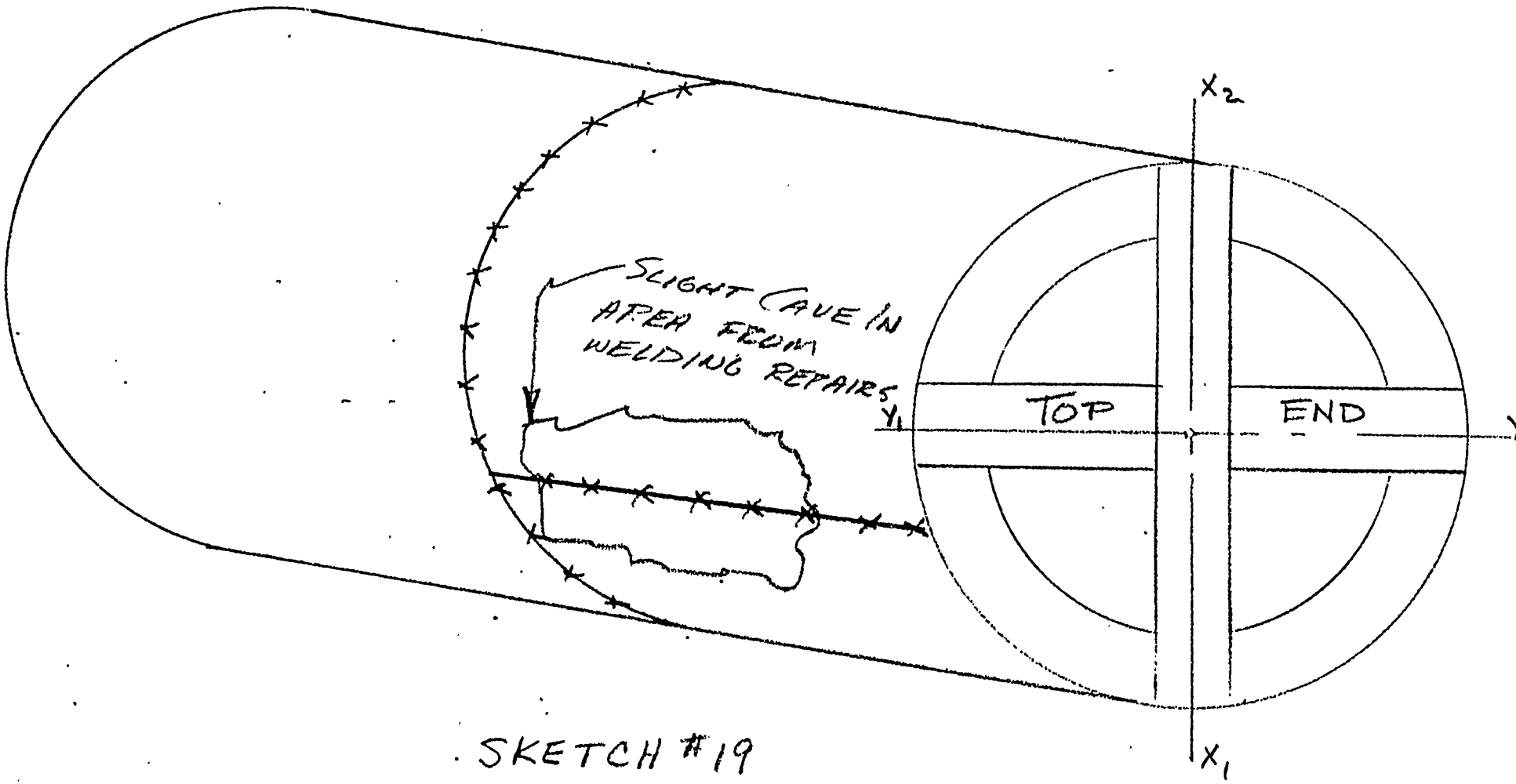
[redacted]

BY: S.R. COCHRAN
FEB.-1953



SKETCH #18

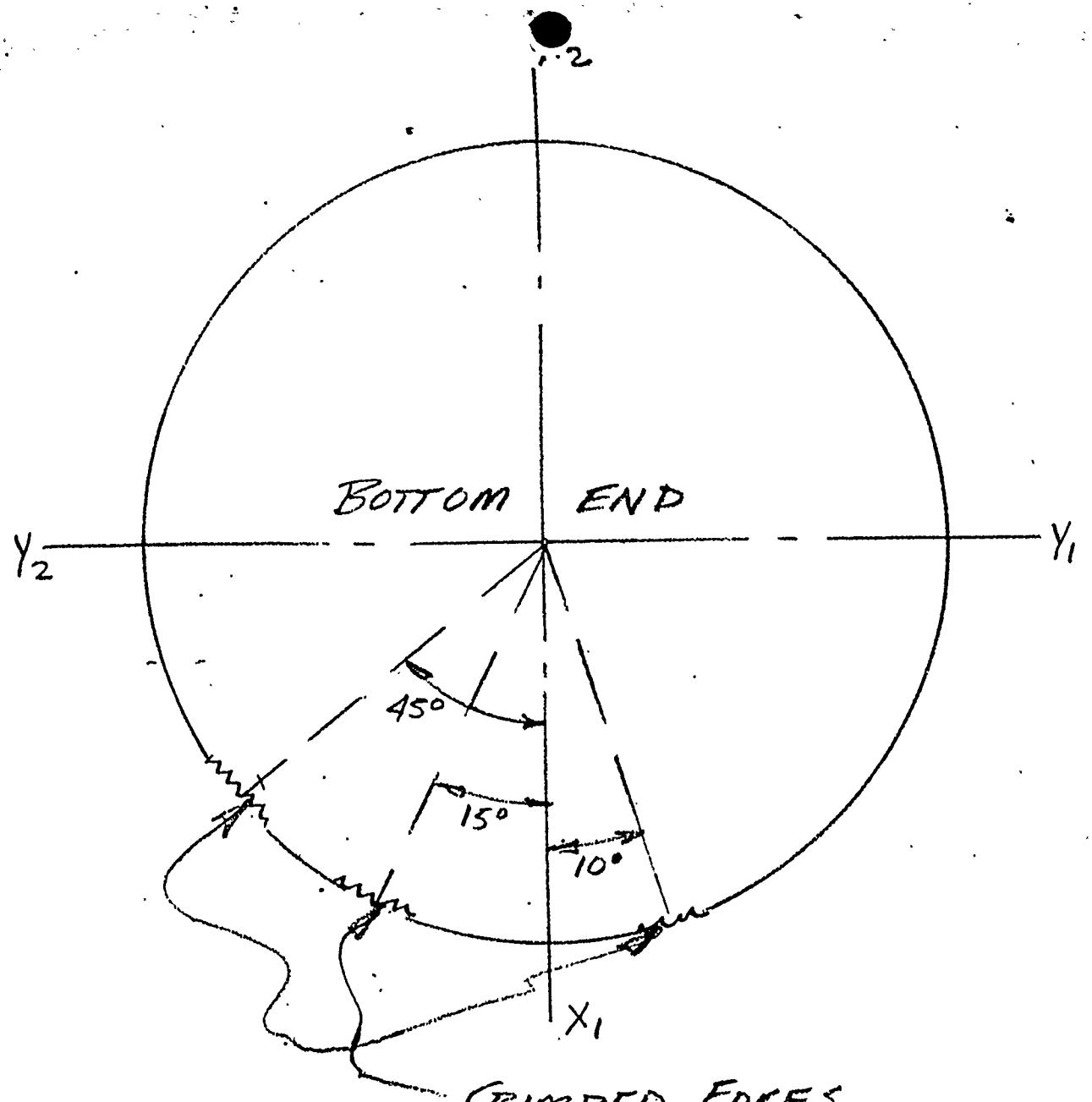
"L" TANK SHELL



SKETCH #19

TOP CIRCUMFERENCE = 51'-3 1/8"
BOTTOM CIRCUMFERENCE = 51'-3 5/16"

"L" TANK SHELL



SKETCH #20

"L" TANK SHELL

(2) Inspection of Bearing Ring, Expansion Joint and Top Tube Sheet Enclosure

a. Bearing Ring and Expansion Joint

The bearing ring and expansion joint were fabricated, welded together and machined to rough dimensions in a similar manner described in Section (2)a and b of this manual.

However, at this stage of fabrication, field complaints on the "R" expansion joint prompted the du Pont Inspection Department to establish a new fabrication procedure for "L", "K" and "C" Units discussed in Section B(2)-h of this manual. Sincd "L" unit's expansion joint had all ready been fabricated before the revisions were made, the only revision that could be incorporated into the "L" expansion joint assembly at this stage of fabrication was re-x-raying of all welding using fine grain film in lieu of coarse grain previously used on this unit. All welding in the "L" expansion joint was re-x-rayed using fine grain film and radiographs examined in accordance with the new film reading procedure outlined in Section B(2)-h of this manual. Upon examining the radiographs, it was found that too many defects in the "L" expansion joint welding were present to justify repairing. It was agreed by all parties concerned that if these weld repairs were made the expansion joint would be warped from welding heat to such a degree that it could not be satisfactorily used in a process unit. Based on this supposition, it was agreed by Design Division, du Pont Inspection Department and New York Ship to scrap the "L" bearing ring and expansion joint assembly and fabricate a new one for this unit.

b. Fabrication Changes and Inspection of New Bearing Ring and Expansion Joint for "L" Unit

The fabrication, machining and inspection of the new bearing ring and expansion joint was similar to that discuassed in Section A(2), except the following changes in fabrication and inspection methods were made on this unit and also "K" Unit.

[1] Welding Specifications were revised to permit manual metallic arc welding on process units in the following cases:

(a) All welds in the "L" and "K" expansion joint

(b) Joint between expansion joint and bearing ring.

(c) Joint between expansion ring and main tank.

(d) All welds on the top tube sheet lifting lug hoods (L, K and C)

(e) Butt welds in the bottom tube sheet 8" half round pipes (L, K and C)

(f) Joint between 8" half round pipes and the bottom tube sheet wrapper

[2] In making of new expansion joint for "L" and "K" Units, segment butt welds were aligned. See Dwg. 6-4 presented herewith in Section A(2)b.

[3] All six expansion joint segments for "L" and "K" Units, were annealed after forming but before welding together. Exhibit #11 presented herewith is a summary of heat treating of expansion joint segments after cold forming to final shape and completion of major welding.

[4] Before annealing all expansion joint segments for "L" and "K" were x-rayed and majority of repairs made. After annealing segments were sandblasted, acid washed and then re-x-rayed and minor repairs made.

