SR/H--861.

REPORT
OF
MATERIAL & EQUIPMENT
SECTION'S
ACTIVITIES
AT
NEW YORK SHIPBUILDING CORP.
DURING FABRICATION
OF
AXC 1671/2
STARTING MAY 18, 1951

PART III [redacted]

BY: JAMES RAY STEWART

MAY 26, 1954 MASTER

Doc No.
DOES NOT CONTAIN
UNCLASSIFIED CONTROLLED
NUCLEAR INFORMATION
Reviewing Official: C. J. Banick, AED Class. Officer
Date November 29, 1988

NYX INSPECTION GAGES

AND

INSPECTIONS PERFORMED BY DU PONT

IN BUILDING 10

Doc No.
Classification Cancelled or Changed
To: UNCLASSIFIED
By: S. W. O'Rear, Derivative Declassifer
Date November 29, 1988

PART III

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SPECIAL GAGES USED BY DU PONT ON THE NYX PROJECT
NEW YORK SHIPBUILDING CORPORATION

I. Introduction

The M & E Group at New York Ship was responsible for all measurements on process units. To carry out this function, it was necessary to develop a great many special purpose gages as well as procure many commercial gages.

This book will describe the development and use of the special gages. In a great many inspection problems in which special gages were utilized, commercial gages in numerous instances were incorporated to obtain the ultimate result. Since the actual use of commercial gages falls under the category of standard machine shop methods and procedures, only those which were applied in a special manner will be described in conjunction with the special purpose gages. For a list of commercial gages used on this project, see Section II-P of this manual.

II. Special Gages

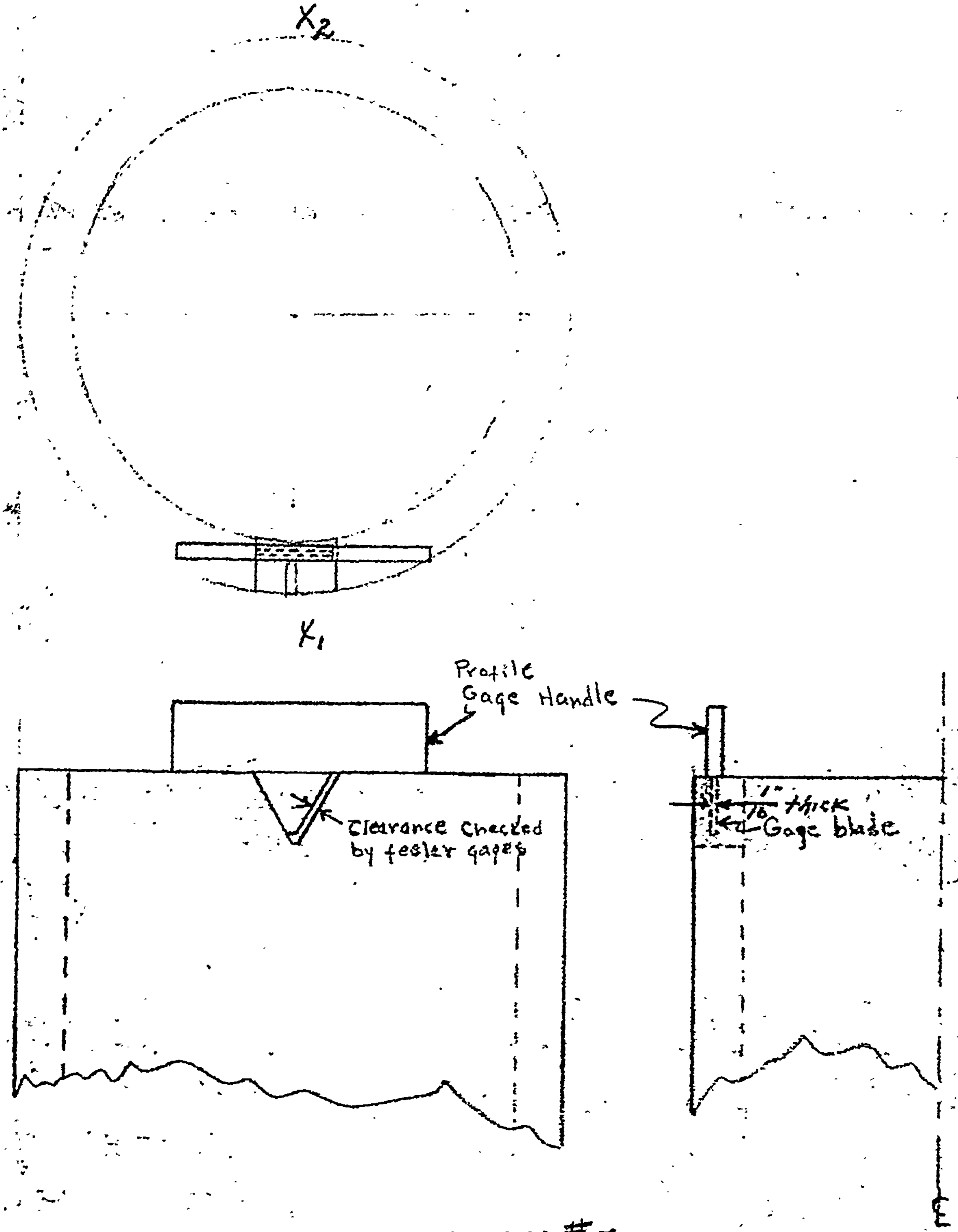
A. Plenum Tube "V" Slot Gages

1. Precision Profile and "V" Slot Functional Gage

a. Development and Use

The need for a profile type gage to measure a finish machined "V" slot milled with flat surfaces in the top end of each 5¼" O.D. plenum tubes was foreseen by the M & E Group at New York Ship. Standard gages were not available at the project site, or manufactured commercially that could be incorporated to obtain these measurements. A sketch of the proposed gage was made and submitted to the New York Ship machine shop for fabrication. The gage was made to fit a slot of exact size, and any deviation was measured by using feeler gages either between the gage and slot wall for oversize slots, and between gage and tube top for undersize slots. The slots were milled (one per tube) with a "Versa-Mill" feeding a rotating vertical cutter across the tube wall parallel to the unit "X" axis on the X1 side. As each slot was machined and de-burred, the size was checked with this gage (See Sketch #1).

The slots in "R" plenum chamber were measured essentially the same as outlined for the NYX unit, except a functional type gage was employed. The M & E Group at New York Ship suggested to the Design Division that a gage of this type, simulating the actual mating part which fits into the tube slot, be designed such that the use of feeler gages would be virtually eliminated, thereby resulting



SKETCH #1

K J H G F E D C B A

ENGINEERING SKETCH SHEET
E. I. DU PONT DE NEMOURS & CO.

PROJ. NO. 8980

SIGNATURE:

PROJ. TITLE Plenum Chamber - NYX Unit Only

DATE 7-25-53

SUBJECT "V" Slot Profile Gage

NO. E-42405

in a reduction of inspection time required per tube slot. This gage was designed by the Design Division, who in turn had the gage fabricated by Northern Engineering and Machine Company, Philadelphia, Pennsylvania. The functional gage "V" slot is identified as equipment piece #790-113. For fabrication details, see du Pont drawing D-112218. After inspecting the gage at New York Ship, the "key" width was found to be .010" undersize; however, the gage was accepted but had to be used in conjunction with feeler gages as described in the above paragraph.

On "R" and subsequent units, two additional "V" slots, each 120° from the original slot on X--axis, were milled in the top end of each plenum tube. For location of these slots with respect to the X & Y axes, see Sketch #3. These were likewise measured using the functional type gage described above. For use of this gage, see Part I-C, Section 3, Photo Serial #63.

The use of this gage was discontinued after using it on the "R" plenum chamber, and a similar gage of advance design was substituted for use on subsequent units. This gage will be discussed in the section to follow.

2. "V" Slot Width Gage

a. Development

With the advent of a plung milling method on "P" unit plenum chamber (resulting in curved slot walls), a new gage had to be devised simulating the function of the mating part (Tapered key on semi-permanent sleeve) and still indicate off-size measurements.

Prior to incorporating the plunge milling method, slots were originally machined by feeding the "Versa Mill" vertical across the plane of tube ends. A special milling machine designed and built by Cincinnati-Bickford reduced the "V" slot machining time considerably and replaced the "Versa-Mill". This machine incorporated the plunge milling method in which the cutter is fed perpendicular to the plane of a tube end. This method of machining resulted in curved slot walls. During inspection of finished "V" slots on "P" unit, the use of the functional gage in conjunction with feeler gages did not produce accurate data as to whether or not slots were within tolerance. It was discovered that the functional gage flange seated properly, but the "key" fitted tight at points "A" and loose at "B". (See Photo Serial Numbers 276 and 277). Feeler gages inserted at points "B" indicated the slot was outside the required tolerance; however, at points "A" it indicated slots were within tolerance.

The multiplicity of measurements and the introduction of the plunge milling method led to the development of the "V" slot width gage. The M & E Group devised the gage required, and conveyed verbally the information to Design, who in turn designed the gage and had it fabricated by Advance Tool and Engineering Company, York, Pennsylvania. Also, a master "setting gage" for calibrating the width gage was fabricated to simulate the actual plenum tube into which the "key" on a semi-permanent sleeve fits. Upon receipt of the above gage at New York Ship, it was inspected and found satisfactory. The "V" slot width gage is identified as equipment piece number 790-136. For details see du Pont drawing D-112893. The master "setting gage" is identified as equipment piece number 790-135. For fabrication details, see du Pont drawing D-110290.

b. Use of Gage

For measuring purposes, the width gage is first calibrated by inserting the barrel into the master "setting gage" and then the dial indicator is set at "0" for nominal slot width. (See Photo Serial #299). Care must be taken to insure that the "key" on the width gage is seated firmly in the master "setting gage" slot, otherwise inaccuracy in calibration will result. After the gage has been properly calibrated, it is then removed and ready for use.

The gage is used by inserting the barrel into a plenum tube with the "key" resting in the slot to be measured. The"key" is then seated in the slot firmly by applying a slight downward had pressure on the "key", and then the dial indicator is read. The dial indicator readings are reversed in sign, i.e., (+) indicates an undersize slot and (-) indicates an oversize slot. Table #1 is utilized to determine actual slot width.

Before inserting the width gage into a tube, it is imperative that the plenum tube end, I.D., and slots be de-burred and thoroughly cleaned (perferably with solvent), as the presence of any foreign material will give an erroneous dial indicator reading.

This gage has been used on "P" and "L" plenum chambers and will be used on subsequent units. For the gage to be used in a tube before the honing operation, it is necessary that the O.D. of the barrel be reduced in size. In this case, the gage could be used in a tube, honed or not, provided the O.D. of the barrel is small enough to clear the plenum tube I.D.

3. Angle Gage for "V" Slot

a. Development

Serial Number 276

RESTRICTED
SECURITY INFORMATION

New York Shipbuilding Corp.
Camden, New Jersey
August 10, 1953

PROJECT 8980 - SAVANNAH RIVER PLANT

This is a mock-up illustrating curved slot walls in a "V" slot.

During inspection of finished "V" slots on "P" unit plenum chamber, it was discovered that the functional gage flange seated properly, but the "key" fitted tight at points "A" (See photo serial number 277) and loose at points "B". Feeler gages inserted at points "B" indicated the slot was outside the required tolerance; however, at points "A" (see photo serial number 277) it indicated slots were within tolerance. The use of the functional gage in conjunction with feeler gages did not produce accurate data as to whether or not slots were within tolerance. This discrepancy led to the development of the width gage for measuring the 3 "V" slots in the top end of all plenum tubes.

The above condition was due to a change in fabrication and machining procedures, in which the plunge milling method was incorporated [illegible] the slots, and a new gage was developed to handle the inspection.

RESTRICTED
SECURITY INFORMATION


5ER-276

Serial Number 277

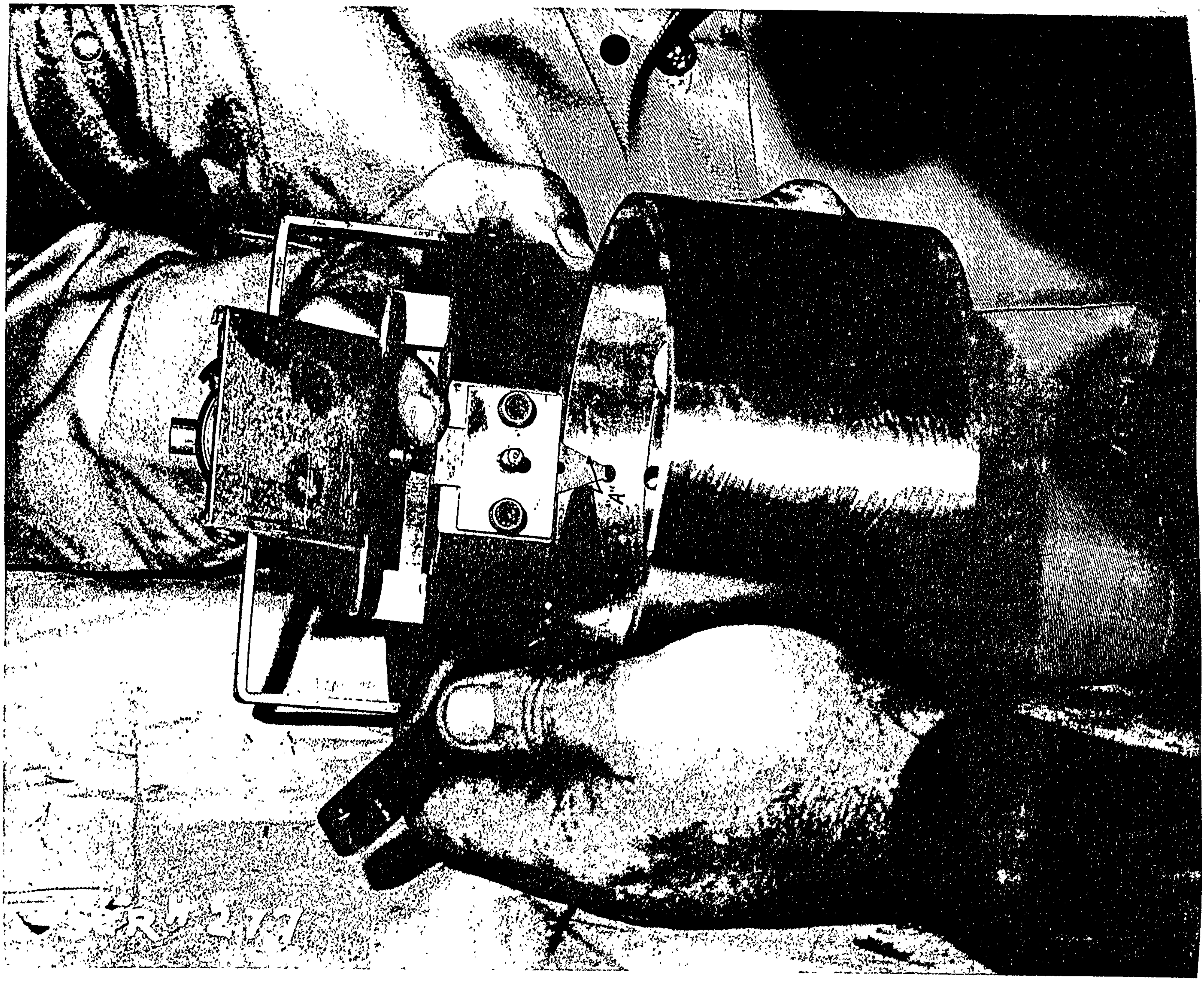
[redacted]

[redacted]ew York Shipbuilding Corp.
amden, New Jersey
August 10, 1953

PROJECT 8980 - SAVANNAH RIVER PLANT

This is a mock-up illustrating curved slot walls in a "V" slot. Refer to photo serial number 276 for explanation.

[redacted]


"A"
RU 277

[redacted]

Serial Number 299

New York Shipbuilding Corp.
Camden, New Jersey
September 3, 1953

PROJECT 8980 - SAVANNAH RIVER PLANT

"V" Slot Width Gage and Setting Stand

Gage (#1) is identified as equipment piece number 790-136. For fabrication details, see duPont drawing D-112893.

Function:

Plug type gage registers in plenum tube sliding key contacts dial indicator which is set at "0" for nominal slot width at top. Any reading shown on dial indicator from .000" to -.006" indicates the tolerance of slot width of .530" to .535". Use setting stand D-110290, shown on right for setting width gage.

[redacted]

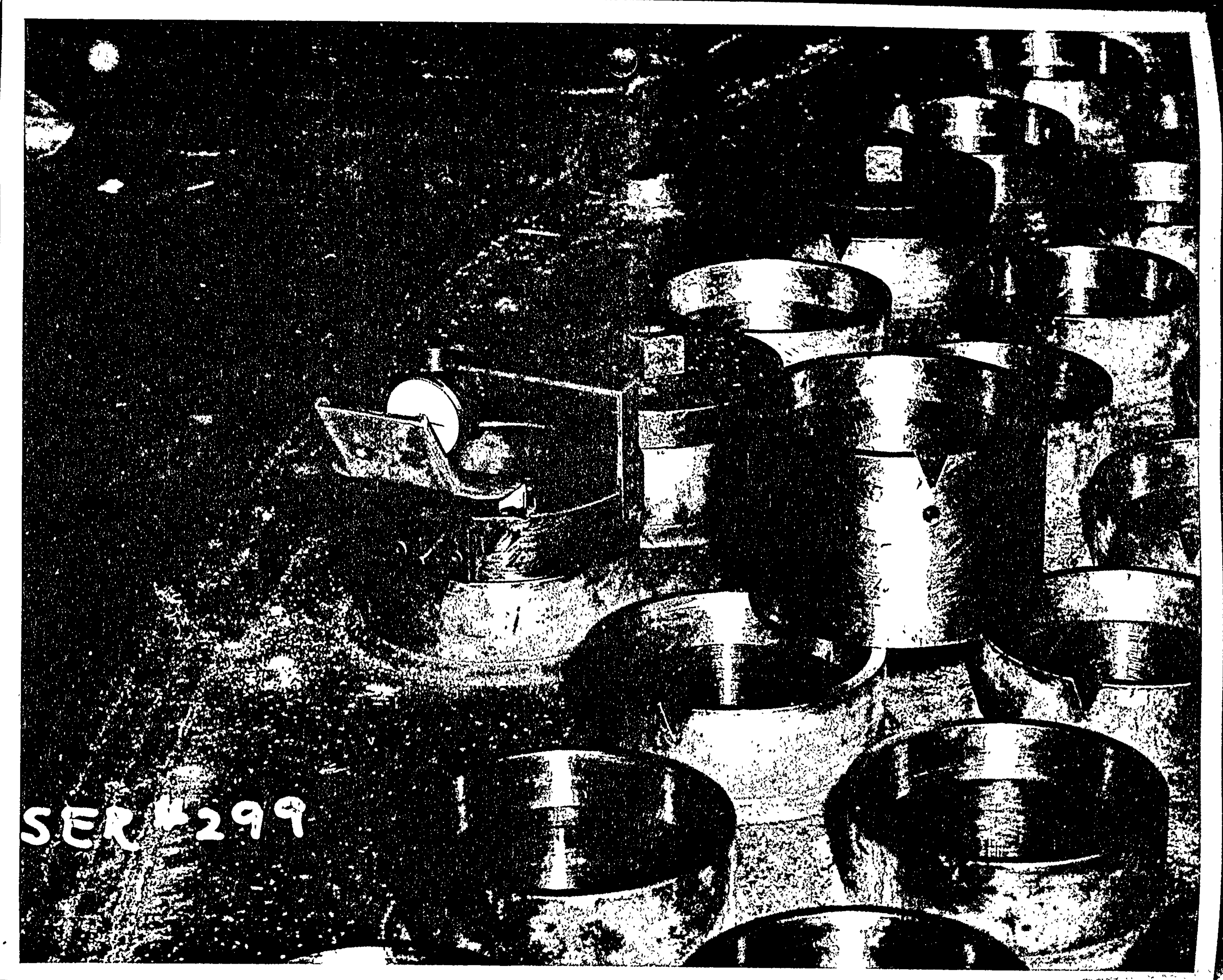
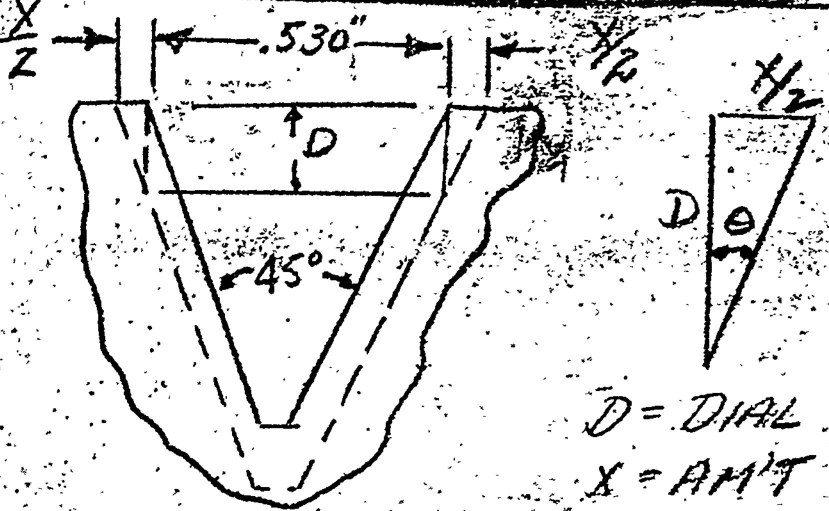

SER#299

CHART FOR DETERMINING SIZE OF VEE SLOTS
TO BE USED WITH GAGE D112893



tan θ = X/2D
X = 2D tan θ
X = 2D tan 22½
X = .828D

D = DIAL READING
X = AM'T OVER .530" (OVERSIZE)
W = SLOT WIDTH

D	X	W	D	X	W	D	X	W
-.001	.001	.531	-.019	.016	.546	-.037	.031	.561
-.002	.002	.532	-.020	.017	.547	-.038	.031	.561
-.003	.002	.532	-.021	.017	.547	-.039	.032	.562
-.004	.003	.533	-.022	.018	.548	-.040	.033	.563
-.005	.004	.534	-.023	.019	.549	-.041	.034	.564
-.006	.005	.535	-.024	.020	.550	-.042	.035	.565
-.007	.006	.536	-.025	.021	.551	-.043	.036	.566
-.008	.007	.537	-.026	.022	.552	-.044	.036	.566
-.009	.007	.537	-.027	.022	.552	-.045	.037	.567
-.010	.008	.538	-.028	.023	.553	-.046	.038	.568
-.011	.009	.539	-.029	.024	.554	-.047	.039	.569
-.012	.010	.540	-.030	.025	.555	-.048	.040	.570
-.013	.011	.541	-.031	.026	.556	-.049	.041	.571
-.014	.012	.542	-.032	.026	.556	-.050	.041	.571
-.015	.012	.542	-.033	.027	.557			
-.016	.013	.543	-.034	.028	.558			
-.017	.014	.544	-.035	.029	.559			
.018	.015	.545	.036	.030	.560			

GINEERING SKETCH SHEET
DU PONT DE NEMOURS & CO.

PROJ. No.

SIGNATURE:

TITLE TABLE #1

DATE

No. E-42423

The need for a gage to measure "V" slot angular deviation with respect to the "Y" axis line scribed on the tube ends was foreseen by M & E at New York Ship, and Design Division was requested to procure the required gage. The gage was fabricated at Wilmington Shops, inspected and accepted at the same location. It was then shipped to New York Ship where it was put into immediate use.

Angular gage for "V" slots is identified as equipment piece number 790-125. For fabrication details, see du Pont drawing D-112872.

b. Use of Gage

This gage is used for measuring the angular position of each "V" slot with respect to a reference line scribed on the face of each tube end. These secondary or reference lines were established using the following outlined procedure:

(1) Unit X & Y axes are astablished (for method of establishing these lines, see Part II-A, Section 13).

(2) An 18' straight edge is aligned coincident with the unit "Y" axis. For position in which straight edge is placed on top of unit, see Part II-A, Section 13, Photo Serial #53).

(3) A planer gage is set to 3.500" - theoritical distance from center of tubes in Y axis to adjacent row of tubes. This gage is used for scribing all tube ends. See Sketch #2.

(4) After planer gage is set, lines are scribed on tube ends in row Y29.

(5) Straight edge is then positioned on row Y29 and aligned coincident with line just scribed. The above procedure is repeated for row Y30. This procedure is followed until all tubes in Y_1 direction are scribed with center lines.

(6) The straight edge is then turned with "face" toward X_2 and the above procedure repeated.

After reference lines have been scribed on the top end of all tubes, measurement of "V" slot angular deviation can now be readily performed. The barrel of the plug type gage is lowered into the tube until the 3 "keys" are properly seated in their respective slots. The positioning bar (both ends) is adjusted to coincide with the tube end centerline. The angular deviation is then read directly from each "key", clockwise or counter-clockwise, whichever the case may be. The inside graduation on the "key" represents 1° deviation each way, and the outside graduations represent ½° each way; ¼° and 3/4°

is estimated. (See Photo Serial #64 and 65). Should one slot be off more than 2°, the deviation of the others cannot be read without removing the interfering "key". Tolerance on "V" slots is ± ½°. The same care must be likewise exercised in regard to cleanliness of tube bore and slots prior to using gage for measuring purposes.

4. Tangential Slot Gage

a. Development

Along with firming the design of the tangential slot, a gage was developed by Design to handle the inspection of these slots. This gage was procured by the Design Division for the NYX Inspection Group. It was fabricated by Chaumont Corporation, Glendora, New Jersey; shipped to New York Ship, inspected and found satisfactory. The tangential slot gage and master gage setting tube is identified as equipment piece number 165-24. For fabrication details, see du Pont drawing W-134436. This gage has been used on "P" and "L" plenum chambers, and will be used on subsequent units.

Since the tangential slot milling operation was in progress, some means of measuring finished slots had to be devised until the above gage was fabricated and received at New York Ship. The M & E Inspection Group modified the obsolete "V" slot functional gage by adding a handle and bar gage to serve as a measuring device until the one from Design could be procured. This gage was used for measuring approximately half the tangential slots in the "P" unit. The gage (See Sketch #3) was inserted into the "V" slot opposite the tangential slot, and the edge of the horizontal bar gage handle was checked for parallelism with the scribed line (opposite "V" slot) on top of the functional gage. The deviation was estimated to the nearest 1/2°. Depth was checked with a 0-1" micrometer and machined block inserted into the tangential slot. Upon receipt of the new gage and master setting stand developed by Design, all slots were re-measured using the new gage.

The new tangential slot gage (No. 165-24) incorporated two salient features: (1) Orientation measurement of tangential slot referencing from a "V" slot, and (2) measurement of radial distance from center of the plenum tube. At this time, the problem of tube wall strength relative to slot depth presented itself and could not be resolved until an additional special type gage (which measures the actual depth in inches from tube O.D. at the horizontal center of the slot) could be made. This depth type gage was developed by the M & E Group at New York Ship and is used in conjunction with the tangential slot gage. Uses of the above gages are discussed in the following section.

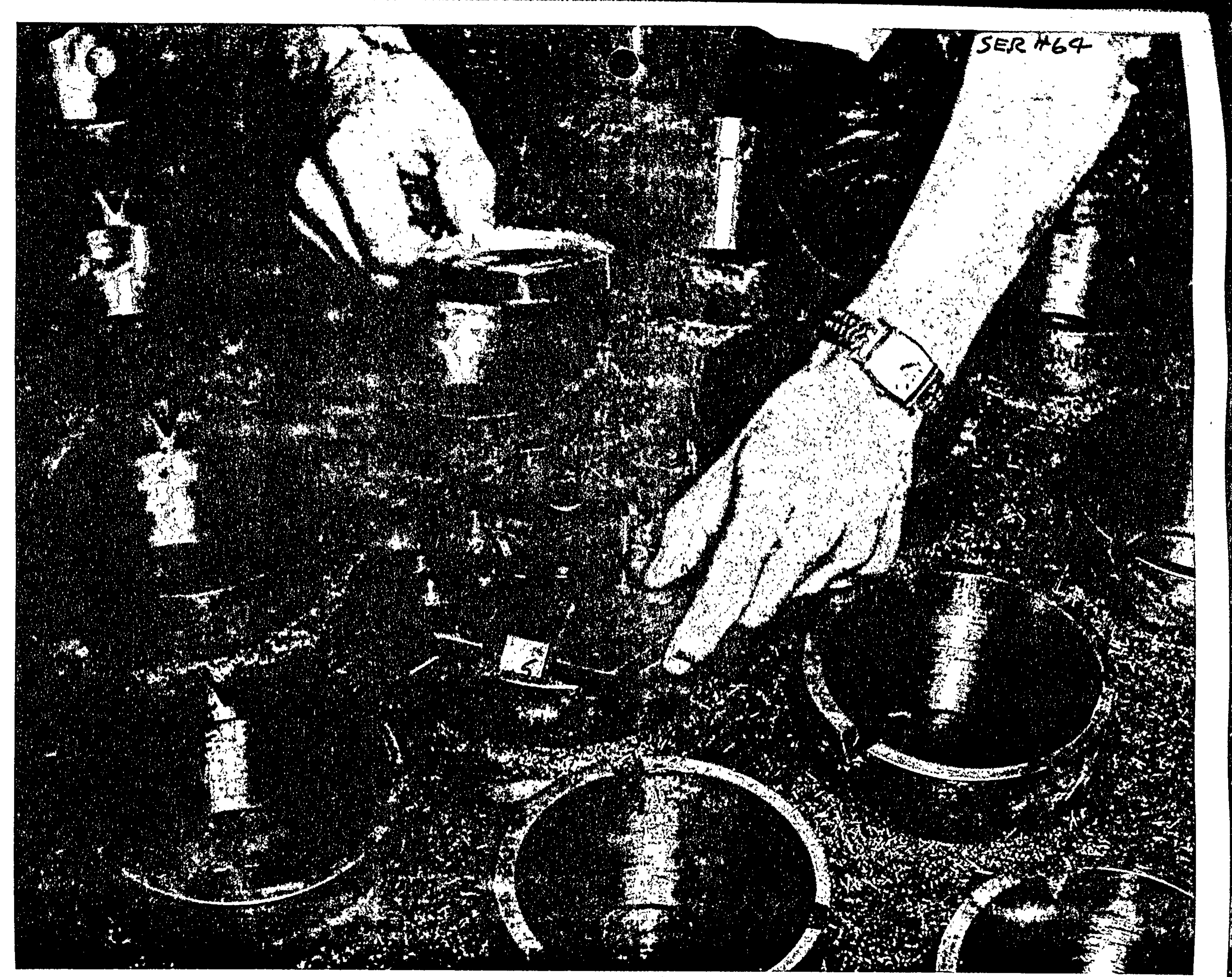
Serial Number 64

New York Shipbuilding Corporation
Camden, New Jersey
August 27, 1952

PROJECT 8980 - SAVANNAH RIVER PLANT

This view shows the use of the Angle Gage for the plenum tube upper key. The angle gage is inserted in the tube with the "removable key" (#1) in position. Next, a scribed line on the tongue of the positioning bar (#4) is brought into coincidence with the scribed line through the center of each tube end. After the positioning bar is set, the thimble (#6) is clamped to hold the gage in place. A magnifying glass is used to set the positioning bar to the tube ends. The scribed lines on the tube ends were scribed parallel to the X1-X2 axes prior to the "V" slotting operation. The deviation, clockwise or counterclockwise, can now be read directly in degrees at point #1.

The "removable key" can be inserted at points 2 and 3 and the above procedure followed for measuring the other two "V" slot deviations.



SER #64

SER. #64

Serial Number 65

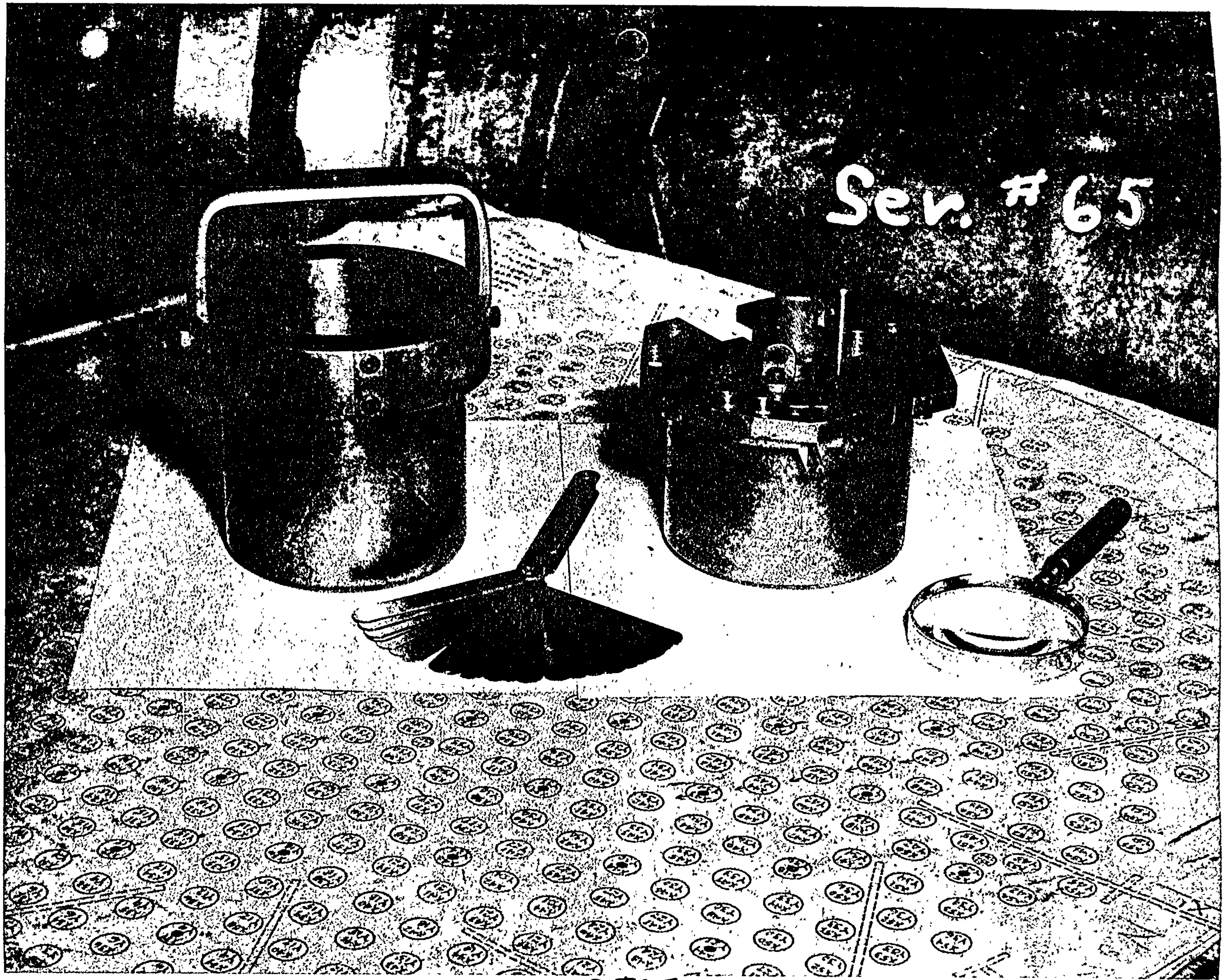
New York Shipbuilding Corporation
Camden, New Jersey
August 27, 1952

PROJECT 8980 - SAVANNAH RIVER PLANT

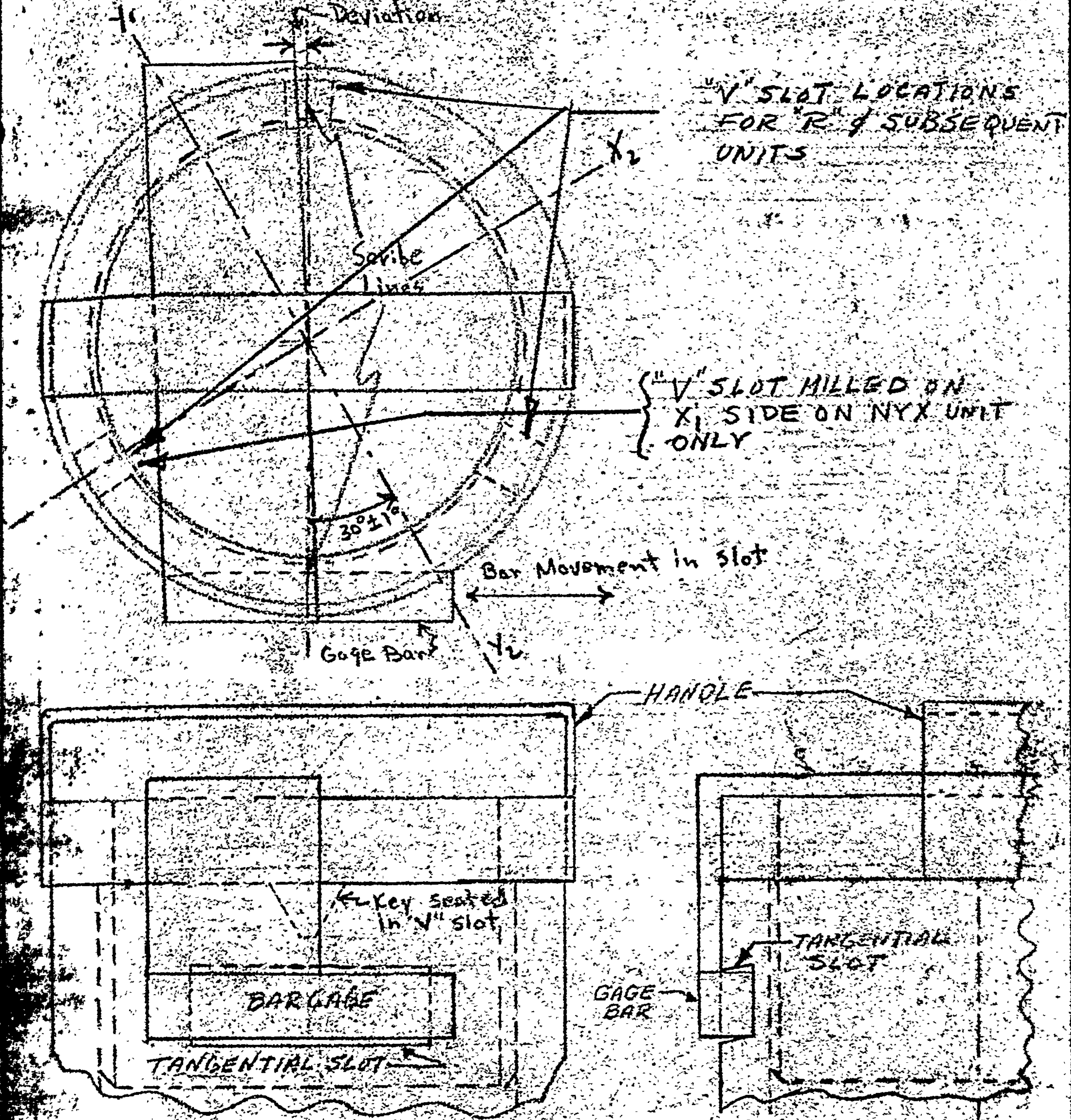
This is a close-up of the two gages used for inspecting the accuracy to which the upper key slots on the Plenum Chambers were milled.

On the left is the "Functional Gage for the Plenum Tube Upper "KeY" (Eq.PC. 790-113 - D-112818-A). To the right is the "Angle Gage for the Plenum Tube Upper Key Slots". (Eq.Pc. 790-125, D-112872). In the center is a feeler gage used with the functional gage. The magnifying glass to the extreme right is used for setting the Angle Gage.

See Serial Number 63 and 64 for use of these two gages.



SER.#65



SKETCH #3

GINEERING SKETCH SHEET
DU PONT DE NEMOURS & CO.
PROJ. No. 8980
SIGNATURE:
TITLE Plenum Chamber—"P" Unit Only
DATE 7-25
ECT: Plenum Tangential Slot Orientation Gage
No. E-489

b. Use of Gages

1. Tangential Slot Gage

The following is the procedure for calibrating and using the tangential slot gage.

(a) With the two gaging arms (#5 & #6) depressed, the barrel of the gage is inserted into the master gage setting tube (#1). The spring loaded "key" (#4 & #4-A) automatically seats the gage in the setting tube. Tension on the "key" is adjusted at #4-B. (See Photo Serial #278).

(b) Dial indicators (#2 & #3) are adjusted to "0".

(c) Gaging arms (#5 & #6) are depressed and gage (#7) is removed.

(d) Gage (#7) is inserted into plenum tube which is to be checked. All gaging is done referencing from the "V" slot on the X_1 side of the plenum tube by means of the spring loaded "key".

(e) Dial indicators (#2 & #3) are read and recorded.

Interpretation of Results:

Results are interpreted keeping two considerations in mind, namely:

1. Angular orientation of slot
2. Radial distance from center of tube.

Angular orientation of slot is determined by determining the algebraic difference of dial indicator readings #2 & #3. The difference obtained is then converted into degrees deviation from location 0°; which represents a perfectly oriented slot. The conversion table listed below is utilized.

Conversion Table for Determining Angular Deviation of Tangential Slot

Algebraic Difference	Angular Deviation From 0°
.002"	.120°
.004"	.230°
.006"	.350°
.008"	.470°
.010"	.567°
------------Upper Limit------------	
.012"	.680°
.014"	.800°
.016"	.920°
.018"	1.050°
.020"	1.150°

The above conversion table holds true for an algebraic difference up to .020". All differences greater than .020" must be mathematically analyzed as individual cases; however, due to method of machining, all slots have been within the .020" upper limit.

Providing the angular orientation of the tangential slot is satisfactory, the radial distance from the center of the plenum tube is determined by noting whether or not 1/2 the algebraic sum of indicator readings are positive or negative values. Positive readings indicate slot is deep and negative readings indicate slot is shallow (with respect to the radial distance from the center of the tube). The latter readings are actual deviations from the nominal radial distance from the center of the tube. In mathematical symbols, the above is stated as follows:

$$\text{M.D. (mean depth)} = \frac{\#2 \text{ indicator reading} + \#3 \text{ indicator reading}}{2}$$

All deep slots were considered acceptable; however, shallow slots were measured with a special type depth gage referencing from the O.D. of the plenum tube. (See Photo Serial #280). For satisfactory operation of mating part during unit operation, Design requested a minimum depth of 3/16" (From O.D. to bottom of slot) to be maintained.