[5] Before final x-ray, all welds in the six segments (L & K) were ground flush to remove the bond line and the entire joint polished to approximately a #4 finish. Concurrently with the grinding operations, a du Pont Inspector checked the thickness of the expansion joint segments using a tubular micrometer fitted with a dial indicator in the standard method of indicator usage. The indicator was set to zero using a .187" standard. Minimum thickness of expansion joint segments was 0.166". These measurements were taken in a zig-zag manner across the weld (1/2" on each side) and the lowest readings were recorded. All readings were above .166" on both "L" and "K" expansion joints and accepted.

[6] After butt welding the six segments to form the expansion joint, the vertical welds were checked for thickness in a similar manner described in part 5 above. All measurements were acceptable.

[7] All other revisions made to the "L" and "K" expansion joints not mentioned above are covered in Section B(2)-h of this manual.

C. Remaining Inspections Performed on the "L" Main Tank Section

The remaining inspections performed on the "L" main tank section after fabricating and machining a new bearing ring and expansion joint for this unit was similar to that previously discussed in Section A(2) and including revisions discussed in

EXHIBIT #11

SUMMARY OF HEAT TREATING "L" AND "K" EXPANSION JOINT SEGMENTS

E. I. DU PONT DE NEMOURS & CO., INC. Report Number 754-K&L

Construction Division

CC: J. B. Johnson
R. K. Mason-D.A.Hauser-SRP (3)
R. K. Mason-J.D.Cook-SRP
H. L. Bunker-J.G.Brewer
J. G. Brewer
H. B. Gage
F. C. Breuninger
L. J. Carroll
R. H. Barto - NYS (3)
File

[redacted]

Nell.

October 29, 1953
New York Ship - Camden, N.J.

FIELD INSPECTOR'S REPORT

TO C. J. VEITH - M & E FILE

FROM S. R. Cochran DATE July 7, 1953

PROJECT NO. 8980 PLANT Savannah River ORDER NO. AXC-167½

EQUIPMENT Expansion Ring Segments. EQ.PC.NO. 150-L & 150-K

DRAWING NOS. W-133252 Rev.7 & W-133628 Rev.9 JOB RATING

VENDOR New York Shipbuilding Corp. LOCATION Camden, N. J.

This is a summary of heat treating of expansion ring segments after cold forming to final shape and completion of major welding.

The segments were heat treated by the following procedure:

1. Furnace was preheated to a temperature of 600°F to 1000°F. (Temperature of pre-heat varied for individual heat treating operations over above range.)

2. Segments were heated to 1950°F to 2050°F at approximately 300° per hour.

3. Segments were then held for 15 minutes at above temperature.

4. After above soaking, segments were rapidly removed from furnace and placed on fire bricks to provide adequate support and prevent distortion during cooling. Segments were air cooled to a black color within 2 minutes after removal from furnace.

Furnace used in heat treating operation is 18' long by 15' wide by 4" high with an arch shaped ceiling, arched over the 15' width. Three burners are equally spaced on one side over the 18' length at an elevation of 18". The furnace is baffled in the center along the 18' length with a wall of fire bricks approximately 30" in height. The burners are manually and individually controlled and fuel used was Atlantic furnace oil, medium weight.

S [redacted]

Temperature measuring device used was a Brown & Sharpe, portable, 4 point recording potentiometer, calibrated and used with chromel-alumel thermocouple leads. Two thermocouple leads were welded to each end of each segments were stress relieved.

The following segments used in "L" & "K" unit expansion rings and identified by x-ray stencil numbers listed were heat treated on the following dates:

1. Segments TER 5-2 and TER 5-4 were heat treated on 2/14/53. J. B. Johnson and R. V. Graham witnessed the heat treatment. Segment TER 5-4 was located on the burner side of the furnace. The furnace was pre-heated to 1000°F and 3 hours 10 min. later a temperature of 2000°F was reached. This is a rate of temperature increase of 316°F per hour. Segments were held for 15 min. at 2000°F, removed from furnace and air cooled to a black color within 2 minutes.

   No appreciable distortion was present.

2. Segments TER 5-3 and TER 5-5 were heat treated on 2/18/53. J. B. Johnson and R. V. Graham witnessed the heat treatment. Segment TER 5-3 was located on the burner side of the furnace. The furnace was pre-heated to 900°F and 3 hours later an average temperature of 1950°F was reached. This is a rate of temperature increase of 350°F per hour. Segments were held for 20 minutes at 1950°F, removed from furnance and air cooled to a black color within 2 minutes. No appreciable distortion occurred.

3. Segments TER 5-1 and 5-6 were heat treated on 2/28/53. J. B. Johnson and R. V. Graham witnessed the heat treatment. Segment TER 5-6 was located on the burner side of the furnace. The furnace was pre-heated to 800°F and 3 hours20 min. later a temperature of 1900°F was reached. This is a rate of temperature increase of 330°F per hour. Segments were held for 17 min. at 1900°F, removed from furnace and air cooled to a black color within 2 minutes. No distortion occurred.

4. Segments TER 6-1 and 6-5 were heat treated on 3/14/53. J.B.Johnson and R.V.Graham witnessed the heat treatment. Segment TER 6-1 was on the burner side of the furnace. The furnace was pre-heated to 1050°F and 3 hours later a temperature of 1950°F was reached. This is a rate of temperature increase of 300°F per hour. Segments were held at 1950°F for 15 min., removed from furnace and air cooled to a black color in 2 min. No distortion occurred.

5. Segments TER 6-3 and 6-4 were heat treated on 3/28/53. M.H.Scholes witnessed the heat treatment. Segment TER 6-3 was on the burner side of the furnace. The furnace was pre-heated to 800°F and 4 hours later a temperature of 1950°F was reached. This is a rate of temperature increase of 288°F per hour. Segments were held at 1950°F for 15 min., removed from furnace and air cooled to a black color within 3 min. No distortion occurred.

[redacted]ED

6. Segments TER 6-2 and 6-6 were heat treated on 4/25/53. M.H.Scholes witnessed the heat treatment. Segment TER 6-2 was on the burner side of the furnace. The furnace was pre-heated to 900°F and 3 hr, 40 min. later a temperature of 1975°F was reached. This is a rate of temperature increase of 329°F per hour. Segments were held at 1975°F for 15 min., removed from furnace and air cooled to a black color within 2 min. No distortion occurred.

7. Segments TER 6-3 and 6-7 were heat treated on 5/9/53. M.H.Scholes witnessed the heat treatment. Segment TER 6-3 was on the burner side of furnace. The furnace was pre-heated to 800°F and 4 hr, 30 min. later a temperature of 2000°F was reached. Rate of temperature increase: 267°F per hour. Segments were held at 2000°F for 15 min. removed from furnace and air cooled to a black color within 2 min. No distortion occurred.

The following segments were used on "L" unit:

TER 5-2	TER 5-5
5-3	5-6
5-4	6-5

The following segments were used on "K" unit:

TER 6-4	TER 6-7
6-2	6-1
6-6	5-1

Segment TER 6-3 was scrapped.

Furnace charts are on file for all segments.

lmw

[redacted]

Section B(2)-h of this manual, except as follows: Since the addition of numerous changes in fabrication affected the procedure originally followed for establishing centerlines and the inspection of welds on the "R" and "P" main tank section, the original inspection procedure had to be revised for performing these additional operations on "L" and "K" main tank sections.

This procedure appears in the following section and is intended to incorporate all revisions and experience gained on "R", "P", "L" and "K" main tank sections with results presented only for the "L" unit. The original procedure discussed for "R" (Section A) remains the same for all units except for revisions that appear in the following section.

d. Revisions to Weld Inspection and Establishing Centerlines on the "L" and "K" Main Tank, Top Tube Sheet Enclosure and Bottom Tube Sheet Nozzle Section with Results Presented for "L" Unit

[1] Rough Machine Bearing Ring

All inspections performed at this stage of fabrication were similar to those discussed in Section (2)a of this manual.

[2] Machine Weld Preparation on Top of Completely Welded Expansion Joint

Inspectors checked the distance from bottom edge to top edge of expansion joint in four places. This inspection is pictorially illustrated in Sketch #9, Section A(2)-b of this manual.

[3] Weld Bearing Ring Extension to Bearing Ring

The following weld inspections were added; (See Dwg. 6-3, Section A(2)-a).

Inside Weld - Visual examination and dy-chek testing of entire circumference in as welded condition with preliminary grinding done was performed to insure good dy-chek results. After machining the top side of the bearing ring to size, dy-chek inspection was performed again because during machining it was necessary to radius the inside weld to clean up on the diameter of the bearing ring.

Outside Weld * Final condition of weld visually examined. Some grindin was necessary to remove questionable defects.

Vertical Seams - Visual and X-ray examination - final condition of weld-flush inside; some grinding on outside to remove questionable defects.

[4] Weld Expansion Joint to Bearing Ring

The following weld inspections were added: (See Dwg. 6-3, Section A(2)-a)

Inside - Visual and dy-chek examination of weld. Final condition of weld - ground flush.

Outside - Visual inspection. Final condition of weld - as welded with some grinding to remove questionable defects.

[5] Final Machining of Tank Expansion Joint and Bearing Ring

All inspections performed were same as discussed in Section A(2)-c of this manual, except as follows:

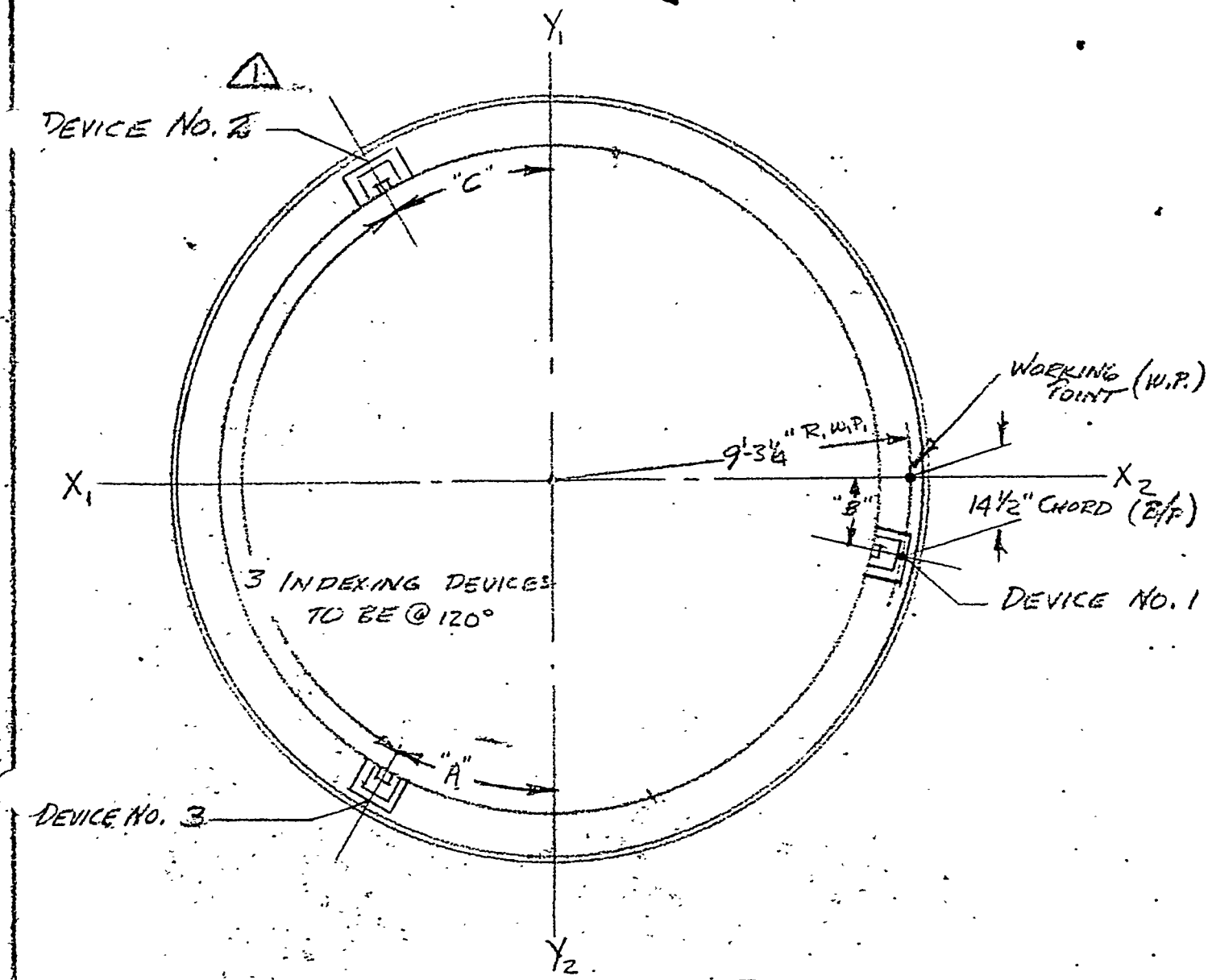
After the welding operations described above [4] were completed and inspected, a check was made to insure that the vendor scribed a line to the proper diameter on the top surface of the bearing ring so that during machining enough of the bearing ring was machined to insure proper fit of the T.T.S.E., but no more weld than absolutely necessary was removed joining bearing ring extension to bearing ring.

Final results obtained on the "L" Unit bearing ring are covered in drawings 6353-4, 6353-5 and 6353-6 presented herewith. As stated above, these measurements were taken in a similar manner described in Section A(2)-c of this manual. All results were acceptable.

[6] Fabrication and Inspection of Top Tube Sheet Enclosure

All inspections performed on the "L" top tube sheet enclosure were similar to those discussed in Section A(2)-d of this manual, except as follows: The original three nozzles (Detail "A", Dwg. 6-1 Section A(2)-d) were scrapped due to excessive weld repairs. New ones were fabricated, inspected and accepted.

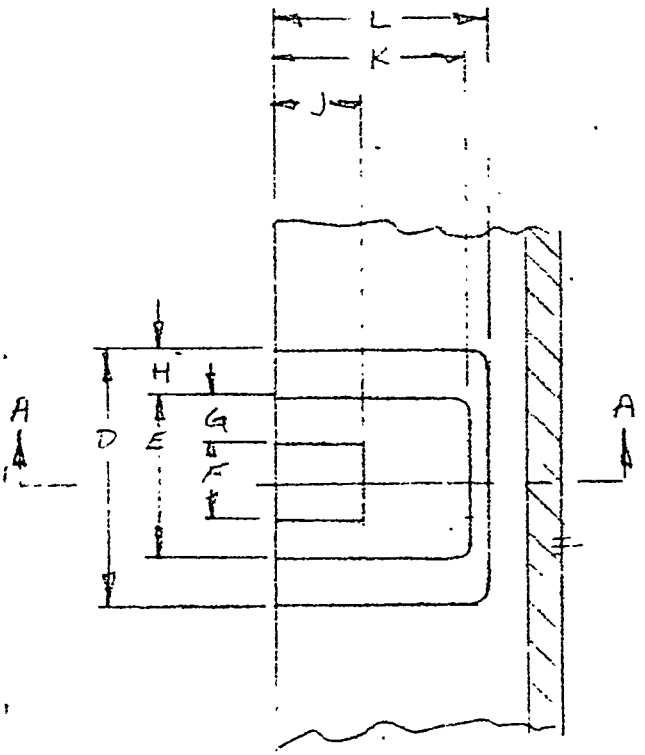
Drawing numbers 6353-1, 6353-2, and 6353-3 presented herewith cover all dimensional inspections taken on this sub-assembly.



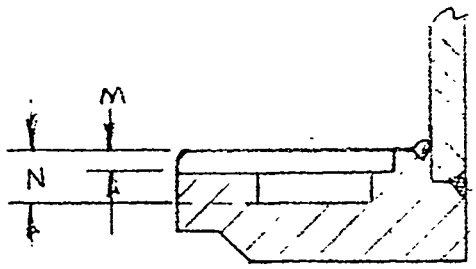
PLAN VIEW — BEARING RING

AS BUILT DIMENSIONS				
DIM.	ARC @ 17'-9 3/8" D.	B/P CALC.	DEG. CALC.	B/P ° CALC
A	70 11/64	70"	37.90°	37.48°
B	14 11/64	14"	7.62°	7.48°
C	41 33/64	41 3/4"	22.30°	22.52°
ABOVE BY A.J. PIATEK ON 5/25/53.				

— THIS DRAWING IS NOT TO S



INDEXING DEVICE DETAIL



SECTION A-A

AS BUILT DIMENSIONS

DIM	NO. 1	NO. 2	NO. 3	B/P
D	3-3 1/32	4	3-63/64	4
E	2-1/4	2-7/32	2-15/64	2-1/4
F	1-17/32	1-15/32	1-15/32	1-1/2
G	25/64	3/8	3/8	3/8
H	27/32	7/8	55/64	7/8
J	1-5/32	1-5/32	1-3/16	1-3/16
K	4-17/32	4-9/16	4-9/16	4-9/16
L	4-23/32	4-3/4	4-3/4	4-3/4
M	9/32	9/32	1/4	9/32
N	7/8	13/16	3/4	25/32

ABOVE BY E.R. BAKER & L.W. MERGENTHALER ON 5/23/53

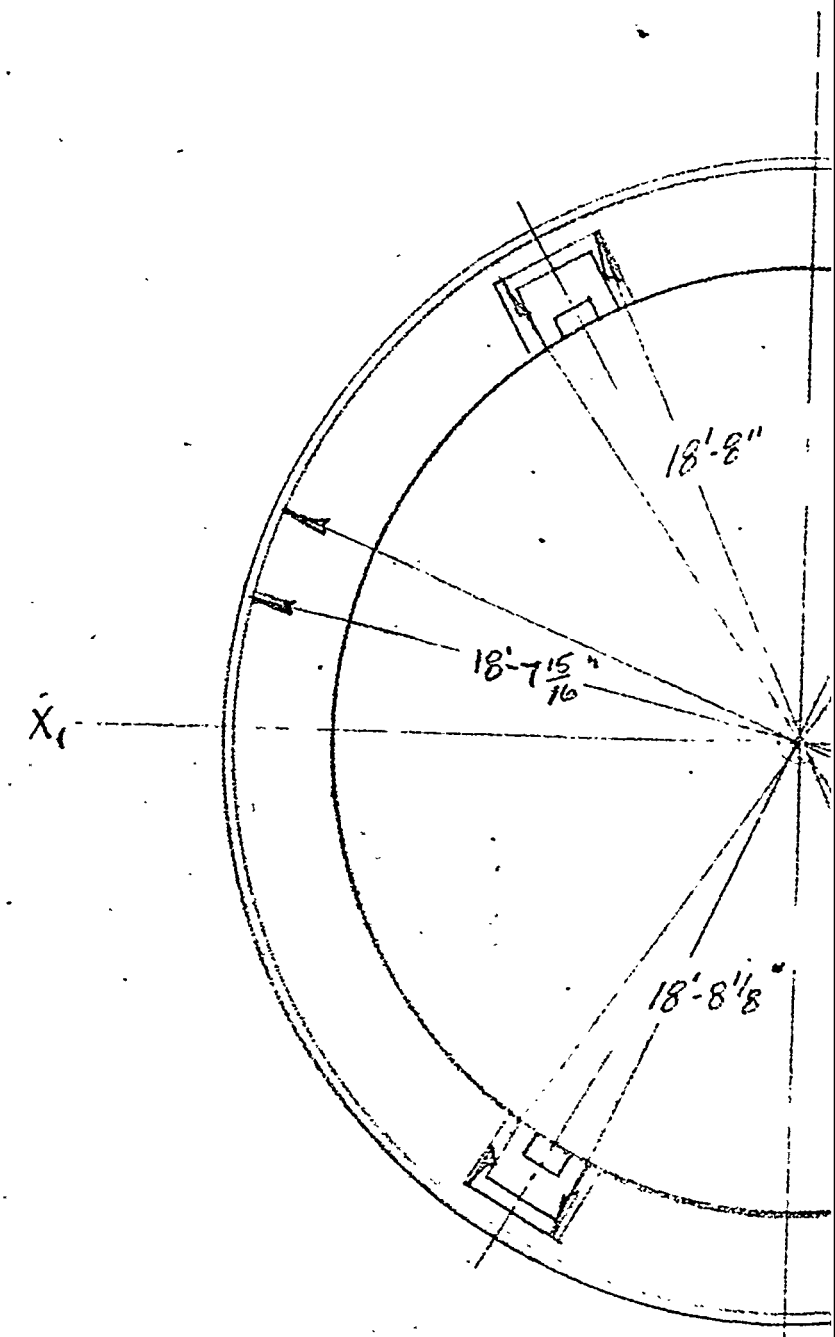
REVISION NO. 1 : DEVICE NO. 2 WAS LISTED AS DEVICE NO. 3