B. Large Tube to Rod Tube Ligament Gage

1. Development

The problem of measuring the center-to-center distance between a large tube and rod tube did not present itself until the final stages of fabrication were completed on the "R" unit plenum chamber and top tube sheet. This measurement was not deemed necessary on the NYX unit; consequently, no gage had been developed to handle this particular phase of inspection. Upon Design's request that this measurement be incorporated into the inspection procedure on "R" and subsequent units, the M & E Group at New York Ship was confronted with the problem of procuring a special type gage for the job. M & E contacted Design, outlined the gage requirements, and requested procurement of the type gage required. In compliance, Design Division designed the gage and had it fabricated by the Chaumont Corporation, Glendora, New Jersey. For identification purposes, the following is a breakdown list of each component part:

(1) Setting stand - One purchased and identified as

[redacted]

Serial Number 278

New York Shipbuilding Corp.
Camden, New Jersey
August 8, 1953

PROJECT 8980 - SAVANNAH RIVER PLANT

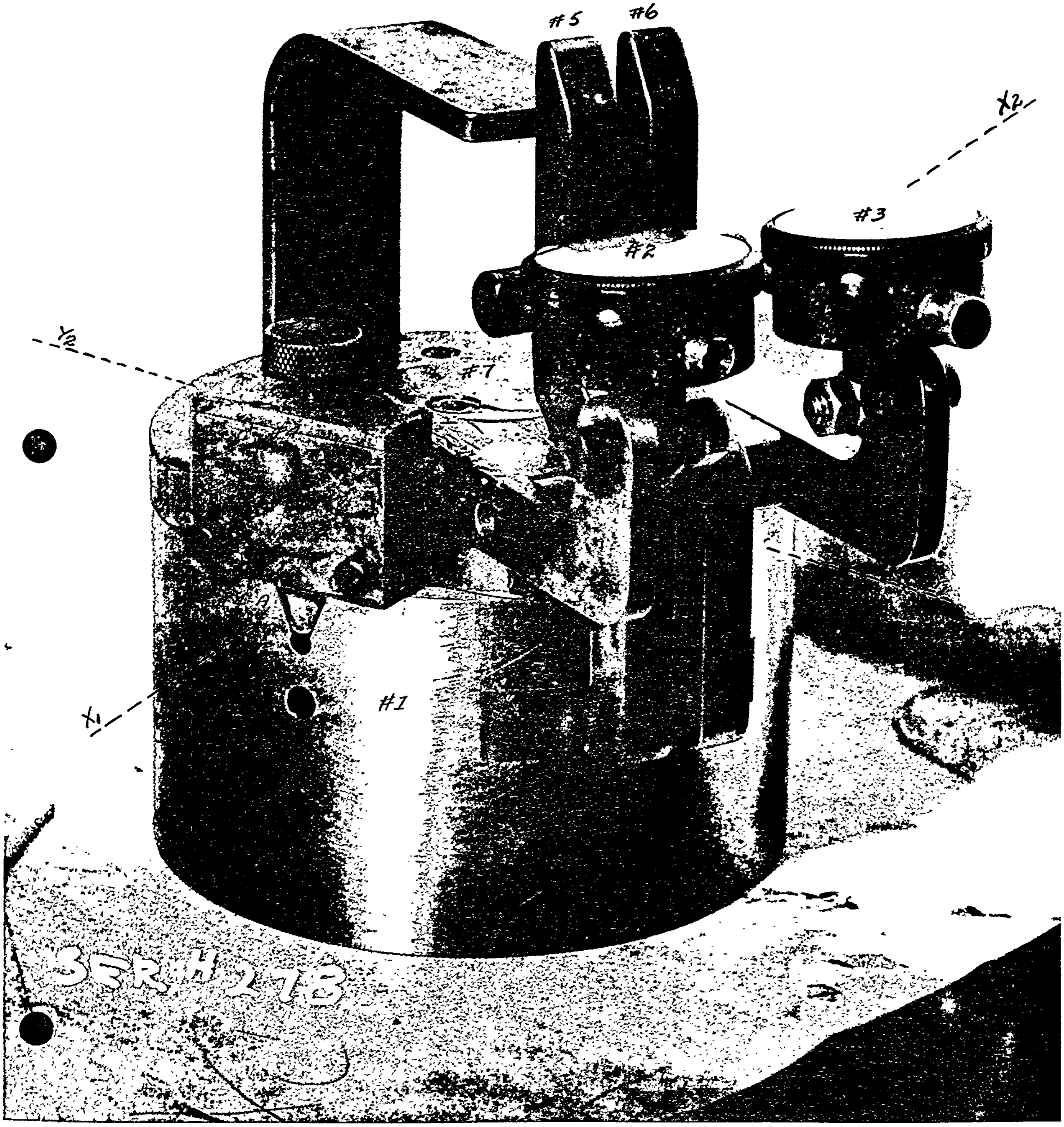
Tangential slot gage and master setting tube.

This gage is used for orientation measurement of tangential slot referencing from "V" slot (#4-A) and measurement of depth with respect to I. D. of the plenum tube.

Tangential slot gage and master setting gage is identified as equipment piece #165-24.

For fabrication details, see DuPont drawing W-134436.

[redacted]

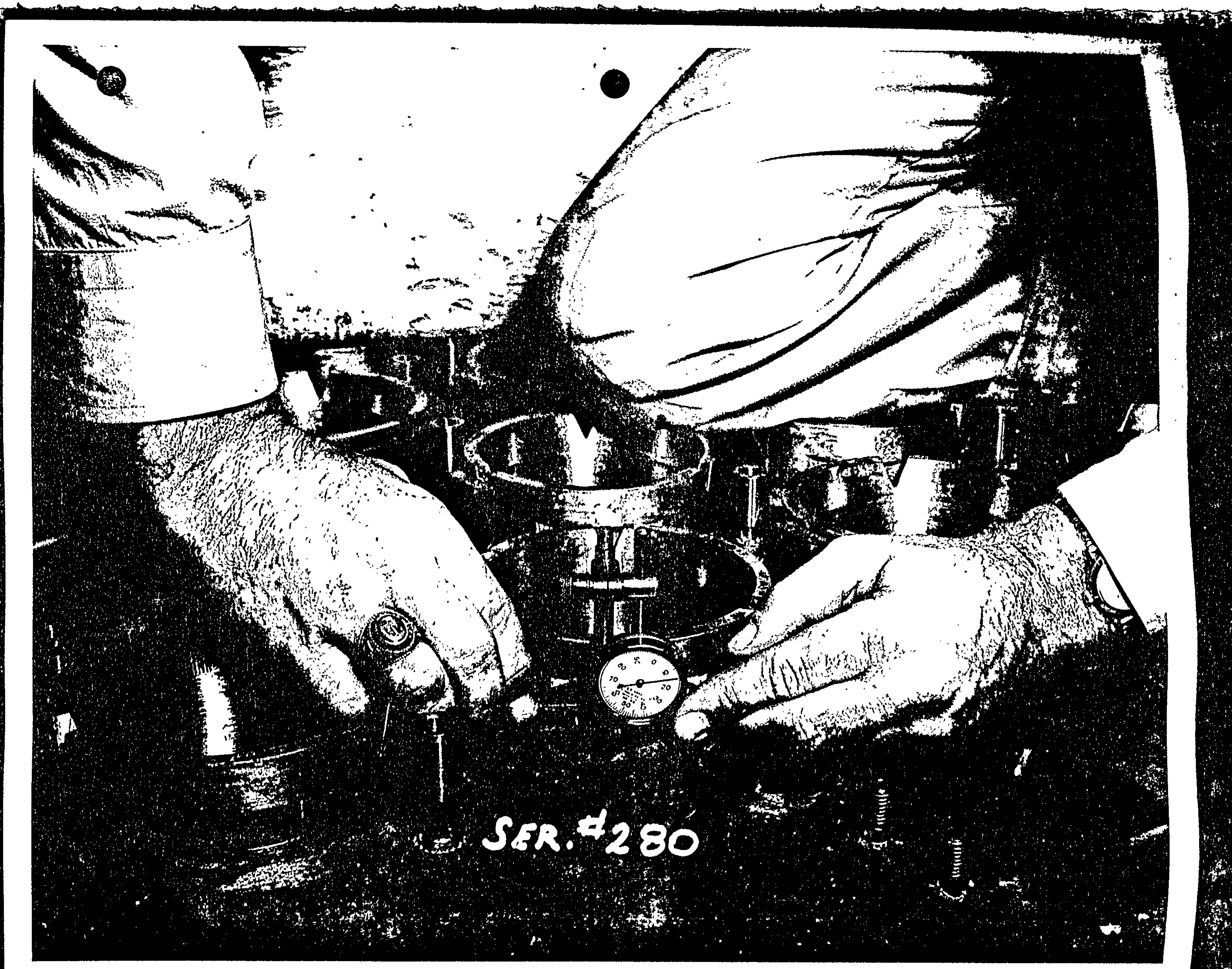

#5
#6
X2
#3
#2
Y2
#7
X1
#1
SERH27B

Serial #280

New York Ship - Camden, New Jersey
August 26, 1953

PROJECT 8980 SAVANNAH RIVER PLANT

Modified depth gage constructed from standard gaging facilities for measuring tangential slot depth referencing from O.D. of plenum tube.


SER. #280

equipment piece #790-126. For fabrication details, see drawing D-114667-J. See item #3 on photo serial number 224.

(2) Bracket with dial indicator attached - Two purchased and each identified as equipment piece #790-126. For fabrication details, see D-114667-D. See item #1-a on photo serial number 224.

(3) Centering pin - Two purchased and each identified as equipment piece #790-126. For fabrication details, see drawing D-114667-A. See item #2 on photo serial number 224.

During the time the above gage was being designed and fabricated, the inspection group was without a gage for obtaining the measurements requested by Design. A "substitute gage" for inspection use until gage No. 790-126 was received was immediately devised by M & E fabricated at New York Ship. This gage consisted primarily of two integral parts: namely, a mandrel and a bracket to which a dial indicator was affixed. (See Sketch #4). Since rod tube location measurements were required on both sides of the plenum chamber and top tube sheet, six individual mandrels were machined to fit varying bore sizes. (See "note" on Sketch #4).

The following is a breakdown of the mandrels used:

TABLE #1

Mandrels for Top End of Rod Tubes on Plenum Only

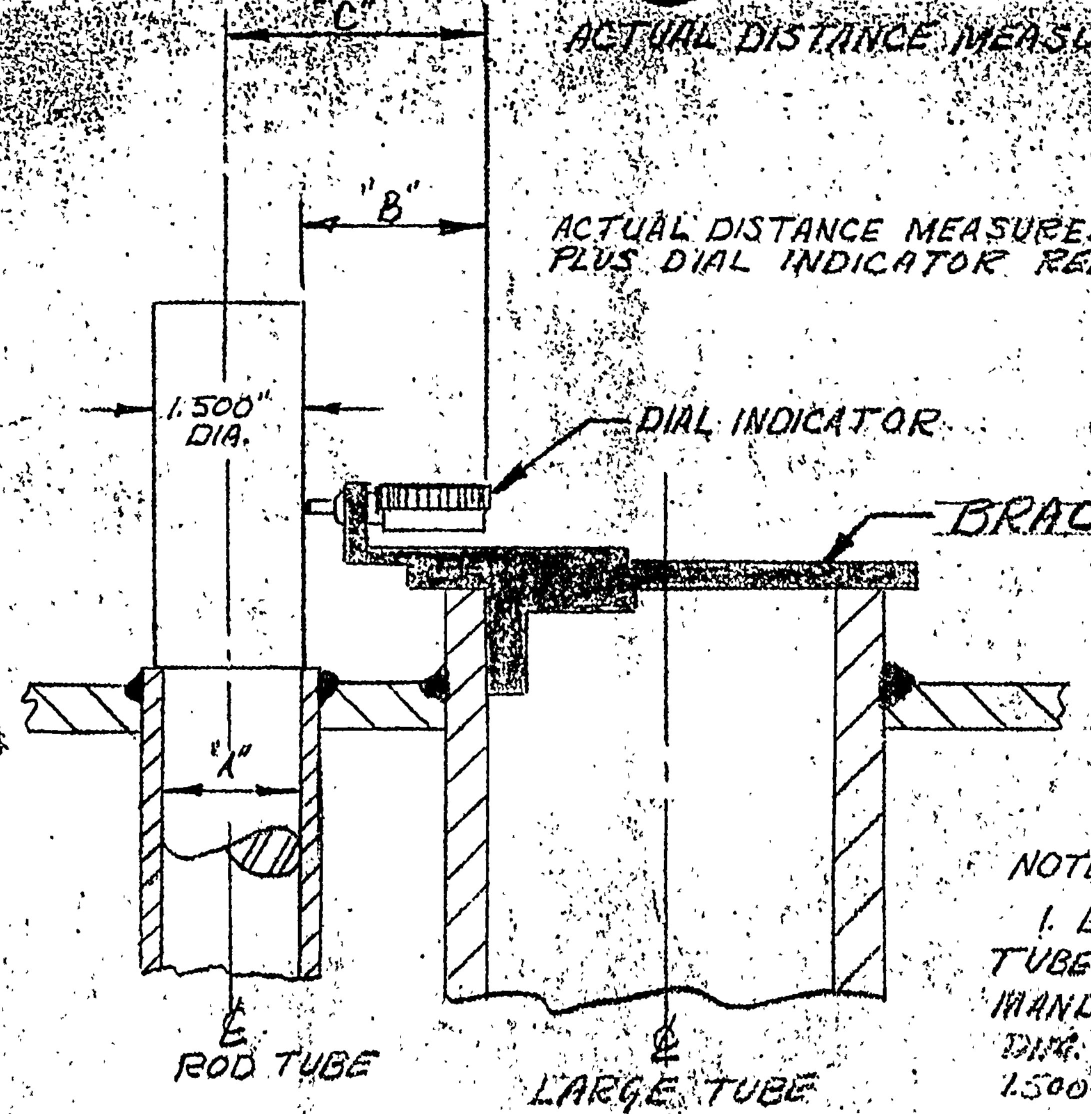
Mandrel #	Dimension "A"	
1	1.489"	
2	1.502"	1.500" Dia. Held Constant (See Sketch #4)
3	1.505"	

TABLE #2

Mandrels for Bottom End of Plenum Rod Tubes and Both Ends of Top Tube Sheet Rod Tubes

Mandrel #	Dimension "A"	
1	1.307"	1.500" Dia. Held Constant (See Sketch #4)
2	1.310"	
3	1.315"	

Since the counter-bore tolerance at the top end of a plenum rod tube was 1.505" to 1.510" and the rod tube bore on the bottom end was 1.3075" to 1.3175", it can



ACTUAL DISTANCE MEASURED PLUS .750

ACTUAL DISTANCE MEASURED (BASIC GAGE SETTING PLUS DIAL INDICATOR READING

NOTE:

1. DIM. "A" WAS DEPENDENT ON TUBE BORE AS 3 DIFFERENT MANDRELS WERE USED WITH DIA. "A" VARYING, BUT THE 1.500" DIA. HELD CONSTANT

METHOD USED IN DETERMINING ROD TUBE LOCATIONS

A	B	C	D	E	F	G	H	J	K

ENGINEERING SKETCH SHEET
E. I. DU PONT DE NEMOURS & CO.

PROJ. No. 8980

SIGNATURE: J Ray Stewart

PROJ. TITLE

DATE 8-20-53

SUBJECT:

No. E-42316

be readily deducted the need for a sufficient number of different size mandrels. The same reasoning holds true for a top tube sheet rod tube in which the bore diameter was 1.3125" ± .005".

Using the above "substitute gage", large tube to rod tube ligaments on both sides of the "R" unit plenum chamber and top tube sheet were measured as outlined in the following procedure:

(1) The bracket with dial indicator affixed is first calibrated with a planer gage. The dial indicator is set at "0" for the nominal rod tube ligament dimension. (See Sketch #4, dimension "B").

(2) The proper mandrels are selected for their respective tube end and all three are tried to determine the best Fit. (Refers to dimension "A").

(3) After a suitable mandrel has been selected, it is inserted into the rod tube.

(4) The bracket is then inserted in a large tube with the calibrated dial indicator registering against the mandrel.

(5) Using a horizontal "rocking Motion", and holding the radiused piece on the bracket bearing against the large tube wall, the highest "positive" reading is determined by noting the fluctuating dial indicator needle.

(6) Reading is recorded and used in conjunction with basic gage setting and mandrel diameter (1.500") for final computation of large tube to rod tube ligament dimension. See Sketch #4 for illustration of computation.

During the course of using the above gage, it was found that measurements obtained were inaccurate, and also the use of the gage itself was cumbersome and time consuming. After the new gages were received from Chaumont Corporation, the use of the substitute gage was discontinued, and the former was used for measuring ligaments on "P" and subsequent units.

2. Use of New Type Gage

This gage is used for taking measurements from large tube to rod tube on top and bottom of both plenum chamber and top tube sheet. The procedure for use of this gage is as follows:

(1) The plate gage or centering pin with three arms is placed on the tops of large tubes, with arms resting on the latter and the tapered plug registered in the rod tube.. (See Photo Serial #224).

(2) A "separate arm" with an integral yoke and dial indicator, is set to the dimensional equivalent of

center distance between tubes using the setting stand. (The actual bore of the specific large tube must also be taken into consideration).

(3) The "separate arm" (1-a) is placed across the tube face with the vertical pin resting against the inside of the large tube.

(4) The minimum reading on the dial indicator is then read and recorded. This reading indicates the deviation from the true center to center distance between the large tube and rod tube.

Special leveling screws are supplied for measurement where plate gage cannot be supported on faces of three large tubes.

C. Probe Pin Inspection Gages

1. Development and Use of Gages

a. Probe Pin Socket Functional Gage

During the machining of probe pin sockets, the need for a special type functional gage for checking the I.D. was foreseen by the M & E Group. The latter contacted Design and requested them to procure the required gage. In compliance with the request, Design Division designed the gage and procured it for the NYX Inspection Group. Essentially this gage was a go-no go plug gage for checking inside diameters of probe pin sockets. The conventional method of gaging was employed. It was fabricated by Advance Tool and Engineering Company, York, Pennsylvania and shipped to New York Ship where it was inspected and found satisfactory. This gage is identified as equipment piece number 790-132. For fabrication details, see du Pont Drawing D-110286.

After probe pin sockets were welded to the top side of the plenum chamber, an additional check using this gage was made to determine whether weld shrinkage affected the I.D. The above inspections were performed on "R" and "P" units only.

Due to a change in design from an unthreaded to a threaded bore on "L" and subsequent units, the functional plug type gage was discontinued and a go-no-go standard threaded plug gage was used. (See Photo Serial #281).

b. Probe Pin Socket and Rod Tube Parallel Gage.

To hold the location of probe pins to drawing specifications, a gage or gages to determine the location of probe pins with respect to a rod tube and large tube was required by the M & E Group. In compliance with a request for required gages, Design Division designed the gage and procured it for the NYX Inspection Group. The gages were fabricated by Advance Tool and Engineering

[redacted]

Serial Number 224

New York Shipbuilding Corp.
Camden, N. J.
March 28, 1953

PROJECT 8980 - SAVANNAH RIVER PLANT

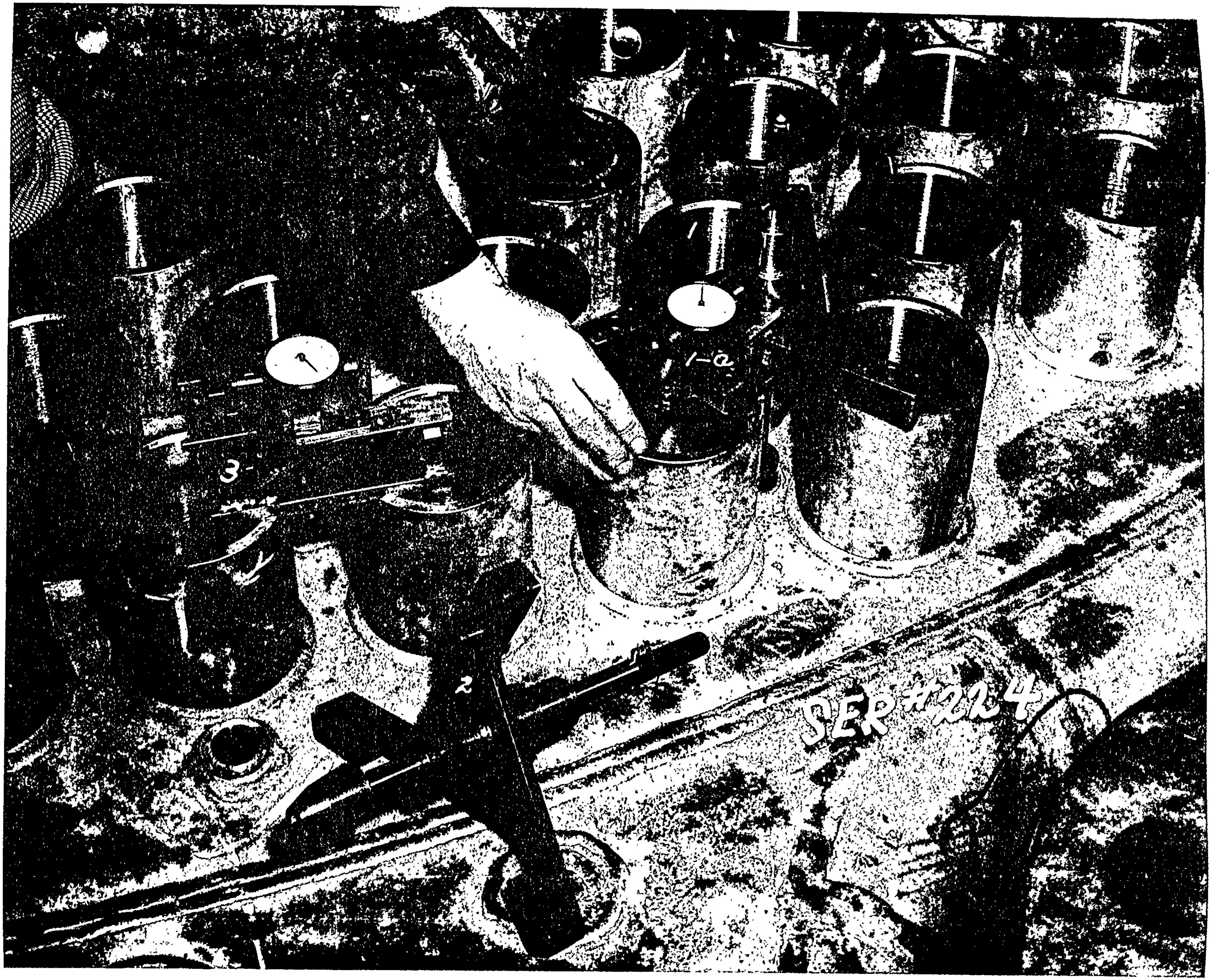
Rod Tube Measurement Gage

1. Inspector is locating rod tube with respect to adjacent large tubes using rod tube measurement gage. Measurements are taken with dial indicator attached to a gage block (see 1-a)

2. Centering pin to which measurements are made after placing in rod tube.

3. Setting gage for zeroing dial indicator

[redacted]


1
1-a
3
2
SER #224

Serial #281

New York Ship - Camden, N. J.
August 17, 1953

PROJECT 8980 - SAVANNAH RIVER PLANT

#1 Latch stud functional gage

Gage is shown in its proper position for functionally checking stud locations (a and b) with respect to a rod tube. Gage is identified as du Pont. Equipment Piece #790-137. For fabrication details, see du Pont drawing D-110291.

#2 Go-Not Go thread plug gages for checking probe pin socket threads on "L" and subsequent units. Two thread gages were used:

a. 7/16" - 20UNF - 2B; GO-Pitch dia. of .4050; NO-GO-Pitch Dia. of .4104

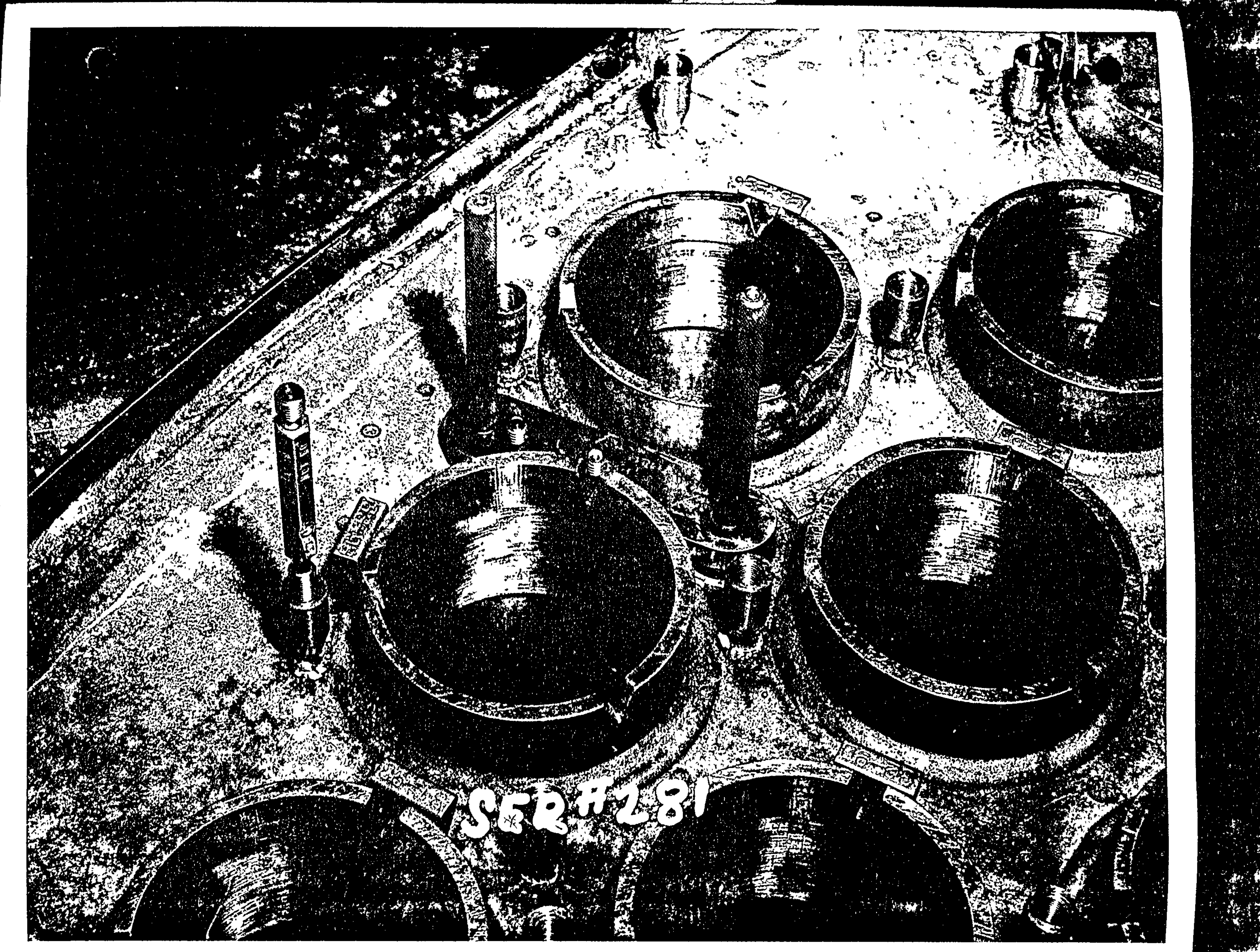
b. 7/16" - 20UNF - 3B; GO-Pitch dia. of .4050; NO-GO-Pitch Dia. of .4091

Threads in probe pin sockets were checked as follows:

a. Insert NO-GO end of 3B gage in all threads, if loose fit exists then,

b. Insert NO-GO end of 2B gage in all 3B loose fits. Any that are a loose fit with 2B gage is considered a 1B fit.

c. Permanent record is made of the number of sockets that are 3B, 2B, and 1B fits, and information forwarded to Design for approval.


SER #281

Company, York, Pennsylvania and shipped to New York Ship. Gages were inspected at this location and found satisfactory. This gage has been used for inspection purposes on "R" plenum chamber and subsequent units. Gage #3 (Photo Serial #234) and component parts are identified as equipment piece number 790-133. For fabrication details, see du Pont drawings W-134987 and D-112891.

(1) Use of Gages

The use of this gage is shown in photo serial number 234, gage #3, parts A, B, and C. This is a dual-purpose gage - it measures the distance from the rod tube center to the center of the probe pin socket, and the parallelism of the rod tube and probe pin socket center with respect to a "Y" axis of a large tube. Since this gage serves as a dual measuring device, the procedure for operating the gage is outlined in two parts:

(a) Procedure for Measuring Center to Center Distance between Rod Tube and Probe Pin Socket

1. Part "A" is first screwed into a probe pin socket as shown in photo serial #234.

2. Part "B", which is a plug type gage with an extended arm, is inserted into a rod tube that is located 7" from the probe pin.

3. With the extension arm of part "B" resting on part "A", the deviation from 7" centers between the rod tube and probe pin socket is read at "B-1". Tolerance on the center to center distance between the rod tube and probe pin socket is 7" ± 1/32". Parts "A" and "B" are graduated with scribed lines in such a manner that deviations from the 7" centers is read accurately at "B-1". If the location of the probe pin socket is outside the required tolerance, it is bent in the required direction until within tolerance.

Due to the accuracy of locating and welding probe pin sockets to the unit, the above method of "bending probe pin socket until within tolerance" was deemed acceptable; since readings were only slightly plus or minus over the specified tolerance in all cases encountered.

(b) Procedure for measuring parallelism of a rod tube and a probe pin socket common center with respect to a "Y" axis of a large tube.

1. With the above parts "A" & "B" in their respective positions as described in section (a), the parallel gage (#3) as

[redacted]

Serial Number 234

New York Shipbuilding Corp.
Camden, New Jersey
August 17, 1953

PROJECT 8980 - SAVANNAH RIVER PLANT

1. Induction welding unit for spot welding tube, number (X & Y coordinates) identification tags to each plenum tube on top side of unit.

2. Vee slot functional gage modified to locate position of identification tags prior to spot welding latter.

3. Probe pin and rod tube parallel gage: Inspector is determining if rod tube and probe pin are in required alignment, and that the center to center distance between the latter is maintained. Gage is identified as equipment piece number 790-133. For fabrication details, see duPont drawing W-134987 and D-112891.

4. Probe pin socket location gage. Inspector is checking probe pin alignment with respect to a large tube. Gage is identified as equipment piece number 790-131. For fabrication details, see DuPont drawing D-114679.

[redacted]

[redacted]


SER #234

shown in photo serial number 234, is inserted into a large tube located adjacent to the rod tube and probe pin socket.

2. The gage (#3) is rotated clockwise or counterclockwise until the line scribed on each side of the positioner disc coincides with the "Y" axis scribed on the top end of the large tube. Stud ("F") tightened, stabilizing the gage (#3) in the large tube.

3. Sliding arm "C" with extended arm "D" at right angles to the former is butted against the plug ("E") in the rod tube and probe pin socket plug "A". If the probe pin socket is not in its proper location, the latter is bent in the direction Z' or Z", whichever case it may be, until the extended arm "D" butts against points "B-1" and "E". The probe pin socket and rod tube common centerline are now at 90° to the tube "Y" axis.

Note: The probe pin was previously checked for alignment in the X_1-X" direction as described above in section a.

c. Probe Pin Socket Location Gage

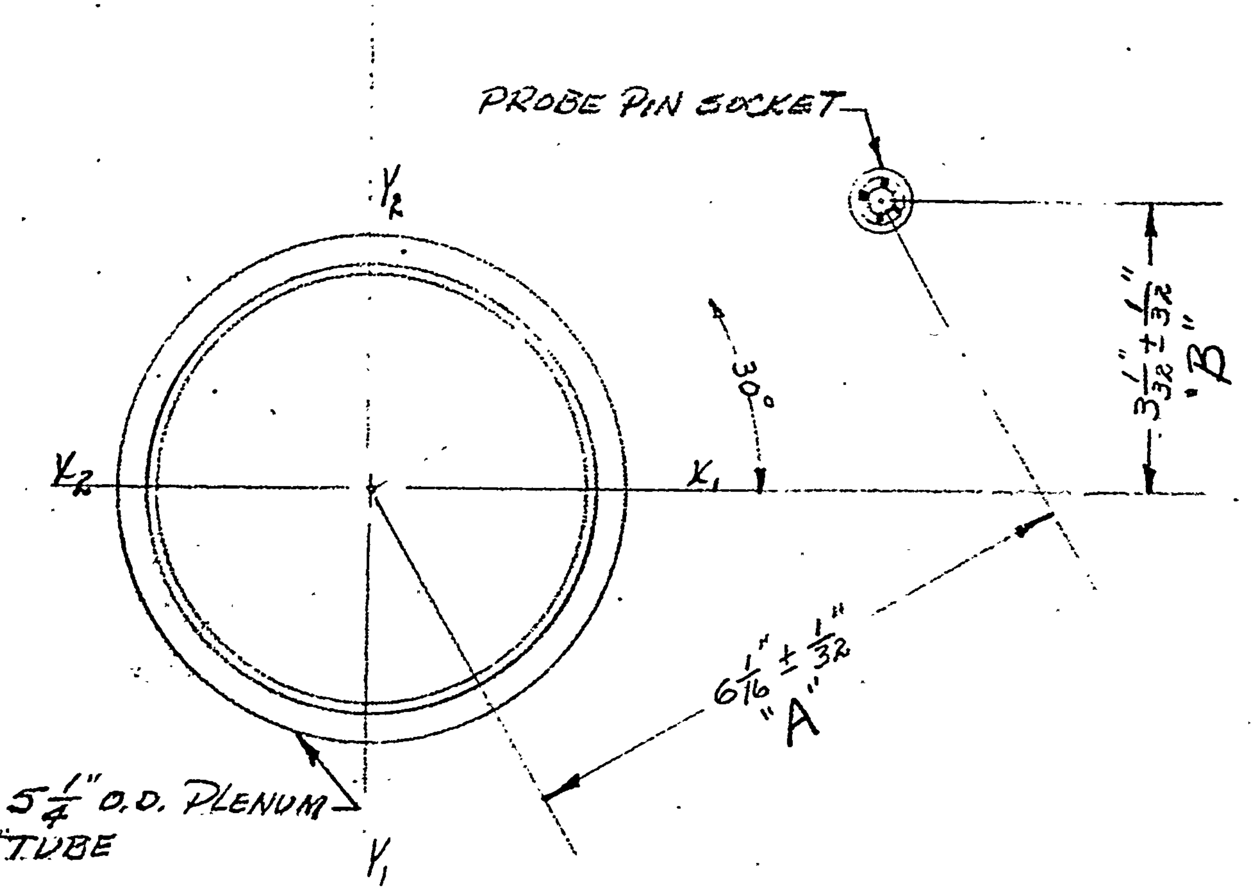
To hold the location of probe pins to drawing specifications, a need for some type gage to determine the location of the latter with respect to a large tube was foreseen by the M & E Group. The latter contacted Design and requested them to procure the required gage. In compliance with the request, Design Division designed the gage and procured it for the NYX Inspection Group. The gage was fabricated by Advance Tool and Engineering Company, York, Pennsylvania, and shipped to New York Ship. It was inspected at this location and found satisfactory. Probe pin socket location gage is identified as equipment piece number 790-131. For fabrication details see du Pont drawing D-114679. This gage has been used for inspection purposes on "H" plenum chamber and subsequent units.

(1) Use of Gage

The use of this gage is shown in photo serial #234, gage #4. It measures dimensions "A" and "B" shown in Sketch #5.

(a) Procedure for Using Probe Pin Socket Location Gage

1. Barrel of gage (#4) is inserted into large tube in such a manner that edge of plate "A" rests over probe pin socket being checked.



SKETCH # 5

ENGINEERING SKETCH SHEET E. I. DU PONT DE NEMOURS & CO.	PROJ. No. 8980	SIGNATURE:
PROJ. TITLE PLENUM CHAMBER - TOP SIDE		DATE 8-17-53
SUBJECT: PROBE PIN LOCATION		No. E-42403

2. Gage (#4) is rotated clockwise or counterclockwise until the scribed lines on both ends of the positioner bar ("B") coincide with "Y" axis line scribed on end of large tube (points 1 & 2). Positioner bar ("B") is clamped in place by means of knurled thumb screw "C".

3. Threaded stud on end of swinging arm "D" is inserted through plate "A" into probe pin socket and screwed into latter.

4. Swinging arm ("D") is first rotated to position as shown in photo serial #234. The deviation of dimension "A" (Sketch #5) is read directly at point #3. Due to construction of gage, deviations from drawing specification is read ± 1/32" from nominal dimension 6-1/16".

5. Swinging arm ("D") is then rotated to position #5. The deviation of dimension "B" (Sketch #5) is likewise read directly at point #5. Due to construction of gage, deviations from drawing specification is read ± 1/32" from nominal dimension 3-1/32". If the probe pin socket is not in its proper location, the latter is bent in the required direction until within tolerance. Due to the accuracy of locating and welding probe pin sockets to the unit, the above method of "bending probe pin socket until within tolerance" was deemed acceptable, since readings were only slightly plus or minus over the specified tolerance in all cases encountered.

D. Latch Stud Functional Gage

On "R", "P", "L", "K" and "C" unit plenum chambers, two latch studs per rod tube were welded to the top side of each unit. Latch stud location with respect to a rod tube was the same on all these units. For location of studs, see du Pont drawing W-133609.

Before the latch studs were welded to the "R" unit plenu chamber, the M & E Group at New York Ship requested Design to investigate the functional tolerances required on the latch studs, and to design and procure the necessary gage. In compliance with M & E Group's request, Design Division designed the gage and had it fabricated by Advance Tool and Engineering Company, York, Pennsylvania. The gage was shippe to New York Ship where it was inspected by the M & E Group an found satisfactory. The latch stud functional gage is identi as equipment piece number 790-137. For fabrication details, see du Pont drawing D-110291.

Essentially this is a flat type gage with a plug on one end that registers in a rod tube, and with two holes drilled (.432"-.436" diameter) 2.500" and 3.000" respectively from the plug center, which passes the latch studs, providing they are in their proper location. (See photo serial #281)

E. Monitor Pin Functional Gage

1. Development and Use.

After "R" and "P" bottom tube sheet assemblies had been completely inspected at New York Ship and accepted, they were shipped to the Savannah River Plant for erection; however, after receiving the above units, preliminary inspection by Savannah River Project personnel on the bottom land of large tubes revealed the following conditions:

a. "R" Bottom Tube Sheet

1. Scratches in the 3-3/8" diameter counterbore in the lower ends of the tubes.

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

3. Length of orienting grooves (in 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.

b. "P" Bottom Tube Sheet

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

The above discrepancies in the units were corrected in the field. However, to prevent occurrence of similar conditions in the "L" bottom tube sheet (under fabrication at N.Y.S.) and later units, it was requested by Design that the M & E Group's inspection procedure for all tube bores on the latter unit be reviewed for adequacy. In addition to checking conformation with all drawing spedifications such as dimensions, finish and freedom from sharp edges, each bore was requested to be independently examined as to its suitability for O-ring. 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, M & E Group 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 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 a length of 1/2". Bushings in the jig were likewise replaced with proper sizes to receive the new type drill.

After correcting the above situation, a suitable means of checking monitor pin groove dimensions as requested by Design was required. Two gages for checking these grooves were developed by the M & E Group and fabricated by New York Ship. These gages, plus the modifications to suit current specifications, were as follows:

1) The first functional gage was fabricated for checking the proper squeeze for upflow pin and sharp edges cutting O-ring. The root diameter of the gage was machined to 3.020", and fitted with an O-ring whose diameter was .222". This gage was used until it was discovered that the gage barrel was too long and would not seat properly in some tubes, and the O-ring hit the tube chamfer. (See photo serial #252, Item #1). Also, photo serial #253, item #2.

2) A second functional gage was fabricated with a 3.005" root diameter and a .222" diameter O-ring for checking slots that were too short and for orientation and depth of slots. It was discovered during its use that the "squeeze" was not tight enough for checking sharpness of slot edges. (See photo serial #252, item #3).

The purpose of gages #1 & 3 (photo serial #252, item 1 & 3) were incorporated into a single gage by having gage #3 metal sprayed, re-machined to a 3.022" root diameter and fitted with a .222" diameter O-ring. (See Sketch #6) This gage now checks:

1) Orientation and depth of 3 slots (See photo serial #254).

2) Proper squeeze + .003".

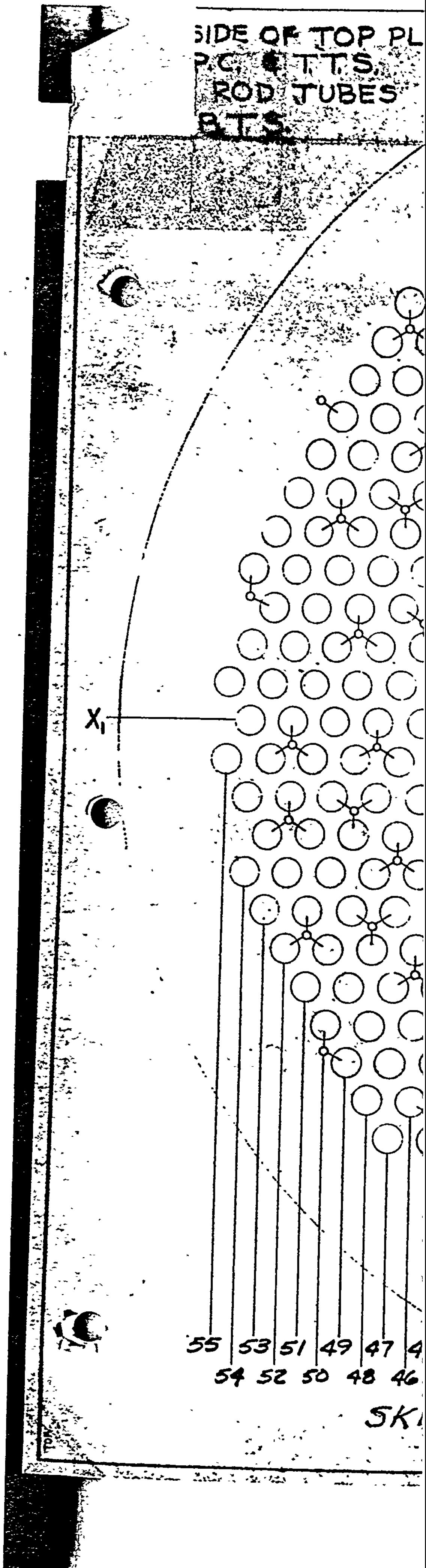
3) Slots too short.

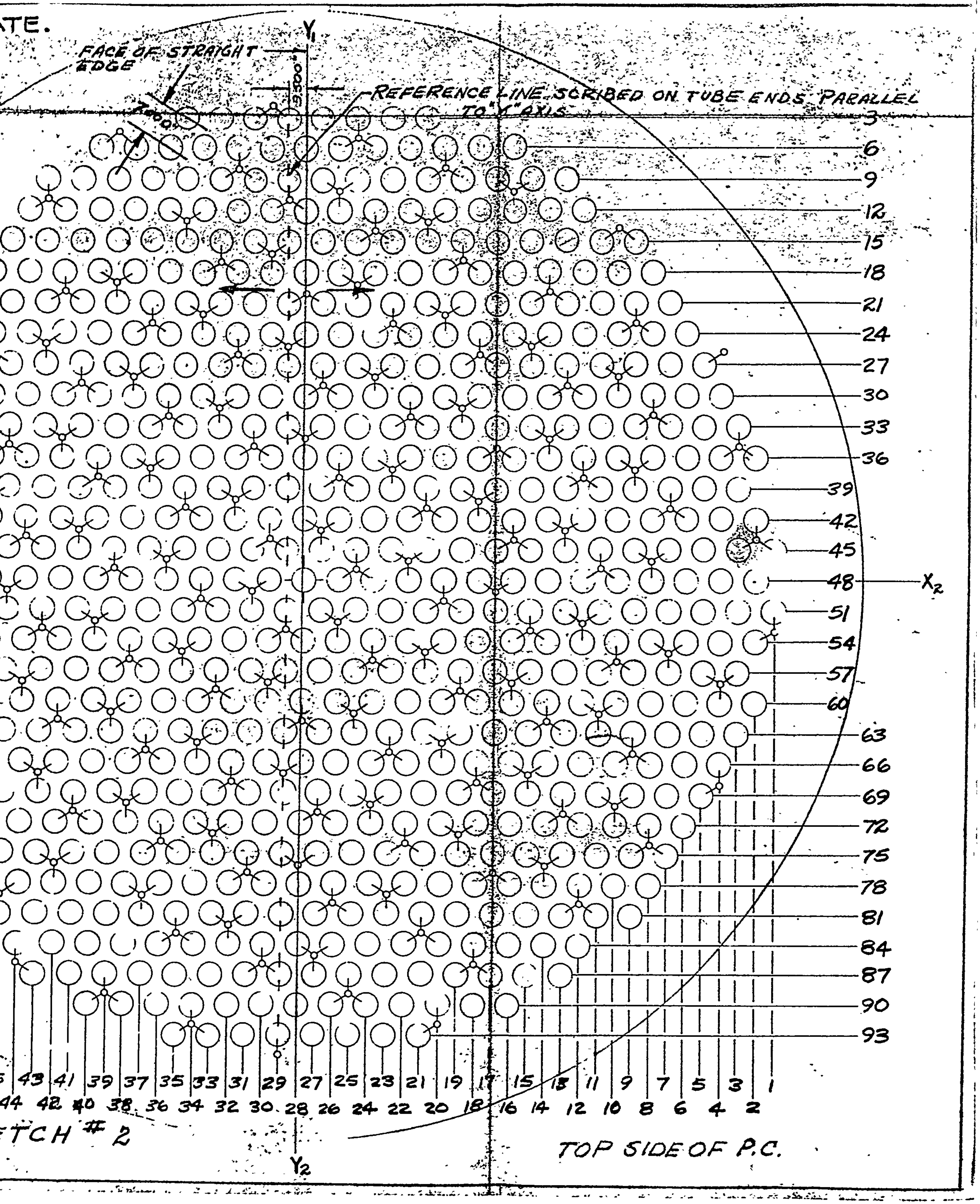
4) Sharp edges.

It is necessary to use a depth mike to determine slots too long. Length of slots are 1/2" (+ .000" -.015"); however, all slots were acceptable by Design up to 9/16" long.

F. Electronic Gage for Line Boring Operation

a. Why Gage was Needed


SIDE OF TOP PL
P.C. & T.T.S.
ROD TUBES
B.T.S.
X1
55
53
51
49
47
4
54
52
50
48
46
SK

ATE.
FACE OF STRAIGHT EDGE
Y1
.9500"
2.000"
REFERENCE LINE SCRIBED ON TUBE ENDS PARALLEL TO "X" AXIS
3
6
9
12
15
18
21
24
27
30
33
36
39
42
45
48
X2
51
54
57
60
63
66
69
72
75
78
81
84
87
90
93
43 41 39 37 35 33 31 29 27 25 23 21 19 17 15 13 11 9 7 5 3 1
44 42 40 38 36 34 32 30 28 26 24 22 20 18 16 14 12 10 8 6 4 2
ETCH # 2
Y2
TOP SIDE OF P.C.