REFERENCE DWG. NO. W133252 R7

"L" UNIT
BEARING RING
INDEXING DEVICE DETAILS

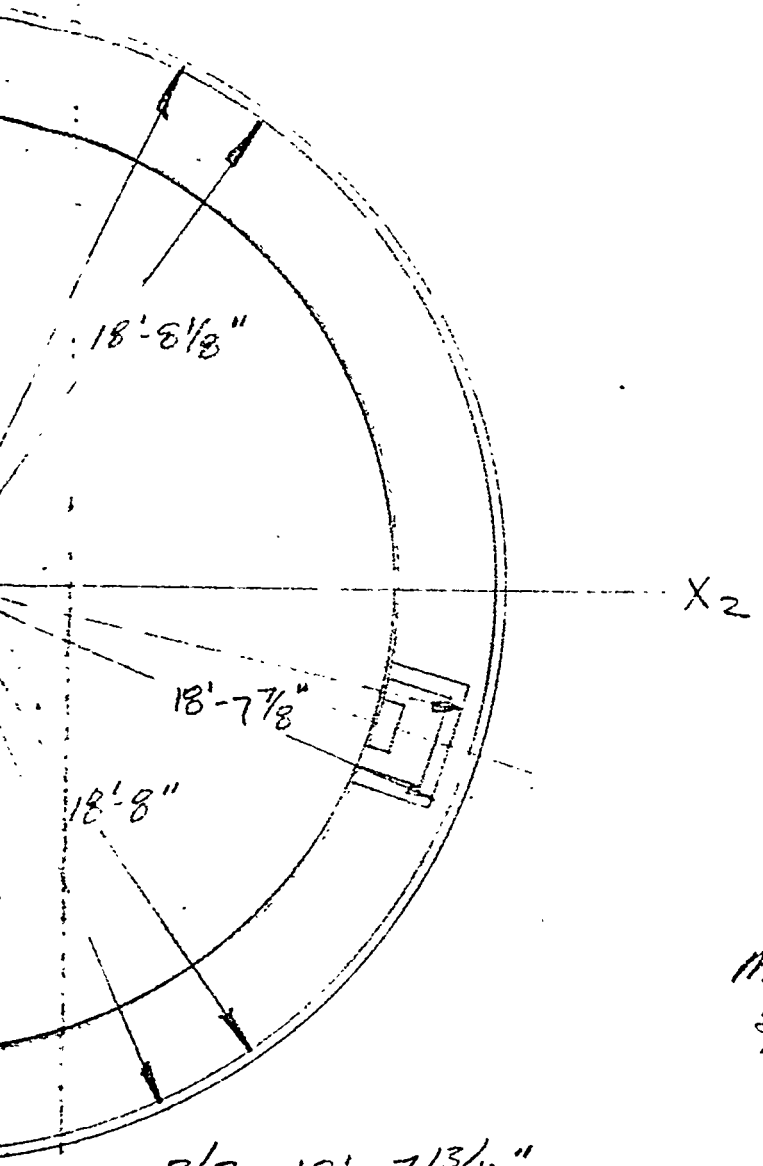
CALE —

DWG. NO. 6353-4



PLAN VIEW - BEA

— THIS DRAWING IS NOT TO



B/P = 18'-7 13/16"

MEASUREMENTS BY R.C. PARKER & L.W. MERGENTHALER ON 5/23/53.

REFERENCE DRAWING W133252R7

PING RING

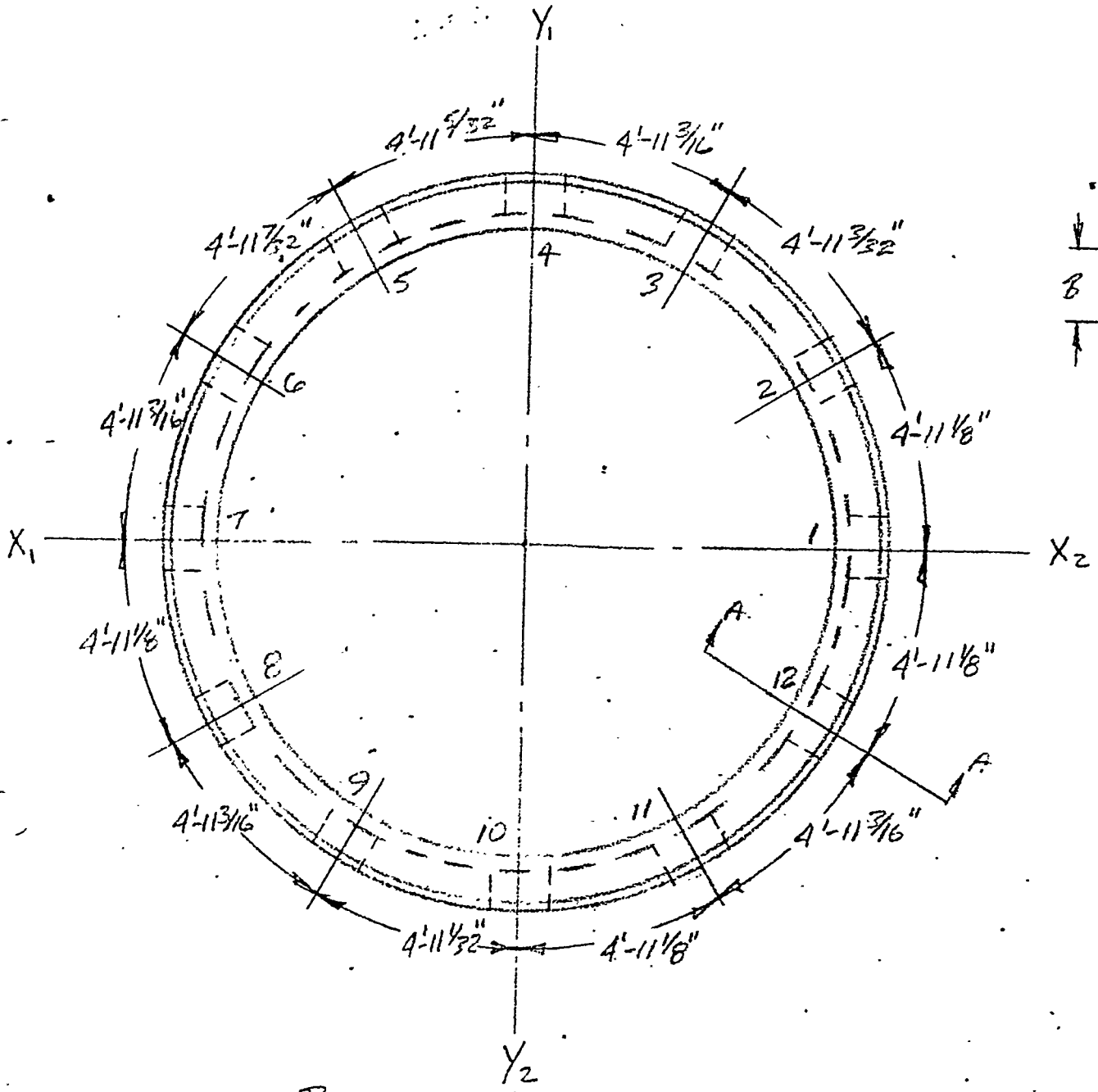
SCALE —

DR. NO. 6353-5

"L" UNIT

BEARING RING

INDEXING TEMPLATE MEASUREMENTS



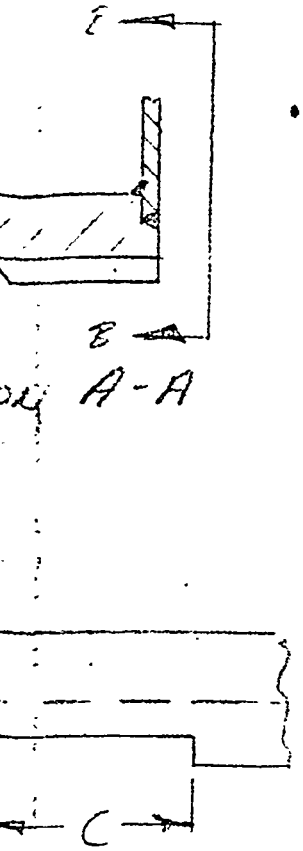
BEARING RING - PLAN VIEW

MEASUREMENTS TO CENTERS OF 12 BEARING PAD CUTOUTS ON BOTTOM SIDE OF RING BY H.E. DILLS & H.E. DAHLKE ON 5/3/55

CIRCUMFERENCE @ MEASUREMENTS = 59'-1 5/8"

30° ARC ON O.D. = 59 9/64"

—THIS DRAWING IS NOT TO



AS BUILT MEASUREMENTS			
POSITION	DIM. "A"	DIM. "B"	DIM. "C"
1	2.003	2.705	12
2	2.000	2.705	12
3	2.003	2.710	12 1/64
4	2.003	2.710	12
5	2.005	2.710	12
6	2.004	2.710	12 1/64
7	2.005	2.710	12
8	2.003	2.705	12 1/64
9	2.003	2.710	12 1/32
10	2.003	2.705	12
11	2.000	2.705	12
12	2.000	2.710	12

NOTE:

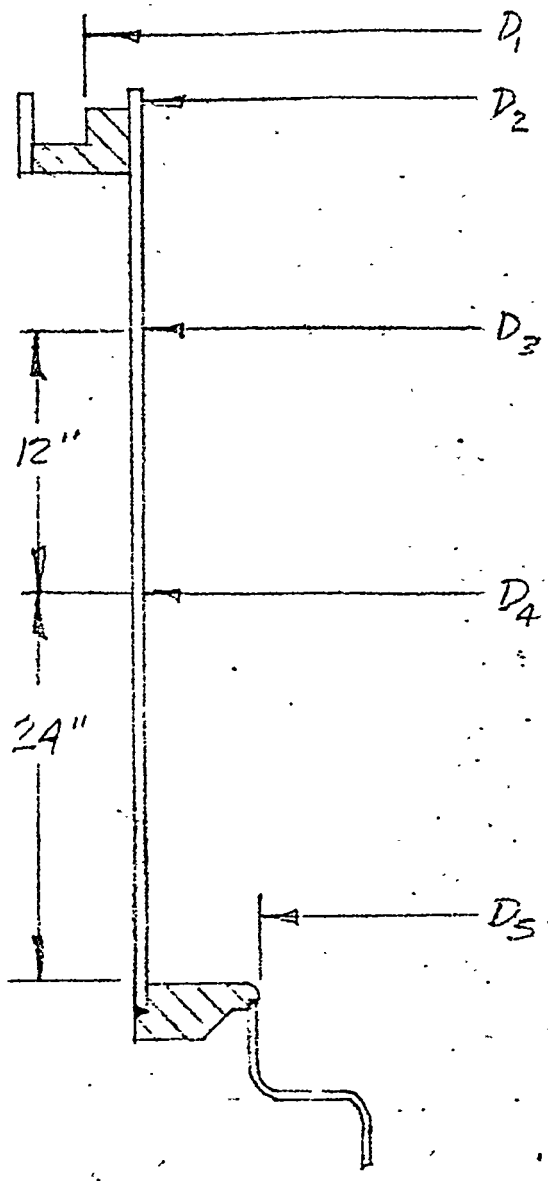
1. DIM. "A" TAKEN BY H.E. DILLS ON 5/13/53
2. DIM. "B" TAKEN BY R.M. LELAND ON 4/24/53.
3. DIM. "C" TAKEN BY A.J. PIATEK ON 5/21/53.