SERIAL #252

[redacted]

[redacted]

New York Ship - Camden, New Jersey
August 21, 1953

PROJECT 8980 - SAVANNAH RIVER PROJECT

Bottom tube sheet monitor pin gages and measuring facilities

#1 Old Functional gage for checking proper squeeze for upflow pin and sharp edges cutting O-ring

Root Diameter of gage - 3.020"
O-ring Dia. - .222"

Gage was too long and would not seat properly in some tubes, and O-ring hit tube chamfer.

#3 New functional gage

This gage checked slots too short and orientation of slots; however, root diameter was 3.005" with a .222" O-ring. Squeeze was not tight enough for checking sharpness of slot edges.

The two above gages were incorporated into one by having gage #3 metal sprayed and re-machined to 3.022" root diameter for use with .222" dia. O-ring. This gage now checks:

1) Orientation of 3 slots
2) Proper squeeze + .003"
3) Slots too short
4) Sharp edges

It is necessary to use depth mike to determine slots too long. Length of slots are 1/2" $^{+\,.000"}_{-\,.015"}$

All slots accepted up to 9/16" long.

#2 This disc is used in conjunction with gage #3 for checking orientation of 3 slots with respect to centerline of tube. (See Photo Serial #254 for explanation and use).

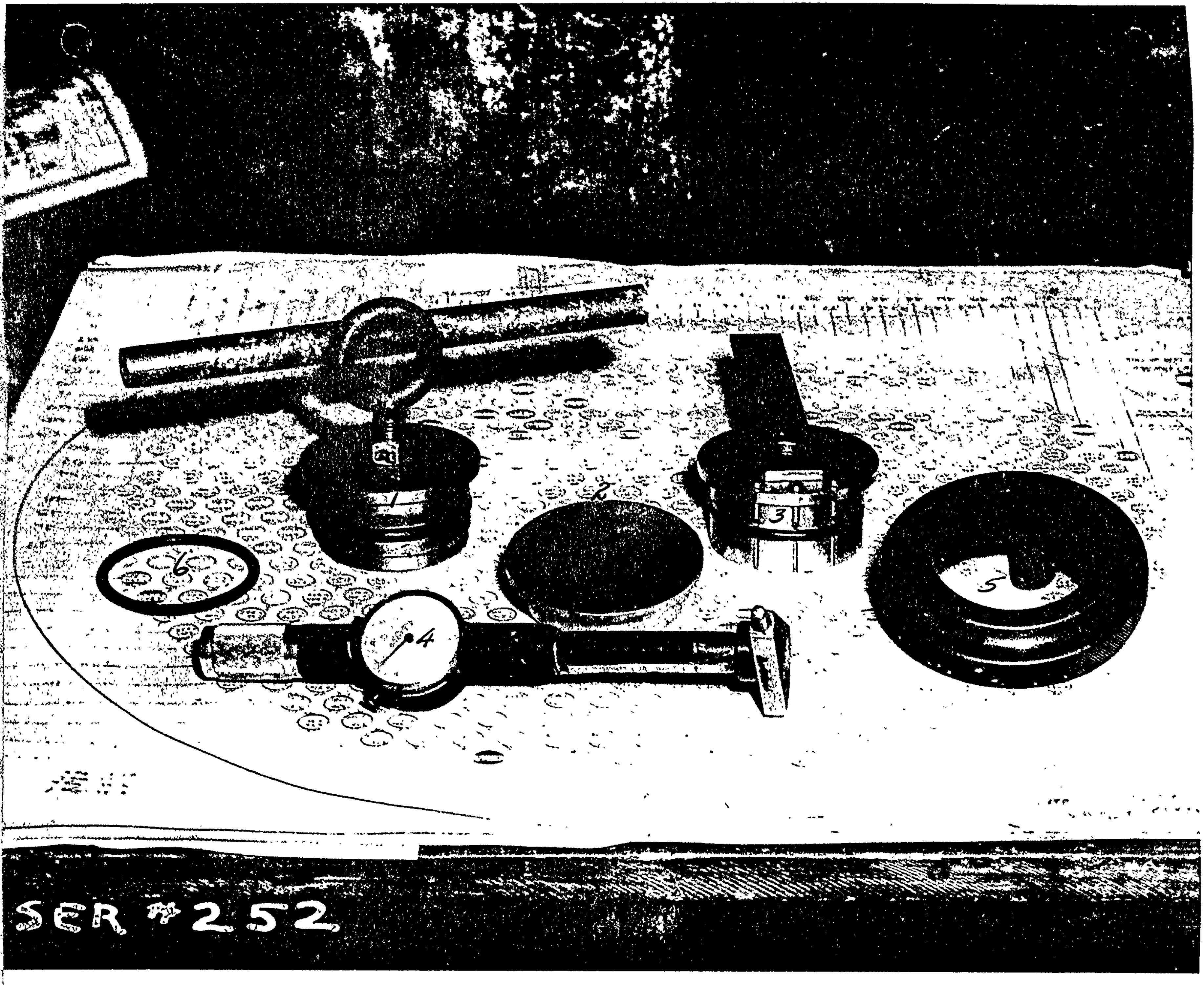
#4 Standard bore gage for checking bottom land I.D. dimension.

#5 Ring gage (3.375") for setting bore

REST[redacted]D

#6 .222" Dia. O-ring.

[redacted]


1
2
3
4
5
6
SER #252

[redacted]

SERIAL #253

[redacted] New York Ship - Camden, New Jersey
August 21, 1953

PROJECT 8980 - SAVANNAH RIVER PLANT

#1 Checking I.D. of counterbore in a bottom tube sheet tube using a standard bore gage. Bore diameter is checked in the X & Y direction at the O-ring seating zone. Bore gage is set using a 3.375" ring gage (See Photo Serial #252).

#2 Old functional gage for checking proper squeeze for upflow pin and sharp edges cutting O-ring.

Root Dia. of gage - 3.020"
O-ring diameter - .222"

Gage was too long and would not seat properly in some tubes, and O-ring hit tube chamfer. Gage was replaced by new type as described on Photo Serial #252.

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national de
meaning of the
Secs.
of w
person prohibited by law.

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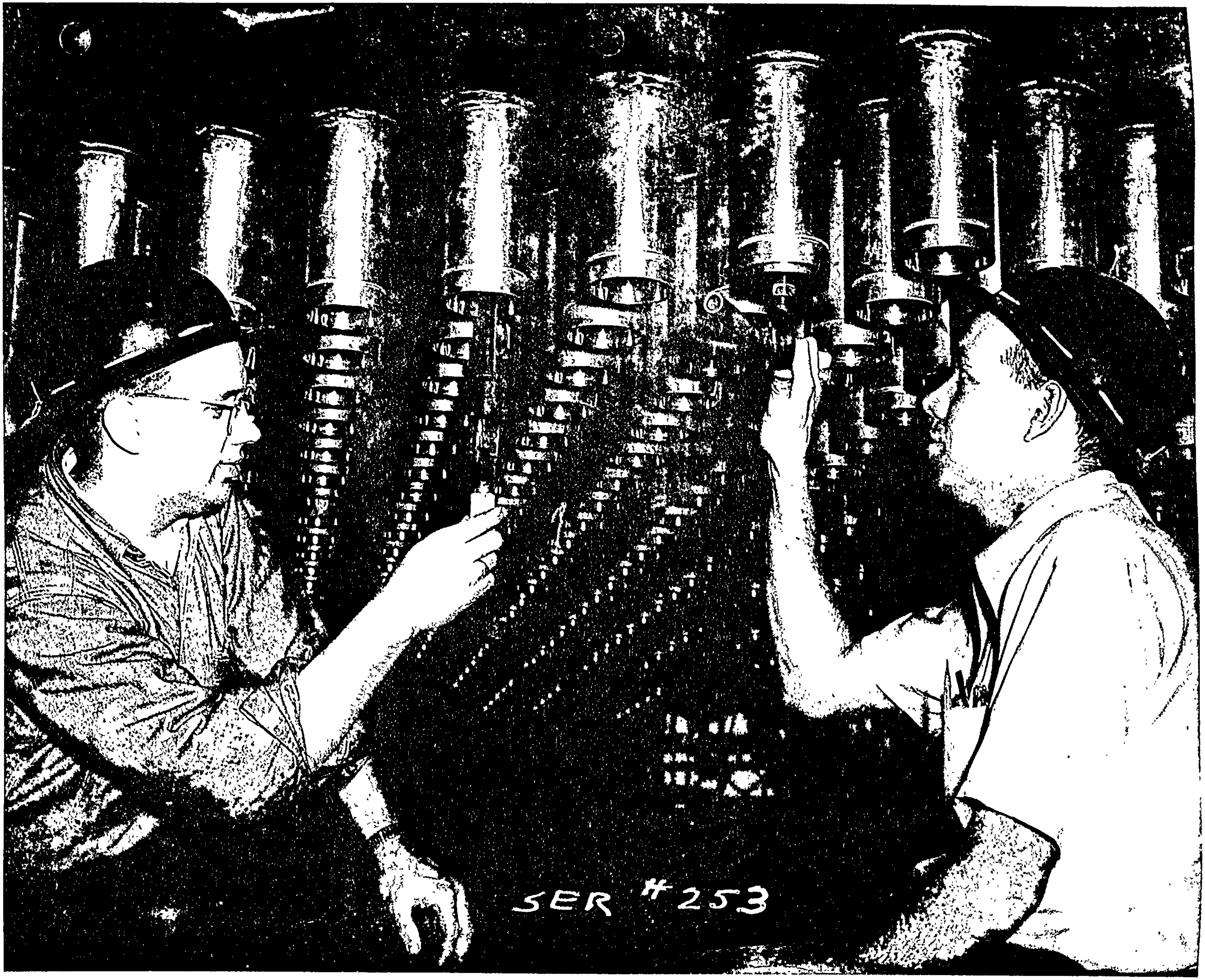
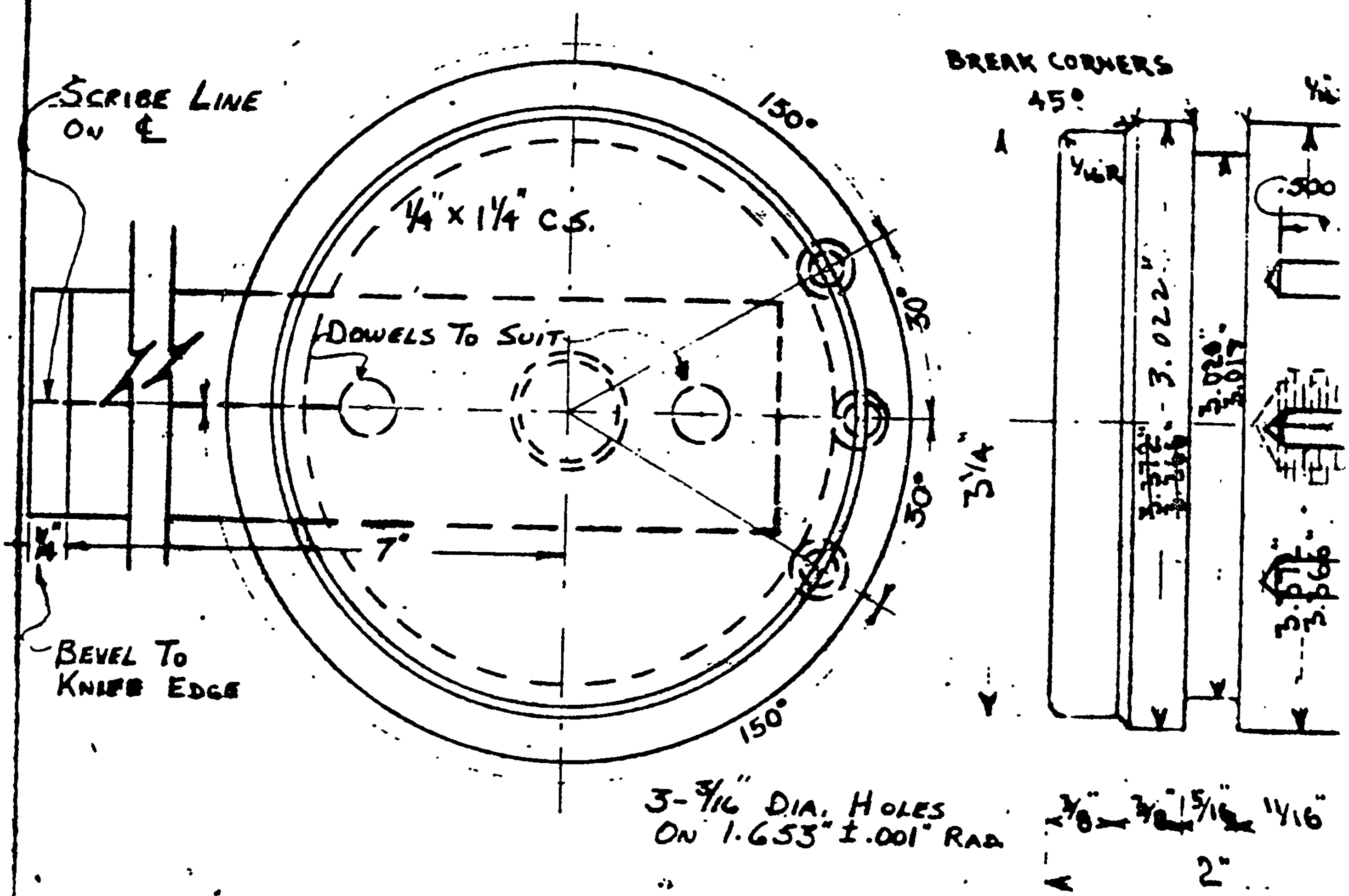


SER #253

1 REQUIRED
MATERIAL: MILD STEEL



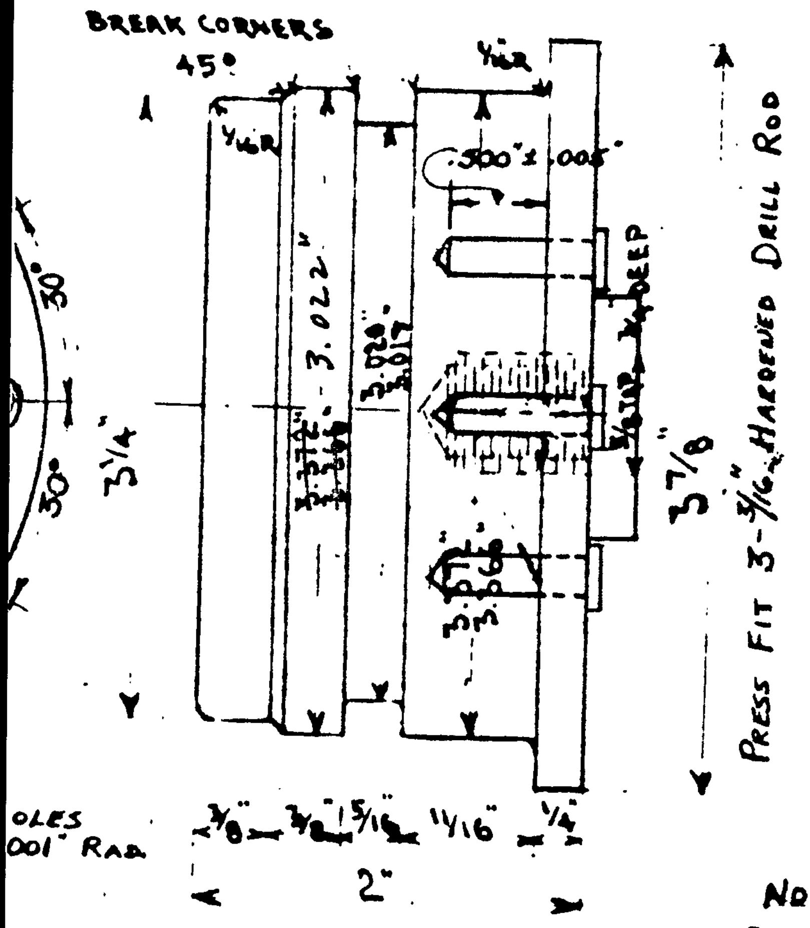
SMOOTH FINISH ALL OVER 63

SKETCH #6

SI

O

.D STEEL



[redacted]

SCALE 12" = 1 FT. MADE BY W.Hg. CHECKED BY DAT

No	REVISION
1	CHANGED "O" RING
	GROOVE DIAMETER TO
	~~3.020" 3.019"~~ 3.022"
2	ADDED BLADE &
	3-3/16" DRILL RODS
3	ADDED NOTE

NOTE - FURNISH 1-5/8" EYE BOLT &
1-5/8" HEX HD. NUT

SKETCH #6

APPROVED__________

FORM 279

Since the line boring operation required that M & E inspectors take measurements both concurrent and after this operation, mechanical gages had been developed to take these precision measurements; however, it was found that the use of these mechanical gages on the NYX unit was inadequate. These inadequacies were time consuming due to number of intricate measurements which required the use of centrality gages. To eliminate this difficulty, it was decided jointly by the Design and Material and Equipment Section to build and develop an electromagnetic gage (electronic gage) proposed by a member of the Mechanical Development Laboratory.

b. Procurement and Application

1. #1 Electronic Gage, Setting Stand Indicating Panel, Panel Stand

The first electronic gage designed by the Design Division was fabricated by the Thau Manufacturing Company, Baltimore, Maryland, and then shipped to Automatic Temperature Control Company, Philadelphia, Pa., for assembly and wiring. After this the gage was shipped to New York Ship, Camden, N. J., for operational purposes and further development. It was identified as equipment piece #790-42. For fabrication details, see du Pont drawings W131242, W131243, W134167 and D114632.

The setting stand for the first electronic gage (See Part I - Section C, paragraph 4, sketch #8) was fabricated by the Thau Manufacturing Company, Baltimore, Maryland, and shipped to New York Ship. It was identified as equipment piece #790-58. For fabrication details, see du Pont drawing D114630.

This gage and its component parts were first utilized for operational and development purposes on the first and second seven tube mock-ups as discussed in Part I - Sections B & C. It was also incorporated into the line boring procedure for the NYX and "R" units; however, due to machanical difficulties encountered in the operation of the gage itself on both units, its use was discontinued and two new gages were built to replace it.

c. Purpose and Functions

The primary purpose of this gage was to determine if a plenum tube is being bored concentric with the mid-point of the corresponding top tube sheet tube within .015". The medium of measurement incorporated into the gage to indicate this condition was a series of differential transformer coils. These coils are connected cascade in electrical circuits which are in turn coupled to an amplifier in the control panel. (See photo serial #223) At the control panel four indicating levels (bottom bore of plenum tube; top, mid-point and bottom of top tube sheet tube) are read directly to the nearest thousandths of an inch. This

SERIAL #254

New York Ship - Camden, New Jersey
August [illegible], 1953

[redacted]CTED

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PROJECT 8980 - SAVANNAH RIVER PLANT

Inspectors are shown checking orientation of monitor pin grooves with respect to the centerline of the adjacent tube on the "L" bottom tube sheet tube counterbore.

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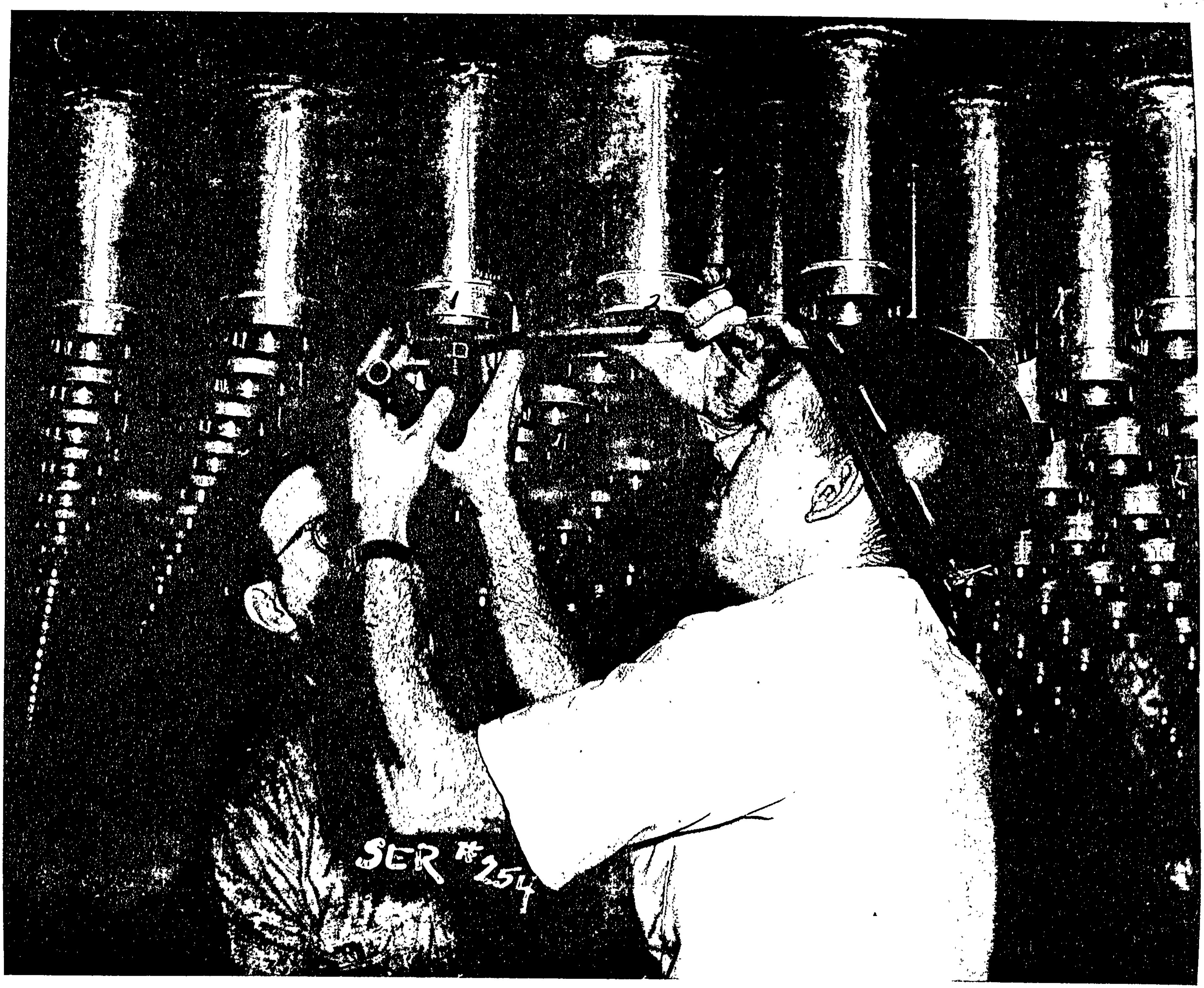


SER #254

Serial #223

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

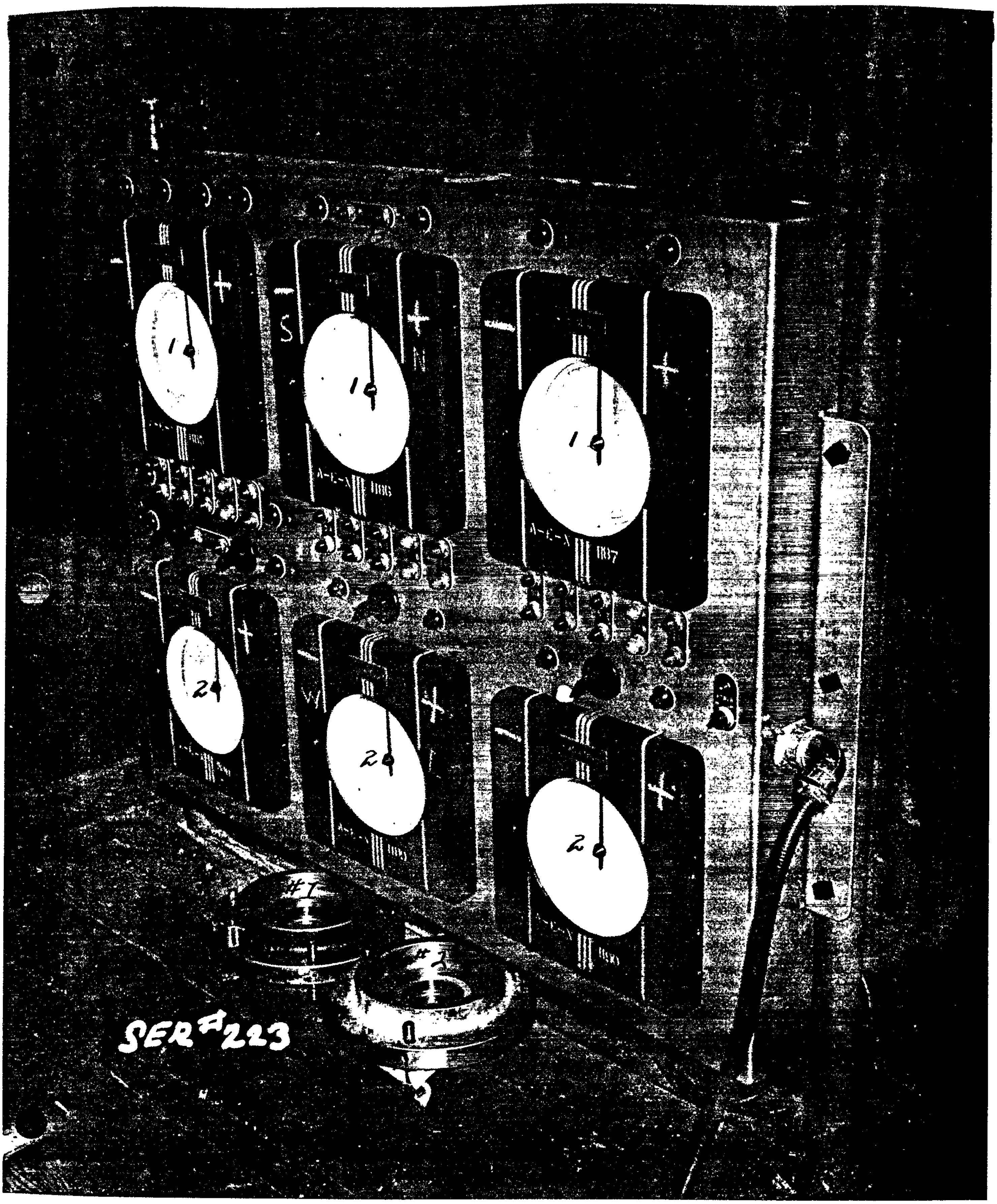
PROJECT 8980 SAVANNAH RIVER PLANT
Electronic Gage Panel & Indicating (Leveling) Fixtures

\# 1&# 2. Indicating fixture for leveling electronic gage after removing New York Ship Base J-8101-4 & 5 or J-8201-6&7. Two are available, #1 with 4.374" pilot and #2 with a 4.376" pilot. #1 &#2 identified as equipment piece #790-89. For fabrication details, see du Pont drawing D-11414-B.

\# 3. Instrument panel with indicators
Four indicating levels are shown on the panel.

- A. Indicating level for lower bore of plenum tube & top of top tube sheet bore
  - a. Switch "Z" in "ON" position
    - 1. Top dial is top-top position (bottom of plenum tube) and indicates North-South readings.
    - 2. Bottom dial in top-top position (bottom of plenum tube) and indicates East-West readings.
  - b. Switch "Z" in "OFF" position
    - 1. Top dial is top position (top of top tube sheet bore) and indicates North-South readings at this level.
    - 2. Bottom dial is top position (top of top tube sheet bore) and indicates East-West readings at this level.
- B. Indicating level for mid-point of top tube sheet bore
  - 1. Top dial is mid-point position (middle of top tube sheet bore) and indicates North-South readings.
  - 2. Bottom dial is mid-point position (middle of top tube sheet bore) and indicates East-West readings.
- C. Indicating level for bottom of top tube sheet bore
  - 1. Top dial is bottom position (bottom of top tube sheet bore) and indicates North-South readings
  - 2. Bottom dial is bottom position (bottom of top tube sheet bore) and indicates East-West readings.

Electronic gage panel stand is identified as equipment piece #790-60. For fabrication and wiring details, see Automatic Temperature Control Co., drawing W4043 (panel) and drawing W3830 (Wiring diagram for "core" in barrel of gage)



SER #223

method of measurement was patented by the Automatic Temperature Control Company, Philadelphia, Pennsylvania.

d. Limitation of First Electronic Gage

The first electronic gage consisted of three stages. These stages were located at three levels; namely, (1) top (2) mid-point and (3) bottom of top tube sheet bore. Each stage consisted of four plungers 90° x 1" in a clockwise spiral, and each plunger had its own differential transformer. The top plunger of any stage is identified as North, second plunger as East, third plunger as South, and fourth plunger as West. All North, East, South and West plungers were in the same relative position.

Another undesirable feature of this gage was the method in which leveling of the gage was done. Each time the gage was rotated to any one of the four quadrants (in check stand or tube), it had to be re-leveled, thus introducing a time consuming factor. This factor was later overcome by re-designing and incorporating into the "gage head" a thrust bearing so as to permit free rotation of the gage without re-leveling each time it was rotated to one or all four quadrants.

e. Electronic Gage Setting Stand

A setting stand was designed and fabricated to calibrate the first electronic gage. (See Part I - Section C, sketch #8). The setting stand presented a few problems. The main one was setting the plungers. Repetitive readings could not be duplicated due to the poor rigidity of the master setting bars.

The setting bars were replaced with a precision honed tube (4.375" bore diameter, equipment piece #790-58 drawing D114630) supported in a rigid box type frame, thus facilitating the setting of the electronic gage plungers to sero panel dial readings.

The above presision honed tube was later replaced with two master cylinders made of high tensile bronze and chrome plated on the I.D. and ground to 4.3750" (I.D.). (In addition, eight more adjustment screws were added to the check stand so that each cylinder's location could be controlled. (See photo serial numbers 273 and 274)

f. #2 and #3 Electronic Gages

The problems and difficulties encountered during actual practice and use of the electronic gage on NYX and "R" unit line boring operations were virtually eliminated through the following design changes:

1. Addition of "plunger stage" at level of bottom bore of plenum tube.

Serial Number 274

New York Shipbuilding Corp.
Camden, N. J.
September 1, 1953

PROJECT 8980 - SAVANNAH RIVER PLANT

Electronic Gage Setting Stand

This is a front view of the revised electronic setting stand. It is identified as equipment piece #790-58. For fabrication details, see DuPont drawing D-114630. (See photo serial #273)

The inspectors left hand is pointing to the cylinder used to set the top-top stage (bottom of plenum bore) and top stage (top of top tube sheet bore) of electronic gage plungers. The right hand is pointing to the cylinder used to set the middle of bottom stages of plungers - for mid-point and bottom bore of top tube sheet tube respectively.

SER# 274

Serial Number 273

New York Shipbuilding Corp.
Camden, New Jersey
September 1, 1953

PROJECT 8980- SAVANNAH RIVER PLANT

Electronic Gage Setting Stand

This is a side view of the revised electronic setting stand. It is identified as equipment piece #790-58. For fabrication details, see DuPont drawing D-114630. (See photo serial #274)

The inspectors left hand is pointing to one of the sixteen (16) adjustment screws for centralizing the two master cylinders with the pilot ring which locates the gage in the check stand. The right hand is pointing to the pilot ring.


SER # 273

This additional stage of plungers was added to locate the bottom land of a plenum tube, and to provide additional information of a finished bored tube. Other than this, it had no direct bearing on pre-determining functional characteristics of a tube or setting and aligning base plates.

2. Addition of Brass Strips for Plunger Tip Protection

Four brass strips were added to the gage barrel to protect plunger tips, and also to serve as a guiding implement during insertion and removal of gage. (See Part I - section 4, photo serial #147 illustration)

3. Addition of Thrust Bearing for Universal Leveling in One Operation

As pointed out in section b, no method for leveling the gage was incorporated which enabled free rotation to any one of the four quadrants without re-leveling each time. This inherent feature was eliminated by re-designing the "head" of the gage and incorporating into it a thrust bearing machanism. (for details, see du Pont drawing D-114414). This feature required leveling of the gage only once for each tube checked; thus eliminating the time consuming job of re-leveling each time gage was rotated to another position during any one tube check.

4. Safety Cam Lock

A safety cam lock was incorporated into the head of the gage to prevent removal of the gage from the check stand or a tube being check without first retracting plungers which enabled the lifting handle to be raised vertical for removal of gage. (for details of safety mechanism, see du Pont drawing W134167)

5. Upper Gage Fixture for Leveling Gage After Removal of NYS Base Plate

Two indicating fixtures (D-11414-B - equipment piece #790-89) were designed and fabricated to permit leveling of the gage after removal of line boring bases. (See photo serial #223, items 1 and 2).

The two new gages were fabricated by the Thau Manufacturing Company, Baltimore, Maryland, and then shipped to Automatic Temperature Control Company, Philadelphia, Pa., for assembly and wiring. After this the gages were shipped to New York Ship, Camden, N. J., for use in the line boring operation. The #2 and #3 electronic gages are identified as equipment piece numbers 790-59 and 790-60.

For fabrication details, see du Pont drawings W134167, W131242, W131243, and D114632.

The setting stand for the first electronic gage was utilized for calibrating the second and third electronic gages. Panels with "Atcotran" dial indicators mounted on it were purched from the Automatic Temperature Control Company, Philadelphia, Pa. These were identified as equipment piece #790-78, drawing - BPF 120400, and equipment piece #790-86, drawing - BPF 120403. The two instrument panel stands are identified as equipment piece numbers 790-60. For fabrication details, see du Pont drawing D-114629.

g. Procedure for Using Electronic Gage and Line Boring Inspection Procedure. (See following memorandum)

G. Pattern gages and Calibrating Stands Used on All Sub-Assemblies.

1. Need for Pattern Gages

Pattern gages were necessary in order to determine the coordinate of each tube relative to the X and Y axis for plenum chamber, top tube sheet, and bottom tube sheet. In other words the distance from X and Y axis to the center of each tube was required. Pattern gages permitted the obtainment of these measurements to the nearest .001".

2. Development of Gages

The original gage used in measuring patterns consisted of a wood beam with a dial indicator attached to one end and a steel hook attached to the other end. Du Pont inspectors assigned to New York Ship were responsible for the conception and production of this gage. (For view of gage, see Part I, section A-1, photo serial #184). This gage was, of course, necessary in order to measure the location of each tube from the X and Y axis rows of tubes. In use, the gage was set to a basic dimension by means of a pin gage calibrated to .001". There were as many different length pin gages used as pattern requirements necessitated. If necessary this gage would span a distance of one-half the diameter of the unit. It received use during pattern measurements on the experimental 8' diameter mock-up after all tubes were welded in place. (See Part I)

Before the time arrived for obtaining final pattern measurements on NYX unit, a verbal request was made to Design for a gage to facilitate more rapid pattern measurements. Four gages were furnished as shown on du Pont drawing W-130903. These gages were used to obtain final pattern measurements on NYX and all subsequent units. Four ligament gages 48" long were fabricated by Newton Tool Co., Wenonah, N. J., and shipped to New York Ship for immediate use.

In order to set the gages to a proper basic setting a calibrating stand was fabricated. This permitted a

February 16, 1953
New York Ship - Camden, N. J.

MEMORANDUM

TO: J. B. JOHNSON

FROM: R. R. BAKER & S. R. COCHRAN SRC

PROCEDURE FOR USING ELECTRONIC GAGE AND LINE BORING INSPECTION PROCEDURE

PART I - GENERAL

The ~~Atcotran~~ duPont Electronic Gage, for inspection of the set-up and final boring of the plenum chamber tubes in relation to the center point of the tubes in the top special tube sheet, is a delicate instrument and should be used with extreme care.

Basically its operation and procedure is simple, but unless some thought and time is used it can be very confusing. The procedure for using this gage should be followed with concern.

PART II - CHECK STAND

A. Reason for:

A check stand has been provided for the electronic gage. It is used for checking the accuracy of the gage as well as setting it.

B. Description:

The stand consists of a rigid frame work that holds in place a "master tube" and a "locating ring". The "tube" is held in place by 8 setting screws. The "locating ring" is bolted and doweled to the frame. The tube is made of stainless (304) steel and the inside diameter has a honed finish of 5 R.M.S. The inside diameter is 4.3751" to 4.3755" from top to bottom.

C. Checking the stand for being level.

Place a precision level graduated in thousandths of an inch on top of the "locating ring" on a diagonal across the columns of the stand.

There are 4 jack screws in the base of the stand, one at each corner, and these jacks control the level of the stand. Adjustment of the stand through these jacks should be done with care and the stand should be checked for level at least once every 24 hour period, or before each work shift.

D. Setting of master tube.

The plungers of the gage are set to 4.3750" diameter. When the gage is placed in the check stand and the instrument panel turned on, the dials will read "zero" at each stage with the control switches at "diameter" position - providing the tube is "centered" and the plungers set correctly.

Positions of the tube may be checked by turning the stage switches to N-E, (north & east), or S-W, (south & west), position. When this is done and a plus or minus reading shows on the dials, the tube is not centered correctly.

Leaving the stage control switches in this position, adjust the 8 setting screws which are found in the 4 frame columns, (4 at top of the tube and 4 at the bottom), until a zero reading is obtained. The screws are 90° to each other; therefore, the adjustment is controlled by 2 screws at 180° to each other. When one screw is loosened, the opposite screw should be tightened, but only finger tight in all cases.

Direction of adjustment may be determined by watching the dials. Each plunger in each stage should be checked for "zero" when the tube is considered centered. Plungers reading other than zero when the gage is rotated 360° should be reset, but only by a qualified person.

PART III - DESCRIPTION

A. General

The electronic gage consists of a bronze bar with a leveling head consisting of thrust bearing for its rotation and a precision "all-way" level on top of the head for leveling purposes.

B. Stage identification

There are 4 stages of plungers in the bar which are extracted and retracted by means of a control handle in the head of the gage. The 4 stages are referred to as Top-Top, Top, Center and Bottom.

C. Plunger identification

There are 4 plungers in each stage and their positions are referred to as north, east, south, and west. The north plungers are in line with the cable connection and the other positions are 90°, 180°, 270° respectively in a clockwise direction.

PART IV - PRECAUTIONS

The electronic gage will be found in place in the check stand and should be kept there when not in use. The gage is set in place, removed from the check stand or boring set-up bases by means of a crane with a block and fall, the latter to be hand operated.

When using the gage in general or checking it, the crane operator and the rigger should be cautioned and instructed as to the necessary care required in raising and lowering the gage into operating position. The inspector should observe each positioning of the gage. Bumping the gage must be avoided, its operation and accuracy might be impaired if a substantial bump or number of bumps occur.

The crane should be used only as a means of locating the gage over the set-up base or check-stand. The block and fall is used to lower or raise the gage into and from its operating position.

The gage must be guided by a rigger or the inspector as it is raised and lowered to prevent it from bumping the sides of the tube which it is being lowered into or raised from.

PART V - CHECKING SET-UP FOR 2ND BORE

A. General

In checking the set-up for the second bore, the usual procedure should be followed using extreme care in lowering the gage into position and removing it.

It must be continually remembered that the gage must always be level before making any readings at any time. The "all-way" level on top of the gage should be level to the degree that the bubble is within one-half line of being central, with the gage positioned in any direction. (See sketch #1)

B. Checking centrality of base plate setting.

Alignment tolerance on this check has been established by design as being .005". This means that the center of the base will be central,(within .005"), with a vertical line passing through the mid-length bore of the corresponding top tube sheet tube. Check this in the following manner:

1. Place gage in base plate. Bubble should be level within one-half line. If it is not, have New York Ship level base until such a condition is reached.
2. Use center stage of plungers and center set of dials.
3. Set selector on centrality.
4. Read top dial for N-S reading and bottom dial for E-W reading.
   a. Precautions
      1. When taking above readings make certain that the north plungers are aligned in a northerly direction.
      2. If the above readings seem radical, then rotate the gage 90° and take a similar set of readings. These should compare with the originals in magnitude. If they do not, there is an indication that the gage requires readjusting by the method outlined in Part II, section D. If the above check in gage stand proves satisfactory, it can be assumed that the top tube sheet tube has a defective bore at the elevation of the plungers. The tube bore should be checked with electronic gage in order to determine bore size. This will ascertain whether the bore is beyond tolerances. Replace gage and choose 4 directions, when tube bore is uniform take new readings. (Return gage to normal position after rotation or adjustment.)
5. If either or both of the above full dial readings, listed in item 4, are above 10, then have base adjusted accordingly by New York Ship until full dial readings are below 10. (Level base after

adjusting and before reading dials.) Sketch #2 shows why the full dial reading of 10 is used in lieu of the .005" alignment tolerance.

6. Record final results on appropriate record sheet.

Note: If base must be shifted, direction of shift can be determined by referring to the following chart:

Centrality N - S	Shift Base	Centrality E - W	Shift Base
+	North	+	East
-	South	-	West

Example: If a reading such as this were obtained: N-S: +15; E-W: -20; the base would be shifted first to the north and then to the west such that the final readings would be below 10.

C. Checking centrality of top bore of top tube sheet tube.

This check is one of two checks made in an effort to determine if the functional gage will properly seat in the tube after final boring. Needless to say, predetermined knowledge of this fact, (seating of functional gage), is an invaluable asset to be credited to the usefulness of the electronic gage. When the gage is handled carefully and conscientiously, and the results properly analyzed, much grief and money can be saved by knowing the answer to this one simple question. Will the functional gage properly seat after the tube is bored? The answer to this question is obtained in the following manner, with the gage still in place after the check of part B:

1. Use top stage of plungers and left hand set of dials.
2. Set selector on centrality.
3. Read top dial for N-S reading and bottom dial for E-W reading.
   - a. Precautions
     1. When taking above readings make certain that the north plungers are aligned in a northerly direction.
     2. If the above readings seem radical, then rotate the gage 90° and take a similar set of readings. These should compare with the originals in magnitude. If they do not, there is an indication that the gage requires readjusting by the method outlined in Part II, section D. If the above check in gage stand proves satisfactory, it can be assumed that the top tube sheet tube has a defective bore at the elevation of the plungers. The tube bore should be checked with electronic

gage in order to determine bore size. This will ascertain whether the bore is beyond tolerances. Replace gage and choose 4 directions, when tube bore is uniform - take new readings. (Return gage to normal position after rotation or adjustment.)

4. Plot resultant of above components, N-S & E-W, on chart, (see sketch #3). Make certain that you have payed proper respect to the plus and minus signs of the components. If you have, the resultant will give both magnitude and direction.
5. If the resultant of above full dial readings exceeds 50, make a note of this and continue with the following check: (Did you ask, "Where does the 50 come from?" The answer to this question will be found on sketch #4.)

D. Checking centrality of bottom bore of top tube sheet tube.

This check is the final phase in obtaining an answer to the question. Will the functional gage properly seat after the tube is bored?

1. Use bottom stage of plungers and right hand set of dials.
2. Set selector on centrality.
3. Read top set of dials for N-S reading and bottom set of dials for E-W reading.
    a. Precautions
        1. When taking above readings make certain that the north plungers are aligned in a northerly direction.
        2. If the above readings seem radical, then rotate the gage 90° and take a similar set of readings. These should compare with the originals in magnitude. If they do not, there is an indication that the gage requires readjusting by the method outlined in Part II, section D. If the above check in gage stand proves satisfactory, it can be assumed that the top tube sheet tube has a defective bore at the elevation of the plungers. The tube bore should be checked with electronic gage in order to determine bore size. This will ascertain whether the bore is beyond tolerances. Replace gage and choose 4 directions, when tube bore is uniform - take new readings. (Return gage to normal position after rotation or adjustment.)
4. Plot resultant of above full dial components, N-S & E-W. on chart. (see sketch #3).

5. If the resultant of above full dial readings exceeds 50 make a note of this and proceed as follows:

E. Analyzing the two resultants, (top bore and bottom bore).

1. In order to analyze the two resultants, top bore and bottom bore, one must be aware of the five cases that can exist. These cases are illustrated on sketch #5, and typify hypothetical sections of the functional gage fully seated in the top tube sheet tube.

a. Explanation of five cases.

Case I - This is what we term a double white area. It is our goal.

Resultant readings in this area indicate that the functional gage will properly seat after boring. These resultant readings will be under 50 for both top and bottom bores. The gage may be removed and tube bored.

Case II-This is what we term a white-red area. It is only a portion of our goal.

Resultant readings in this area indicate that the functional gage will clear the top bore but not the bottom bore. The resultant will be under 50 for the top bore but over 50 for the bottom bore.

To correct the above situation it will be necessary to shift the base and disregard the full dial reading of 10 for the middle bore. Proper shifting of base will be in a direction opposite to largest resultant plotted on chart.

At completion of final shifting of base, the top bore resultant and bottom bore resultant should be equalized to an amount under 50, if possible.

At this point it will be necessary to check the mid-length bore centrality and determine if the resultant is under 50. It will rarely, if ever, be over 50 if the above method has been followed.

Note: If it was found to be impossible to obtain a double white area, (all resultants under 50), contact your shift supervisor and supply him with your results. He and others will make a decision as to whether the tube can be successfully bored.

Case III-Here we have a red-white area. This is the reverse of Case II. It too, is only a portion of our goal.

Resultant readings in this area indicate that the functional gage will not clear the top bore, but will clear the bottom bore.

Rectification of this situation is the same as the procedure followed in Case II.

Case IV-This is a double red area. It is the most problematical situation that exists. It is the exact opposite of our goal.

Both top and bottom bore resultant readings will be above 50. Here also, rectification of the condition can sometimes be accomplished by following the procedure of Case II. That is, a compromise resulting in equalization of the two resultants.

Again if both resultants after adjusting do not both fall in a white area, contact your shift supervisor. He and others will make a decision as to whether the tube can be successfully bored.

Case V- This is a rare case indeed. It is a double red area, but notice that tube is actually bent. This can be determined with the gage by noting that the resultants fall in the same or adjacent quadrants and are above the 50 limit. In the first four cases the resultants fell in opposite quadrants on the chart.

Rectification of this situation can sometimes be accomplished following the procedures of case II and case IV.

Make certain that the mid-bore resultant does not exceed 50 after final adjustments. This applies to all cases.

After satisfactory readings have been obtained in all five cases the gage may be removed from the base and the tube bored.

Always be certain that you have recorded your results on the appropriate record sheet.

PART VI - CHECKING SET -UP FOR 3RD BORE, (FINAL BORE.)

A. Reason

This check is made in order to determine whether the base moved after making the 2nd bore.

B. Procedure

Follow the same procedure as that followed in Part V - Checking set-up for 2nd bore.

You will find that it will be necessary to adjust the base slightly in 50% of all cases. Remember, adjustment will be slight, so you should be able to accurately "breeze through" this check.

C. Results

Record your results on the appropriate record sheet.

PART VII - INSPECTION OF FINAL BORE

A. General

We are going to divide the inspection of final bore into two categories, namely:

1. Inspections made with electronic gage.
2. Inspections made with other gages.

B. Inspections made with electronic gage.

1. General

Results of the final bore are obtained in a somewhat different manner than heretofore. There are two "special" bases made, each base having a different pilot diameter.

2. Procedure

Using a bore gage set for 4.375" diameter, check the top land of plenum for bore size. After the bore size has checked "OK", (4.375" - 4.378" approx.) the boring fixture base plate must be removed and the bore swabbed clean until dry, including the tube in the top special tube sheet.

Select the "special" base for the electronic gage which has a pilot diameter nearest, (on the minus side), to that of the bore size. Position the base and lock into position by means of the locking fingers.

Level the base by means of a "precision level" as close as possible. The "precision level" should be positioned in line with the axis, first in one direction and then the other. After this step is completed, position the electronic gage and adjust the base for level by means of the "all-way" level.

Extend the plungers with the north plungers aligned in a northerly direction and continue as follows.

3. Results

USE ON "P" ONLY

a. Centrality on bottom land of plenum chamber tube.
   1. Use top-top stage of plungers with selector set on centrality.
   2. Read top left hand dial for N-S reading and bottom left hand dial for E-W reading.
   3. Record the <u>full dial</u> readings showing the proper plus or minus signs for each.

b. Centrality of mid-length bore of top special tube.
   1. Use center stage of plungers with selector set on centrality.
   2. Read top-center dial for N-S reading and bottom center dial for E-W reading.
   3. Record the <u>full dial</u> readings showing the proper plus or minus signs for each.

C. Inspections made with other gages.

1. Bore size - using bore gage
   a. At one inch below top surface of plenum chamber tube in X & Y directions.

b. From one to three inches below chamfer on bottom land of plenum chamber tube in X & Y directions.

2. Verticality

I. In north, east, south, and west directions showing direction as well as amount of verticality. The end of the arm on which the dial indicator is mounted is to be used as a directional finder. Record plus and minus signs for each reading.

3. Surface finish of bore on plenum tube in r.m.s. micro-inches.

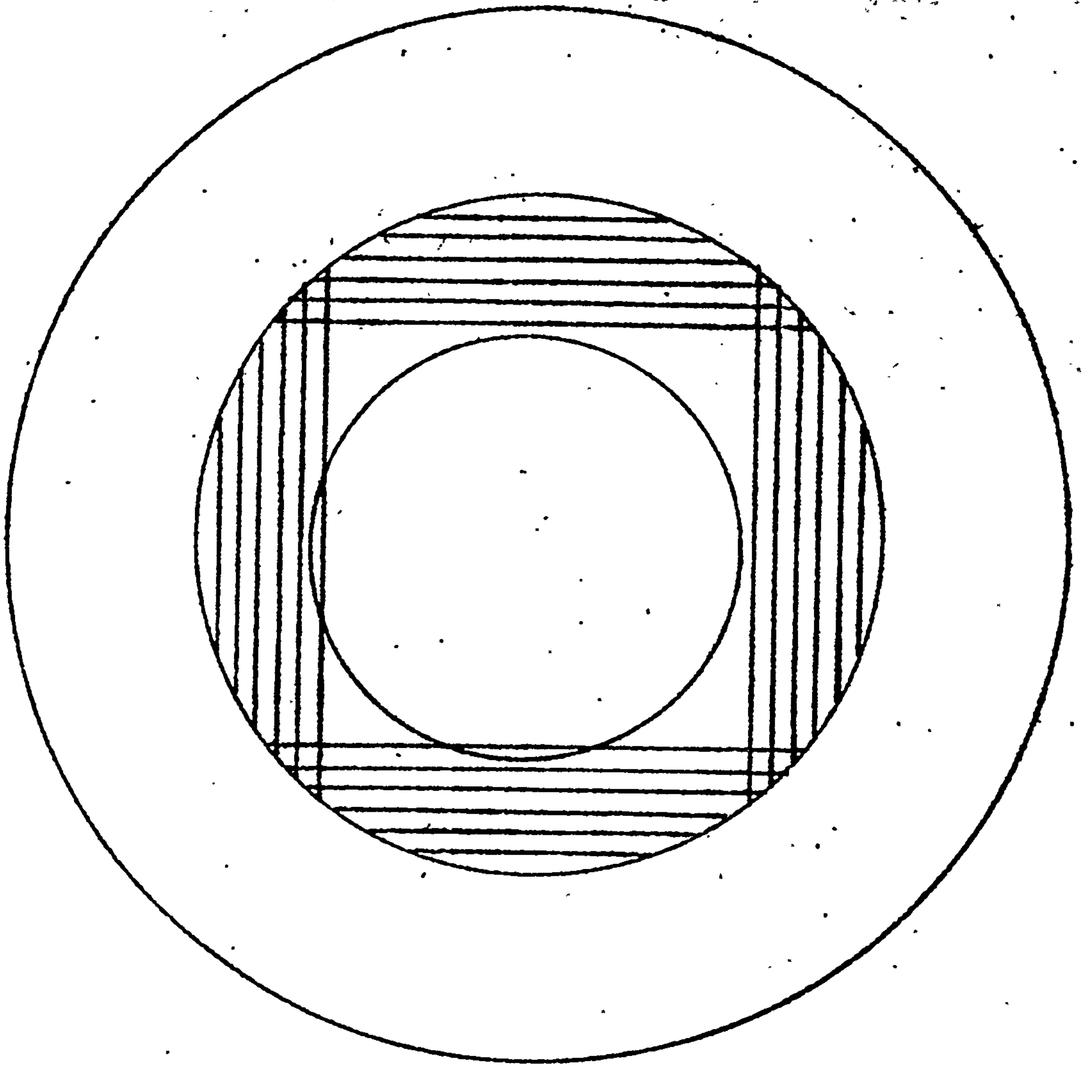
Do this using your finger - nail and comparing with roughness specimens. Segregate your results and record under one of the three classifications as follows:

a. 0-63
b. 63-125
c. 125-UP.

4. Functional Gaging

a. Use 4.365" - 4.330" diameter functional gage.
b. Record as go or no-go.
c. If no-go, explain how much gage lacked of seating without any force whatsoever. If slight amount of force, by hand, permitted gage to seat, then record this also.

5. Use the remarks column generously on record sheet to explain all discrepancies.



ALL-WAY LEVEL

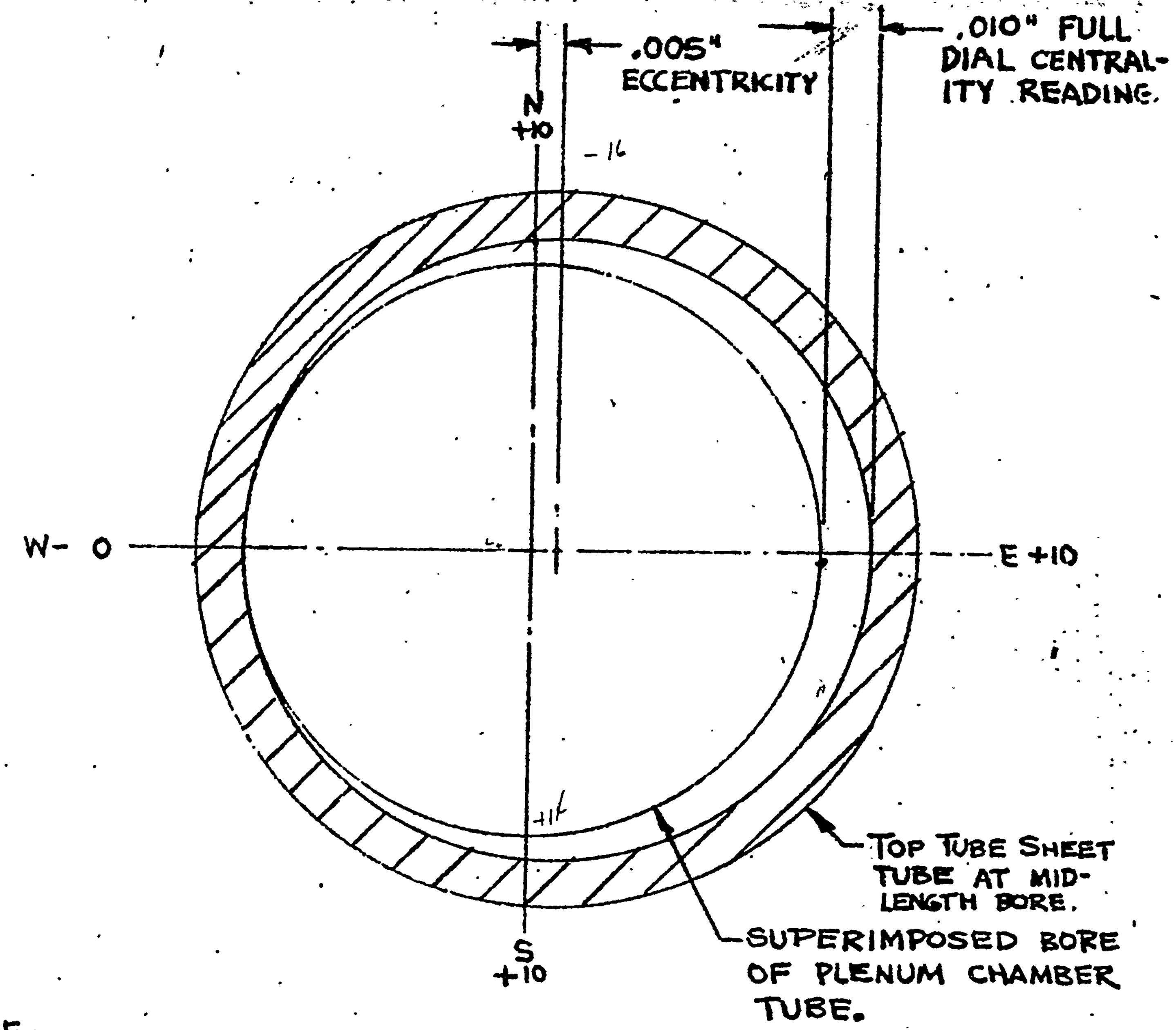
LEVELLING LIMITS – BUBBLE MUST BE LEVEL WITHIN ½ LINE, AS SHOWN, BEFORE MAKING ANY READINGS AT ANY TIME.

EACH LINE REPRESENTS .0005" PER FT.

SK # 1

NOTE:

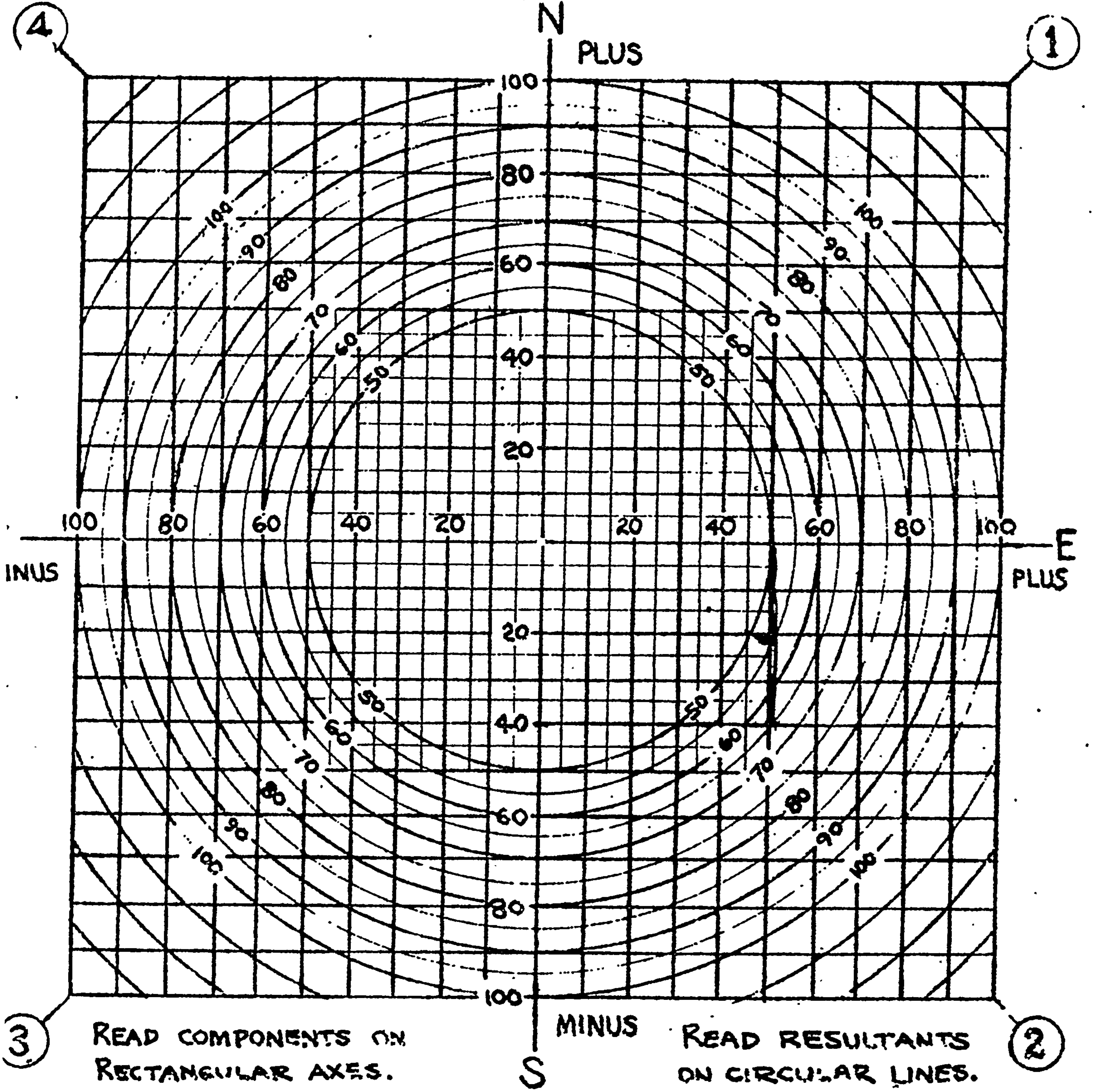
FULL DIAL CENTRALITY IS. DOUBLE ECCENTRICITY OR ALIGNMENT.



EXAMPLES OF ELECTRONIC GAGE READINGS.

PLUNGER READINGS				FULL DIAL CENT.		REMARKS
N	E	S	W	N-S	E-W	
+10	+10	+10	0	0	+10	EXAMPLE AS SHOWN
+30	-15	-10	+15	+40	-30	SHIFT BASE N & W
-16	+12	+14	-18	-30	+30	SHIFT BASE S & E

SK # 2



READ COMPONENTS ON RECTANGULAR AXES.

READ RESULTANTS ON CIRCULAR LINES.

CENTRALITY CHART

1. USE FULL DIAL READINGS

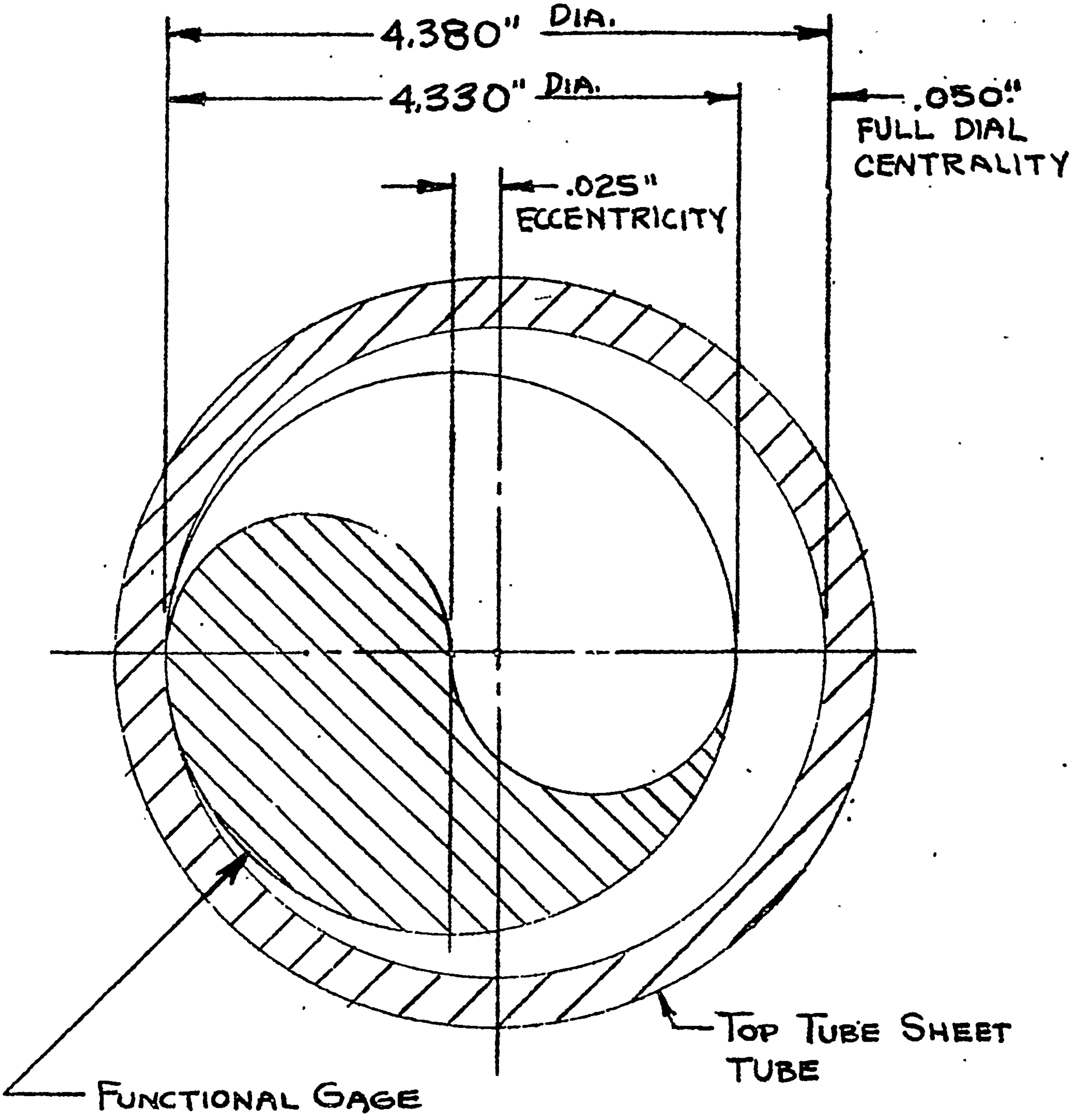
RED AREA - RESULTANTS OVER 50

WHITE AREA - RESULTANTS UNDER 50

4. EXAMPLE: N-S = -40; E-W = +50. RES. = 64 (RED IN QUAD. 2.)

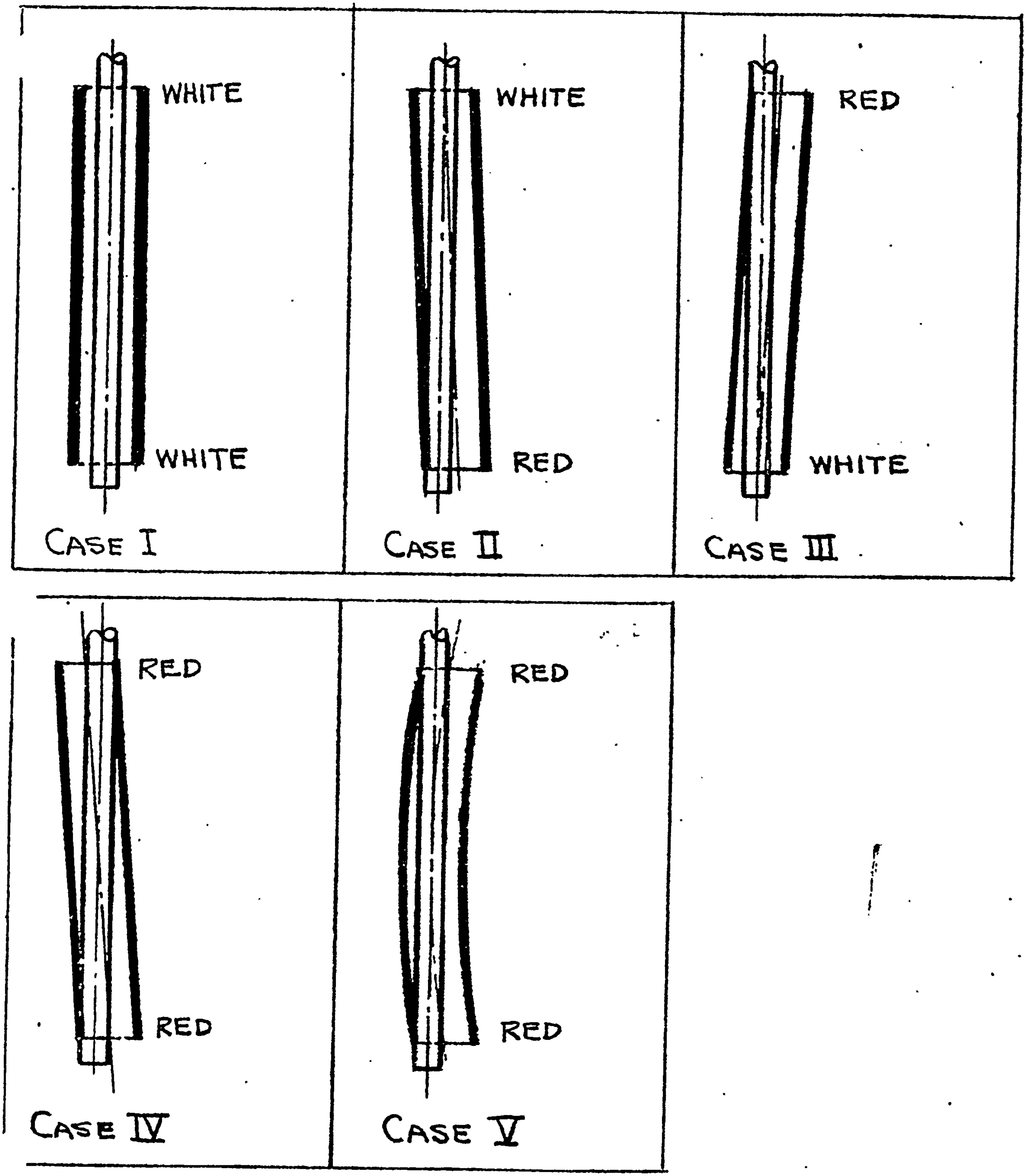
5. QUADRANTS NUMBERED AT CORNERS.

SK # 3



IT BECOMES EVIDENT THAT THE .050" IS BASED ON MINIMUM BORE LIMIT OF TOP TUBE SHEET TUBE.

SK # 4



CASE I

CASE II

CASE III

CASE IV

CASE V

SECTIONS THROUGH FUNCTIONAL GAGE & TOP TUBE SHEET TUBE.

SK #5

rapid, accurate means of setting the gage in the X direction only for the plenum chamber and top tube sheet. In order to set the gage for other patterns, (Y direction on plenum chamber and top tube sheet and X and Y direction on the bottom tube sheet), pin gages of appropriate length calibrated to .001" were used. This method was used on NYX and "R" units.

As the job progressed it became evident that the above method of setting the gage by means of pin gages was cumbersome, time consuming, and gave reason for susceptibility of errors. Therefore, calibration stands were made to dimensions as listed below:

(1) Plenum Chamber and Top Tube Sheet

  a. Top side and bottom side - "X" direction (Bore 4.380") 2.620", 9.620", 16.620", 23.620", 30.620", 37.620", 44.620".

  b. Top side and bottom side - "Y" direction (Bore 4.380") 7.744", 19.868", 31.992", 44.116".

(2) Bottom Tube Sheet

  a. Top side - "X" direction (Bore 3.275") 3.725" 10.725", 17.725", 24.725", 31.725", 38.725", 45.725".

  b. Top side - "Y" direction (Bore - 3.275") 8.849", 20.973", 33.097", 45.221".

  c. Bottom side - "X" direction (Bore 3.380") 3.620", 10.620", 17.620", 24.620", 31.620", 38.620", 45.620".

  d. Bottom side - "Y" direction (Bore 3.380") 8.744", 20.868", 32.992", 45.116".

Of the above, one calibrating stand 1-a, was already in existence and was modified to suit the above dimensions. Pattern gages and calibrating stands are shown on photograph serial #157 in Part II-A, Section 8. The above six calibrating stands were fabricated by the Thau Mfg. Co. Baltimore, Maryland, and inspected at this location by an inspector from New York Ship and found satisfactory.

3, Pattern Coordinate Calculations

The object of the pattern coordinate report, is to show the position of the center of each tube from the X and Y centerlines. To do this it is a simple calculation combining ligament measurements with bore sizes. Ligament measurements by definition are the distances between tubes.

First, however, the position of the basic tubes are established from the centerlines (X & Y axes). Measurements are taken to rows X28 and X29 from the X centerline, and Y45 and Y48 from the Y centerline. If the bore diameter of tube X28-Y45 is 4.386", and the distance of the outside edge of the I.D. from centerline is 2.200", then the center of the tube is .007" to the left of the centerline. The remainder of the tubes are then measured from these basic tubes but it must be remembered that all basic tubes have their own coordinates. It is apparent then a correction must be applied for the basic tubes. As an example: Tube X39-Y21 has a ligament measurement of 30.598" from tube X29-Y21 which has a coordinate of 3.520". The bore of tube X39-Y21 is 4.390" and X29-Y21 is 4.386". The coordinate of tube X39-Y21 is 3.520" + 2.193" + 30.598" + 2.195" or 38.506". The pattern coordinate is graphed as the actual distance 38.506", and + .006" which is the variation from the theoretical.

An alternative to the above is to set all ligament gages at theoretical distances, then when calculating the pattern, add all deviations, and subtract the deviation from the theoretical distance thereby obtaining the pattern coordinate. This method is more rapid and less cumbersome, and is actually used to calculate the pattern.

For an illustrative example of a completed pattern, see Part II-A, Section 18, NYX plenum pattern (top and bottom side).

H. Eccentricity Gages

1. Development and Procurement

In the early stages of the NYX Project, the Design Division realized that it would be necessary to have data relative to the eccentricity between the plenum chamber tube bore and the top tube sheet tube bore. It was agreed that the eccentricity should be taken at the mid-point of the top tube sheet bore relative to both the upper and lower bore of the plenum chamber tube.

Due to the basic design of the plenum chamber and top tube sheet, Design Division specified that all eccentricity measurements should be in thousandths of an inch. At this point, it was postulated that a dial indicator would have to be inserted into the tube bore and read at the mid-point of the bore of the top tube sheet tube. In reality, it was the final decision of Design that a sleeve type gage would have to be fabricated with a dial indicator mechanism suspended in the hollow part of the gage. The first gage (see Photograph Serial No. 275, Item #2) was fabricated and assembled by the Newton Tool and Manufacturing Company, Wenonah, New Jersey in accordance with Drawing No. D-114396-A. It was assigned du Pont Equipment Piece No. 790-76.

Photo Serial #275

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

PROJECT 8980 SAVANNAH RIVER PLANT

Eccentricity Gage

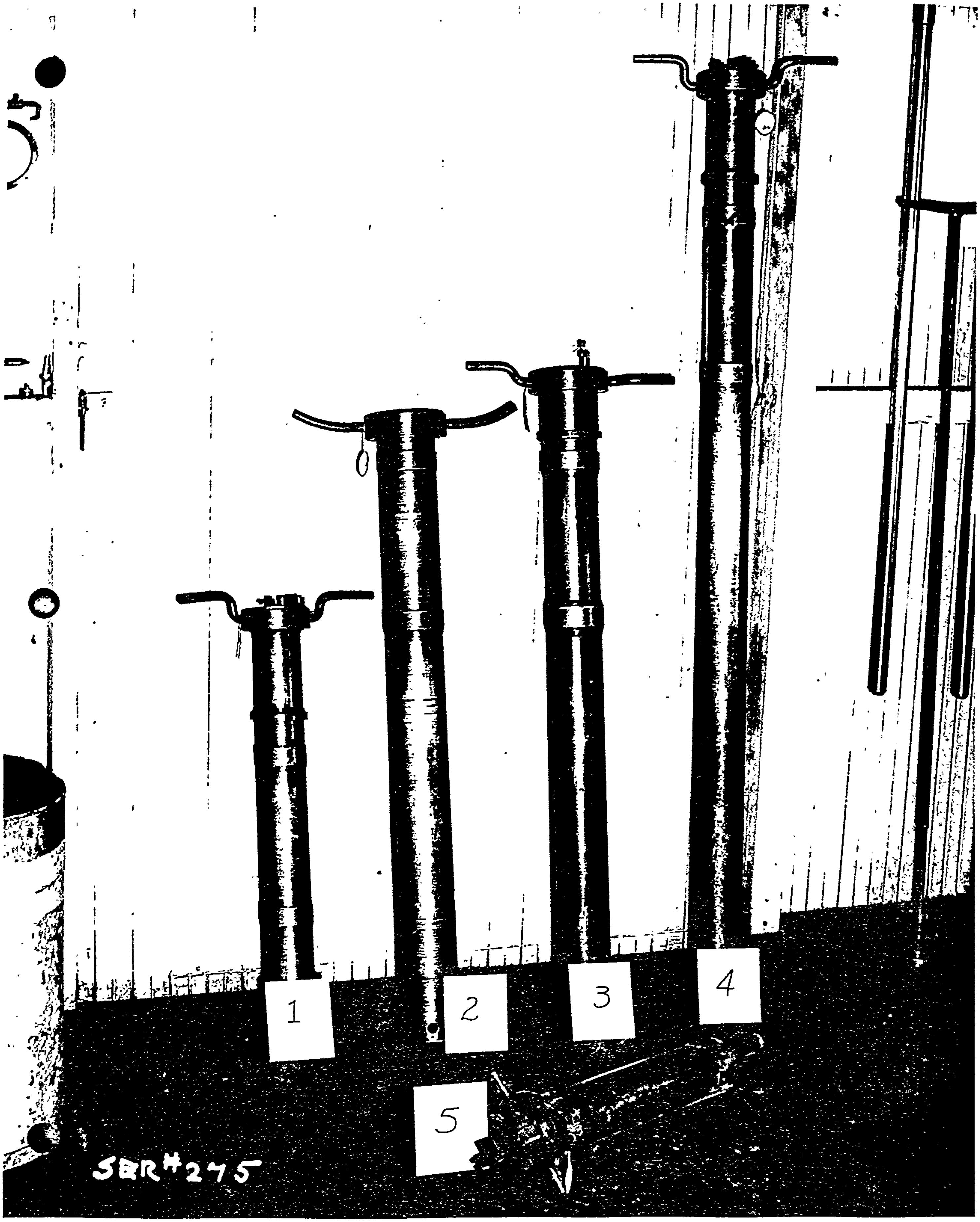
#1 Plenum & TTS Tubes (Top of TTS tube) plenum pilot 3.684". Equipment piece #790-111, Dwg. D114479-A. Registers in sealing sleeve D-112788 (for use on NYX test only). Function: for measuring motion movement of top plate of TTS assembly by establishing eccentricity change of dimension at 4 azimuth points. It must be applied in bore of sealing sleeve D-112788.

#2 Plenum and TTS tubes (Mid-point of TTS tube) Plenum pilot 4.373" - 4.374". Equipment piece #790-76. Dwg. D-114936-A. Same as above, except eccentricity is obtained at mid-point of TTS tube. Also, gage pilots in both upper and lower bore of plenum with nominal clearance. Dial indicator measures the eccentricity and is located in the bore of tubular gage at level of point of indication. A retracting mechanism protects dial indicator pin.

#3 Plenum & TTS tube (mid-point of TTS tube) plenum pilot 4.376" - 4.377". Equipment piece #790-77. Dwg. D-114936-B. Function: Same as #2, except pilot size.

#4 Plenum & TTS tubes (Bottom of TTS tube). Plenum pilot 3.684". Registers in plenum sealing sleeve D-112788 (For use in NYX test only). Equipment pc. #790-112, Dwg. D-114479-B. Function: Same as D114479A, except measures movement of bottom plate of TTS assembly.

#5 Plenum TTS tubes (Top of TTS tube) - Plenum tube bore 4.375". Equipment piece #790-32. Dwg. D-114897. Function for measuring eccentricity at top of TTS tube with respect to plenum tube when plenum is assembled on TTS assembly. This gage was never used & deemed obsolete.



SBR#275

When the first eccentricity gage was received at New York Ship, it was observed that the gage had several limitations. In the first place, the dial indicator was mounted in the bottom end of the gage in such a manner that the plunger of the dial indicator could not be retracted between readings. After a series of readings had been taken, it was found that the dial indicator plunger had been damaged. Evidently, the plunger caught on the plenum chamber or top tube sheet tube when the eccentricity gage was inserted or removed from the tube being measured.

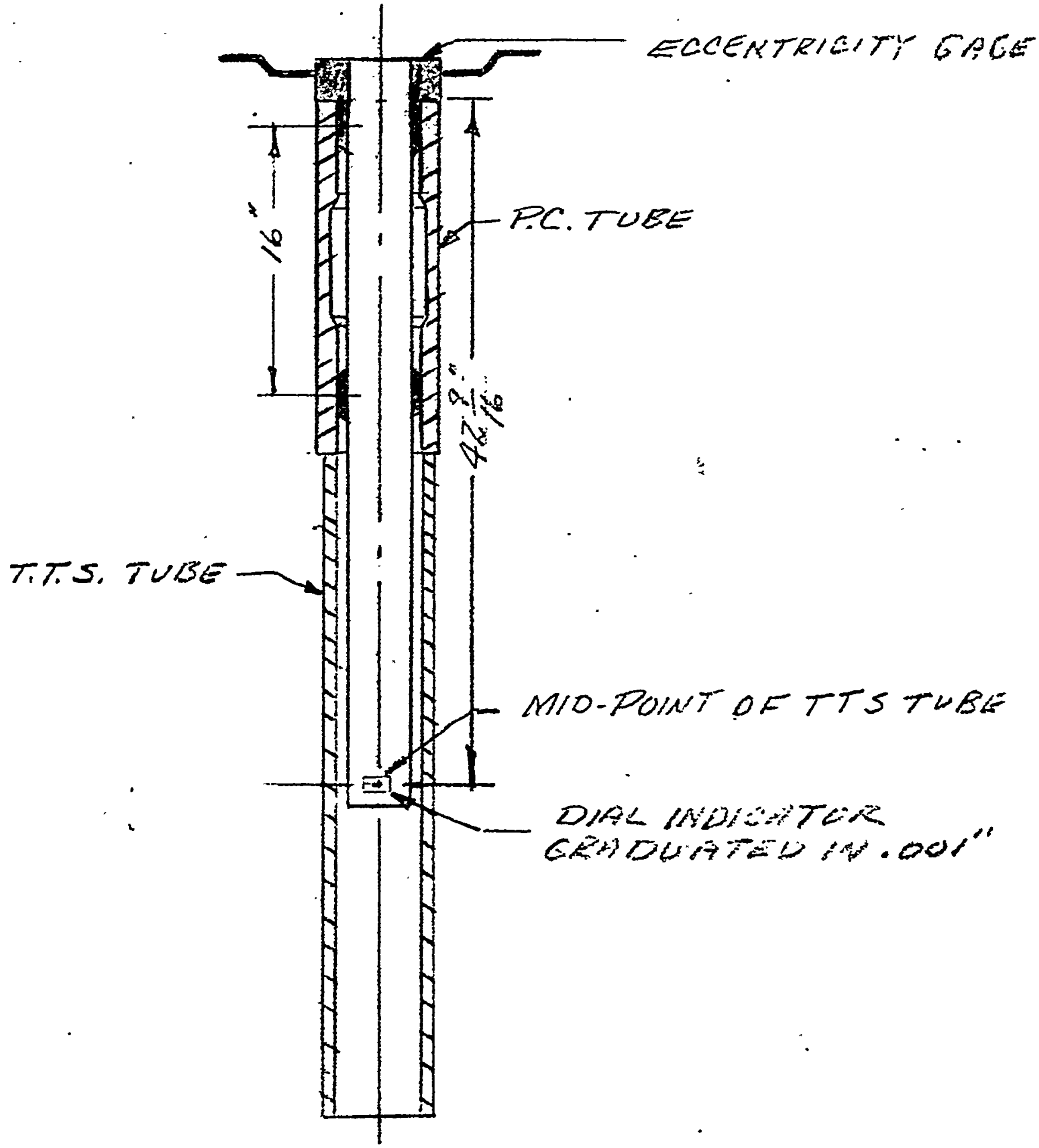
To alleviate this condition, M & E Inspection personnel devised a method of retracting the dial indicator plunger when the gage was not in use. Modification of the gage was accomplished by attaching a cord to the dial indicator plunger inside the gage body. This allowed the plunger to be retracted while inserting or removing the gage from the tube bore.

However, it was again observed that this modified gage (see Photograph, Serial No. 275, Item #2, du Pont Equipment Piece No. 790-76) could be damaged if the operator using the gage forgot to retract the dial indicator before removing the gage from the tube bore. This problem was presented to the Design Division for review and their recommendations.

In due time, the Design Division designed a new eccentricity gage (see Photograph, Serial #275, Item #3, du Pont Equipment Piece #790-77) to replace the old gage. Since it was considered impractical to modify the old gage, the gage was considered obsolete. The new gage was fabricated and assembled by the Newton Tool and Manufacturing Company, Wenonah, New Jersey.

The new gage had several good features incorporated in the basic design that had been omitted in the design of the old eccentricity gage. During the line boring of the NYX plenum chamber and top tube sheet large tubes, carbon steel base plates were positioned over the tubes for aligning and supporting the boring bar. To take a reading with the first eccentricity gage, it was necessary to have this base plate removed before inserting the gage in the tube. By making the gage longer or by adding to the length of the tube body to compensate for the thickness of the base plate, it was possible to take readings when the base plate was in the position used for line boring the tube. This made it possible to take eccentricity readings before, during, and after the line boring operation. A special collar was fabricated for the gage body to act as a stop for the gage (see Sketch #7). This collar could seat on the plenum chamber tube face and give positive control of the depth to which the gage was inserted into the tubes. It also insured the operator that the dial indicator plunger was making contact with the mid-point of the interior of the top

TYPICAL CROSS SECTION OF ECCENTRICITY GAGE INSERTED IN UNITS



SKETCH # 7

ENGINEERING SKETCH SHEET
E. I. DU PONT DE NEMOURS & CO.
PROJ. No. 8980
SIGNATURE:
PROJ. TITLE TYPICAL ECCENTRICITY GAGE
DATE 10/15/53
~~SUBJECT:~~
No. E-42440

tube sheet tube wall. With a positive method of controlling the degree of inserting the gage in the tube bore, it also became apparent that the two other collars fabricated into the body of the gage were seating properly in the upper and lower bores of the plenum chamber.

To overcome the safety hazard of damaging the dial indicator plunger when the eccentricity gage was being withdrawn from the tube bore, the gage was re-designed so that the dial indicator plunger was automatically retracted by a spring loaded fork and plunger arrangement. When a reading was taken, the operator had to depress the plunger located at the top of the gage. This allowed the dial indicator plunger to come in contact with the inner wall of the top tube sheet tube mid-point. However, it was found that it was quite difficult to keep the gage in proper adjustment. This was partially due to the fact that the readings were being taken in thousandths of an inch. At this point, a special ring gage was designed and fabricated. This ring gage was used as a known standard for setting and checking the eccentricity gage before readings were obtained. At this point, it was felt that no more difficulties would be encountered in the usage of the eccentricity gage.

Nevertheless, after taking several hundred eccentricity readings, the observation was made that these readings could not be duplicated to within several thousandths of an inch. It was speculated that the variation of the tube bore was great enough to cause this variation in the readings. Since this gage was designed to take measurements to the nearest thousandth of an inch, it was decided that the gage was not accurate and, therefore, for all practical purposes, it was placed on a standby list. In other words, gages number two and number three in Photograph, Serial #275, were obsolete.

Several months elapsed between the time that the NYX plenum chamber and top tube sheet were line bored, and the same units were placed in operation at New York Shipbuilding Corporation. During this interval of time, some emphasis was placed on the conjecture that the eccentricity gages should be re-designed. However, after considerable investigation, it was decided that the present gages (see Photograph, Serial #275, Items 2 and 3) could not be modified to obtain accurate data during the operation of the above referenced NYX units.