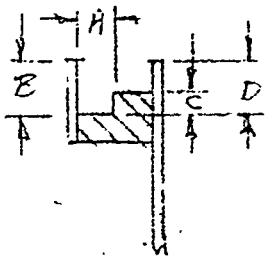
REFERENCE DWG. NO. W133252 R7

"L" UNIT
BEARING RING
BEARING PAD CUT-OUT DETAILS

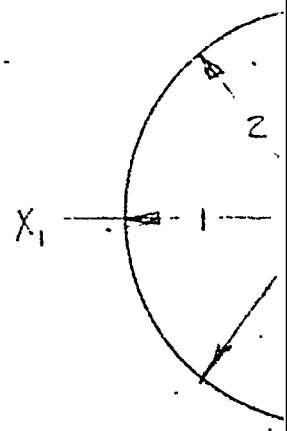
SCALE—

DW'G. NO. 6253-6

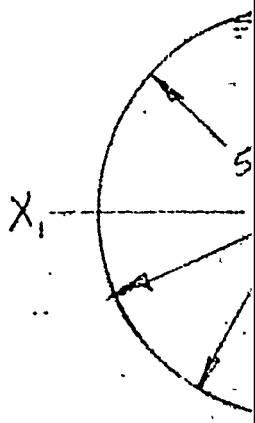




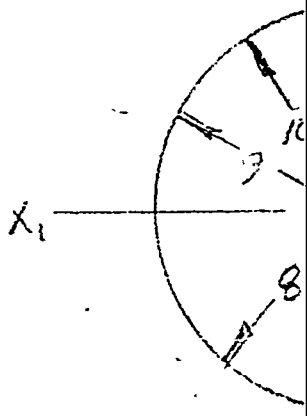
SEAL RING DETAILS



POSITION



POSITION



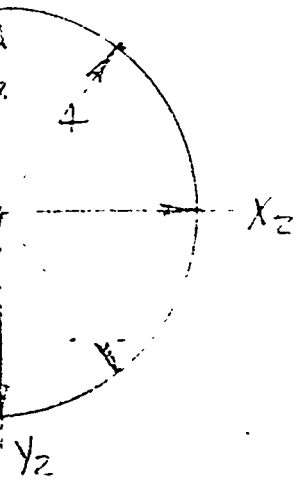
POSITION

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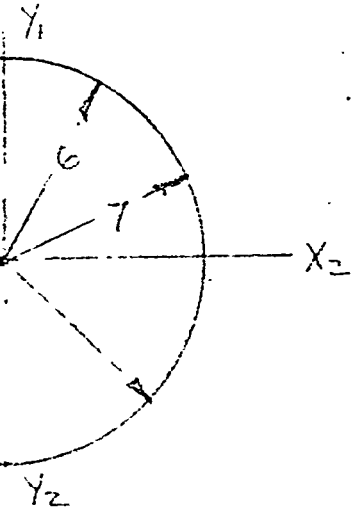
"AS BUILT" MEASUREMENTS

DIM.	POSITION				B/P
	1	2	3	4	
D_1	17'-1 23/32"	19'-1 3/4"	19'-1 13/16"	19'-1 3/4"	19'-1 3/4"
D_2	18'-8 3/4"	18'-8 7/8"	18'-8 13/16"	18'-8 7/8"	18'-8 3/4"
	5	6	7		
D_3	18'-8 7/8"	18'-8 15/16"	18'-8 13/16"		18'-8 3/4"
D_4	18'-9 1/16"	18'-9"	18'-8 15/16"		18'-8 3/4"
	8	9	10		
D_5	17'-9 3/8"	17'-9 3/8"	17'-9 3/8"		17'-9 3/8"

ABOVE MEASUREMENTS BY A. J. PIATEK & R. R. BAKER ON 5/20/53.



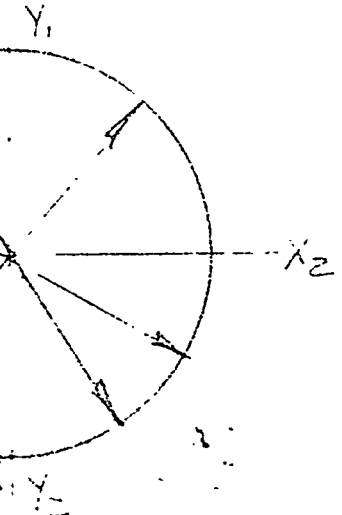
FOR I.M. D_1 & D_2



FOR I.M. D_3 & D_4

DIM.	MEASUREMENT	B/P
A	1 9/32"	1 5/16"
B	1 1/2"	1 1/2"
C	1/2"	1/2"
D	19/32"	1 1/4"

ABOVE DIM. BY H. E. DILLS ON 5/13/53.