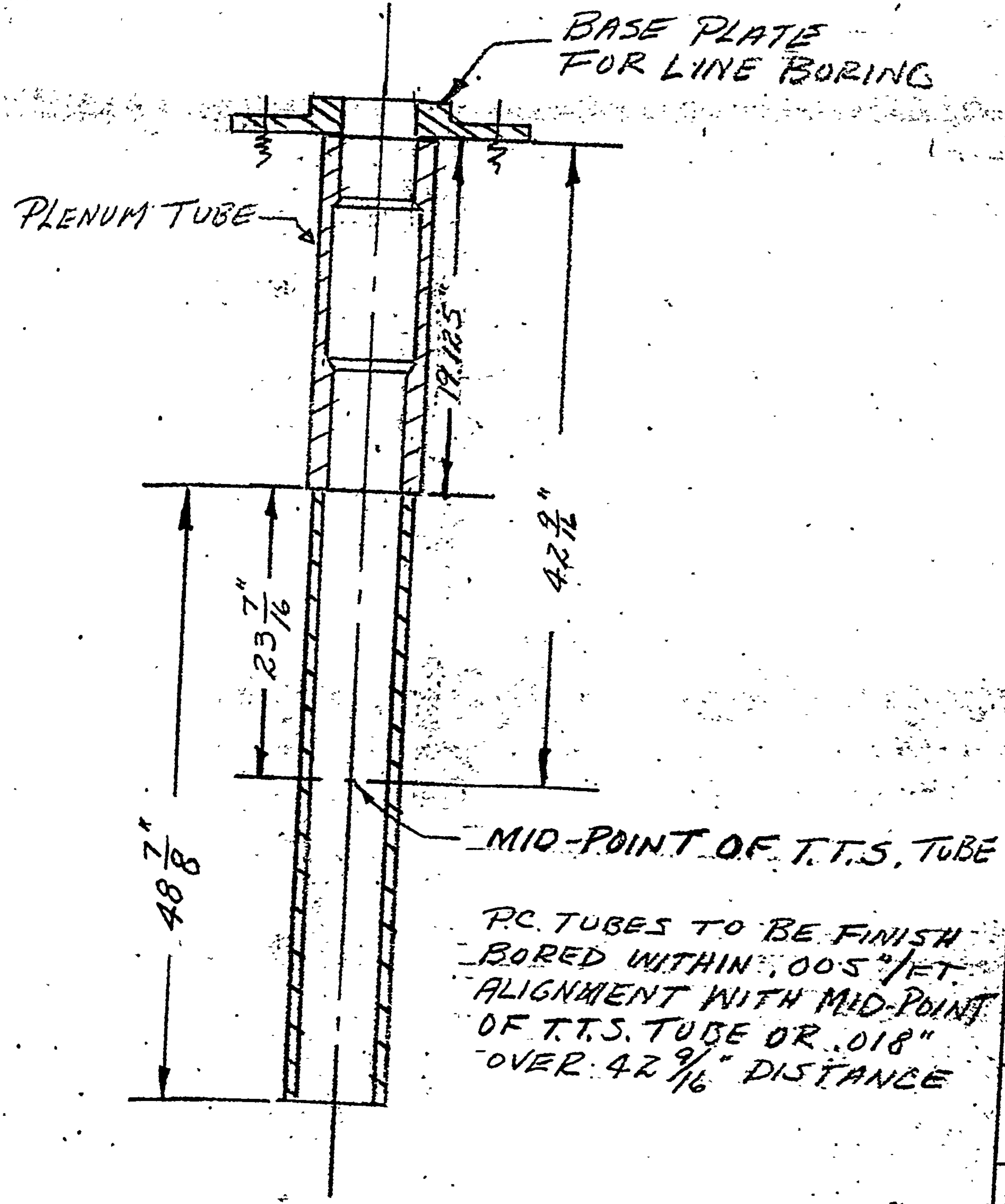
To take measurements prior to and during the operation of the NYX unit at various temperatures and pressures, it was necessary to design new eccentricity gages. Two gages were required. The first or short gage was designed to measure the eccentricity between the plenum tube bore and the top of the top tube sheet tube. The second, or longer gage, was designed to measure the eccentricity between the plenum tube bore and the bottom of the top tube sheet tube bore. Both gages were designed to take measurements to the nearest thousandths of an inch.

These gages are shown on Drawing D-114479 and were fabricated by the Chaumont Corporation, Glendora, New Jersey. In regard to functional design, the gages (see Photograph, Serial #275, Items #1 and #4) were similar to the eccentricity gages used during the line boring of the NYX plenum chamber and top tube sheet assembly. However, both gages employed a rack and pinion gear to retract the dial indicator plunger. This not only resulted in more accurate readings, but also reduced the amount of time required for standardizing the gage. As was the case with the previous eccentricity gages (see Photograph, Serial #275, Items #2 and #3) a special ring gage had to be designed for standardizing the new eccentricity gages.

To use the new gages and obtain readings accurate to a thousandth of an inch, four special sleeves were designed. The sleeve was inserted in the plenum tube and held secure by a set screw. In turn, the body of the eccentricity gage was inserted into the sleeve. Since the inside diameter of the sleeve was accurate to thousandths of an inch, the variation in the readings obtained during the operation of the NYX assembly was considerably less than had been previously experienced during the line boring of the subject units. Nevertheless, after analyzing a series of eccentricity gage readings obtained during the trial operation of the NYX assembly, it was concluded that the readings were not accurate to the nearest thousandths of an inch. In effect, it was decided that for all practical purposes the latter two eccentricity gages were obsolete.

At one time during the early stages of designing eccentricity gages, a gage (see Photograph, Serial #275, Item #5, du Pont Equipment Piece #790-32) was designed for measuring boring eccentricity between the plenum chamber tube and the top tube sheet tube. This gage was fabricated by the Thau Manufacturing Company, Baltimore, Maryland, Drawing D-114897-A. As was the case with the other eccentricity gages, it was observed that the variation in the size of the plenum chamber tube bore caused considerable divergence in the resultan eccentricity readings. These readings were taken duri the line boring of the NYX plenum chamber and top tu sheet assembly. Based on the degree of inaccuracy this gage, it was considered proper to declare th obsolete (see Sketch #8).

At the time a program was initiated to design of the original eccentricity gages was begun to accomplish some spade work



P.C. TUBES TO BE FINISH BORED WITHIN .005"/FT. ALIGNMENT WITH MID-POINT OF T.T.S. TUBE OR .018" OVER 42 9/16" DISTANCE

SKETCH # 8

ENGINEERING SKETCH SHEET E. I. DU PONT DE NEMOURS & CO.	PROJ. No. 8980	SIGNATURE:
PROJ. TITLE CROSS SECTION OF P.C. & T.T.S. TUBES		DATE 10/15/53
SUBJECT:		No. E-42421

method of obtaining eccentricity reading data. The majority of the experts agreed that data obtained electronically would be far more accurate than the data obtained with a mechanical type of eccentricity gage. In addition, the electronic gage could obtain with one setting the exact relationship in four directions (90° apart) between the top and bottom lands of the plenum chamber tube, and the top, middle, and bottom of the top tube sheet tube. Not only was it observed that the electronic gage could obtain readings accurate to within a thousandth part of an inch, but it was also realized that the electronic gage was a great time saver when it was compared to the mechanical type of gage. Therefore, the advent and successful application of the electronic gage definitely placed the mechanical eccentricity gages on the obsolescence shelf.

2. Operation and Use

The eccentricity gages were first used during the line boring of the tubes in the plenum chamber and top tube sheet assemblies. To use the first gage (see Photograph Serial #275, Item #2, du Pont Equipment Piece No. 790-76) the operator would grasp the handles of the gage and manually lower the gage into the tubes allowing the gage by virtue of its own weight and inertia to seat itself. It was understood that since the subject assemblies were mated and leveled prior to starting the line boring operation, the bore of a tube was in a vertical plane common to all other large tubes in the units. It follows that the gage readings were taken when the body of the gage had aligned itself with the bore of the plenum and top tube sheet tube.

Generally speaking, the first reading was taken when the stem of the dial indicator plunger coincided with either the "X" or "Y" axis of the subject units. Readings were taken for each quadrant or at 90° intervals covering a span of 360°. This allowed a total of four readings with two readings on the "X" axis and two readings on the "Y" axis.

When the stem of the dial indicator was depressed, the hand of the indicator revolved in a clockwise direction. The operator with the aid of a flashlight could take readings and record them for each of the quadrants. As previously indicated, this first gage was not designed for mechanically retracting the dial indicator plunger. Early in the game, it was placed on the inactive gage listing.

The next gage (see Photograph Serial No. 275, Item #3, du Pont Equipment Piece No. 790-77) allowed the operator to release a spring loaded fork and plunger arrangement before taking a reading. When released, the plunger came in contact with the tube wall and a reading could be taken. As before, the eccentricity gage had to be set to a standard ring gage, so all readings taken were in either a plus or minus direction to the standard setting of zero in most cases.

Both of the above gages were set aside when the line boring of the NYX unit was completed.

For obtaining eccentricity readings during the operation of the NYX units (Building 10), two new gages were designed. The gages are shown in the Photograph Serial #275, Item #1, du Pont Equipment Piece #790-111 and Item #4, du Pont Equipment Piece #790-112. These gages were inserted into the large tubes after the units had been mated, leveled and placed in operation. As discussed before, four sleeves were used in conjunction with these gages. These gages employed a rack and pinion gear to retract the dial indicator. After the gage aligned itself with the sleeve bore, the operator could release the dial indicator plunger, so it came in contact with the wall of the top tube sheet tube. With the aid of a flashlight, dial indicator readings were taken. As before, the readings were usually taken at 90° intervals and covered a range of 360°. The dial indicator had to be previously set to a known standard. The standard was used as a basis for making all eccentricity calculations.

In conclusion, all five of these gages were declared obsolete because accurate readings could not be obtained to the nearest .001". After changing to the electronic gage, readings were accurately obtained to the nearest .001". The electronic gage was used for controlling the line boring operation and the test operation of all units.

I. Special Gages used in Building 10 for Obtaining Measurements Before, During, and After Operational Tests conducted on the NYX Process Unit

General:

This report covers the procedure used in securing measurements on the NYX process unit in Building 10, and the special type gages and instruments required to perform this job. All measurements were taken after installation and alignment of the process unit for experimental testing purposes.

The procedures outlined herewith were set up by the du Pont Operations Technical Group. They, in turn, requested the M & E Inspection Group located at New York Ship to obtain the necessary operational data. The original procedures as outlined by the Technical Group were of a general nature. It was the responsibility of the M & E Group to develop the actual inspection techniques utilized for completing the assignment.

All data and information recorded by the M & E Inspection Group was presented to the Technical Group in formal report form.

1. Rotational Movement of Plenum Chamber with Respect to Silo

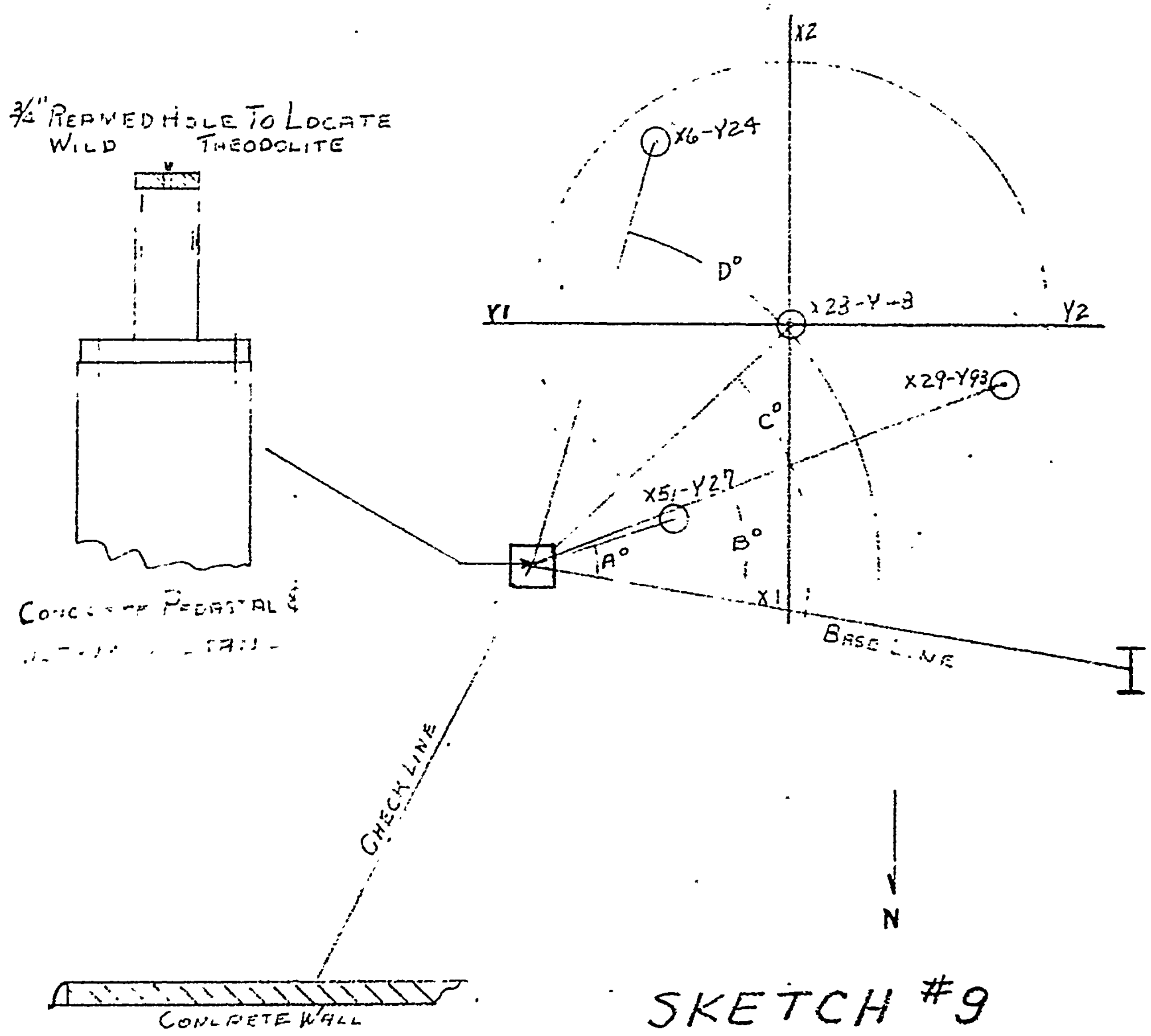
While outlining a procedure for the operation and testing of the NYX Unit, it was the opinion of the Operational Group that the plenum chamber probably moved when subjected to various temperatures and pressures. Based on this supposition, this group requested the M & E Section of the construction division to secure exact data as to the degree to which the plenum chamber would move.

At a later date, the M & E Section requested the Operational Group to specify the directional movement that they were primarily concerned with. They in turn indicated their desire to ascertain how many increments on the outer periphery of the plenum chamber moved in respect to a fixed point during the interval of operating the NYX Unit. It was considered adequate to take all rotational measurements in a clockwise or counter-clockwise direction and confine these measurements to a horizontal plane. To facilitate the analyzing and calculating the exact amount of this rotational movement, readings were taken before, during, and after each of a series of operational test runs.

Several instruments and methods were considered by the M & E Section for carrying out this specific assignment. Based on past experience, the M & E Inspection Group settled on the Wild T-1 Theodolite, (See section "K".) as the proper instrument for taking accurate measurements in a minimum amount of time.

For a fixed point to serve as a bench mark for setting up and using the Theodolite, a spot was selected on the northeast corner of the concrete silo. To establish and hold this bench mark as a permanent fixed point from which all rotational measurements could be obtained, the M & E Section suggested that a steel instrument mount be fabricated. This instrument mount (See Sketch #9) would be mounted on a concrete pedestal located on the silo. It was mutually agreed that the concrete silo did not move to any appreciable degree when the NYX unit was operating. Therefore, it followed that the steel pedestal should be installed on top of the concrete silo. As an added feature for obtaining accurate measurements over a period of several weeks, the top plate of the instrument mount was machined to a plane having a ground finish.

Prior to operating the NYX unit on a test basis reference points were established. One reference point was placed on the concrete block wall northeast of the instrument mount. This point established a check line running from a point on the instrument mount to the point on the concrete block wall. Another reference point was established on the building steel located to the northwest of the instrument mount. This point established a



SKETCH #9

ENGINEERING SKETCH SHEET
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SET UP TO CHECK ROTATIONAL MOVEMENT OF PLENUM.

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SUBJECT:

No. E-42404

base line running from a point on the instrument mount to the point on the building steel. All measurements were taken from this base line.

Four reference tubes in the plenum chamber were selected for studying the rotational movement of the NYX unit. One tube was the center tube of the plenum chamber. Its coordinate was designated as X28, Y48 in respect to the X and Y axis of the plenum chamber. The other three reference tubes were located on the outer periphery of the plenum chamber approximately 120° apart. Their coordinates were X6;-Y24;, X29;-Y93;, X51;-Y27.

A special sleeve was inserted in each of the four chosen tubes. For all practical purposes, the bore of any sleeve was considered perpendicular to the machined plane formed by the top surface of the plenum tube ends. A mandrel with a flat surface milled on one side and along its length was inserted in each of the four sleeves. Since the sleeve bores were uniform in size to within a few thousandths of an inch, this mandrel was machined to give a snug fit when fully inserted into any one of the four special sleeves. A centerline was scribed on the flat surface of the mandrel. When the mandrel was seated in a special sleeve, this center line for all practical purposes, was considered perpendicular to the machined plane outlined by the top surface of the plenum tube ends. A small center punch mark was located on this center line. When taking a reading the milled flat surface has to face the instrument set up on the northeast corner of the silo.

All readings were taken in the following manner; A total of twelve readings were taken between the base line and check line. Six readings were taken directly and six readings were obtained indirectly. Indirect readings were taken to nullify any error in the theodolite. Next, a total of twelve readings were taken between the base line and the four plenum chamber tubes referenced above. Six of these readings were taken directly and six were obtained indirectly. Likewise, the indirect readings were taken to cancel out any error in the theodolite. It should be pointed out that to take indirect readings the operator merely reversed the telescopic part of the instrument.

Using these readings, calculations were made to find the angles between the base line and an imaginary line running from the punchmark on the flat surface of the mandrel to a point in the theodolite. Since direct and indirect readings were taken, it was necessary to average the angles obtained between the base line and the line of sight of the theodolite when the instrument was focused on the punch mark located on the flat surface of the mandrel. These angles (See Sketch 2A) were designated as A. B, C, and D. The angles were calculated from data obtained before, during, and after operating the NYX unit on a test basis. The deviation between the angles measured at various temperatures and pressures gave the amount of rotation of the plenum chamber during its operation.

For an illustration of the results obtained refer to du Pont report number 132-X, Exhibit B1, Part B1-2.

2. Verticality of Plenum Chamber with Respect to Top Tube Sheet

Prior to placing the NYX process unit on an operational basis, it was realized that data would have to be secured as to the degree of movement of the plenum chamber in respect to the top tube sheet.

When the units were installed, particular emphasis was placed on seeing that the tube faces on the top side of the top tube sheet and the bottom side of the plenum chamber were properly mated. To aid in accomplishing this feat, verticality gages were employed. Several tubes were selected as being representative of all tubes in the units. By finding the best average verticality for these tubes, it was concluded that all tubes in the units were properly aligned.

Based on the above, it was the opinion of the M & E Inspection Group that a verticality gage would give the desired data for finding the degree of movement of the plenum chamber relative to the top tube sheet.

Four tubes were selected for these measurements. Location of these tubes has been shown on Sketch 2A in this section. They were assigned the following coordinate tube numbers: X6-Y24, X28-Y48, X29-Y93, and X51-Y27. A special steel sleeve was inserted in each of these tubes. to obtain more accurate readings.

Since none of the verticality gages on hand would fit in the steel sleeve, a special gage was designed by the Design Division and Wilmington Shops. It was fabricated by the Chaumont Corporation, Glendora, New Jersey. To comply with the fact that verticality measurements represent the amount of inclination of a tube bore in respect to a vertical line, the gage was built to take measurements to .001" per foot. A dial indicator calibrated in thousandths of an inch was attached to the arm of the gage. A spirit level and adjusting screw were also made essential components of this special verticality gage.

In taking verticality readings the gage was manually lowered into one of the four special sleeves. Next, the verticality gage was leveled by adjusting the hand adjusted set screw until the spirit level indicated that the bubble had located between the middle two graduations on the glass of the spirit level. After leveling the gage, readings were taken in each of the four quadrants covering 360o . Each measurement was taken along either the X or Y axis.

All verticality data was presented by the M & E Inspection Group to the Techanical Operations Group. Based on this data calculations were made to ascertain the exact amount the plenum chamber moved in respect to the top tube sheet. Readings were taken before, during, and after operating the NYX process unit on a test basis.

3. Centrality of Plenum Chamber with Respect to Top Tube Sheet

During the period of agreeing on what measurements should be taken when the NYX unit was operating on a test basis, it was realized that data would have to be secured to determine the degree of movement of the plenum chamber in relation to the top tube sheet.

The units were installed by using the best average tube centrality readings. At the time it was observed that such readings not only aided in aligning the tubes in the plenum chamber and top tube sheet, but also helped in mating the tube faces on the bottom side of the plenum chamber and the tube faces on the top side of the top tube sheet. All centrality readings were obtained by measuring a representative number of tubes with gages similar to those discussed in Section H.

Based on experience gained in previously using the eccentricity gages, it was decided by the M & E Inspection Group that two eccentricity gages would give the required data for determining the movement of the NYX plenum chamber in respect to the top tube sheet during the operation of the entire NYX assembly on a test basis.

Four tubes were selected for these measurements. Their coordinates were as follows: X6-Y24, X28-Y48, X29-Y93, and X51-Y27. Special steel sleeves, with bores machined to a close tolerance, were inserted into the above referenced tubes. It was found that more accurate data was obtained when the steel sleeves were fitted in the subject four tubes. This conclusion was based on a comparison of readings obtained with the eccentricity gages inserted in the steel sleeves versus the eccentricity readings secured without the sleeves in these tubes. Location of the tubes in the units has been shown on Sketch 2A.

In lieu of the fact that the first eccentricity gages would not fit in the sleeves, two new gages were designed by the Design Division as shown on detail drawing D-114479. The gages were procured from the Chaumont Copporation, Glendora, New Jersey, on inquiry number C30-816, order number AXC 6700½. At the time they were received at the New York Shipbuilding Corporation they were assigned equipment piece numbers 790-111 and 790-112, respectively.

The first gage, equipment piece number 790-111, dwg. detail D-114479A was designed to measure the eccentricity between the plenum tube bore and the top of the top tube sheet tube bore. The second gage, equipment piece number 790-112, dwg. detail D-114479B was designed to measure the eccentricity between the plenum tube bore and the bottom of the top tube sheet tube bore.

Eccentricity or centrality readings were taken before, during, and after operating the NYX assembly on a test basis. Four readings were taken for each tube covering 360° with one reading in each quadrant. All readings were taken along either the X or Y axis of the plenum chamber.

Readings were taken by manually lowering the eccentricity gage into the tube being measured. To take a reading the stem of the dial indicator was depressed. This permitted the dial indicator plunger to make contact with the inner wall of the top tube sheet tube. The operator, with the aid of a flashlight, could take readings and record them for each of the quadrants.

All centrality data was presented in report form to the Technical Operations Group by the M & E Inspection Group. They, in turn, examined the data and calculated the degree of movement of the plenum chamber in relation to the top tube sheet. Where possible a correlation was made between the results obtained with the centrality data and other data such as that secured with verticality gages.

4. Deflection of the Top Tube Sheet

While making a study of the types of movement during the operation of the NYX unit on a test basis, the M & E Inspection and Technical Operations Groups realized that measurements should be taken of the amount of vertical movement of the plenum chamber, top tube sheet and tank bottom. It was concluded by these groups that a measurement of the deflection of the top tube sheet would suffice. In other words, the data obtained in studying the deflection of the top tube sheet represented to a great degree the overall picture of the NYX assembly. Deflection data was collected before, during, and after operating the NYX assembly on a test basis.

After considering several instruments and ways of taking the deflection measurements, it was the concerted opinion of all parties involved that a Wild NIII precision level could be utilized to the best advantage. For a fixed point to serve as a bench mark for setting up and using the Wild Level, a spot was selected on the northeast corner of the concrete silo. To establish and hold this bench mark as a permanent fixed point from which all deflection measurements could be secured, the M & E Inspection Group suggested that a steel instrument mount be fabricated. This instrument mount was mounted on a concrete pedestal located on the silo. The assumption was made that the concrete silo did not move to any appreciable degree when the NYX unit was operating. It followed that a steel pedestal had to be installed on top of the concrete silo to support the Wild NIII Precision level. As an added feature for obtaining accurate measurements over a period of several weeks, the top plate of the instrument mount was machined to a plane having a ground finish.

The wild precision measuring staff was used in conjunction with the wild level. A point was established on the silo at a known elevation. It was postulated that the elevation of this point or bench mark did not change to any appreciable degree.

Four tubes were chosen to represent all tubes in the NYX unit. They were assigned the following coordinate numbers: X6-Y24, X28-Y48, X29-Y93, and X51-Y27. In the bottom land of each of the four top tube sheet tubes a stainless steel plug with two "O" rings was inserted. These plugs served as a stop or base for the wild precision measuring staff.

Prior to taking any deflection readings the wild level was set up over the steel instrument mount. (See Section J). Next the wild precision measuring staff was set on the bench mark having an established elevation. Readings were taken using both faces of the precision staff. This procedure nullified any error in the staff.

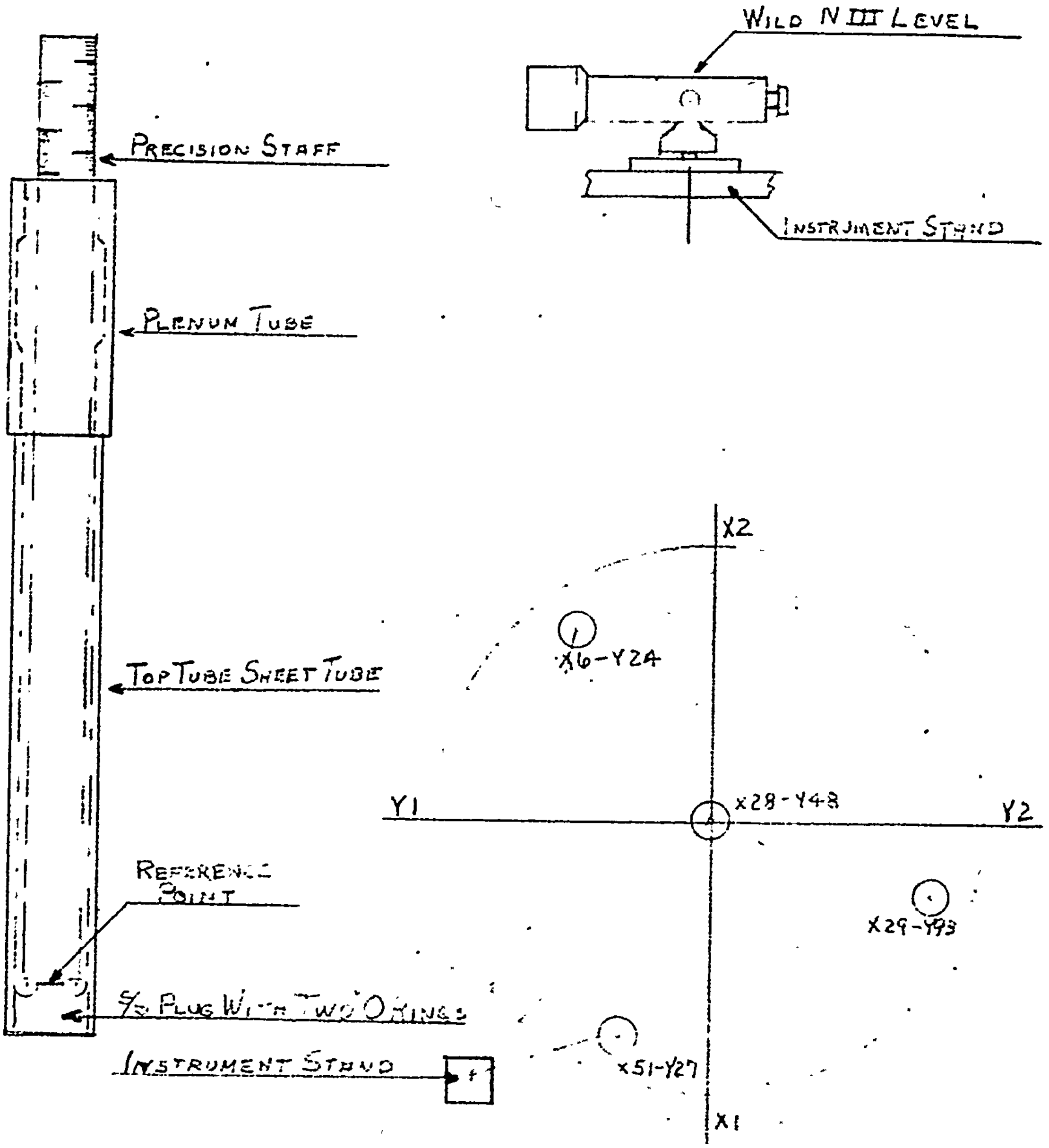
Next, the staff was removed from the bench mark having a known elevation and inserted in one of the above referenced four tubes shown on Sketch #10. The bottom of the measuring staff seated itself on the top face of the stainless steel plug located in the bottom of the tube. At times considerable difficulty was experienced when the tube was full of water. In this case the water had to be pumped from the tube before inserting the wild precision staff. For all readings it was considered advisable to use both faces of the staff to cancel any error in the staff. Likewise, the telescopic part of the wild level was reversed for each reading to nullify any error in the instrument. These readings automatically gave the elevation at the reference point located on the top of the stainless steel plug.

By calculating the difference in the readings at any one reference point before, during, and after operating the NYX assembly on a test basis the corresponding deflection data was obtained.

All deflection data was presented by the M & E Inspection Group to the Technical Operations Group. In turn, they examined this data and applied it to the complete study of the movement of the entire NYX assembly.

5. Radial, Vertical, and Rotational Movement of the Top Tube Sheet with Respect to the Silo

When the Technical Operations Group outlined the various steps for covering the operation of the NYX unit



SKETCH #10

ENGINEERING SKETCH SHEET
E. I. DU PONT DE NEMOURS & CO.

PROJ. No. 8980

SIGNATURE:

TITLE
Set Up To Check Deflection Of Top Tube Sheet

DATE

SUBJECT:

No. E-42406

on a test basis they listed the movement of the top tube sheet with respect to the silo in three directions. The three directions specified were; radial, vertical and rotational. Radial measurements indicated the degree of movement along the radius of the top tube sheet. Vertical measurements gave some indication of the amount of contraction or expansion that took place in a vertical direction when the unit was subjected to a series of different temperatures and pressures. Rotational measurements primarily revealed how much the unit moved in a clockwise or counter-clockwise direction.

It was further specified that the inspection data should cover these movements at three external points approximately 120° apart along the circumference of the unit.

All measurements were taken and recorded to the .001". A Federal Dial Indicator Gage (see photo, serial #309) calibrated and graduated in .001" was procured to handle this assignment. To standardize this dial indicator gage a gage stand was ordered from the Newton Tool Company, Wenonah, New Jersey, on inquiry number C30-847, order number AXC 6776½, drawing detail D112849-A. After receiving the gage stand or set block at New York Ship, it was assigned equipment piece number 790-116. A special clamp-type bracket or base was fabricated and attached to the stem of the dial indicator as illustrated in the above referenced photograph. This special base served as a stop for setting up the gage, as well as a stop for taking the required measurements. For example the dial indicator gage was set to take measurements with a standard setting of 2" from the top face of the gage stand to the bottom face of the special base attached to the stem of the dial indicator. This setting was accomplished by having a distance of approximately 2" from the face of the gage stand to the bottom of the special stop. For this standard setting the dial indicator was hand adjusted by rotating the face to a reading of zero.

With this setting in mind steel brackets were fabricated for mounting on the silo and the NYX bearing ring (See Sketch #11). The bearing ring was locked to the top tube sheet with three indexing lugs. Therefore, the bearing ring became the movable part for taking measurements while the silo remained as a fixed point for these measurements. Brackets with holes drilled in each were fabricated and welded to the bearing ring. The drilled holes were large enough to accept the stem of the dial indicator. Each bracket was mounted on the bearing ring so that the hole in the bracket faced in the direction of the movement being measured. The directions, as noted above were: radial, vertical and rotational.

The face of the bracket mounted on the silo was parallel to the face of the bracket having a hole drilled in it. It followed that the distance between the parallel bracket faces had to be approximately 2".

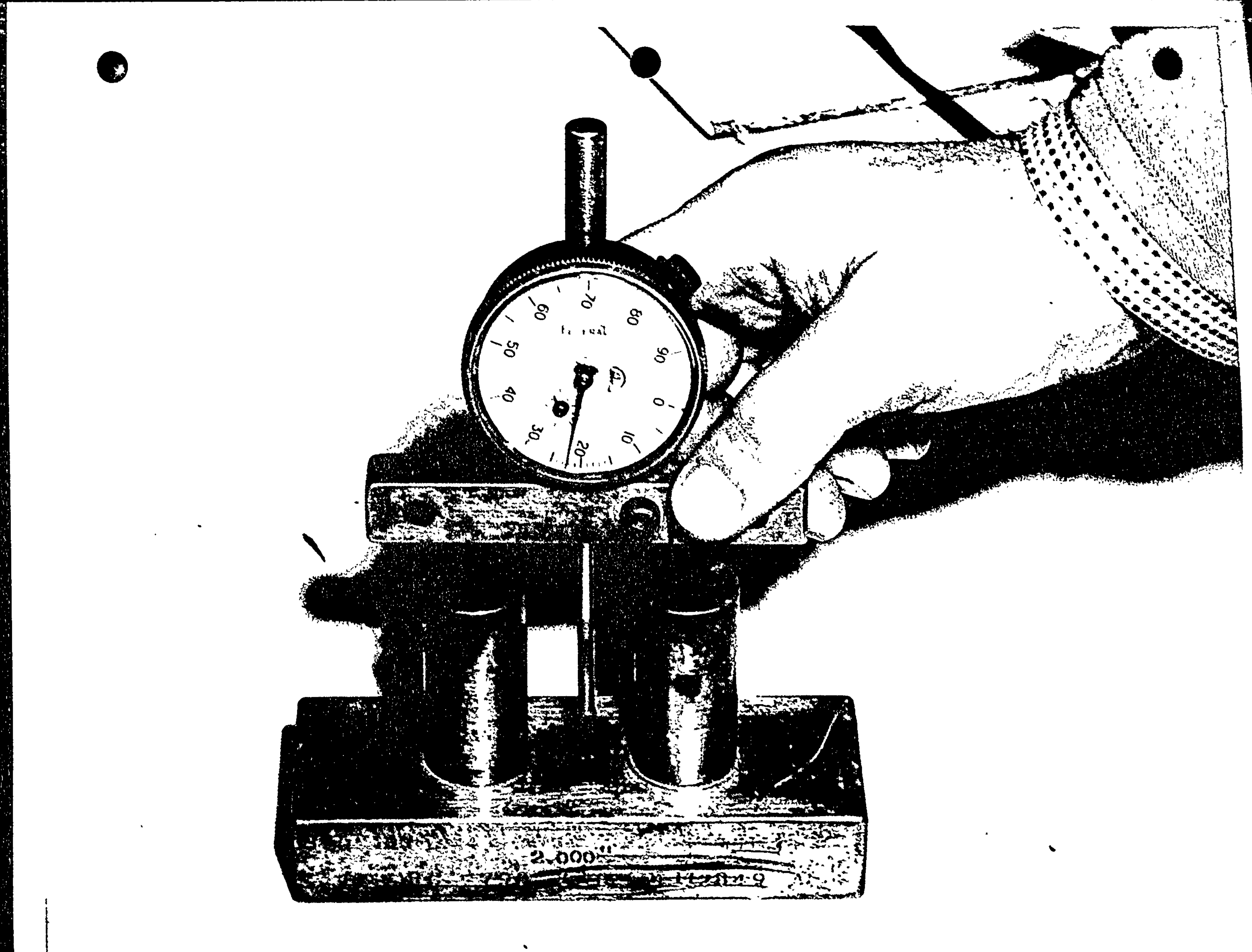
Serial Number 309

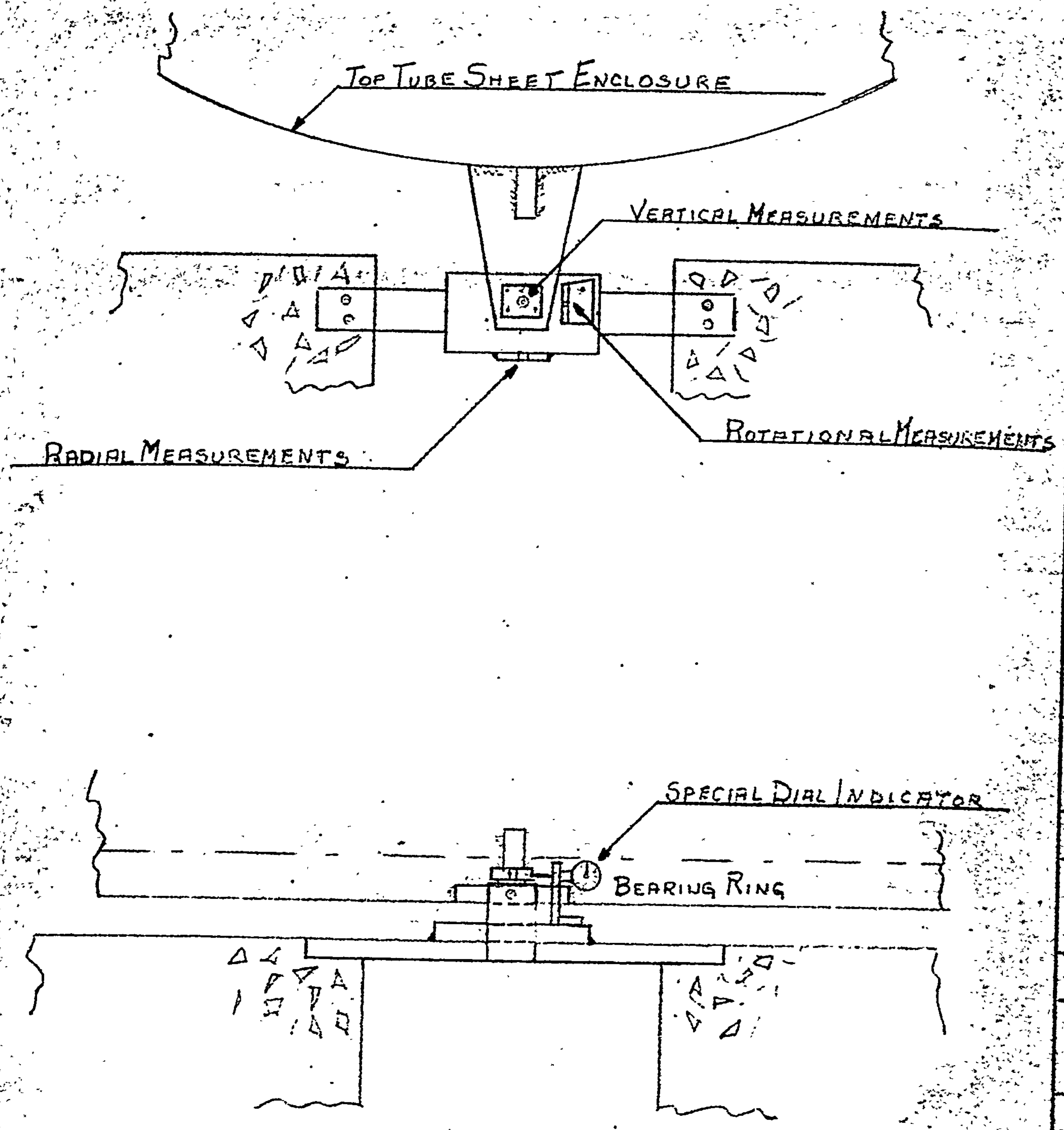
New York Shipbuilding Corporation
Camden, New Jersey
October 22, 1953

PROJECT 8980 - SAVANNAH RIVER PLANT

"Federal Dial Indicator Gage graduated in .001 inches and check stand - Eq. Pc. #790-116, drawing detail D-112849-A."

Instrument, check stand, and special base attached to dial indicator used to measure the amount of movement of the NYX assembly in radial, vertical and rotational directions.


2.000"



SKETCH #11

ENGINEERING SKETCH SHEET
E. I. DU PONT DE NEMOURS & CO.

PROJ. No. 8980

SIGNATURE:

TITLE
SET UP TO CHECK VERTICAL, RADIAL & ROTATIONAL MOVEMENT

DATE

SUBJECT:

No. E-42408

Readings were taken before, during, and after operating the NYX unit on a test basis. To take a reading the shaft extension of the dial indicator gage was inserted in a bracket hole allowing the tip of the shaft extension to make contact with the face of the bracket mounted on the silo. Next, the face of the special stop attached to the dial indicator gage stem seated itself on the face of bracket welded to the bearing ring. Dial indicator readings were recorded for each of the specified directional movements.

These readings were presented to the Technical Operations Group by the M & E Inspection Group. Further analysis, primarily based on a difference of the readings for any one movement, revealed that the top tube sheet moved very little when the NYX unit was subjected to various operating and non-operating conditions.

6. Deflection of the Bottom Tube Sheet with respect to the Concrete Silo Floor

In outlining the steps for covering the operation of the NYX unit on a test basis, the Technical Operations Group included a step for determining the amount of deflection of the bottom tube sheet.

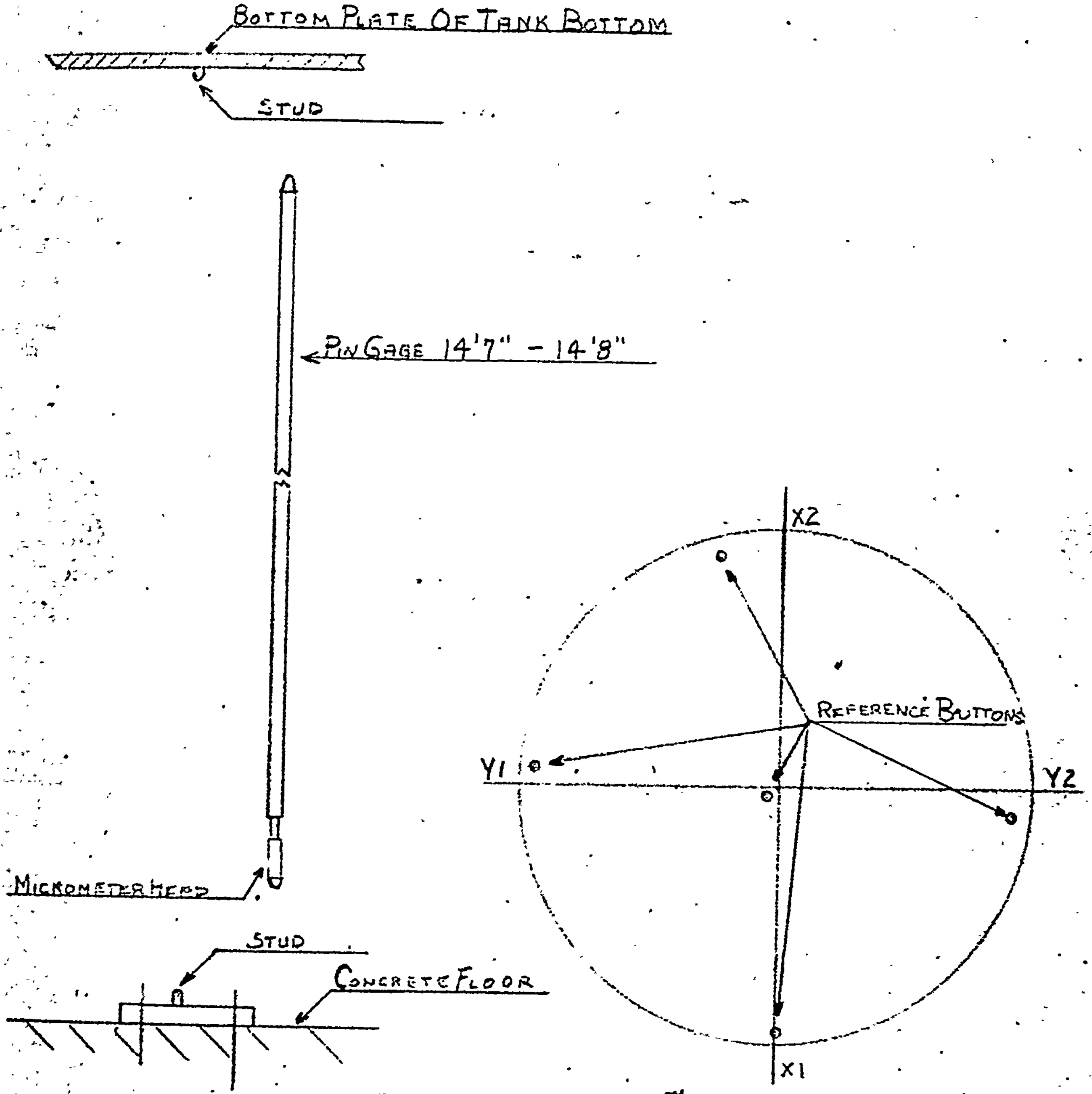
The M & E Inspection Group examined the NYX overall assembly and decided that the silo floor was the logical fixed point for the deflection measurements. Deflection of the bottom tube sheet was the amount of movement in the unit in a vertical direction.

Deflection measurements were taken from points located at the extremities of the X and Y axis and the center of the NYX assembly. This made for a total of five points as shown on Sketch #12.

Using a stud welding gun five special studs were welded to the bottom plate of the bottom tube sheet. A plumb bob was attached to each of the five studs to establish a fixed point on the silo floor as the lower extremity of an imaginary vertical line running from the stud welded to the bottom tube sheet to the fixed point on the concrete silo floor.

Five steel plates having one stud welded in the middle of each were securely anchored to the floor of the silo. The plumb bob was employed to check the location of the ten studs to be positive that the mid-points of the studs represented the upper and lower extremities of an imaginary vertical line. All studs were located prior to operating the NYX assembly on a test basis.

A micrometer head was attached to a long pin gage for measuring the distance between the studs. This pin gage was calibrated by the New York Shipbuilding Corporation and had a variable overall length from 14'-7" to 14'-8". The gage was accurate to .001".



SKETCH #12

ENGINEERING SKETCH SHEET
E. I. DU PONT DE NEMOURS & CO.
PROJ. No.
SIGNATURE:
TITLE
SET UP TO CHECK DEFLECTION OF BOTTOM TUBE SHEET
DATE
SUBJECT:
No. E-42407

One hour before readings were taken this special gage was stored in the silo. This time was considered sufficient for the studs and special gage to achieve the temperature of the surrounding air. Deflection data was secured before, during, and after placing the NYX assembly on a test basis.

To take a reading the operator positioned the special gage between the upper and lower studs. Next, the micrometer head was hand adjusted to properly mate each tip of the special gage to its corresponding stud. By taking the difference between the readings obtained for any one pair of studs at various temperature and pressures, one automatically knew the exact amount the bottom tube sheet moved in a vertical direction at one point in the bottom tube sheet.

The M & E Inspection Group presented the deflection data to the Technical Operations Group. They, in turn, assimilated this data with other movement data pertaining to the NYX assembly.

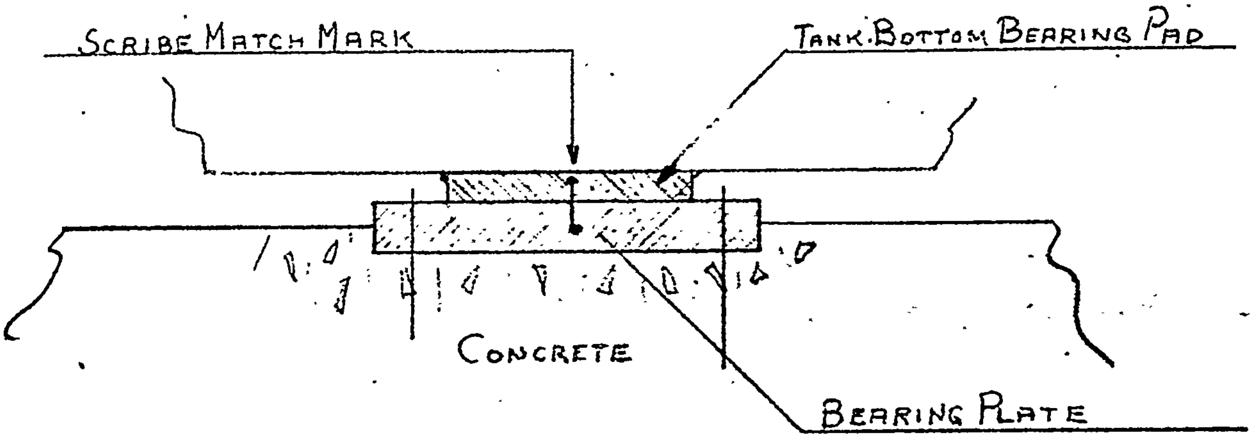
7. Radial, Rotation and Other Movements of the Bottom Tube Sheet with respect to the Silo

In addition to deflection data covering the bottom tube sheet during its operation on a test basis, the Technical Operations Group requested that a radial and rotational study be conducted pertaining to this unit,

After considering several accessible locations in the bottom tube sheet for studying the various movements, the M & E Inspection Group decided that the tank bottom stainless steel bearing pads (See Sketch #13) best represented the unit. As fixed reference points the steel bearing plates imbedded in the concrete silo were chosen. Four locations at the extremities of the "X" and "Y" axis were selected for this study.

Next, white paint was applied to the vertical surfaces of the bottom tube sheet pads and the bearing plates. Paint was applied to only those surfaces that were perpendicular to the radius of the NYX unit and located on the inside edge of the above pads and bearing plates. After the paint had dried four vertical match marks were scribed across the painted surfaces. All painting and scribing operations were performed prior to operating the NYX assembly on a test basis.

With the aid of a magnifying glass the match marks were visually inspected before, during, and after operating the NYX assembly on a test basis. The four locations were considered adequate for observing any type of movement of the bottom tube sheet. In addition it was felt that any movement greater than .002" could be observed in this manner. It was expected that some movement would be noted in one location with no apparent



SKETCH #13

ENGINEERING SKETCH SHEET
E. I. DU PONT DE NEMOURS & CO.

PROJ. No. 8980

SIGNATURE:

TITLE: SET UP TO CHECK ROTATIONAL MOVEMENT OF TANK BOTTOM

DATE

SUBJECT:

No. E-42409

movement in the other three locations.

However, in spite of a careful study the match marks retained their original relationship during the entire period that the NYX assembly was operating on a test basis. The fact that no movement was visualized was formally reported by the M & E Inspection Group to the Technical Operations Group.

8. Radial Movement of the Top Plate of the Tank Bottom with respect to the Silo

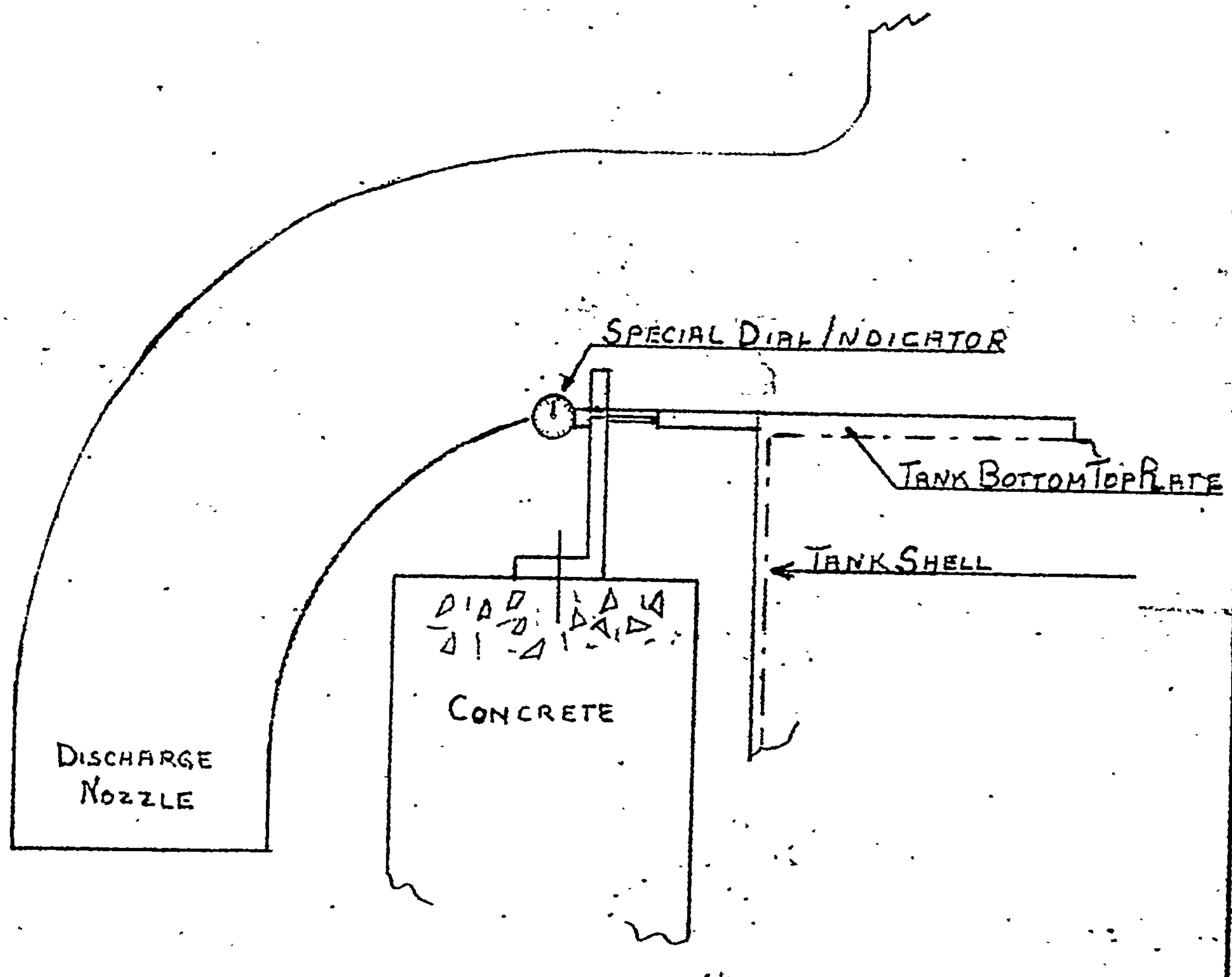
In the process of outlining the various steps for securing the movement measurements when the NYX assembly was operating on a test basis, a step was included pertaining to the tank bottom assembly.

After obtaining the opinions of the Technical Operations Group, the M & E Inspection Group considered several locations on the surface of the assembly for checking the movement of the unit. Three locations approximately 120° apart were selected. Each location was adjacent to a discharge nozzle (See Sketch #14) of the main tank section of the NYX assembly. As a fixed reference point for all measurements, the M & E Group chose the concrete silo.

Three steel brackets (See Sketch #14) were fabricated with a hole drilled in the one plate of each bracket. This hole was large enough to accept the stem of a special dial indicator. Each steel bracket was anchored to the concrete silo with the one plate containing the hole in an upright or vertical position. The face of the vertical bracket was parallel to a spot on the outer edge of the tank bottom unit top plate.

Readings were taken before, after, and during the operation of the NYX unit on a test basis. Before taking a reading the special dial indicator was standardized. This was accomplished by placing the dial indicator on a check stand (See photo serial #309) allowing the special stop attached to the stem to rest on the two upright posts of the check stand. The tip of the dial indicator stem seated itself on the surface of the check stand base. At this point the dial indicator was set on zero.

The procedure for taking readings to find the amount of movement in the tank bottom unit was similar to standardizing the dial indicator. The stem of the dial indicator was inserted in the bracket hole allowing the tip of the stem to make contact with a spot on the outer edge surface of the top plate of the tank bottom unit. Next, by placing a slight amount of hand pressure on the gage the fixture attached to the stem of the gage seated itself on the face of the vertical steel bracket. At this point a reading was taken in thousandths of an inch. The time and location was recorded for each reading.



SKETCH #14

ENGINEERING SKETCH SHEET
E. I. DU PONT DE NEMOURS & CO.

PROJ. No. 8980

SIGNATURE:

TITLE
SET UP TO CHECK RADIAL MOVEMENT OF TANK BOTTOM TOP PLAT.

SUBJECT:

DATE

No. E-42411

All readings were formally reported by the M & E Group to the Technical Operations Group. They, in turn, made the necessary calculations for finding the degree of radial movement of the top plate of the tank bottom with respect to the silo. In addition, all movement data for the tank bottom unit was correlated with other data pertaining to the NYX assembly.

9. Radial Movement of the Top of the Tank Shell with respect to the Silo

(a) Readings taken with Dial Indicator

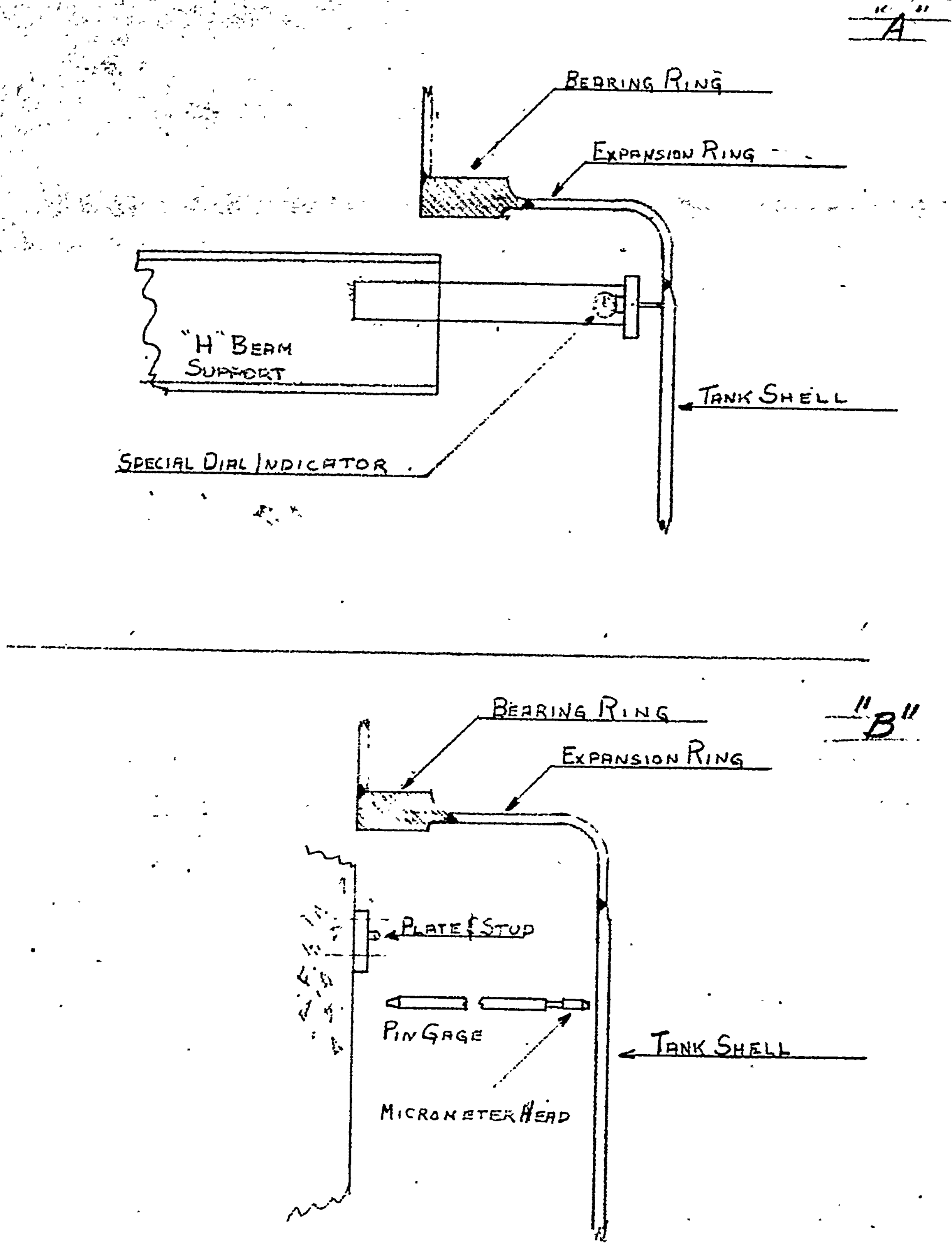
As one of the steps in studying the overall movement of the NYX assembly during its operation on a test basis, the Technical Operations Group listed the radial movement of the tank. Three positions approximately 120° apart were selected on the outer surface of the tank shell. Each of these spots approximately one inch below the weld (See sketch #15-A) joining the expansion ring and the top of the tank was located opposite a steel "H" beam support. These spots were marked with a scribe line to insure the fact that the same locations were being used for taking each set of motion measurements.

In a horizontal plane opposite each scribed mark a fabricated steel bracket (See sketch #15-A) was welded to an "H" beam support. The flat face of the one leg of each bracket was set at a prescribed distance from the scribe mark on the tank shell. The subject bracket leg had a hole drilled in it large enough to accommodate the stem of a special dial indicator.

With this set-up the steel bracket was considered the fixed reference point and the tank shell the variable reference point.

Readings were taken before, during, and after operating the NYX assembly on a test basis. Before taking a reading the special dial indicator was standardized. This was done by placing the dial indicator on a check stand (See photo serial #309) allowing the special stop attached to the stem to rest on the two upright posts of the check stand. The tip of the dial indicator stem seated itself on the surface of the check stand base. At this point the dial indicator was set on zero.

To take a reading the stem of the dial indicator was inserted in the bracket hole (See sketch 15-A) allowing the tip of the stem to make contact with a spot on the outer surface of the tank shell. Then, by exerting a slight amount of hand pressure on the gage, the fixture attached to the stem of the gage seated itself on the face of the vertical steel



SKETCH #15.

ENGINEERING SKETCH SHEET
E. I. DU PONT DE NEMOURS & CO.

PROJ. No. 8980

SIGNATURE:

TITLE Set Ups To Check Radial Movement Of Tank Shell

DATE

SUBJECT:

No. E-42412

bracket. At this point a reading was taken in thousandths of an inch. The time and location was recorded for each reading.

After a series of readings had been taken they were analyzed by the Technical Operations Group. This analysis indicated that the steel bracket or fixed reference point moved during the operation of the NYX assembly. Therefore, for all practical purposes, it was decided that an alternate set-up would have to be devised to accurately measure the movement of the tank shell.

(b) Readings Taken with Pin Gage

For the new set-up (See sketch #15-B) the concrete silo, instead of a steel "H" beam, was selected as the fixed reference point. A steel plate with a 1/4" diameter by 1/2" long stud welded to one flat surface was anchored to the silo wall. As was the case for the other set-up scribed marks were located on the outside of the tank shell approximately one inch below the weld joining the expansion ring and the tank shell. These scribed marks and the studs were opposite each other in a common horizontal plane. All three locations were approximately 120° apart.

Next, a pin gage with a micrometer head was assembled to a length matching the average horizontal distance between a scribe mark on the tank and the head of a stud welded to one of the three plates. Before any readings were taken the pin gage was calibrated to a definite length when the micrometer head was set on zero.

Readings were taken before, during, and after operating the NYX assembly on a test basis. To take a reading the operator placed one end of the pin gage on the scribe mark on the tank surface and the other end of the pin gage on the tip of the stud. Next, the pin gage was adjusted to give a snug fit. A reading was taken to the nearest thousandths of an inch at this point. The time and location was recorded for each reading.

All radial movement data based on the latter set-up was formally presented to the Technical Operations Group. A careful analysis indicated that the last set of readings was accurate.

In other works, the concrete silo, for all practical purposes, remained as a fixed reference point and the difference of various readings represented the amount of radial movement of the tank shell. These results were correlated with other data covering the operation of the NYX assembly on a test basis.

10. Deflection of the Expansion Ring with respect to the Bearing Ring

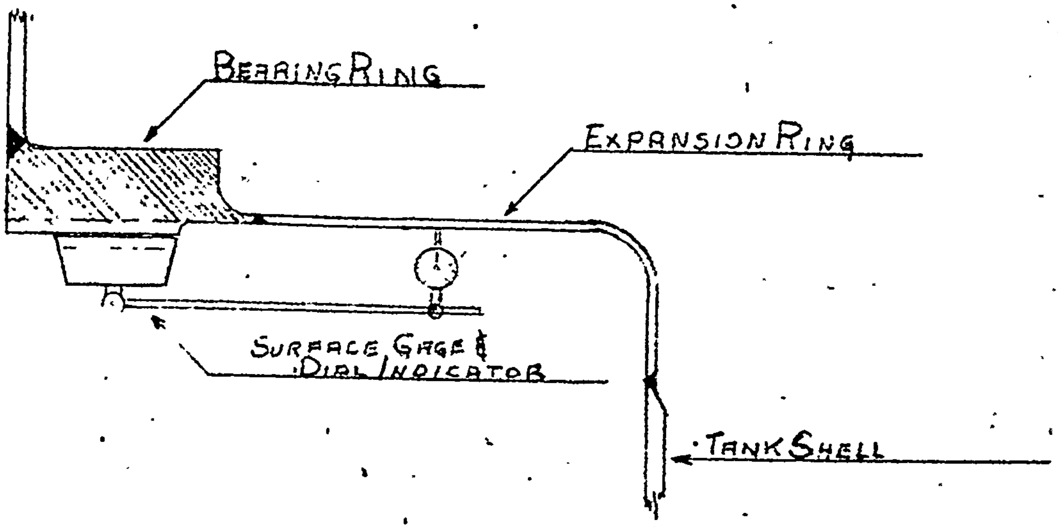
In the process of outlining the steps for covering the operation of the NYX unit on a test basis, the Technical Operations Group included a step for determining the amount of deflection of the expansion ring with respect to the bearing ring. For all practical purposes, deflection of the expansion ring was the amount of movement in the unit in a vertical direction.

The M & E Inspection Group and Technical Operations Group examined the NYX assembly and decided that three locations approximately 120° apart would be sufficient for obtaining the required deflection data. Each of the three locations was adjacent to a bearing pad. To facilitate measuring the amount of deflection in the expansion ring (See Sketch #16), it was deemed essential that scribe marks be placed on its outer surface. For each of the three chosen locations four marks were scribed on the outer surface of the expansion ring. These marks were located at a distance of 3", 5", 7", and 8½", respectively, from the weld joining the bearing ring and expansion ring.

At the same time scribe marks were placed on the bottom side of the bearing ring. All scribe marks were placed on these surfaces to not only allow for greater accuracy in obtaining the deflection measurements, but also to aid the inspector in setting up the necessary equipment for performing this operation. The scribed lines on the bearing ring surface were located at a predetermined distance from the weld joining the expansion ring and bearing ring.

It was the logical conclusion of the M & E Group that the flat machined surface of the bearing ring could serve the same purpose as a surface plate for securing the deflection data. Next, a dial indicator graduated in .001" was attached to the arm of a surface gage. A check stand simulating the ideal relationship between the bearing ring and expansion ring surfaces was devised and used to standardize the surface gage. Before taking any readings the surface gage was placed on the check stand and the dial indicator was adjusted to a zero reading.

Readings were taken before, during, and after operating the NYX assembly on a test basis. To take a reading the base of the surface gage was positioned between the two scribe marks on the bearing ring flat surface with the arm of the gage extended in a horizontal direction permitting the dial indicator to make contact with the expansion ring surface. Next, a slight amount of manual pressure was exerted on the surface gage to properly position the tip of the dial indicator stem on one of the expansion ring scribe marks. Once the inspector had assured himself that the base of the surface gage and the dial indicator were properly positioned, a reading was taken to the nearest thousandths of an inch.



SKETCH #16

ENGINEERING SKETCH SHEET
E. I. DU PONT DE NEMOURS & CO.

PROJ. No. 8980

SIGNATURE:

[redacted] TITLE
SET UP TO CHECK EXPANSION RING DEFLECTION

DATE

SUBJECT:

No. E-42417

Along with the dial indicator reading the location, time, and operating conditions were recorded for each of the four scribe marks. The difference in the readings indicated the degree of movement or deflection of the expansion ring when subjected to various operating conditions.

[illegible] deflection data was presented to the Technical [illegible] Group by the M & E Inspection Group. They [illegible] made the necessary calculations for correlating [illegible] deflection data with other data pertaining to the assembly.

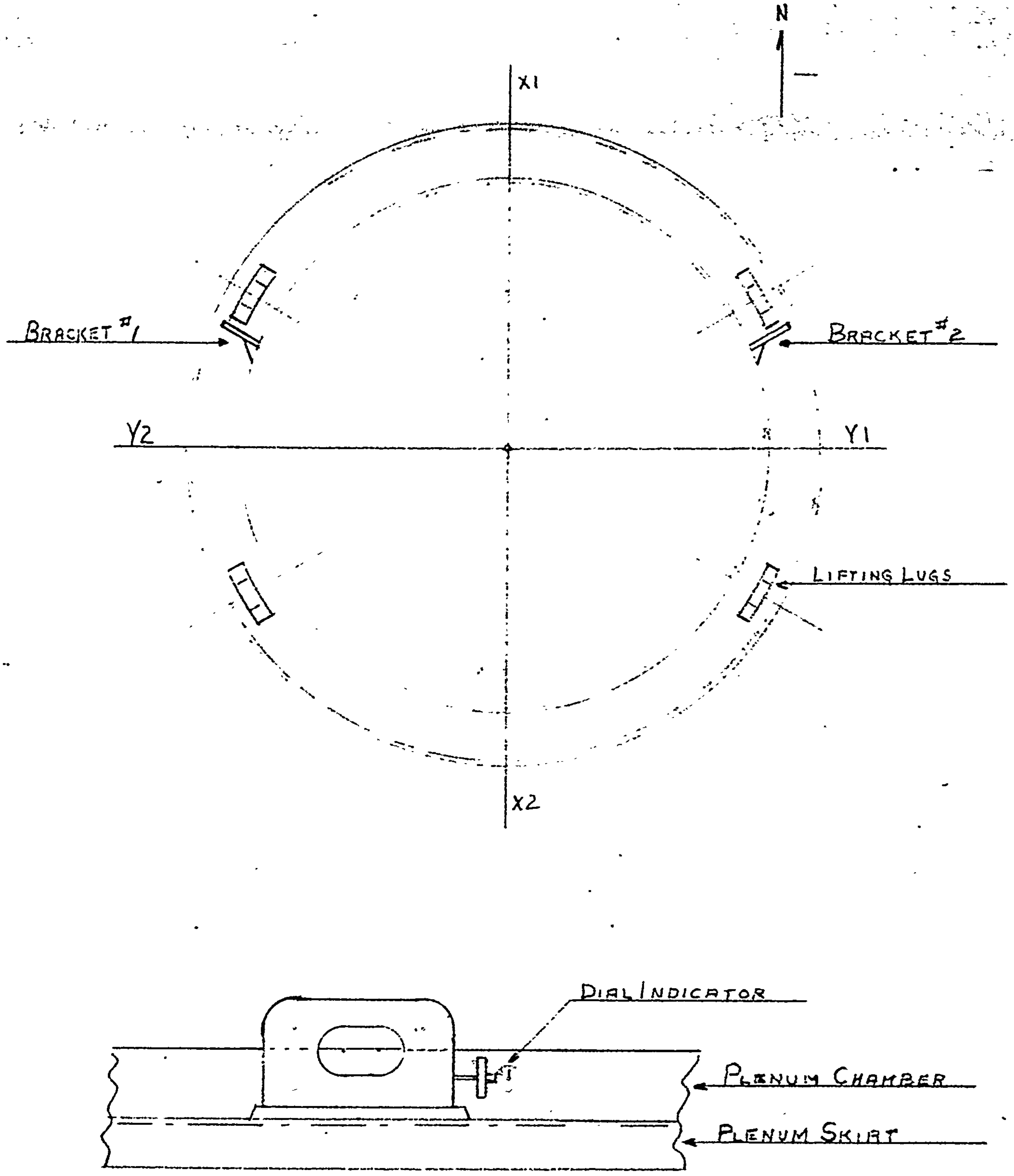
[illegible] Movement of the Plenum Chamber with respect [illegible] Top Tube Sheet

During the process of outlining the steps required [illegible] measuring the amount of movement in the NYX assembly [illegible] operation on a test basis, a step was included [illegible] the rotational movement of the plenum chamber [illegible] respect to the top tube sheet.

Several locations were considered for taking rotat- [illegible] movement measurements. Finally, it was the opinion [illegible] the M & E and Technical Operations Groups that [illegible] movement data could be obtained by measuring the [illegible] of movement of a top tube sheet lifting lug (See [illegible] with respect to a point on the plenum chamber [illegible] also decided that checking two of the [illegible] would be sufficient coverage for secur- [illegible] data. The lifting lug located [illegible] axis of the plenum chamber and [illegible] noted as lifting lug number one, [illegible] located between the X-1 and Y-1 axis [illegible] lug number two.

[illegible] brackets were designed and fabri- [illegible] measurements. Each bracket [illegible] plate of sufficient size [illegible] indicator. Each bracket [illegible] the face of the plate [illegible] 2" from the narrow [illegible] lifting lug. To make [illegible] steel gusset (See [illegible] skirt and bracket

[illegible] recorded to the [illegible] (See photo, serial [illegible] procured to [illegible] dial indic- [illegible] Tool [illegible] number C30-847, [illegible] 12849-A. After [illegible] York Ship, [illegible] 116. A special [illegible] attached [illegible] in the



SKETCH #17

ENGINEERING SKETCH SHEET
E. I. DU PONT DE NEMOURS & CO.

PROJ. No. 8980

SIGNATURE:

[redacted], TITLE SET UP TO CHECK ROTATIONAL MOVEMENT OF PLENUM

DATE

SUBJECT:

No. E-42418

above referenced photograph. This specialbase served as a stop for setting up the gage, as well as a stop for taking the required measurements. To set-up the dial indicator, it was placed on a check stand allowing the special stop attached to the stem to rest on the two upright posts of the check stand. The tip of the dial indicator stem seated itself on the surface of the check stand base. At this point the face of the dial indicator was manually adjusted to a setting of zero.

Readings were taken before, after, and during operating the NYX assembly on a test basis. To take a reading the stem of the dial indicator was inserted in the bracket hole (See Sketch #17) allowing the tip of the stem to make contact with the narrow vertical face of the lifting lug. Then, by exerting a slight amount of hand pressure on the gage, the fixture attached to the stem of the gage seated itself on the face of the vertical steel bracket. At this point a reading was taken in thousandths of an inch. The time and location was recorded for each reading.

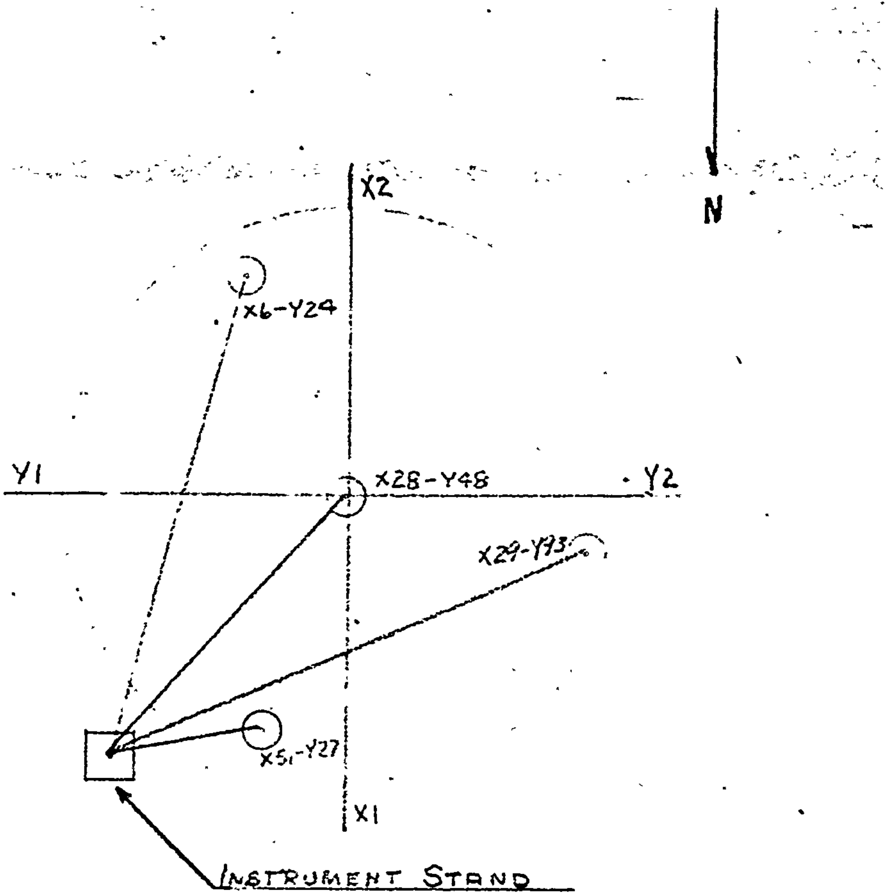
Rotational data covering the movement of the plenum chamber with respect to two of the four top tube sheet lifting lugs was presented to the Technical Operations Group by the M & E Inspection Group. In turn, this data was analyzed and correlated with other data pertaining to the NYX assembly.

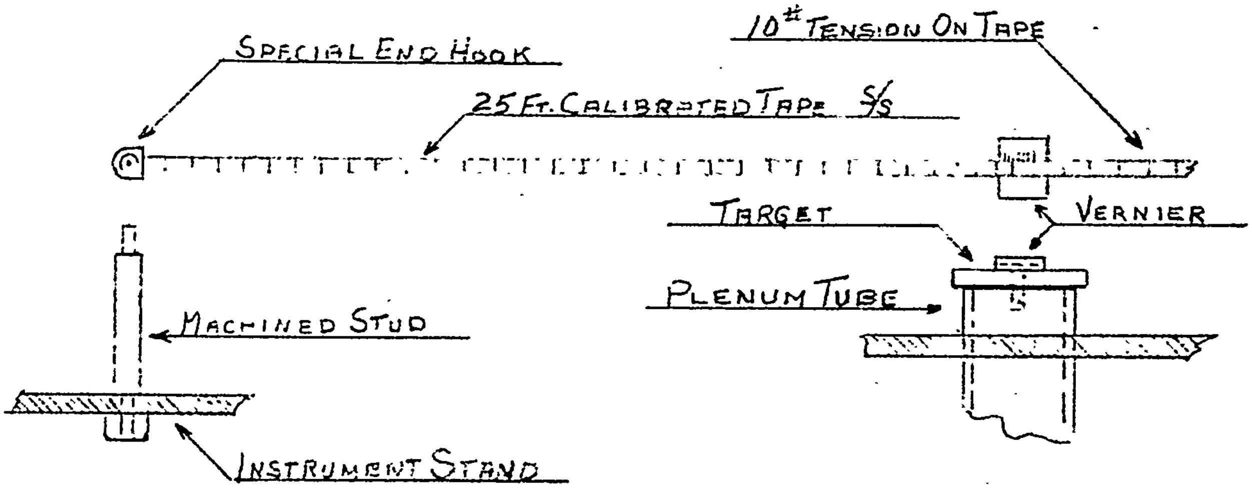
12. Plenum Chamber Tube Motion Measurements

At the time the various steps were outlined for studying the movement of the NYX plenum chamber during its operation on a test basis, one step was included for measuring the movement of the plenum chamber tubes.

The M & E Inspection Group and the Technical Operations Group agreed that four tubes would be representative of all of the plenum chamber tubes. The four tubes (See Sketch #18) selected had the following coordinates: X6,-Y24; X28,-Y48; X29,-Y93; and X51,-Y27. The X28,-Y48 tube was located on the center of the unit at the intersection of the X and Y axis. None of the other three tubes were on either the X or Y axis. They were approximately 120° apart and located on the outer periphery of the unit where it was postulated the maximum amount of tube movement could be detected.

Four special sleeves were designed for the subject plenum tubes. All sleeves had precision machined surfaces with the bore of the sleeves designed and machined to accept a special mandrel. Only a few thousandths of an inch was allowed for the clearance between the plenum chamber tube wall and the outer surface of the sleeve. Likewise, only a few thousandths of an inch was allowed as the clearance between the inner sleeve wall and the outer surface of the mandrel. In other words, it was necessary to have a snug fit for these component parts to secure accurate measurements covering the movement of





SKETCH #18

ENGINEERING SKETCH SHEET
E. I. DU PONT DE NEMOURS & CO.

PROJ. No. 8980

SIGNATURE:

[redacted]. TITLE
SET UP TO TAKE TAPE MEASUREMENTS

DATE

SUBJECT:

No. E-42419

the four plenum tubes. A ½" hole was drilled and reamed in the top of the special mandrel to accept a precision ground plug type vernier scale. This vernier scale, calibrated in 1/64", was used in conjunction with a standard steel tape.

After considering several locations as possible fixed points for measuring the movement in the plenum tubes, it was the concerted opinion of all parties involved that a portion of the concrete silo could be utilized to the best advantage. A spot was selected on the northeast corner of the concrete silo. To establish and hold this bench mark as a permanent fixed point from which all motion measurements could be secured, the M & E Inspection Group suggested that a steel mount be fabricated. This steel mount was mounted on a concrete pedestal located on the silo. The assumption was made that the concrete silo did not move to any appreciable degree when the NYX unit was operating. As an added feature a precision ground plate was mounted in a horizontal plane and welded to the top of the steel stand. A ½" hole was drilled and reamed in the center of this plate. A special pin was machined to press fit in the hole in the plate. Next, the standard end loop of a 25 foot Starrett, stainless steel tape was removed. A special loop with a ½" hole was precision machined and attached to the end of the steel tape in place of the standard end loop. A very small clearance was allowed for the special loop with a ½" eye to fit over the steel pin at the top of the instrument mount.

Measurements were taken before, during, and after operating the NYX assembly on a test basis. To take a reading the special eye attached to the end of the calibrated steel tape was placed over the precision ground plug mounted on the instrument stand. The tape was stretched in the direction of the vernier scale plug previously inserted in the mandrel located in one of the four plenum tubes being measured. With the tape subjected to a 10# spring-type tension, it was passed over the vernier scale and read to the nearest 1/64".

All measurements were formally presented to the Technical Operations Group by the M & E Inspection Group. After noting that there was a difference in the readings, it was concluded there was movement in the plenum tubes when the NYX unit was subjected to various temperatures and pressures over a period of several weeks. This data was correlated with rotational (See Part II, Section K, Wild T1 double center theodolite) and other measurements to complete the study of the degree and direction of movement of NYX plenum chamber tubes.

J. Wild NIII Precision Level and Accessories

1. Procurement

The Wild NIII precision level was procured primarily for the purpose of leveling unit assemblies. However, in addition to this, it was also used for alignment and leveling purposes as set forth in the following listed items: (1) leveling tube sheets in circumferential handling jig prior to insertion of large tubes (2) leveling holding rack assemblies (3) leveling forest structures for the five telescope actuator systems, and many other jobs which required a unit or a component part to be level during any one particular fabrication or machining operation.

The instrument was bought by the du Pont Company from the Henry Wild Surveying Instruments Supply Co., Brooklyn, N. Y., on AXC order #788½. The order was placed with the vendor November 26, 1951, and the instrument was delivered to M & E Group at New York Ship several months later. Upon receipt of the instrument, du Pont equipment piece #790-54 was assigned to it. On April 10, 1952, two (2) precise leveling rods and base plates were ordered on AXC order #6576½ for use with the precision level in determining relative elevations.

In addition to the above, four special level targets were designed by du Pont Design at the request of the M & E Group at New York Ship. They were fabricated by the Newton Tool Co., Wenonah, N.J., and shipped to New York Ship for immediate use. For fabrication details, see du Pont drawing D114941. Each of the four targets are identified as equipment piece #790-62. Two of these targets were later sent to the Savannah River plant site for use during unit erection work.

After using the above targets for leveling operations, it was discovered that additional targets with a revised housing structure were needed to facilitate the ease in handling during set-up operations for leveling tube sheet assemblies. A verbal request was made by the M & E Group to Design to produce the required targets. In compliance with the request, Design Division designed the gage and procured it for the M & E Group. Four of these newly designed targets were fabricated by Newton Tool Company and shipped to New York Ship. Upon their receipt at the latter location, du Pont equipment piece #790-63 was assigned to each of the four targets. Also, two of these targets were likewise sent to the Savannah River plant site for use during unit erection work.

Note: The above Wild NIII Precision Level and targets are calibrated in the metric system rather than the more desirable English system. The reason for this selection was due to the fact that the level and precise rods were procured as used equipment. The manufacturer could not supply a new instrument and accessories within a reasonable length of time. Also, targets designed by du Pont were likewise calibrated in the metric system.

2. Procedure for Using Wild NIII Precision Level

To observe the spherical level, loosen the locking screw (13). This enables the instrument to be swung around to the most convenient position (See Photo Serial #310 & 311). Then turning the large illiminating mirror (2) will allow clear observation of the bubble in its surface. The bubble is centered precisely by adjusting the foot screws (7).

The instrument is now ready for leveling. In high precision leveling a very firm tripod stand must be assured. Obtain the preliminary approximate leveling with the spherical level and along the lines of sight by means of the tubular level (17). In order to render this practical, the position of the tubular level in which its principle tangent stands vertical to the instruments vertical, rotation axis must be noted and is quickly found with the aid of drum scale (5). The drum should then always be set at the reading so obtained before the reading is sighted. Pointing the telescope along the line of sight and using the open sights on top of the instrument, an approximate setting may be determined. The azimuthal locking screw (13) is then lightly tightened and the eye-piece (1) is turned until the cross lines of the graticule appear sharp and black. Sharp focusing is obtained with knob (3) and tested by moving the eye up and down before the eye-piece to assure that there is no movement of the image against the horozontal line of the graticule. The vertical centerline of the graticule is brought to the center of the measuring staff or target by means of the azimuthal fine-adjustment screw (12) found beside the locking screw (13).

Centering Level:

Obtain the most satisfactory illumination while oberving the tubular level (17) thru the eye-piece by turning the reflector (2). The tilting screw (4), placed directly beneath the eye-piece, is then turned until the two half images of the level bubble form a single continuous curve. (See Sketch #19).

Reading the Staff or Target:

The optical micrometer is utilized for all staff or target readings. The knob (11) is turned until the wedge lines of the graticule symmetrically enclose an interval-line on the measuring staff or target. (See Sketch #19). The interval-line thus enclosed gives the reading in centimeters. The micrometer reading is observed thru the eye-piece (18); its scale runs from right to left and the figures thereon represent millimeters while the smaller intervals represent tenths of millimeters. The reading thus obtained on the micrometer added directly as a decimal fraction to the staff or target reading.