FOR I.M. D_5

REFERENCE DWG. NO. W133266 R1
W133252 R7

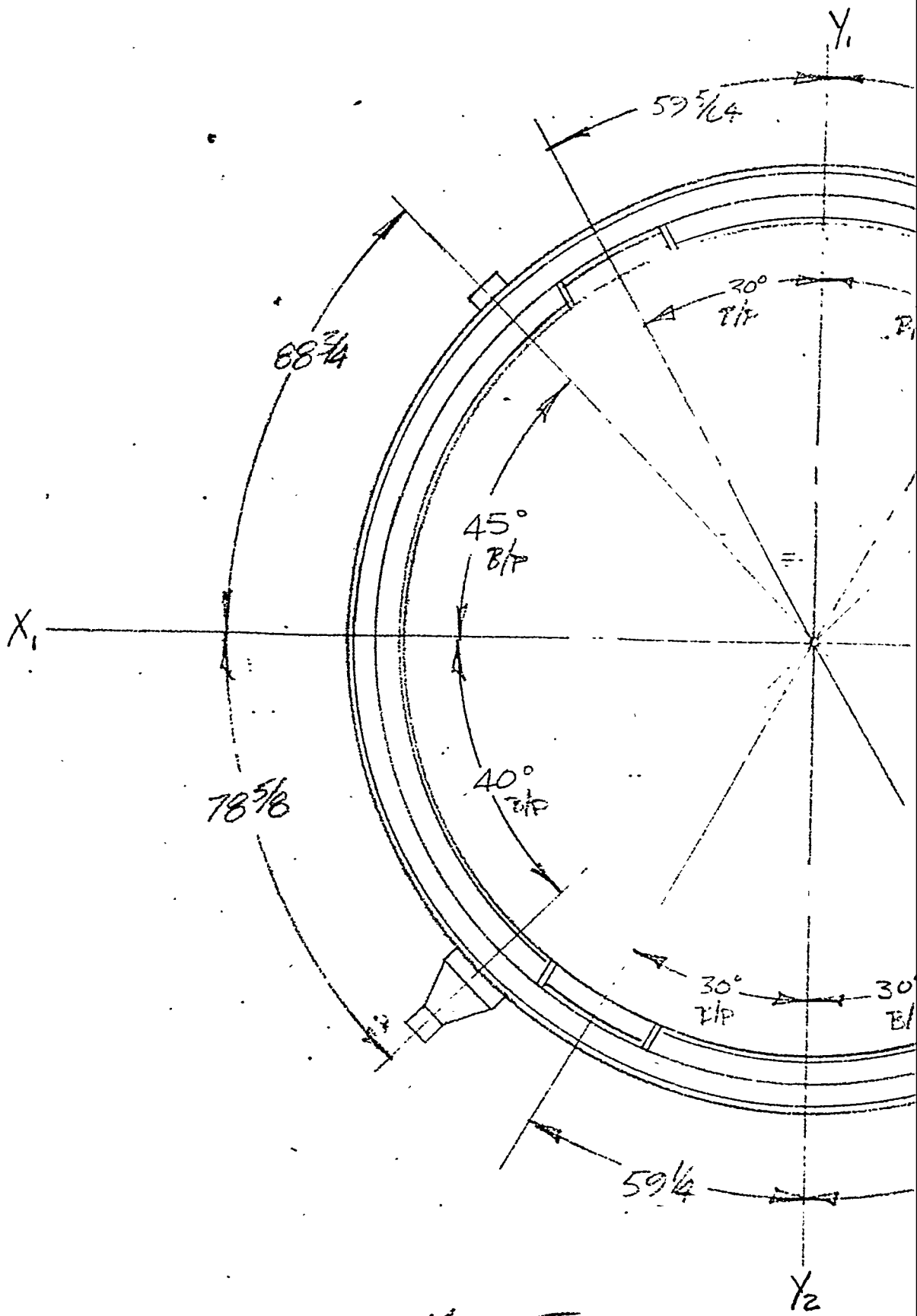
"L" UNIT

MAIN TANK – TOP SHELL

DIAMETER MEASUREMENTS

SCALE —

DR. NO. 6353-1



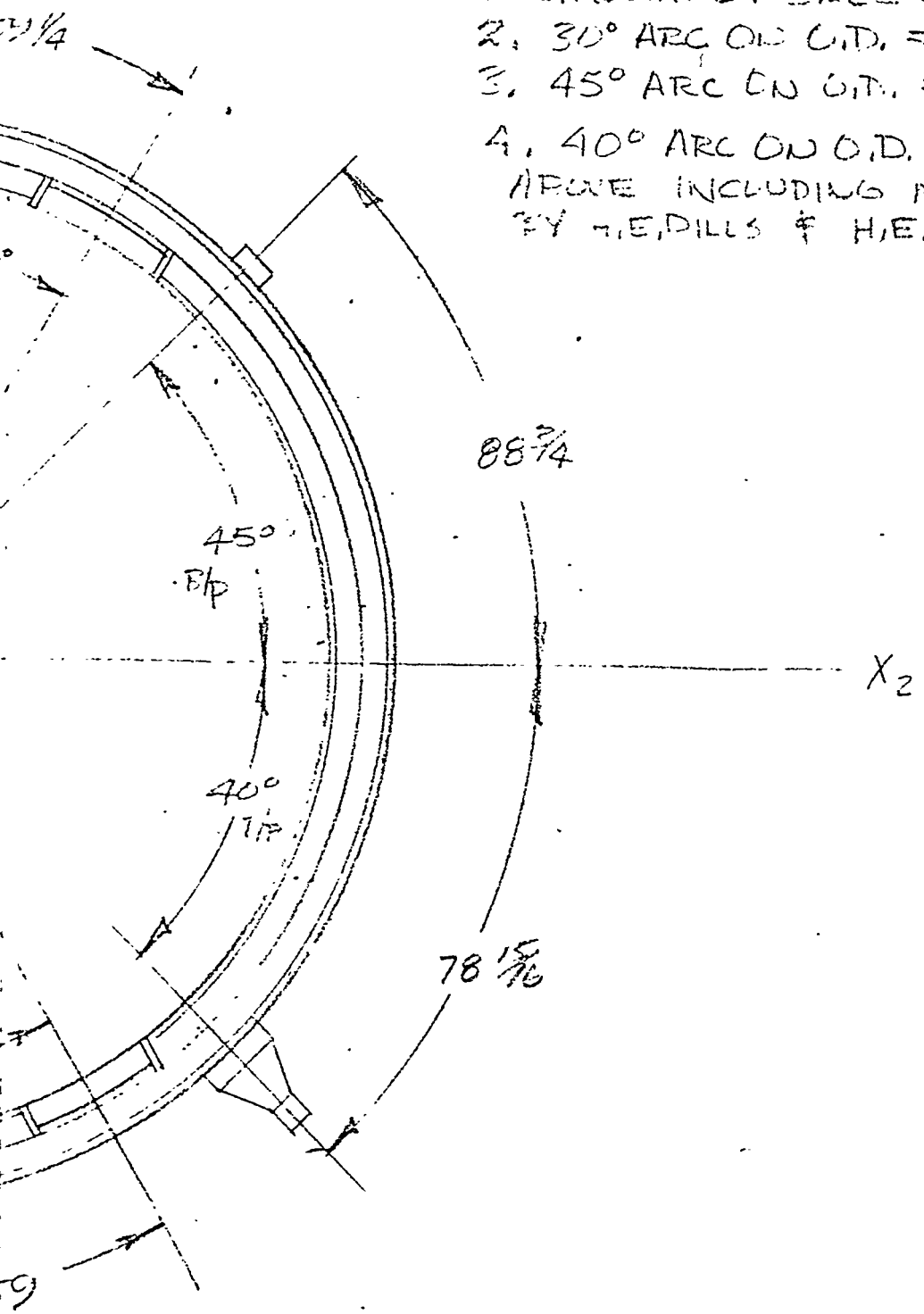
MAIN TANK - TOP SHELL -

- THIS DRAWING IS NOT

CALCULATIONS

1. CIRCUMFERENCE = 59' 2 1/16"
2. 30° ARC ON O.D. = 59 11/64"
3. 45° ARC ON O.D. = 88 3/4"
4. 40° ARC ON O.D. = 78 29/32"

APPROVED INCLUDING MEASUREMENTS BY H.E. DILLS & H.E. DAHLKE ON 5/3/53



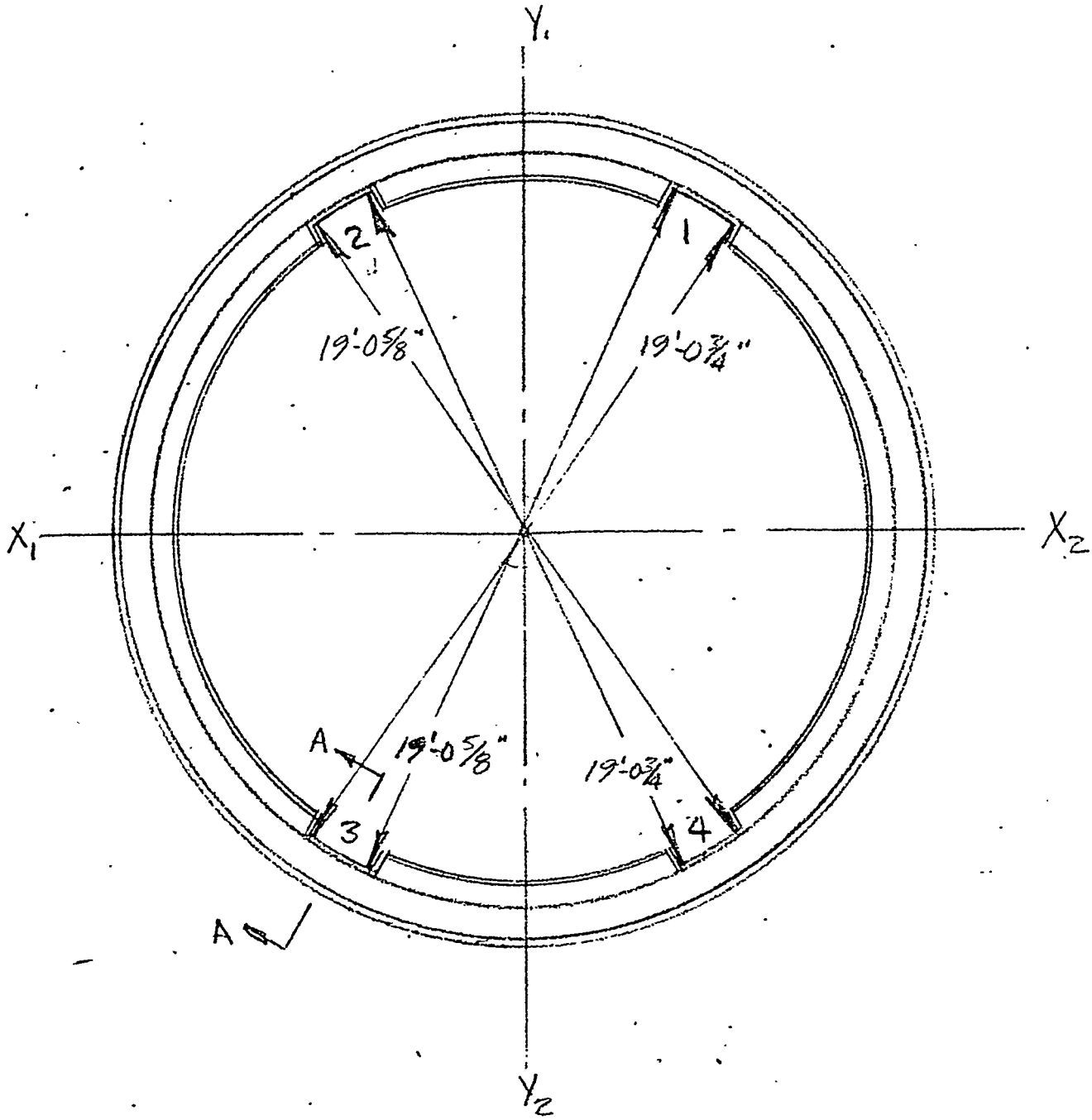
REFERENCE DWG. NO. W133266 R1

PLAN VIEW

TO SCALE—

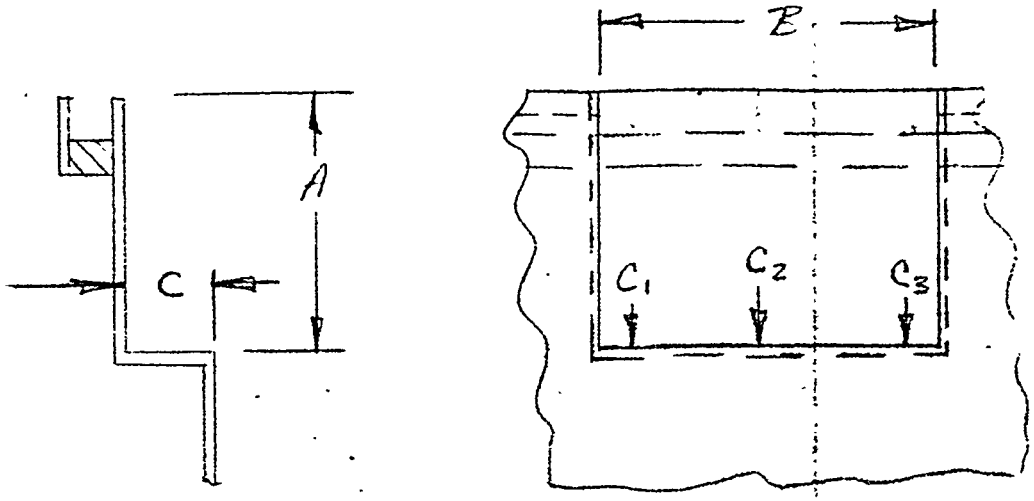
DWG NO. 6353-2

"L" UNIT
MAIN TANK - TOP SHELL
ORIENTATION OF NOZZLES & LIFTING LUG CUTOUTS.



DIAMETER MEASUREMENTS OF LIFTING LUG CUTOUTS
B/P: 19'-0 3/4"
MEASUREMENTS BY R.R. BAKER & L.W. MERGENTHALER ON 5/23/53

— THIS DRAWING IS NOT



SECTION A-A

DIM	POSITION				B/P
	1	2	3	4	
A	7"	7 1/32"	7 1/16"	7"	7"
B	22"	21-31/32"	22"	21-31/32"	22"
C_1	1-31/32"	1-31/32"	2"	2-1/32"	2"
C_2	2"	2-1/32"	2 1/32"	2-1/32"	2"
C_3	2-1/16"	1-62/64"	2"	1-63/64"	2"

ABOVE MEASUREMENTS BY R.R. BAKER & L.W. MEIZGENTHALER ON 5/23/58.