The reading is then recorded and the same procedure is followed in taking a series of readings by re-locating

Serial #311

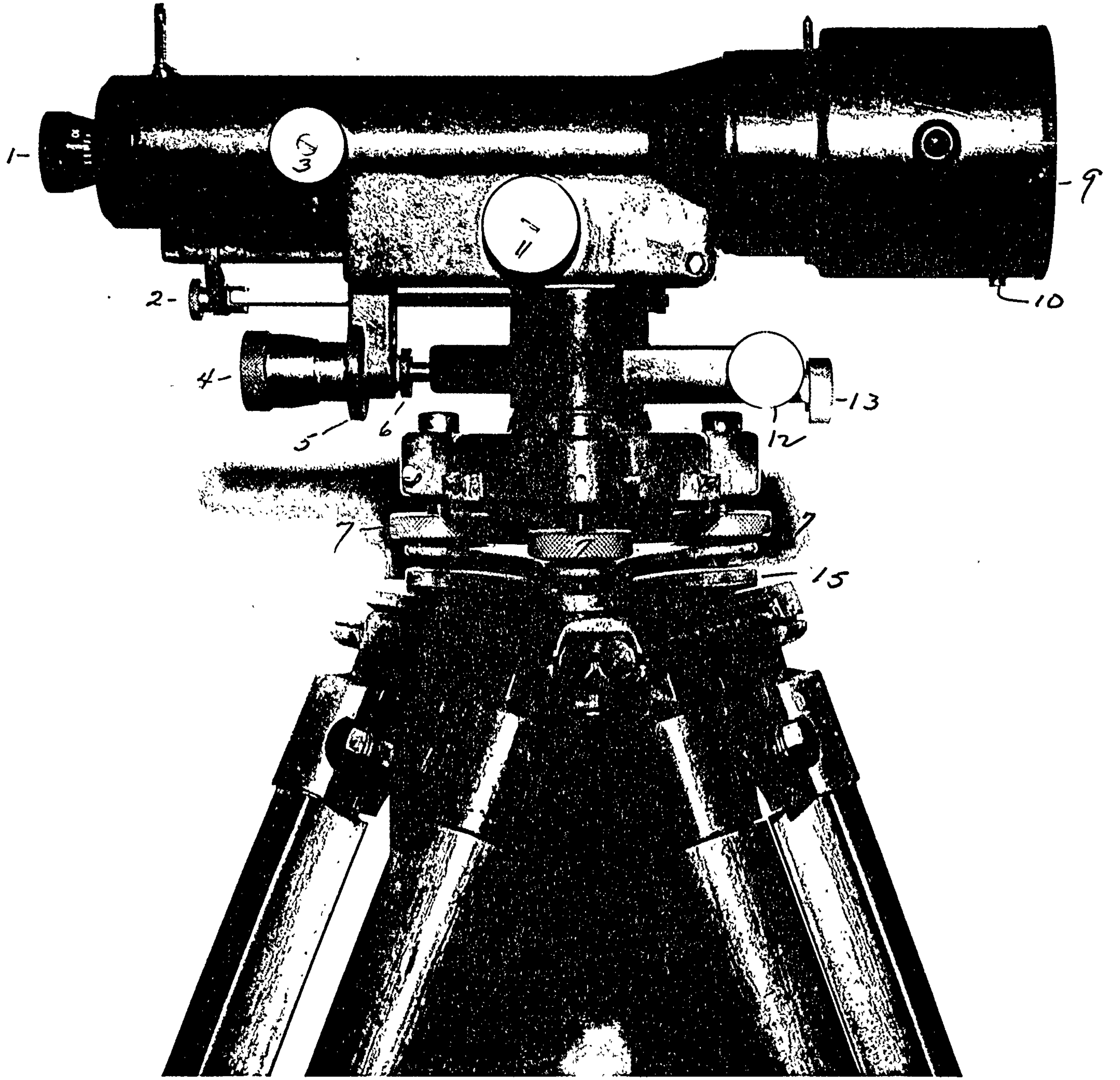
New York Shipbuilding Corp
Camden 4, New Jersey
October 17, 1953

PROJECT 8980 - SAVANNAH RIVER PLANT

WILD N111 PRECISION LEVEL

Identification of Operating Parts

1. Telescope eye-piece
2. Reflector-knob
3. Focussing-screw
4. Tilting-screw
5. Drum-scale
6. Adjusting nut for Screw 4
7. Foot-screws
8. Lug
9. Protecting-glass mounting
10. Locking-screw for protecting-glass
11. Micrometer-knob
12. Fine adjustment screw for azimuthal movement
13. Azimuthal locking-screw
14. Adjusting-screw
15. Triangular base-plate
16. Spherical-level
17. Eye-piece for tubular-level
18. Eye-piece for micrometer-scale


1
2
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13
15

Serial #310

New York Shipbuilding Corp.
Camden, 4, New Jersey
October 17, 1953

PROJECT 8980 - SAVANNAH RIVER PLANT

WILD N111 PRECISION LEVEL

Identification of Operating Parts

1. Telescope eye-piece
2. Reflector-knob
3. Focussing-screw
4. Tilting-screw
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7. Foot-screws
8. Lug
9. Protecting-glass mounting
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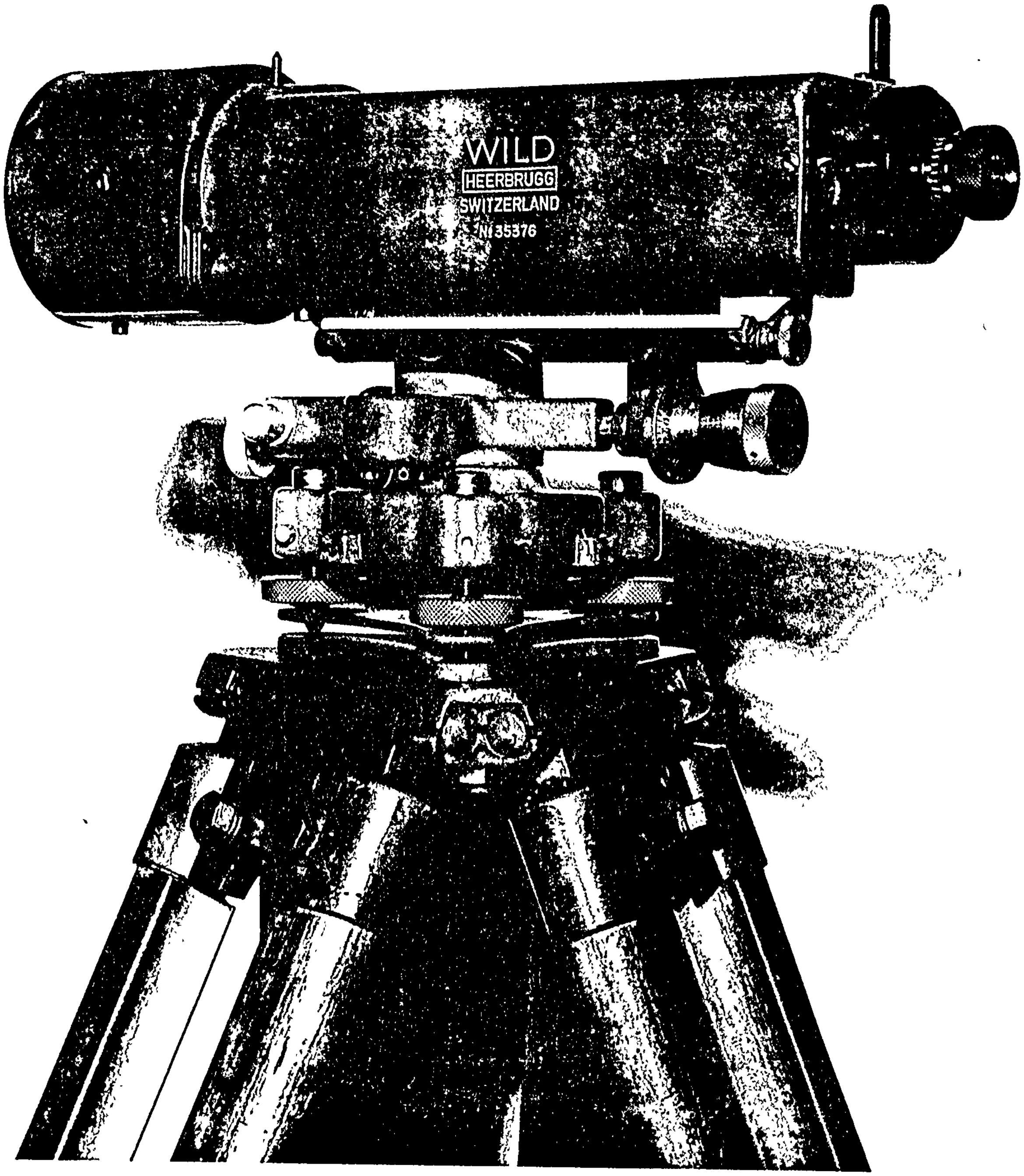
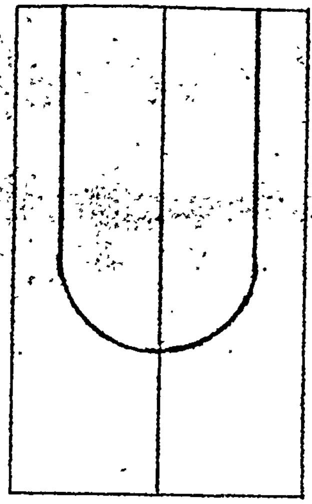
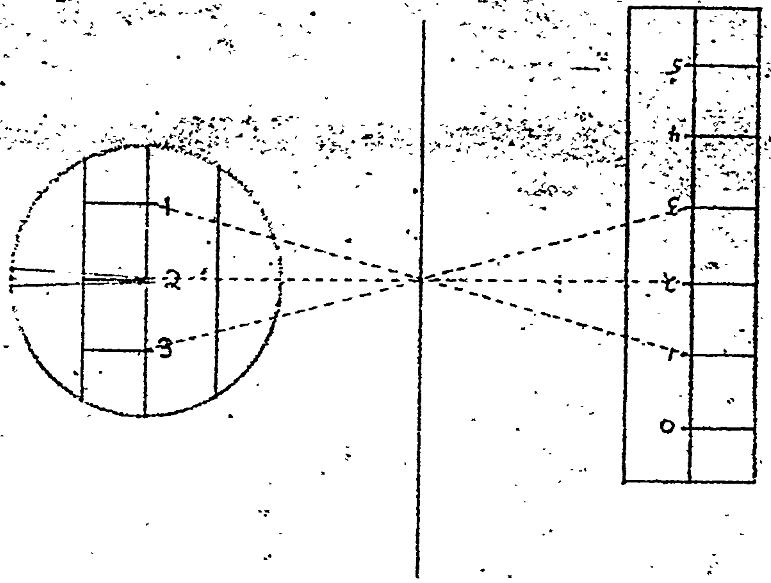
11. Micrometer-knob
12. Fine adjustment screw for azimuthal movement
13. Azimuthal locking-screw
14. Adjusting-screw
15. Triangular base-plate
16. Spherical-level
17. Eye-piece for tubular-level
18. Eye-piece for micrometer-scale


WILD
HEERBRUGG
SWITZERLAND
N 35376

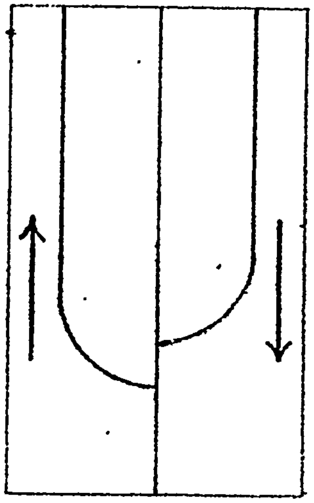


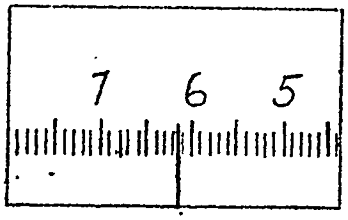
TUBULAR
LEVEL
BUBBLE



TARGET AS
VIEWED THROUGH
INSTRUMENT

TARGET





OPTICAL
MICROMETER

TARGET READING: 2.614

SKETCH # 19

ENGINEERING SKETCH SHEET
E. I. DU PONT DE NEMOURS & CO.

PROJ. No. 8980

SIGNATURE:

PROJ. TITLE

DATE

SUBJECT: WILD N III LEVEL

No. E-42441

the staff along various points of the unit to be leveled. This having been accomplished a comparsion of readings is made and the necessary steps are taken to improve the levelness of the unit after which the leveling procedure is again repeated until the desired degree of levelness is attained.

K. Wild Tl Double Center Theodolite

1. Procurement

In anticipation of the installation of NYX and other units it was realized that X and Y centerlines (which are established on the top side of each plenum chamber after line boring) would have to be transferred to the top tube sheet. This is necessary because the top tube sheet (although it is keyed to the plenum chamber to reproduce the orientation of the two pieces as established at the time of line boring) must be installed in the tank and oriented to building axis by itself. In order that the plenum chamber axes fall on the building axes when it is mated with the top tube sheet, the two sets of axis must fall in the same vertical planes. In view of the physical size of the pieces involved and the degree of accuracy required, same method of optical plumbing was considered best. But, to do this job, the "Wild Tl" double center theodolite was selected and purchased from Henry Wild Surveying Instrument Co. on P.O. AXC 6514½. After receiving the instrument at New York Ship, equipment piece #790-90 was assigned to it. (See photo serial #156 in Part II-A, Section 7-b)

2. Uses of the Instrument at New York Ship

The procedure for transfering axis from the top of the plenum chamber to the bottom of the plenum chamber and the top and bottom of the top tube sheet assembly is as follows:

a. Set up the instrument on a tripod in the center of the top of the plenum chamber after line boring and while the plenum chamber and top tube sheet are still level and mated.

b. The instrument is leveled, and by means of a cross slide bore (described later) the line of sight of the telescope is made to coincide with one axis of the plenum chamber which has been established and punch-marked on the tops of the tubes.

c. The telescope is then revolved on its vertical axis and sighted on the floor at suitable metal bench marks.

d. A center punch is then moved across the bench mark to coincide with the telescopes line of sight and a punch mark made. Another such bench mark is then established as far as possible from the first (approximately 40' to 50' is desirable). This procedure is repeated on both ends of both axes.

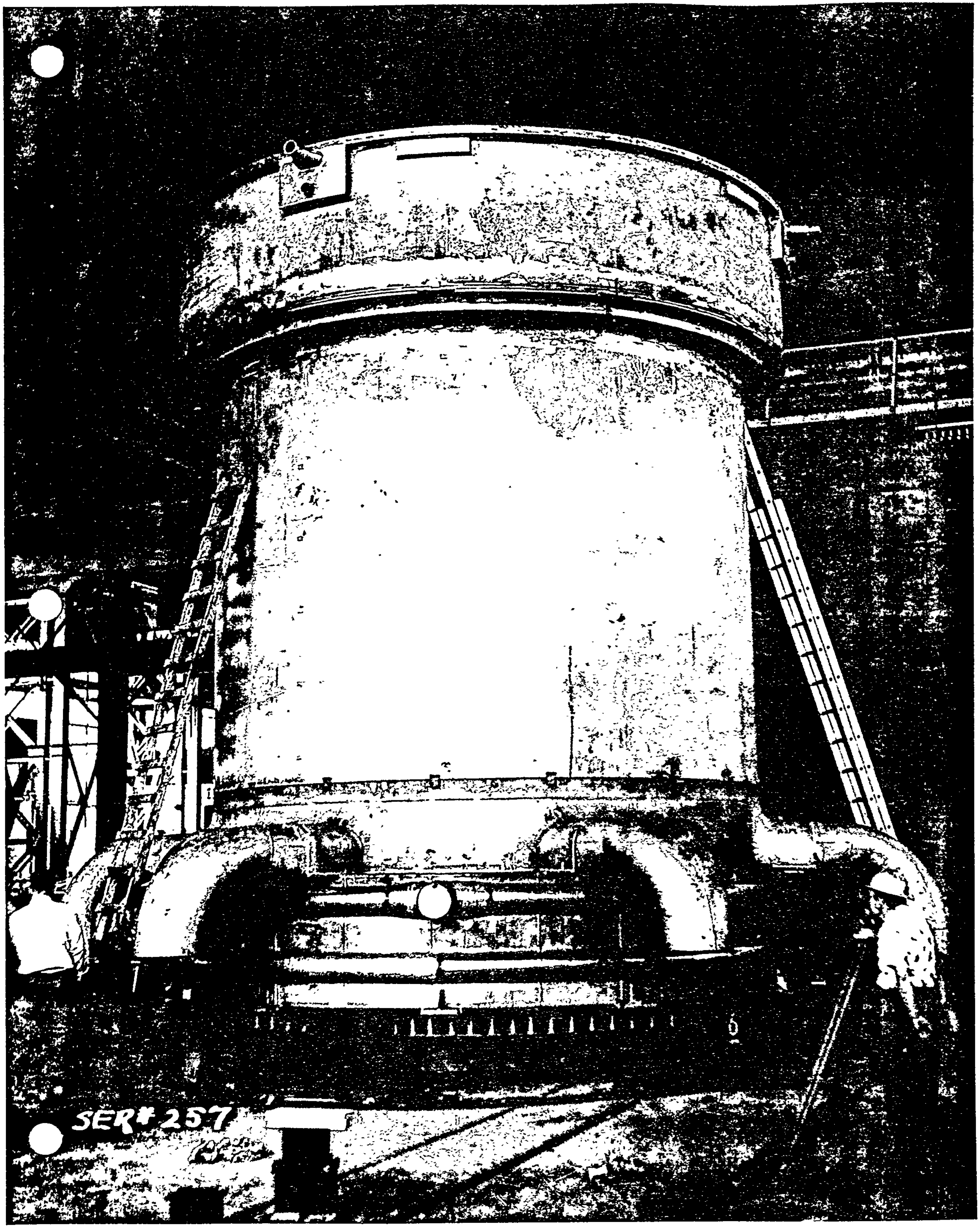
Serial Number 257

New York Shipbuilding Corp.
Camden, N. J.

PROJECT 8980 - SAVANNAH RIVER PLANT

Fitting the "L" unit main tank shell to the bottom nozzle assembly for field welding

The "Wild Theodolite" is set up on the extended centerlines and the verticality and alignment of the vertical centerlines are checked at the BTS bearing pads, field joint, bearing and seal ring. If it is necessary, the Tank is slightly rotated or the levelness is adjusted to plumb the average vertical centerlines.


SER# 257

MANDREL TO CHECK VERTICALITY OF 8FT MOCK UP

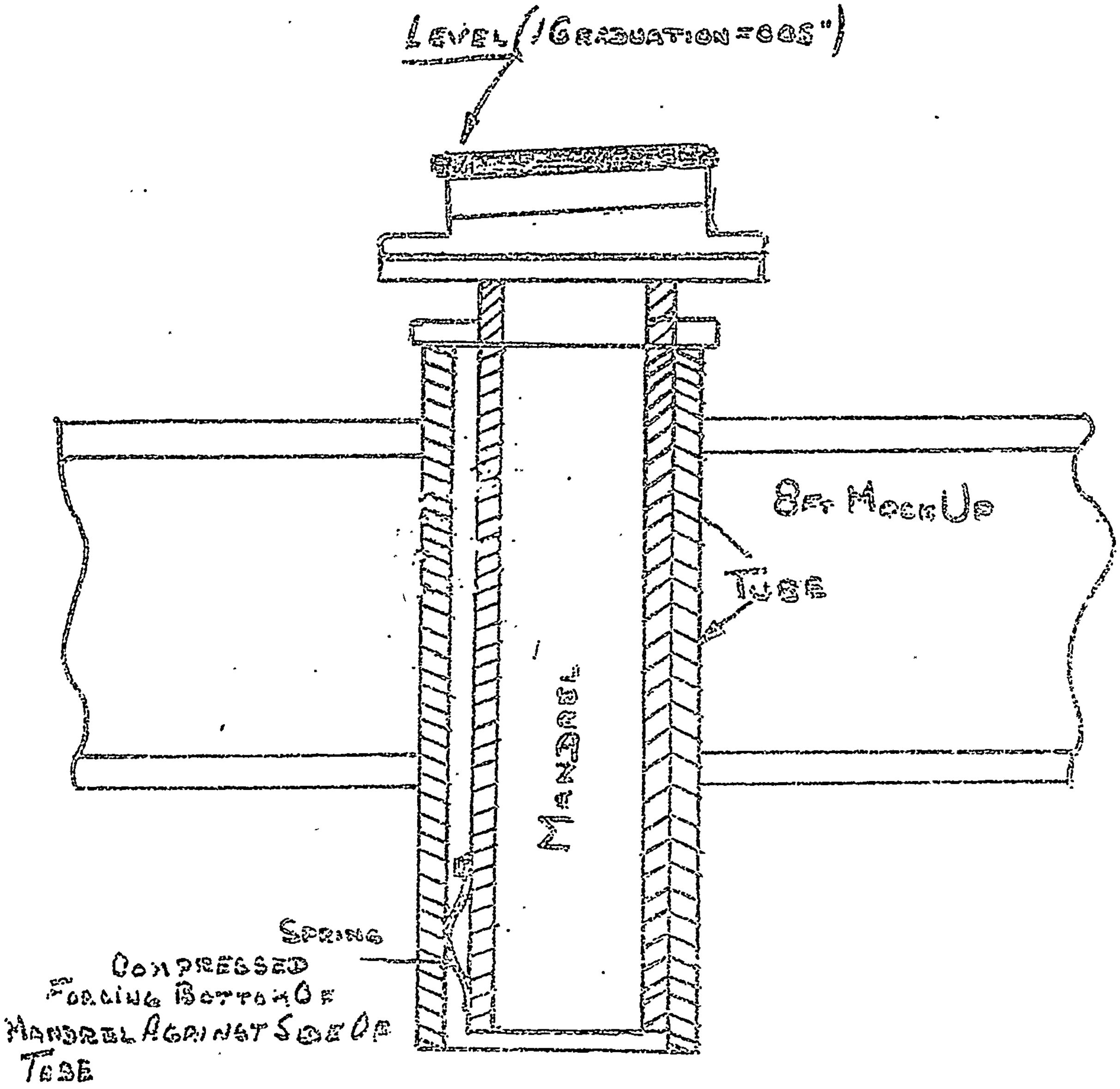


FIG. 1

cumbersome and slow, lead the way for approved details on designing a verticality gage.

Through the cooperation between Design and inspection, a definite plan for design of the verticality gages was agreed to. The design of the verticality gages for the plenum chamber, top special and tank bottom units was the same except for the difference in size for the different size tubes; therefore, a detail description and use of one verticality gage will be given to represent all the different verticality gages used to measure the out of vertical the tubes are in the units.

Figure 2 shows the different sizes of the verticality gages that are used for the different units. Fig 2 also shows a sketch with nomenclature of each part of the gage. The shoes, both movable and fixed, are located on the circumference of the gage's mandrel 120° apart. with no compression on the springs of the movable shoes, the diameter of mandrel plus the shoes is 1/8" larger than the nominal diameter of the tube bores. The springs of the movable shoes can be compressed 3/16"; this is to take into account the blue print tolerances of the tube bores.

To properly understand the use of the verticality gage, a tube that is perfectly vertical in all directions, north, east, south and west, will first be considered. When the gage is inserted into the tube bore the springs of the movable shoes will be compressed. As explained before the diameter of mandrel plus the shoes is larger than the bore of the tube; therefore, for the gage to fit into the tube bore, the springs will have to compress forcing the movable shoes inward to make a smaller diameter to coincide with diameter of the tube bore. The compressed springs will force the fixed and movable shoes against the wall of the tube bore giving a tight metal-to-metal fit of all the shoes against the tube wall. The tube is perfectly vertical; therefore, the mandrel will be parallel to the tube; the fixed bar will be perpendicular to the mandrel; the movable bar will be parallel to the fixed bar; and because of perfect verticality of the tube, the tube and gage will be in a perfect plane with the earth giving a zero reading on the level. No adjustment is necessary on the movable bar; therefore, the dial indicator reading is zero.

Tubes with perfect verticality for all the different units are set up here at the vendors shop. These tubes are used as master gages to properly set and adjust the verticality gages. It is not necessary to have the verticality gage set perfectly. An average reading of any two points 180° apart will give the exact amount a tube is out of vertical. The dial indicator is set in the verticality gage to give a plus .125" and a minus .125" readings from zero setting.

A tube such as the one shown in Figure 3 will now be taken into account. The verticality gage is inserted

Verticality Gage
With Nomenclature Of Parts

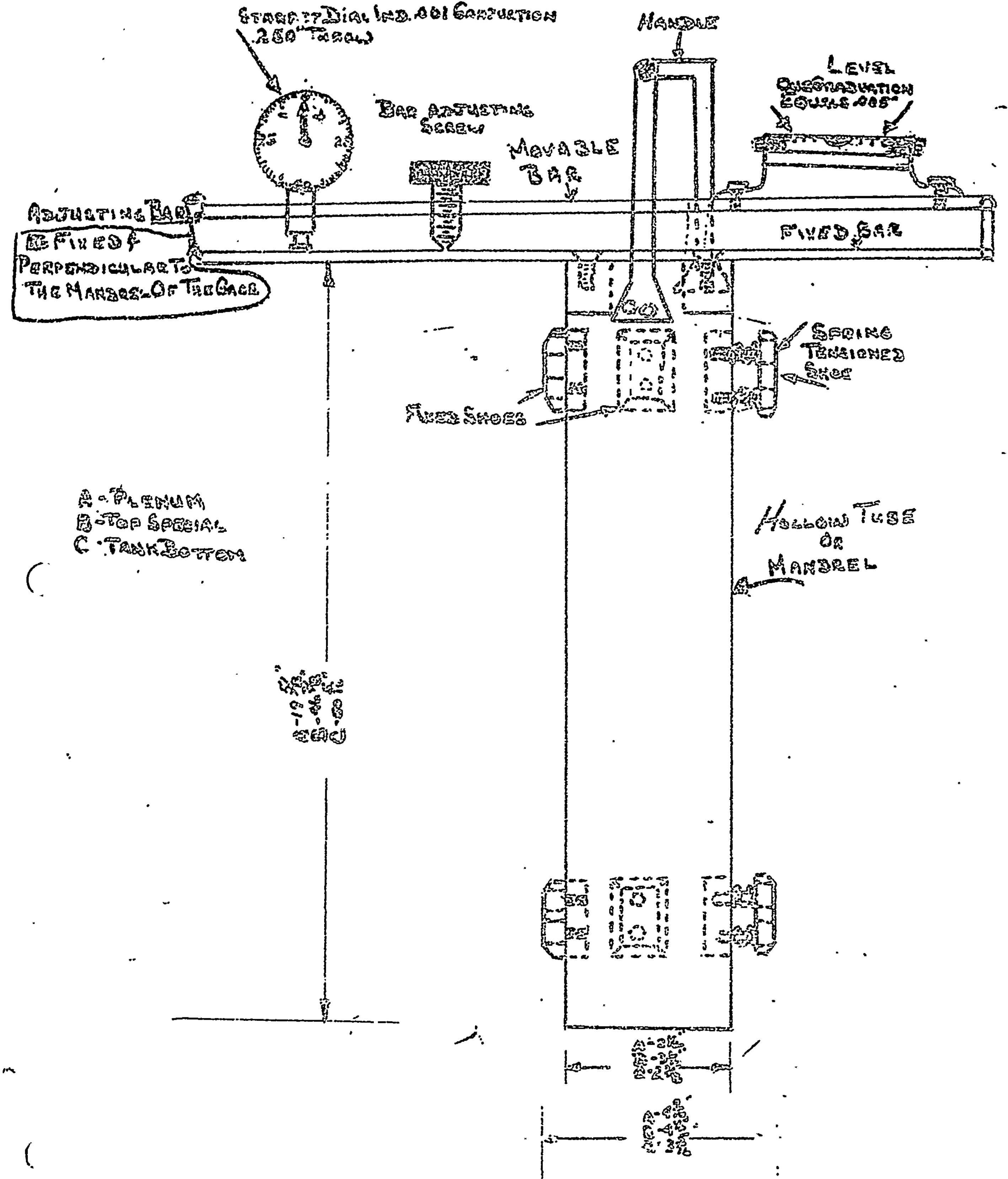
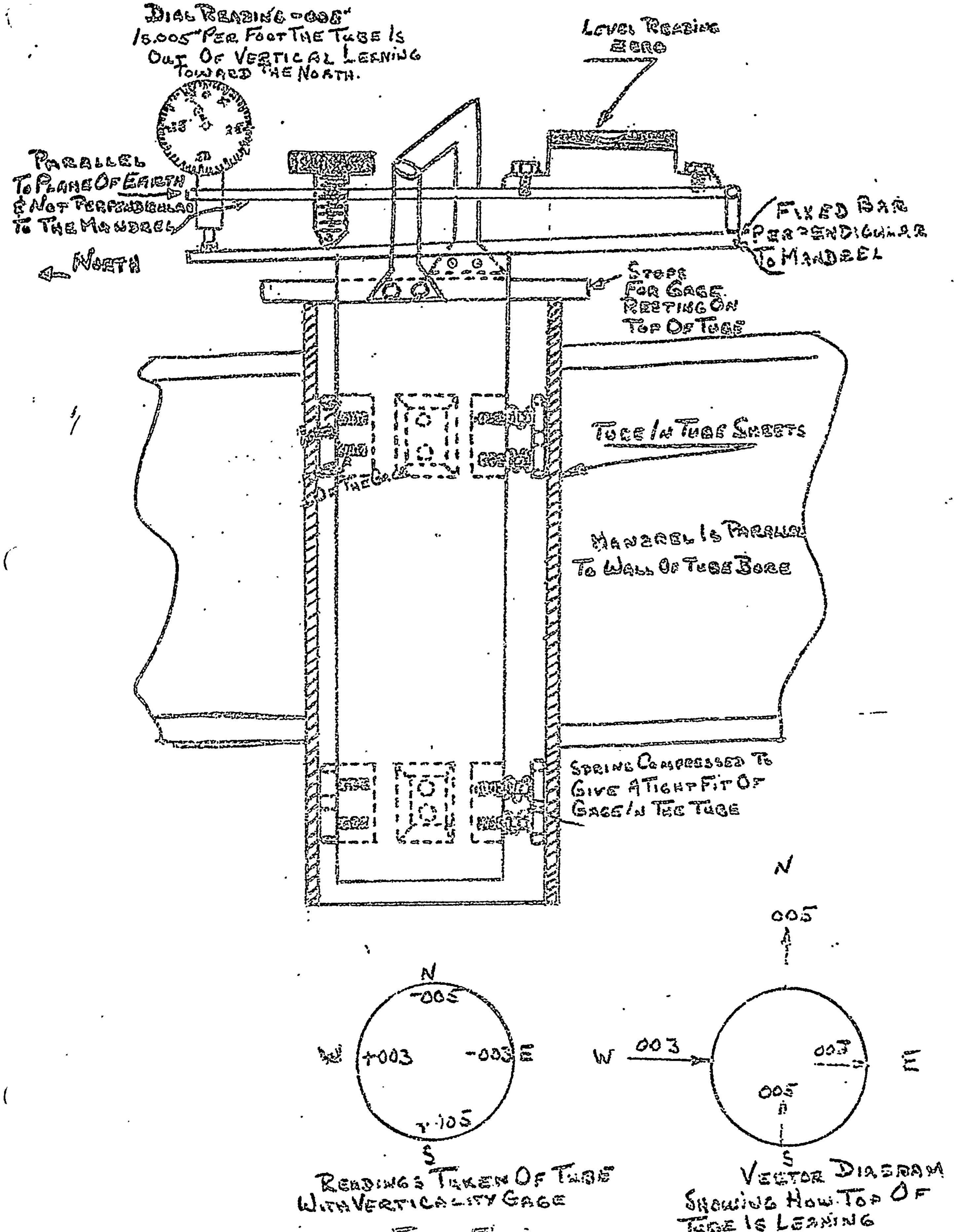


Fig. 2

VERTICALITY GAGE INSERTED IN TUBE THAT IS NOT PERFECTLY VERTICAL



READINGS TAKEN OF TUBE WITH VERTICALITY GAGE

VECTOR DIAGRAM SHOWING HOW TOP OF TUBE IS LEANING

FIG. 3

into the tube. The springs will compress forcing the shoes against tube wall. First the north reading will be taken. The open end of the movable and fixed bar is set to face the north to obtain a north reading. As shown before the mandrel will be parallel to the wall of the tube; the fixed bar will be perpendicular to the mandrel, and the movable bar will be parallel to the fixed bar. The tube not being perfectly vertical will be indicated on the level on the movable bar. The adjusting screw is used to raise or lower the movable bar in order to adjust the movable bar to a perfect plane with the earth to obtain a zero reading on the level. The up or down movement of the movable bar will cause the stem of the dial indicator to move inward or to extend out giving a direct reading on the indicator of plus or minus so many thousandths. This reading is the out of vertical reading the tube is in one foot. The minus reading on the indicator indicates that tube is leaning in the direction of the minus reading. The gage is rotated with the open end of the bars facing east to obtain out-of-verticality the tube is in the east direction. Same procedure is used as in the north direction. This is done in all four directions of North, East, South and West. If the gage is pre-set in the master gage, the 180° apart readings, or East and West readings will be the same but in opposite directions. For example, if North reading is .005", the south reading will be + .005" giving an average of .005" the tube is leaning towards the north.

To show that the gage does not need to be pre-set an example will be given of such a gage. The gage is inserted into the tube bore with the open end of the fixed and movable bar facing north. The adjustment knob is turned to bring the level into a zero reading. The dial indicator shows a reading of .010" for the north reading. The gage is then rotated 180° with the open end of the bars facing south. The adjustment knob is again turned to bring the level into a zero reading. The dial indicator shows a reading of .000" for south reading. The average of both readings is .005". This indicates that the top of the tubes is leaning towards the North. From these readings the person using the verticality can make necessary adjustments on the dial indicator to have the proper setting on the gage. Fig. 3 shows a vector diagram of how the verticality of the tube is computed.

M. Installation of Precision Crane in Building #10

1. General

It was the responsibility of the Field Construction Group assigned to New York Ship to install the precision crane in Building #10 for the NYX unit while operating on a test basis. Since the M & E Group assigned to the same location had the necessary instruments and trained personnel to perform this work, the Field Construction Group requested the former to provide the necessary personnel and equipment. However, Construction engineers would still retain full responsibility of the crane installation and supervise M & E personnel performing the work.

In the following sections a resume of the work procedure performed by M & E personnel assigned to New York Ship is presented herewith. This work was performed between August, 1952, and March, 1953. It required the services of two men from the M & E Group, one full time and the other part time.

2. Layout of Center and Control Lines on Floor and at High Elevation

   A. Floor Elevation

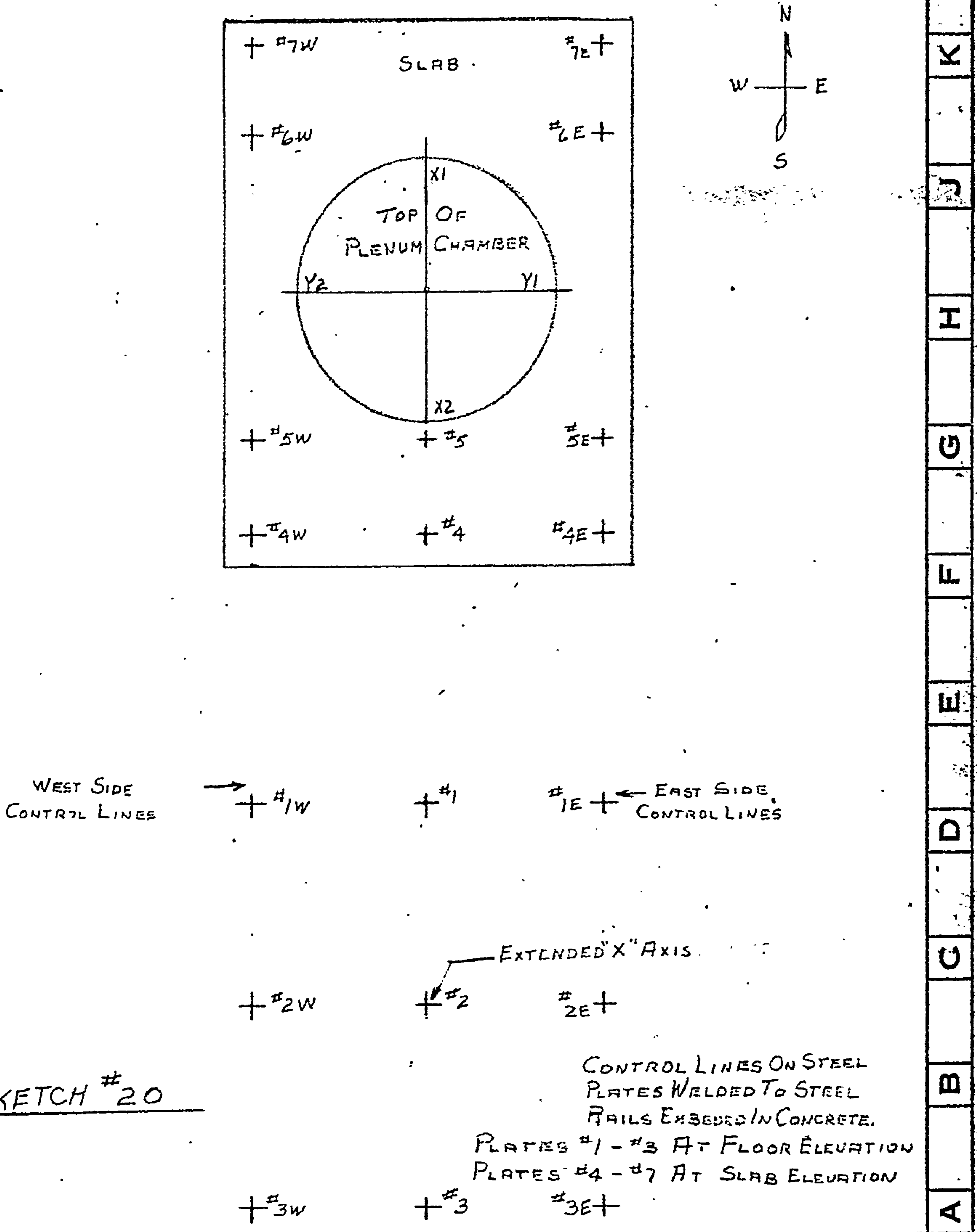
      1. The "X" axis on the top side of the NYX plenum chamber was extended down to the concrete floor on the south side of the silo. Secondary or control lines (which are parallel to the extended centerline on the east and west side) were laid out referencing from the "X" axis located on the floor using a Wild T1 double center theodolite and a scribe for a target. All other measurements were made with a 100' stainless steel tape calibrated by the U. S. Bureau of Standards.

      2. The approximate location for the steel plates on which the lines are scribed was laid out on the floor. At these locations steel plates were welded to steel rails embedded in the concrete floor.

      3. The instrument was set on top of the plenum chamber and its line of sight adjusted to coincide with the "X" axis centerline on the top side of the plenum. This line was extended to plates numbered 1, 2, and 3 located on the floor using a scribe as a target. (See Sketch #20)

      4. The instrument was then placed over the center of the #1 plate which was located on the "X" axis. Next, the line of sight was adjusted to coincide with the "X" axis centerline scribed on plates #2 and #4 as shown in Sketch #20. Then the instrument was turned 90° to the east and a line was scribed on plate 1E. The instrument was plunged and a line was scribed on plate 1W. A chalk line was stretched from the scribed lines on plates 1E to 1W and a line scribed on plate #1, thus, locating the first lines on the floor. The east side control lines on plate #1E were then established by measuring from the "X" axis on plate #1 with a 100' stainless steel tape held in line with the 90° lines scribed on plates #1 and #1E. The west side control line on plate #1W was established in the same manner. The above procedure was also used to establish lines on plates numbered 2, 2E, 2W, 3E and 3W.

      5. The instrument was then set between plates #1 and



CONTROL LINES ON STEEL PLATES WELDED TO STEEL RAILS EMBEDDED IN CONCRETE.
PLATES #1 - #3 AT FLOOR ELEVATION
PLATES #4 - #7 AT SLAB ELEVATION

SKETCH #20

ENGINEERING SKETCH SHEET
E. I. DU PONT DE NEMOURS & CO.

PROJ. No. 8980

SIGNATURE:

DATE

[redacted] LAYOUT OF CONTROL LINES ON FLOOR

SUBJECT:

No. E-42462

#2 and adjusted to coincide with the "X" axis. The "X" axis was then extended to plates #4 and #5 (See Sketch #20) located on the concrete slab. (See Sketch #21) The east and west control lines were scribed on plates 4E and 4W, 5E and 5W following the procedure as outlined above in section #4.

6. The instrument was then set between plates #5E and #6E and adjusted to the control lines on plates #4E and #5E. After this the instrument was plunged and control lines on #6E and #7E were scribed. The control lines on plates #6W and 7W were then scribed in the same manner. The distance between the east and west control lines on plates #6E and #6W, #7E and #7W were checked with the 100' stainless steel tape. The center or "X" axis was not necessary on the north side of the unit.

B. Temporary Installation for Assembling and Testing of Crane

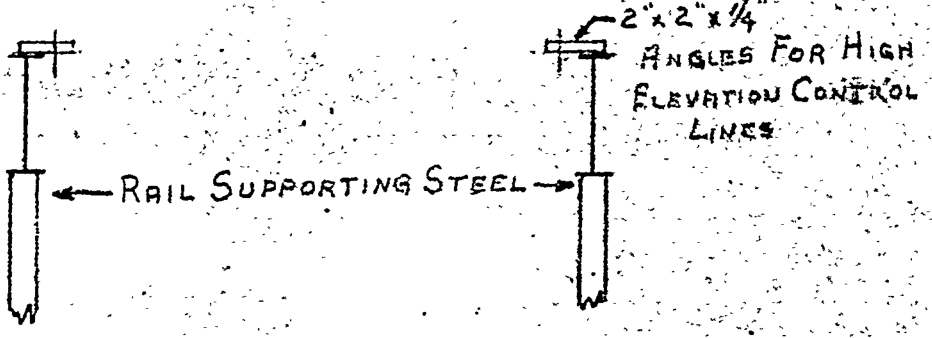
Since the precision crane was to be assembled and tested at New York Ship, a temporary installation approximately 8' above the floor level was fabricated to facilitate the assembling of the crane's component parts. This installation consisted of one left hand and one right section of crane rail and the necessary supporting steel spaced at the proper distance to receive the crane bridge. (See Sketch #22)

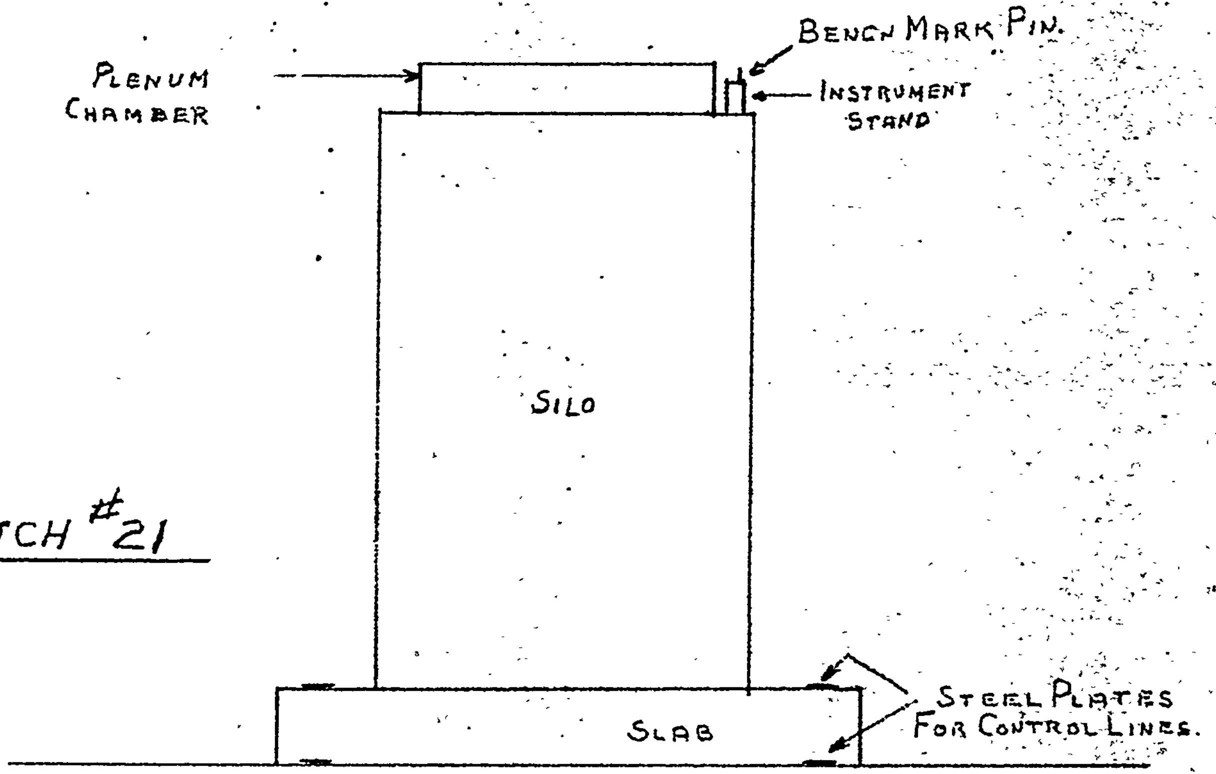
In the following procedure a resume of the work involved in setting and aligning the left and right hand sections of crane rail is presented herewith.

a. The centerline for the location of the rail saddles was transferred to the supporting steel from the east and west control lines. (See Sketch #22) The rail saddles were set on 2' centers. Then the centerline of the saddles were aligned with the centerline on the supporting steel and clamped tight with hook bolts.

b. The rails were leveled and aligned with jack screws in the saddles. The jack screws were held in adjustment with check nuts. The top end of the leveling jack screws in the east and west rail saddles were set in a level plane, using the Wild NIII precision level.

c. The crane rails were then placed in the saddles. First, the west rail was roughly aligned (± 1/32") to the control line using a 12" scale. Then, the elevation of the rail at the north end saddle was checked with the Wild NIII precision level and lighted target. Next, the balance of the rail at each saddle was set to the same elevation. Concurrent with setting the rail at the required elevation, the rail level (crosswise) was checked with a Starrett 12" precision level.





SKETCH #21

ENGINEERING SKETCH SHEET
E. I. DU PONT DE NEMOURS & CO.

PROJ. No. 8980

SIGNATURE:

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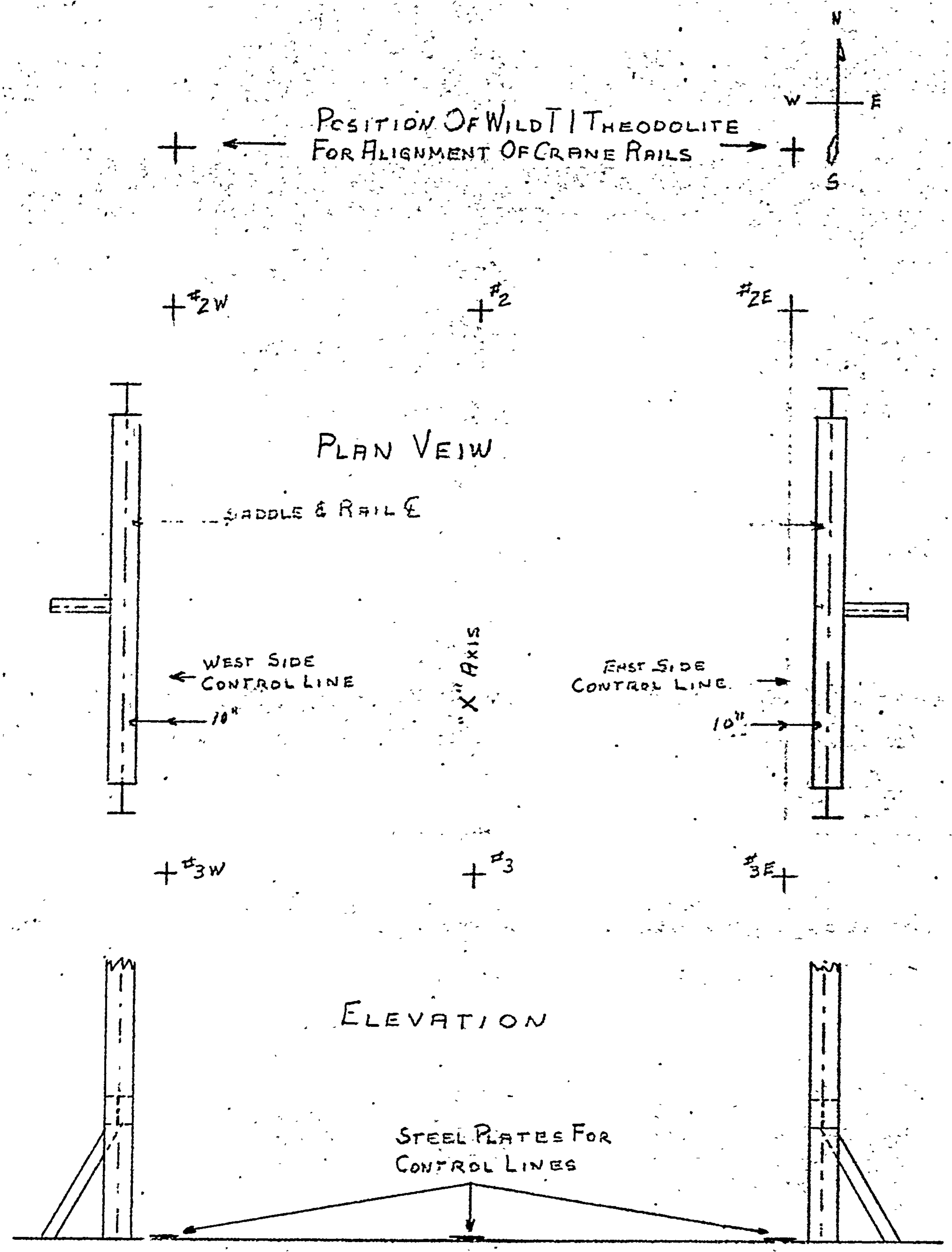
HIGH ELEVATION CONTROL LINES & BENCH MARK

DATE

SUBJECT:

No. E-42463



ENGINEERING SKETCH SHEET
E. I. DU PONT DE NEMOURS & CO.