REFERENCE DR. NO. W133266 E1

"L" UNIT

MAIN TANK - TOP SHELL

MEASUREMENTS OF LIFTING LUG CUTOUTS

SCALE —

DR. NO. 6353-3

[7] Welding of Top Tube Sheet Enclosure to Bearing Ring and Expansion Joint Assembly

The fabrication and inspections performed at this stage of fabrication were similar to that described in Section A(2)-e except as follows:

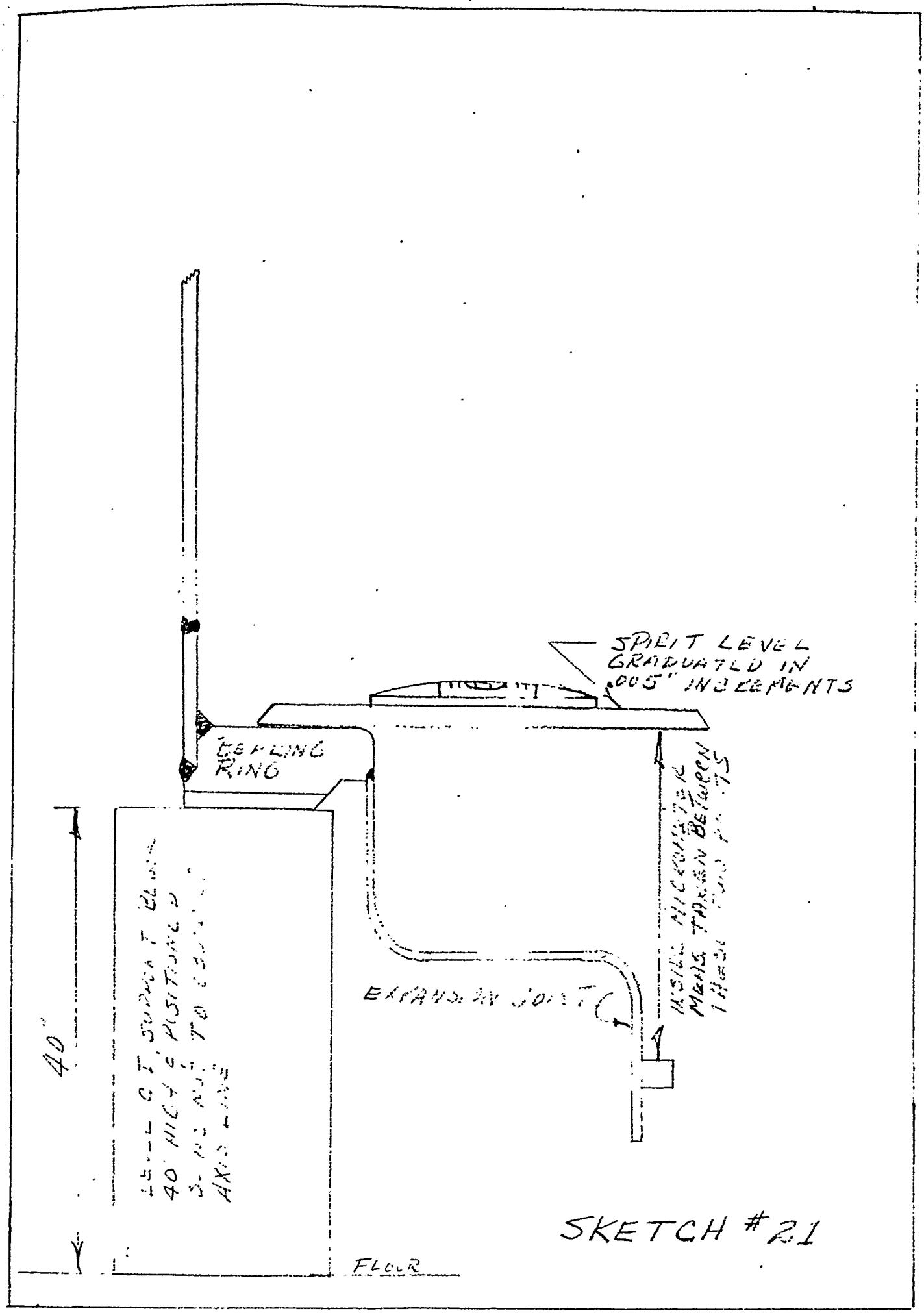
After machining the seal ring on the top tube sheet enclosure, the entire assembly was moved to a level platen and set on 40" high pedestals and leveled. When the unit was set up, inspectors checked the position of the four pedestals located near the extremities of the X and Y axes to see that they did not fall on the end axis pointsaand obstruct the line of sight of the theodolite. (This occurred on the "R" assembly and is discussed in Section A(2)-e of this manual). The transferring of centerlines was performed in a similar manner pictorially illustrated in Sketch #12, Section A(2)-g of this manual, except it was not necessary to off-set the theodolite on "L" and "K" units because the 40" high pedestals were positioned so as not to obstruct the instruments line of sight.

Following the above mentioned set-up, the vendor's personnel welded four reference buttons on each of the four axes. The assembly was supported as shown in Sketch #21 in order that the expansion ring was in an unstrained position. After taking the micrometer reading (Sketch #21) from the reference button to the spirit level, the inspector stenciled an "O" mark on the button at the point measured, and also scribed lines on the bearing ring for re-location of the spirit level at a later time. These measurements were checked three times in order for the inspector to be sure that this method was exact. These measurements were duplicated when the expansion joint was joined to the tank shell, thereby verifying that the expansion joint was still in an unstrained position.

[8] Fitting and Welding Expansion Joint to Tank Shell

The fitting and welding of the expansion joint to the tank shell and inspections performed were done in a similar manner pictorially illustrated in Sketch #14, Section (2)-h of this manual, except an additional inspection was performed on "L" and "K" units and was as follows:

After the expansion joint was tacked to the main tank shell and level readings on the bearing ring were taken, measurements from the top face of the bearing ring to each of the four reference


SPIRIT LEVEL
GRADUATED IN
.005" INCREMENTS
FEELING
RING
EXPANSION JOINT
40"
FLOOR

SKETCH #21

buttons welded to the expansion joint were again taken in a similar manner described in item [7] above. This was deemed necessary in order to determine if the expansion joint was still in an unstrained position.

If reference measurements taken in [7] deviate considerably from measurements taken after tack welding the expansion joint to the tank shell, the expansion joint is in a strained position. If this condition exists, the readings are made to compare to reference measurements by adjusting the spider web gear inside the main tank assembly until readings are duplicated within a few thousandths of reference measurements.

[9] Transfer of Axes from Bottom Tube Sheet to Nozzle Section

In order to assist the field construction force to assembly and set up units at the plant site, X and Y axes previously established on the "L" (or "K") were transferred to the bottom of the bottom tube sheet and to the inside and outside of the bottom tube sheet nozzle section at a point approximately 1" below the prepared welding edge on the nozzle assembly. Transfer of centerlines was done with the aid of the Wild T1 theodolite. This was accomplished by "waking" the theodolite in on the established centerlines, transferring these lines to the floor, and then setting up the instrument on the established floor points. These points were picked up from the floor in a similar manner to that shown in Sketch #14, Part VII, Section III, and projected back to the outside of the nozzle assembly, BTS wrapper plates and the bottom ends of the extreme tubes located on the X and Y axes. These points were then used for lofting in the main section described in the next section.

[10] Orientation and Fit-up of the Main Tank and Enclosure to the Bottom Tube Sheet Nozzle Section

With the bottom tube sheet level within .008", the "L" main tank shell and enclosure was placed on the bottom tube sheet nozzle assembly with the aid of an overhead crane. The theodolite was then set-up and on the flor points established at the extreme ends of one of the axis. (See Sketch #16, Section A(2)-h which pictorially illustrates where the theodolite was first placed). After adjusting the instrument to coincide with the floor points, the instrument's line of sight was projected from the bottom tube sheet centerline points to the centerlines on the top tube sheet enclosure. The enclosure

and main tank were then rotated until all axis lines on this side coincided. These axis lines were checked on all four sides of the tank shell in a similar manner to that pictorially illustrated in Sketch #16 referenced above.

Following the above procedure, the bearing ring was leveled and the expansion joint adjusted (if necessary) until the bearing ring was level and in an unstrained position. This adjusting of the bearing ring sometimes causes mo ement of the entire tank shell so the theodolite was set up again and all tank centerlines checked for being coincident as described above.

After the assembly met the above requirements, the distance from the bearing ring to the tops of bottom tube sheet tubes was checked at positions X_1, X_2, Y_1, and Y_2. This was measured by placing a straight edge on the bearing ring and taping the distance between the face of the straight edge and tube ends with a 100 ft. stainless steel tape graduated in 1/16". Dimenion "C" on Dr. No. 6353-8 presented herewith illustrates pictorially where these measurements were tkane and the results obtained.

If these measurements are long, the main tank is removed and the excess metal is chipped from the top edge of the nozzle assembly. After this the main tank is again put back on the nozzle assembly and the entire procedure discussed above is repeated. The measurements from the bearing ring to bottom tube sheet tubes are again taken and if they within a tolerance of to -1/32", these measurements are accepted.

Finally, measurements from the 12 bearing ring cutouts to the bottom of each bottom tube sheet bearing pad were taken using a level and 100' stainless steel tape graduated in 1/16".

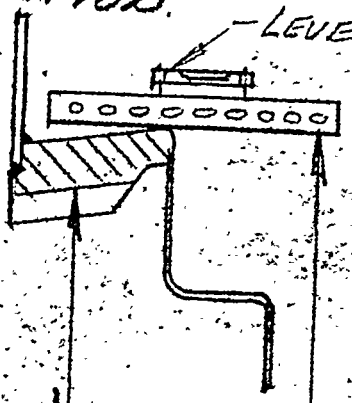
Results of the above inspections are covered in Dr. No. 6353-8 presented herewith and were acceptable.

Before removing the main tank section from the bottom tube sheet, diameter measurements were taken on the assembly. The method used was similar to that described in Section A(1)-b of this manual.

Final results of tank diameter measurements are shown on Dr. No. 6353-7 presented herewith.

The main tank was accepted, removed from the bottom tube sheet assembly and prepared for shipmentto the Savannah River Plant located in the state of South Carolina.

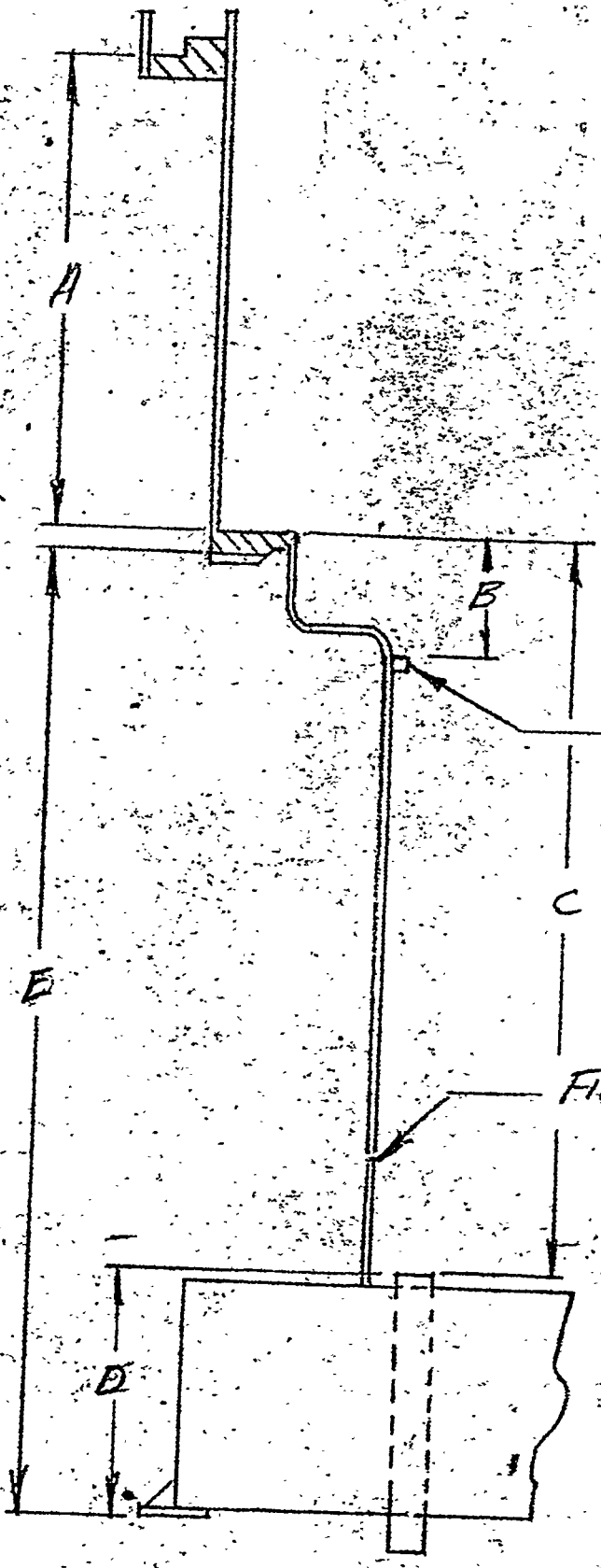
IN SOME AREAS TILT IS IN OPPOSITE DIRECTION.

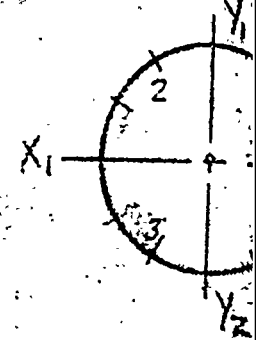


DIM. "E" FROM MID POINT

DIM. "B" & "C" FROM HIGH POINT

DETAIL "A"



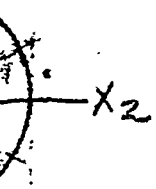


POSITION F

REFERENC
(ONE BUTTO

FIELD WELD PRE

THIS DRAWING IS NOT TO



DIMENSIONS

BUTTON
AT EACH AXIS)

RATION

DIM	POSITION						B/P
	X_1	X_2	Y_1	Y_2			
A	48 15/64"	48 15/64"	48 15/64"	48 15/64"			4-8 1/4"
B	11.239"	11.215"	11.205"	11.244"			SEE NOTES
C	15'-2 3/4"	15'-2 49/64"	15'-2 49/64"	15'-2 47/64"			15'-2 3/4"
D	41 1/2	41 1/2	41 1/2	41 1/2			41 1/2
	1	2	3	4	X_1	X_2	
E	18'-6 1/4"	18'-6 15/64"	18'-6 1/4"	18'-6 15/64"	18'-6 9/32"	18'-6 17/64"	18'-6 1/4"

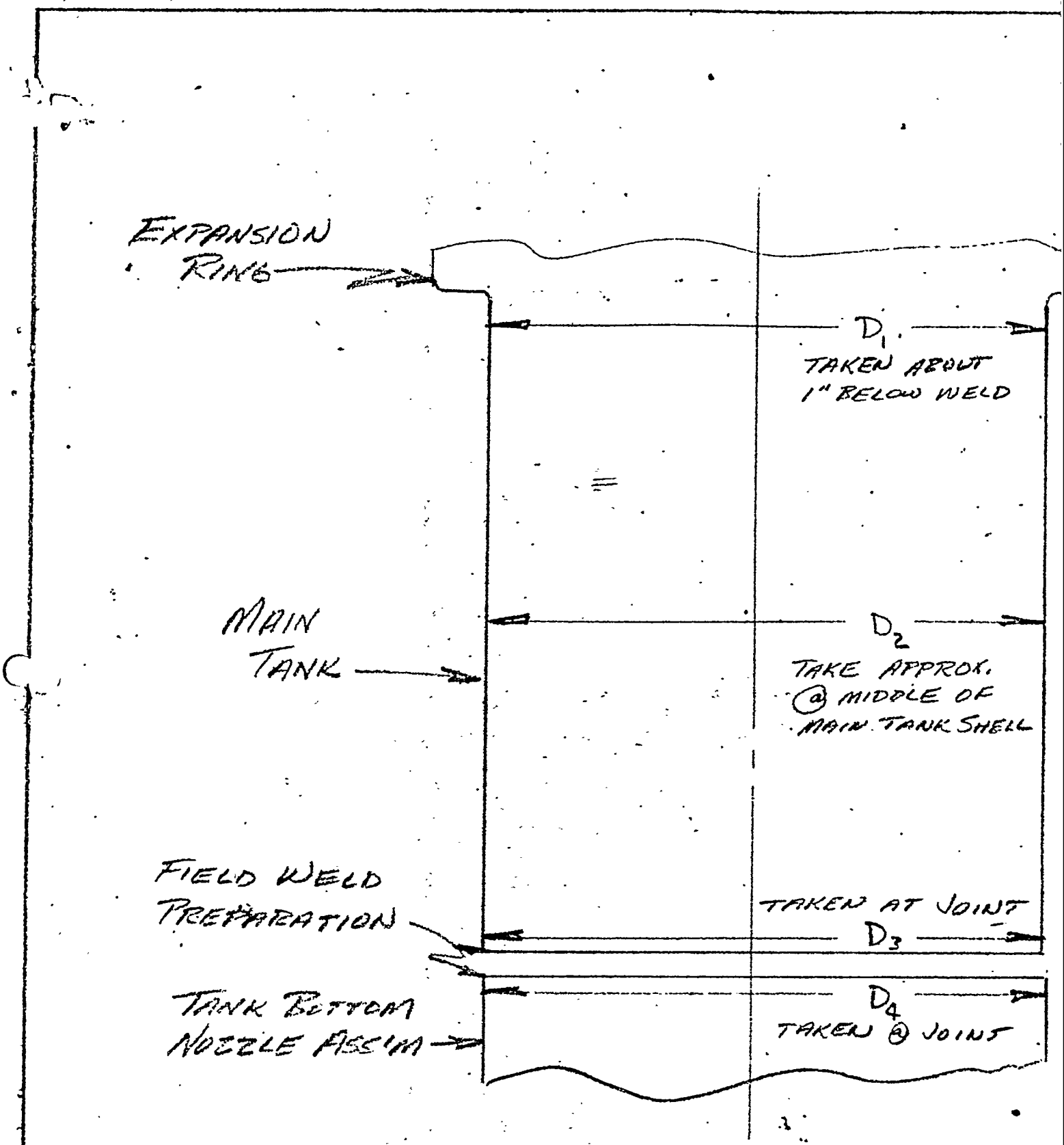
NOTES,

1. DIM. "A" BY H.E. DILLS ON 5/13/53
2. DIM. "B" BY A.J. TIATEK ON 5/27/53 WITH EXPANSION RING IN UNSTRAINED POSITION.
3. DIM. "C" BY A.J. PIATEK ON 5/29/53 WITH EXPANSION RING IN UNSTRAINED POSITION.
4. DIM. "D" BY A.J. PIATEK ON 2/5/53
5. DIM. "E" BY R.E. CHANEY ON 5/29/53 WITH EXPANSION RING IN UNSTRAINED POSITION,
6. DUE TO TILT OF BEARING RING AS SHOWN IN DETAIL "A", DIM. "B" & "C" WERE TAKEN FROM HIGH POINT OF RING & DIM. "E" WAS TAKEN FROM MID POINT OF RING.

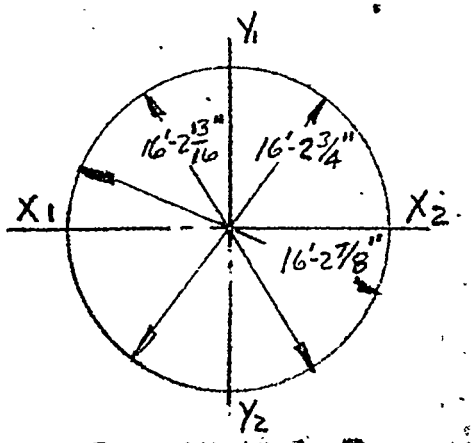
REFERENCE DRAWINGS: W133266 R1
W133252 R7
W132760 R14

"L" UNIT
TANK & BOTTOM TUBE SHEET
VERTICAL DIMENSIONS

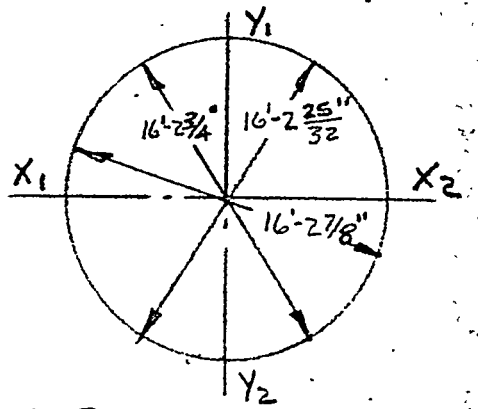
SCALE —— | DR. NO. 6353-8



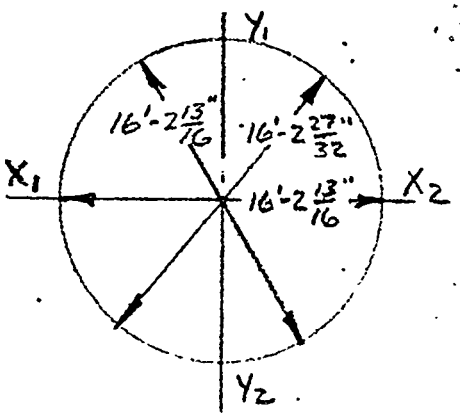
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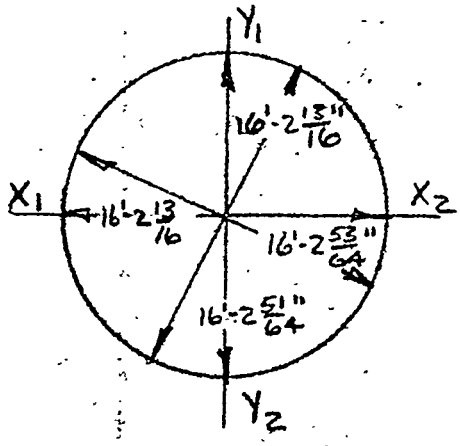
DIMENSION D_1



DIMENSION D_2



DIMENSION D_3
CIRCUMFERENCE = 51'-3 7/16"



DIMENSION D_4
CIRCUMFERENCE = 51'-3 15/32"

NOTE:
1. ALL DIAMETERS ARE INSIDE DIAMETERS. B/P SPECS. ARE 16'-2 3/4" I.D.

REFERENCE DR. NO. W133252 R7
W132760 R14

"L" UNIT
MAIN TANK
DIAMETER MEASUREMENTS

SCALE —

DR. NO. 6353-7