PROJ. No. 8980

SIGNATURE:

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LAYOUT OF TEMPORARY INSTALLATION

DATE

SUBJECT: SKETCH #22

No. E-42464

Also, at the same time the rail alignment was checked from the side of the rail to the control line using a 12" scale. This was necessary since final elevation and leveling adjustments with the jack screws moved the rail laterally.

C. High Elevation

1. The control lines on the east and west side were transferred from the east and west plates on the floor to targets at the high elevation. (See Sketch #21) These targets were 2" x 2" x 1/4" angles welded and braced to the rail supporting steel at the north and south ends. These targets were located at the required elevation for aligning the rail saddles and the rail.

2. The instrument was set between plates #1W and #2W and adjusted to coincide with the lines on plates #1W and #3W. Then, the instrument was focused on the 2" x 2" x 1/4" angle target located on the south end of the rail supporting steel. At this point the high elevation control line was scribed. The control line on the north end target was scribed by setting the instrument between plates #5W and #6W about 10 feet from plate #6W in the same manner described above. The east side high elevation control line was laid out following the same procedure outlined for the west side.

3. This completes the layout of the control lines at the high elevation.

4. The layout of all lines was re-checked for accuracy by plunging and reversing the instrument to eliminate all possible human and instrument errors. This completes the layout of the centerline and control lines at floor elevation.

5. The elevation, level and alignment of the east rail was set the same as the west rail using the Wild precision level and lighted target as outlined in Paragraph #3. The distance between the rails was checked with a 100' stainless steel tape.

6. The crane bridge was lifted into position and placed on the rails. The level of the crane bridge was then checked with the Wild level and precision measuring staff.

7. Wild T1 theodolite was set on a rigid platform over the west side control line. The instrument's line of sight was adjusted to coincide with the control line. It was then turned 90° and the crane bridge moved until the drive wheel centerline coincided with the instrument line of sight. The crane wheels were blocked, thus holding the crane bridge in position 90° to the "X" axis.

8. The crane bridge was received with the trolley

rail saddles welded in position. Next, it was necessary to adjust the leveling jack screws to a level plane at the proper elevation above the crane rail. This elevation was checked with the Wild precision level and precision measuring staff. The trolley rails were then placed in the saddles and bolted together with a splice plate which had a lock fitting into a hole in the center saddle to hold the rails in position lengthwise.

9. A target with adjustable brackets was tack welded to each end of the crane bridge in line with the drive wheel centerline and at the same elevation as the trolley rail. The adjustable brackets were aligned with the drive wheel centerline using a straight edge and precision box level.

   A #13 piano wire was used for the final alignment of the trolley rails. The wire was stretched across the crane bridge, supported in "V" slots cut in the 2" x 2" x 1/4" angles which were clamped to the crane bridge. The piano wire was aligned from the two adjustable brackets with a pin gage (micrometer head on one end) to a point 2" from the final position of the rail so a 2" pin gage could be used for the final alignment of the rail.

10. The Wild NIII precision level was set in the center of the south rail. Working from this position the west end of the north rail at the first saddle was set to the proper elevation above the crane rail using the Wild NIII precision level and precision measuring staff. The rail was clamped on the leveling jack screws with clamps fabricated for this purpose. This clamping was found necessary because when adjusting the second saddle. the jack screws at the first saddle would move. At least six saddles had to be clamped at all times during leveling. The final alignment of the rail was done concurrently with the leveling. When the north rail had been completed the south rail was leveled to the same elevation as the north rail. Using the Wild precision level set in the center of north rail, the space between the north and south rails was set within a tolerance of ±.002" with a pin gage of the proper length which had a micrometer head on one end.

3. Installation of Crane Rails (High Elevation)

   a. The high elevation bench mark for setting the crane rails was taken from the instrument stand bench mark which had previously been established. The Wild NIII precision level was set on top of the plenum chamber and the elevation of the bench mark on the instrument stand was transferred to a target welded on the steel column. Another target was welded to the rail supporting steel at the same elevation as the rail and directly over the lower target. The high elevation bench mark was established on the high target by measuring from the lower target with a 100' stainless steel tape.

b. The saddles were placed on 2' centers. The centerline of the saddles was aligned from a #13 piano wire stretched the full length of the rail supporting steel 2" from the final position of the rail. The wire was aligned from the high control lines scribed on the 2" x 2" x 1/4" angle targets. After the saddles were aligned and clamped tight with C clamps, they were welded to the supporting steel.

c. The top end of the leveling jack screws were all set in a level plane at the proper elevation. Next, the rails were placed in the saddles. The rails were held together with splice plates, which had one splice plate with a square boss on the underneath side that fits into a square hole in the saddle to hold the rail in position lengthwise.

d. The east side crane rail was roughly aligned (± 1/32") from the piano wire before starting to level the rails. The Wild precision level was set on a bracket clamped to the supporting steel and focused on a lighted target placed on top of the crane rail over the saddle nearest to the bench mark. The crane rail at this point was set (± .005") to the proper elevation, and at the same time the level of the rail crosswise was checked with a Starrett 12" precision level. The rail was then clamped to the leveling jack screws. The final alignment of the rail was done concurrent with the leveling.

e. When the crane rail at the first saddle had been set level at the proper elevation (± .005"), the balance of the east rail in the precision area (the area over the silo) was set and aligned at each saddle. It was found necessary to clamp the rail on the leveling jack screws at 10 saddles at all times. This completed the leveling and alignment of the east rail in the precision area.

f. The west rail in the precision area was then roughly aligned (± 1/32") parallel to the east rail. The Wild precision level and its supporting bracket was clamped to the west rail supporting steel and focused on the lighted target placed on the east rail over the saddle nearest the bench mark. The lighted target was then transferred to the west rail and placed over a saddle approximately the same distance from the Wild precision level. The west rail at this point was then leveled and aligned (± .005") to the same elevation as the east rail. The distance between the rails was checked with a 100' stainless steel tape.

g. The balance of the west rail in the precision area was then leveled and aligned (± .005") fo procedure outlined for the east rail. The between rails was checked at 5' intervals.

h. The balance of the east and west rails whic in the precision area was leveled and align a tolerance of (± 1/64")· which was conside ate enough for the operation of the crane.

i. After completing the leveling and aligning o and west crane rails, the Wild T1 Theodolite on top of plenum chamber and the instrument l sight adjusted to coincide with the "Y" axis. "Y" axis was extended to the east and then to west crane rails. At these locations a line w scribed. This line was used as a point for se the drive racks for the crane and for setting t crane bridge parallel to the "Y" axis.

j. The crane drive racks were in 5' sections and we doweled in position with 3/8" diameter dowels. tooth pitch of the racks was aligned with one an using a gage fabricated for this purpose.

k. This completed the leveling and alignment of the r and racks.

4. Installation of Crane (High Elevation)

a. After the component parts had been assembled to the crane bridge and trolley, the trolley was lifted off the bridge and placed on wood blocks on the floor. The crane bridge was then lifted up to the high elevation and placed on the rails and the drive gears meshed with the drive rack A special adaptor was installed on the crane drive motor to temporarily drive the crane with a large air motor.

b. The crane was moved to he precision area where the extended "Y" axis had en scribed on the east and west rails. The crar drive wheel centerline was checked for being pa lel with the "Y" axis on th rails. The west en f the crane was found to be 3/16" off parallel he west end of the crane was jacked up and the ve gear jumped one tooth, and then it was lower nd the crane bridge adjusted until the drive v l centerline was parallel to the "Y" axis.

The drive t was temporarily doweled and the crane bridge w oved approximately 20' away from the "Y" axis, returned; the alignment was checked, and the crane dge backed off and returned again. In both case alignment was checked and found to be satisfac

c. The trolle ls were then checked for being parallel to the "Y" after which it was checked for levelness.

d. The crane was returned to the area where the lifting gear was installed and the trolley lifted into place on the bridge. The crane was then returned to the "Y" axis for the alignment of the mast base plate.

e. A #13 piano wire was stretched across the mast base plate in alignment with base plate centerline which was parallel to the "X" axis. The Wild Tl theodolite was set on top of the plenum and the instrument line of sight adjusted to coincide with the "X" axis. The instrument was then focused on the piano wire on the base plate. Next, the base plate was adjusted until the centerline coincided with the "X" axis. The base plate was bolted and doweled in position and the alignment rechecked. The crane was then moved to a position over the staging which had been erected for the assembly of the masts. After assembling the masts, the crane was returned to a position approximately 10' from the silo so that masts could be checked for vertical alignment with the Wild Tl theodolite. They were set to a vertical plane and re-checked with the theodolite.

f. The movement of the supporting steel when the brakes were applied on the crane was checked by clamping a 6" steel scale on the east rail and setting the Wild Tl theodolite on the floor. The instrument was then focused on the scale and the amount of movement was determined optically. The amount of movement was 3/32".

5. Alignment of Probe Pins

a. Since the precision straight edge, which was to be used in conjunction with the probe pin setting gages, did not arrive at New York Ship in time to be used, the Wild Tl theodolite was used in lieu of the straight edge to align the setting gages.

b. The probe pin setting gage was placed in its mating tube and the instrument line of sight adjusted to coincide with either the "X" or "Y" axis, and then the base of the setting gage was set parallel with the "X" axis using a 6" scale as a target. The probe pin setting gage was then locked in place. The probe pin was set by reading the indicators on the setting gage.

c. This completes the work on the precision crane on Building #10.

N. "C" Unit Bottom Tube Sheet Monitor Pin Locating Slot Gages.

a. Development and Procurement

The Design Division changed the three monitor pin slots drilled in the I.D. of all BTS large tubes to three Vee slots pre-machined in stainless steel strips and spot welded to the O.D. of "C" B.T.S. large tubes. This design change brought about the need for two additional gages. One to check the depth of a slot referencing from the bottom tube end and another gage to check the orientation of the three Vee slots referencing from the units "Y" axis.

A detail sketch of each gage was made by the du Pont Inspection Department and submitted to the New York Ship machine shop for fabrication. After the two gages were fabricated, they were inspected and found to meet all requested specifications.

b. Use of gages

1. Functional gage for checking Slot Depth

After one Vee slot strip had been spot welded to the O.D. of each "C" B.T.S. large tube, the three Vee slots on each strip were checked for depth using a functional gage of the type shown on the left had side in photo serial #374. The key on the gage was machined to a nominal size as shown on du Pont drawing W134132-R11. Since the Vee slot strips were pre-machined to depth and width, inspected and accepted before spot welding to the tubes, it was only required to check the depth of the slots referencing from the bottom face of all large tubes.

For measuring purposes, the functional gage was used in the following manner:

(a) First, calibrate the gage. This is done by setting a depth micrometer to read .234". Place the micrometer's spindle perpendicular to the bottom side of the key's housing and orient the face of depth micrometer such that it depresses the bottom end of the key. The dial indicator plunger is now registered to the top end of the key. Set the dial indicator to read "zero". The gage is now calibrated and ready for use.

(b) Insert the barrel of the gage into a large tube and align the bottom of the key in the slot and check to see if it is seating properly. The key is then seated in the slot firmly by applying a slight downward hand pressure on the key.

(c) Record reading as Plus (+) or minus (-) so many thousandths from the zero setting.

(d) Analyze results:

Results are analyzed keeping two things in mind; namely,

(1) minus (-) reading means slot depth is deep.

(2) plus (+) reading means slot depth is shallow.

Photo Serial 373

New York Shipbuilding Corp.
Camden, New Jersey
May 18, 1954

PROJECT 8980 - SAVANNAH RIVER PLANT

The "[illegible]" Unit bottom tube sheet orientation gage is shown in the foreground. This gage is used for checking the orientation of three monitor pin Vee slots pre-machined in strips spot welded to the O.D. of large tubes. All angular measurements are referenced from the tubes "Y" centerline.

The functional gage for checking the depth of each Vee slot is shown in the background.

See section "F" of this manual for discription and use of the above two gages.

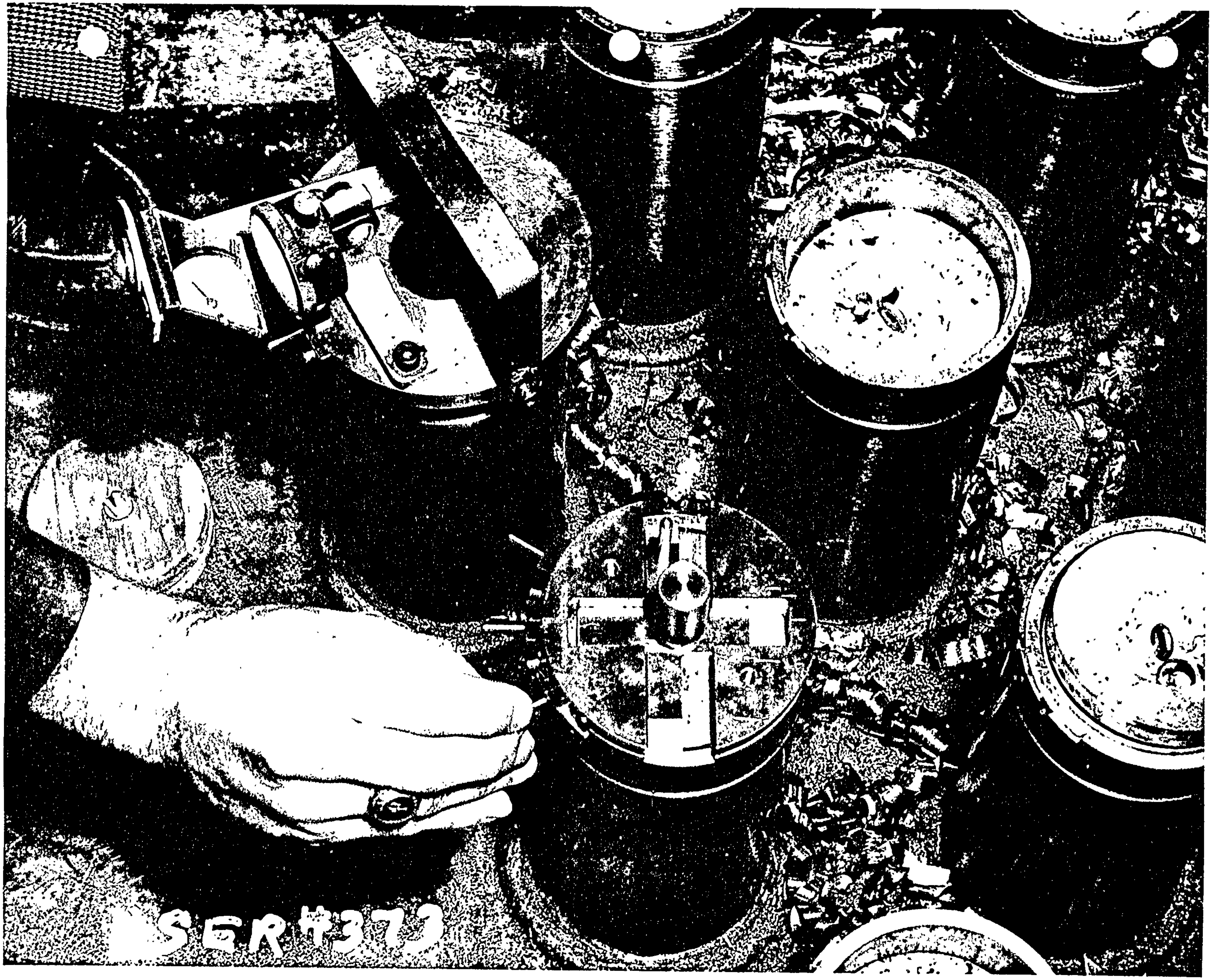

SER#373

Photo Serial 374

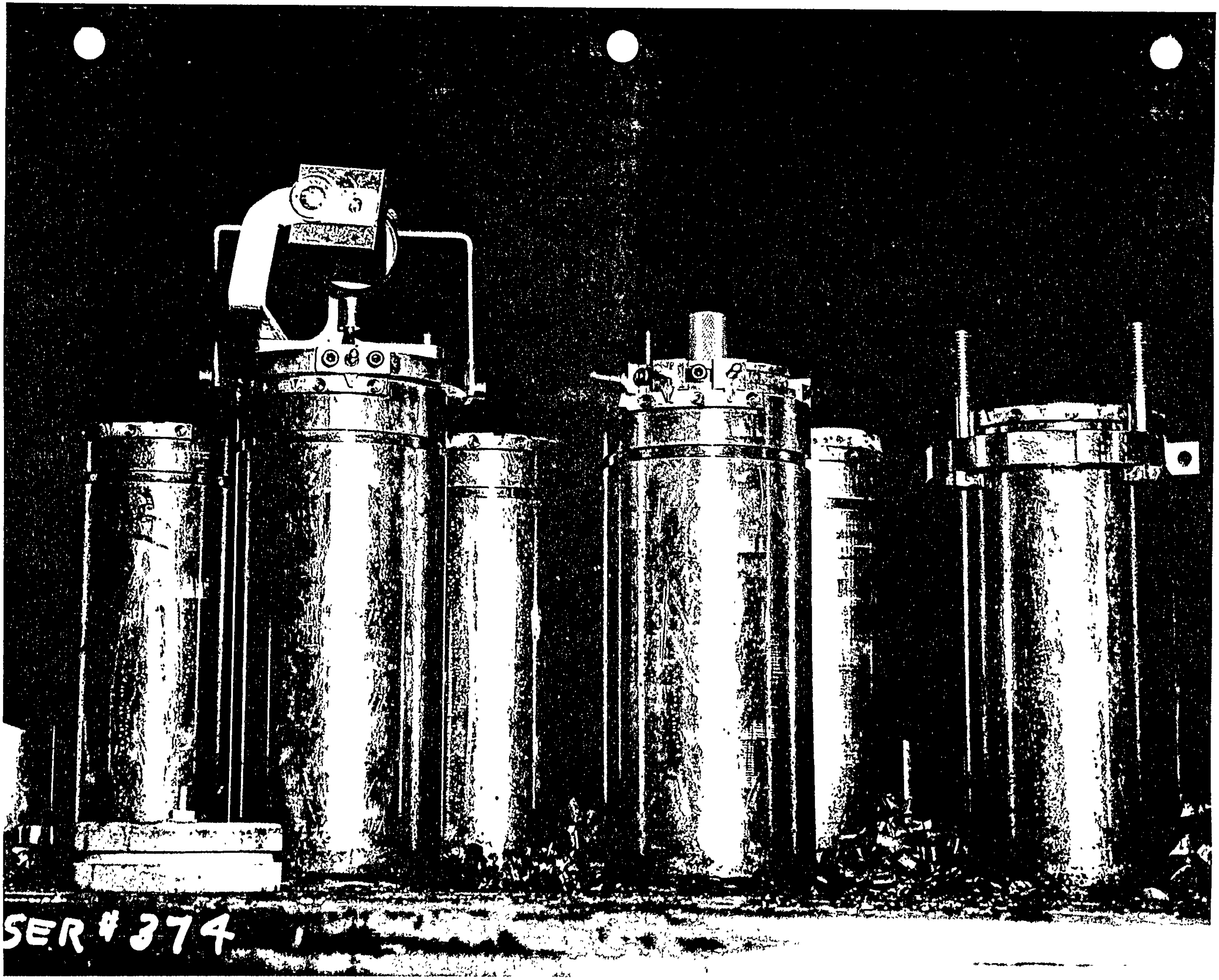
New York Shipbuilding Corp.
Camden, New Jersey
May 16, 1954

[illegible] 6980 - SAV[illegible]

A side view of "C" Units Bottom Tube Sheet Monitor in functional gage is shown on the left and in position for checking slot depth.

A side view of [illegible] Unit's bottom tube sheet monitor pin orientation gage is shown in the center and in position for checking angular location of a Vee slot with respect to the tubes "Y" Axis.

On the right is a [illegible] split retainer ring (half-section) positioned in its proper location for checking clearance between the two upright studs and monitor pin Vee slot strip.


SER #374

Design specified a tolerance of + .000" - .010". Using positive or negative readings read directly from the gage dial indicator, final results compared with Design's tolerance is direct and no signs (+, or -) are to be changed. For example, a dial indicator reading of + .002" would mean the slot is .002" shallow. A reading of -.008" would mean the slot is deep by .008" referencing from the zero setting. In the first case, the slot is .002" over the specified tolerance and in the latter the slot is .008" under tolerance which is within the -.010" specified tolerance.

Before inserting the gage into a tube, the following items should be checked:

(a) Check to see if all strips are flush with the bottom tube ends before inserting gage. This is necessary since the face of the functional gage will ride the top edge of the strip and hence, an erroneous reading will result.

(b) Before inserting the functional gage into a tube, it is imperative that the large tube end and I.D. be de-burred and thoroughly cleaned (preferably with F.O. 128), as the presence of any foreign material will give an erroneous dial indicator reading.

2. Orientation Gage

This gage is used for measuring the angular position of each Vee slot with respect to a reference line scribed on the face of each tube end. These secondary or reference lines were established using the following outlined procedure:

(a) Unit X & Y axes are established (for method of establishing these lines, see Part II-A, Section 13).

(b) An 18' straight edge is aligned coincident with the unit "Y" axis. For position in which straight edge is placed on top of unit, see Part II-A, Section 13, Photo Serial #53.

(c) A planer gage is set to 3.500" - theoritical distance from center of tubes in "Y" axis to adjacent row of tubes. This gage is used for scribing all tube ends.

(d) After planer gage is set, lines are scribed on tube ends in row Y29.

(e) Straight edge is then positioned on row Y29 and aligned coincident with line just scribed. The above procedure is repeated for row Y30. This procedure is followed until all tubes in Y_1 direction are scribed with center lines.

(f) The straight edge is then turned with "face" toward X_2 and the above procedure repeated.

After reference lines have been scribed on the top f all tubes, measurement of Vee slot angular deviation ow be readily performed. The barrel of the plug type is lowered into the tube until the 3 keys are properly d in their respective slots. The positioning bar (both is adjusted to coincide with the tube end centerlines ngular deviation is then read directly from each key, ise or counter-clockwise, whichever the case may be. hoto Serial #373) The inside graduation on the gage r ents 1° deviation each way. Should one slot be off m han 2°, the deviation of the others cannot be read wi removing the interfering key. Tolerance on Vee sl s ± 1°. The same care must be likewise exercised in re to cleanliness of tube bore and slots prior to using gag measuring purposes.

O. Func il Gages

ational requirements of the production units for close rances in the plenum - top tube sheet assembly tube (resulted in the use of functional gages. These functi gages were used for determining the alignment betwee plenum tube bore and corresponding top tube sheet tube bo o that the operating element will pass through the tub res with no interference. These gages were designed the Design Division and procured by the M & E Section consisted of rods or cylinders which could be inserted o the appropriate tubes.

Three zes of gages were called for: A rod tube gage with a low diameter of 1.271" and upper shoulder diameter of 1.484"; large tube gage with lower diameter of 4.330" and upper s lder of 4.365"; and a second large tube gage with the sa lower diameter as the preceeding one but a 4.375" shoul r diameter. The latter gage was used after final honing the tubes.

Though n required by specifications, du Pont inspectors used gag with a 4.378" shoulder in their final inspection sh ting to the 4.375" gage when binding was encountered

The rod ub functional gage was first fabricated from carbon steel t bing, chrome plated. However, during use it was discovered hat this type gage was somewhat flexible. It was finally nt after forcing the gage by hand into finished bored r tube holes that were not concentric. As a result of this, t was suggested by a member of the M & E Section that a new od tube functional gage be fabricated from a solid piece carbon steel bar stock, chrome plated. Two of the solid typ functional gages were made and substituted for the orig al hollow type which was later scraped. At a later date, a mem er of the Design Division procured an improved model fabricat d from "Elastus" - trade name of material supplied by Hor ce T. Potts, Phila., Pa. - which according to specificatio s was more rigid and required a larger bending movement to distort the gage during use. The large tube functional gages were fabricated from carbon

carbon steel, chrome plated. The gages were procured from the Chaumont Manufacturing Co., Glendora, New Jersey, and the Wilmington Shops.

The rod tube functional gages (total of 3) were assigned equipment piece number 790-64. From fabrication details, see du Pont drawing D112706. The large tube gages (total of 6) were assigned equipment piece number 790-30. For fabrication details, see du Pont drawing D112621.

A complete story and pictorial illustrations on the use of functional gages discussed in Part VII, Section I.

P. List of Commerical Gages and Tools used by Inspectors at New York Ship

Amount	Description
1	Profilometer Head & Arm
1	Precision Camera, Motor and Table (Tube Pattern)
1	3/4" O.D. Boroscope, Regulator & Target
34	Federal Dial Indicators (1" Travel (.250 Travel (.001" Grad
11	Standard Bore Gages (#5 - 3-3/32" to 6-1/8"; #2 - 1" to 1-17/32")
1	Small Boroscope, 1/4" O.D. x 3 Ft.
1	2" to 6" Starrett O.D. Micrometer.
1	5" to 6" Starrett O.D. Micrometer
1	4" to 5" Starrett O.D. Micrometer
2	3" to 4" Starrett O.D. Micrometer
2	2" to 3" Starrett O.D. Micrometer
1	1" to 2" Starrett O.D. Micrometer
1	0 to 1" Starrett O.D. Micrometer
1	1-1/2" to 12" I.D. (Lufkin) Micrometer
2	Starrett 12" Bench Levels
2	Starrett I.D. Micrometer 2" to 8"
1	Starrett 100' S/S Tape
2	Starrett 25' S/S Tape
1	1-1/4" to 2-1/8" Starrett Telescope Gage
1	2-1/8" to 3-1/2" Starrett Telescope Gage
1	1/2" to 3/4" Starrett Telescope Gage
1	.400" to .500" Starrett Hole Gage
1	.300" to .400" Starrett Hole Gage
1	B & S Depth Micrometer 0 - 1"
1	Starrett Planer Gage
1	Starrett 12" Surface Gage
1	Etching Machine
1	100' Lufkin S/S Tape
2	Starrett Dial Indicator Gage Sets
1	Fell Precision Level
2	Blue Point See-ee-Zee Mirror
1	4" to 40" Lufkin I.D. Micrometers
3	Magnifying Glasses
1	B & S Hermo Calipers
1	6" Starrett I.D. Calipers
1	0" to 1" Spec. Offset Micrometers
1	1" to 2" Ligament Gage
1	2" to 3" Ligament Gage
1	3" to 4" Ligament Gage

Amount	Description
1	.3745" Go & .4688 No Go
4	General Electric Halide Leak Detectors
1	Set Trammel Points
1	Picker X-Ray Intensifier
1	G.E. Fluoroline (X-Ray Viewer)
1	Zyglo Equipment
1	Dy-chek Equipment
1	Ferroxyl Test Kit
1	Drafting Table & Suitable Drawing Equipment
	Suitable Ring Gages to set Bore Gages

REPORT
OF
MATERIAL & EQUIPMENT SECTION'S ACTIVITIES
AT
NEW YORK SHIPBUILDING CORP. DURING FABRICATION
OF
AXC 167 1/2

STARTING MAY 18, 1951

PART V

BY: JAMES RAY STEWART

DEC. 15, 1953

CONTENTS

PART V

PROCESS ROOM HOLDING RACKS - "R", "P", "L", "K", "C" UNITS

CONTENTS (Continued)

CHRONOLOGICAL LIST OF ILLUSTRATIONS

CHRONOLOGICAL LIST OF ILLUSTRATIONS (con't)

DRAWING LIST FOR "R" & "P" PROCESS ROOM HOLDING RACKS (EQUIPMENT PIECE #179.1)

The following list covers all vendor take-off drawings pertaining to fabrication of "R" and "P" process room holding racks.

Since American Machine and Foundry drawings (approved by du Pont Design) did not show all fabrication details, it was necessary for New York Ship to prepare their own drawings. Likewise, the M and E Group used these drawings for final inspection purposes.

This list was prepared from existing drawing files located in the M and E Office at New York Ship on November 21, 1953. New York Ship drawings are listed by number, revision number and title.

N.Y.S. Drawing Number	Revision No.	Title
8212-1	3	General Arrangement
8212-2	0	Container
8212-3	0	Tank Bottom
8212-4	0	Anchor Bolt Locations
8212-5	0	Mounting Plate
8212-6	1	Rack Plate and Tube Assembly
8212-7	0	Holding Rack Assembly
8212-8	0	Rack Plate
8212-9	0	Probe Holder Long
8212-10	3	Plug and Muff Tube
8212-11	3	"S" Rod Tube
8212-12	4	Permanent Sleeve (Weldment) Top End Fitting ("S" Foil)
8212-13	4	Permanent Sleeve (Weld)
8212-14	2	Permanent Sleeve (Weld)
8212-15	0	Plug and Muff Tube
8212-16	0	"S" Rod Tube & 35W5 Rod Tube
8212-17	0	Crane Drip Pan Collector Assembly and Details
8212-18	0	Support for Testing Molding Rack

DRAWING LIST FOR "K", "L", AND "C" PROCESS ROOM HOLDING RACKS (EQ. PC. 179.3)

The following list covers all du Pont drawings pertaining to the fabrication of "K", "L", and "C" process room holding racks.

This list was prepared from existing drawing files located in the M and E Office at New York Ship on November 21, 1953.

Du Pont drawings are listed by number, revision number and title.

Du Pont Dwg. No.	Revision No.	Title
W-160289	0	Crane Drip Pan Collector Assembly and Details
W-160291	0	Holding Rack Arrangement
W-160300	0	Rack Plate and Tube Arrangement
W-160307	0	General Arrangement
D-110320	0	Mounting Plate
D-113105	0	Permanent Sleeves, Sheet #2
D-113106	0	Plug and Muff Tube and 35W5 Rod Tube
D-113107	0	Permanent Sleeves, Sheet #1
D-113108	0	"S" Rod Tube and Sleeve Tube
D-113109	0	Permanent Sleeves and Top End Fitting (S-Foil)
D-113110	0	Probe Holder, Long
D-113111	0	Tank Bottom
D-114244	0	Rack Plate
D-114246	0	Container

V. Process Room Holding Racks - "R", "P", "L", "K" and "C" Units

I. General Design and Fabrication Specifications

The five process room holding racks designated as "R", "P", "L", "K" and "C" units were designed by E. I. du Pont and the American Machine and Foundry Company, Buffalo, New York. All assemblies are alike except for minor details.

After surveying the facilities and work schedules of several fabricators, it was initially decided by du Pont that F.F. Slocomb Company, Wilmington, Delaware, would be awarded the contract for fabricating all five holding racks in accordance with the specifications furnished by du Pont. Du Pont would purchase, expedite, and inspect the material required to fabricate the holding racks. Orders were placed on various material suppliers for stainless steel plates, tubes, etc., with instructions to ship the material to the F. F. Slocomb Company.

At a later date it developed that the F. F. Slocomb Company would not fabricate the five holding rack assemblies.

Du Pont Design and M and E Inspection Group: contacted New York Ship and asked New York Ship if they would fabricate the five process room holding racks providing du Pont furnished the material. In turn, New York Ship agreed to fabricate the first two holding racks. These were designated as "R" and "P" units.

Several factors were in du Pont and New York Ship's favor pertaining to the fabrication of the five assemblies. In the first place, du Pont had an inspection force located at New York Ship to cover the inspection during the fabrication of the main process units. Gages and other instruments that had been designed for inspecting the main process units could be readily adapted to inspecting the holding rack assemblies. In other words, many of the steps required for inspecting the holding rack assemblies would be similar to the steps required in performing the inspection on the main process units. On the other hand, New York Ship pointed out that they could use part of the working force, including their Engineering Department, normally assigned to the main process units for fabricating the holding racks.

Nevertheless, du Pont told New York Ship that they had authorization to fabricate two holding rack assemblies. Du Pont instructed F.F. Slocomb to ship the material they had on hand assigned to holding racks to New York Ship. A list of all of this material was furnished to New York Ship by du Pont. Du Pont granted permission to New York Ship to purchase the additional material required for all five holding racks. It was evident that New York Ship might receive the contract for fabricating the last three holding racks. These were designated as "L", "K" and "C" Units.

To best adapt the American Machine and Foundry Company and du Pont drawings to New York Ship fabricating technique, New York Ship asked du Pont for permission to make their own shop drawings. Permission was granted on the basis that all New York Ship drawings had to be presented to du Pont and American Machine and Foundry Company for their approval. Agreement was reached on this basis and all drawings covering the first two units were drawn up and assigned New York Ship drawing numbers.

In conjunction with the revision and make-up of the drawings at New York Ship, du Pont specified that New York Ship would have to comply with any special instructions issued by du Pont and the American Machine and Foundry Company. Static head testing was waived at New York Ship with the provision that it would take place at the Savannah River site; based on this New York Ship would ship a unit in two sections properly prepared for field welding the two sections at Savannah River. In addition, final cleaning of all units would take place at Savannah River.

Support fixtures, for the final fabrication of a holding rack at Savannah River, were fabricated at New York Ship. New York Ship shipped the first support fixture to Savannah River on May 21, 1953.

All welding for the holding rack weldment had to be inert gas shielded arc welding, either non-consumable tungsten electrode or consumable stainless steel electrodes or coated electrode arc welding.

It was further specified that New York Ship should fabricate all units in accordance with du Pont cleanliness specification #3056. This involved sandblasting, passivating, and ferroxyl testing of all stainless steel surfaces.

On July 16, 1953, du Pont authorized New York Ship to fabricate the three holding racks, equipment piece numbers 179.3-L, 179.3-K and 179.3-C. These were in addition to the two authorized on March 23, 1953, and assigned equipment piece numbers 179.1-R and 179.1-P.

Later, du Pont authorized New York Ship to use stainless steel tubes which did not meet the minimum specifications for the main 100 Area process units. A special inspection procedure was written for inspecting the excess tubes on hand at New York Ship. The following is a list of these inspections:

1. The O.D.'s of all tubes had to be checked with outside micrometers.

2. The I.D.'s of all tubes had to be checked top, center and bottom with a bore gage. Any out-of-roundness, as long as the major diameter is within B/P specs., it is acceptable for tubes to be reamed after installation.

3. Overall length of all tubes had to be checked with a steel tape.

4. Straightness of all tubes had to be checked by laying each tube on a surface plate and checking with feeler gages.

5. Concentricity of the I.D. to O.D. and run out of all tubes had to be checked by measuring the wall thickness at each end of the tube with a ball micrometer.

6. All lugs, slots, cutouts, etc. had to be checked for size, location and finish.

7. All tubes had to be checked for correct finish.

8. All welding had to be visually inspected for soundness.

Due to the fact that it was discovered that many of the excess tubes did not meet the above tube specifications, the M and E Inspection Group contacted the Design Division for their opinions. In turn, the Design Division relaxed the tube tolerances, and as an example, A. E. D. and Design agreed that tolerances of plus .032" minus .005" was acceptable for the I.D. of the excess tubes.

Even though the original American Machine and Foundry drawings were revised and re-issued with New York Ship drawing numbers, the du Pont Design Division decided that the last three holding racks would be fabricated to du Pont drawings. As a result of this decision, New York Ship made auto positives and twelve copies of each drawing and forwarded them to the du Pont Design Division.

Among the problems confronted by du Pont and New York Ship in fabricating the five holding racks was the type of lead used in the racks. The drawings for the five holding racks called for type ASTM B-29 chemical lead. However, New York Ship used type ASTM B-29 Grade A common desilverized lead "A" for the "R", "P" and "L" holding racks. The du Pont Design Division agreed to accept the substitution with the stipulation that ASTM B-29 chemical lead be used in "K" and "C" units.

The pertinent facts relating to heat numbers probe pin location, mounting plates, concrete specifications, dimensional tolerances, etc. have been discussed in detail in other sections covering the fabricat assembly and testing of the five holding racks.

II. "R" and "P" Holding Racks

A. Tube Nest Inspections

1. Pre-assembly Inspection of Tubes

All tubes (a total of 41 tubes identified by drawings NYS 8212-1, 8212-6, 8212-10, 8212-11, 8212-12, 8212-13, 8212-14, 8212-15 and 8212-16), were inspected prior to assembly. Inspection consisted of a complete dimensional check, determination of surface finish, and examination of circumferential butt welds on those tubes which were welded.

The dimensional check consisted of measuring tube outside diameters with micrometers. Inside diameters were checked using a plug gage machined to the required tolerance, depending on which type tube was being checked. All other dimensions were measured using a scale of the required length graduated in 1/64". Surface finish (RMS) was determined by feel.

The tubes that were butt welded together were visually inspected for undercutting, porosity, cracks and other defects.

All tubes were found to meet dimensional and surface finish specifications. Visual examination of tubes butt welded together revealed that welds were completely penetrated and of a sound quality.

2. Rack Plates and Probe Holder (See NYS Dwg. No. 8212-8 and 8212-9)

The holes in the rack plates (2/unit and identified as plates A & B) were jig drilled; therefore, only one tube sheet for each unit was given an overall and detailed dimensional inspection. All bore sizes were measured using inside micrometers. Hole locations with respect to plate edges and to each other were measured using a 25' stainless steel tape graduated in 1/16". All dimensions were found to meet drawing tolerances, and the inspected plate for each unit was positioned over its mating rack plate and the alignment of the two plates in each case was checked visually and found to be satisfactory.

The probe holder plate was likewise given an overall dimensional inspection followed by a secondary inspection during assembly of the probe holder to tube nest. This inspection in both cases consisted of measuring the plate with a scale graduated in 1/64". Results of these dimensional inspections were in accordance with blueprint specifications.

Upon completion of the above dimensional inspections, the rack plates and probe holder were sandblasted, acid washed and ferroxyl tested. Results of ferroxyl testing and visual inspection indicated plates were free of rust, free iron and surface defects.

3. Assembly of Tubes in Tube Nest

Rack plates and tubes were assembled in a manner similar to that for process units. However, an additional jig plate at top end of tubes was used to help setting of tubes to align Vee slots, and to maintain required verticality during tacking and welding. (See photo Serial #250). After installing shoulder tubes and assembling rack plates and bolting the box type carbon steel jig shown in photo serial #250, the top plate was then leveled using the Wild N111 Precision Level and target (Procedure for using this instrument is discussed in Part III, Section J). The top plate was leveled within a range of .005" to .012", based on readings taken at each corner and a reading at the center of the top plate. Holding the plates level within this range, they were adjusted in such a fashion as to provide optimum verticality of shoulder tubes. Verticality of shoulder tubes were checked concurrent with leveling and shifting of plates until tube verticality ranged from 0 to .008" per foot. Four shoulder tubes were involved in this adjustment.

After the above condition was satisfied, the remaining tubes were assembled into the plates, and the location of tubes was checked to insure that each type tube was placed in its proper location. All tubes were in their proper location. (See photo Serial #314)

Next, the parallelism of the Vee slots on the "C", "D", "E" and "F" tubes were checked. This inspection was made by first establishing the fact that two tubes on the center-line were oriented such that the Vee slots were in tolerance. A straight edge was then employed, and referencing from the two original tubes, it was found that all Vee slots were in the 1/32" parallelism alignment tolerance. This was accomplished after some adjusting. Size of the slots were also checked using a 6" scale graduated in 1/64". All were found to be within tolerance.

Before welding tubes to plates, the distance from the top ends of all tubes to top of rack plate was checked. This inspection was done using a straight edge and 6' scale graduated in 1/64".

Tubes were tack welded and then visually inspected for undercutting and found satisfactory. After this the tubes were fully welded to the top and bottom rack plates. Welds were visually inspected for undercutting, pinholes, cracks and other mechanical defects. Welding was considered satisfactory.

The "R" Unit was re-leveled (using the top plate as a reference plane) within .018", and verticalities of twenty-eight (28) representative tubes were taken. (For use of verticality gage, see Part III, Section "L"). Verticalities were found to be within the range of .001" to .025" per ft. This was considered satisfactory.

The "P" Unit was re-leveled within .008", and verticalities of eight (8) representative tubes were taken. Verticalities were found to be within the range of .0005" to .0195" per ft. This was considered satisfactory.

After the units were leveled within the ranges stated above, all tube bores were reamed in an area adjacent to the tube weld. This was done to produce a round bore of proper size as welding tends to shrink the tube in the area adjacent to to the tube weld. (See photo Serial #331)

Upon completion of the "neck" reaming operation, the tube bores were checked in the following manner:

a. Tube in positions 2, 3, 4, 5, 8, 9 and 10 (see Dwg. No. HYS 8212-1), were functional gaged with a 4.375" diameter functional gage. All accepted the gage for the entire length after minor repairing.

b. Tubes in positions 1, 6, 7, and 9 were checked with a standard dial indicator bore gage. After minor repairing it was found that these tubes met drawing bore size tolerances.

c. The top 3" in the four rod tube bores were checked with a profilometer to determine if the 63RMS had been maintained. They were all satisfactory.

d. All tube bores were visually inspected for evidences of scratches, gouges, etc., and accepted.

4. Fitting of Tube Nest to Container

With the tube nest placed in the container and the assembly resting on a level platen, level readings were taken on the top edge of the container at each corner using the Wild N111 Precision Level and target. (For view of container before the tube nest is placed inside, see photo Serial #333) Results indicated the container ("R") to be level within .020". Verticality readings were taken on six (6) representative tubes. Results of these readings indicated verticalities ranging from .001" to .012" per ft. For "P" unit, the container was leveled within .003". Verticality readings were taken on five (5) representative tubes. Results of these readings for "P" unit indicated verticalities ranging from .000" to .010" per ft.

After these checks the $2\frac{1}{2}$" x 3" x $\frac{1}{2}$" flange plates, (for supporting the tube nest), were tack welded into the container. The tube nest was then removed and the flange plates were fillet welded at top and bottom around the entire container. Welds were examined visually for undercutting, cracks, pinholes, and other mechanical defects. The welding was considered satisfactory and the tube nest was replaced in the container. The tube nest was fully welded to the container and then the following inspections were made:

a. The fillet weld joining the top rack plate to container and the fillet weld joining the flange plate to the bottom rack plate were visually inspected for undercutting, cracks, pin holes and other obvious defects. The welds were considered satisfactory.

b. Verticality readings on the previous six (6) representative tubes were taken and favorably duplicated within .003" to .004" per ft. with the original readings above ("R"). Verticality readings were not taken at this stage of fabrication on "P"; however, they were taken at a later date as discussed in the next section.

5. Pouring of Concrete and Lead and Subsequent Operations and Inspections

Prior to pouring of concrete and lead, the interior of the tube nest and container was inspected for cleanliness. Upon satisfaction of this inspection the concrete was poured, and care was taken to provide vibration in order that honey combing would not result. The concrete was allowed to set approximately 48 hours before pouring lead. (See photo Serial Number 316). The concrete filled the area between the top and bottom rack plates.

The container in the area in which lead was to be poured was preheated with torches. (For explanation of lead pouring, see photo serial number 320). This was done to prevent lamination due to thermal shock. Lead was then satisfactorily poured.

After pouring of concrete and lead, the tube nest was functional gaged and final bore sizes were obtained as follows:

a. Tubes in positions 2, 3, 4, 5, 8, 9, and 10 (See dwg. No. NYS 8212-1), were functional gaged with a 4.365" diameter gage. All tubes accepted the gage for the entire length after minor repairing.

b. Tubes in positions 1, 6, 7, and 9 with a standard dial indicator bore gage and ring gage. These tubes were

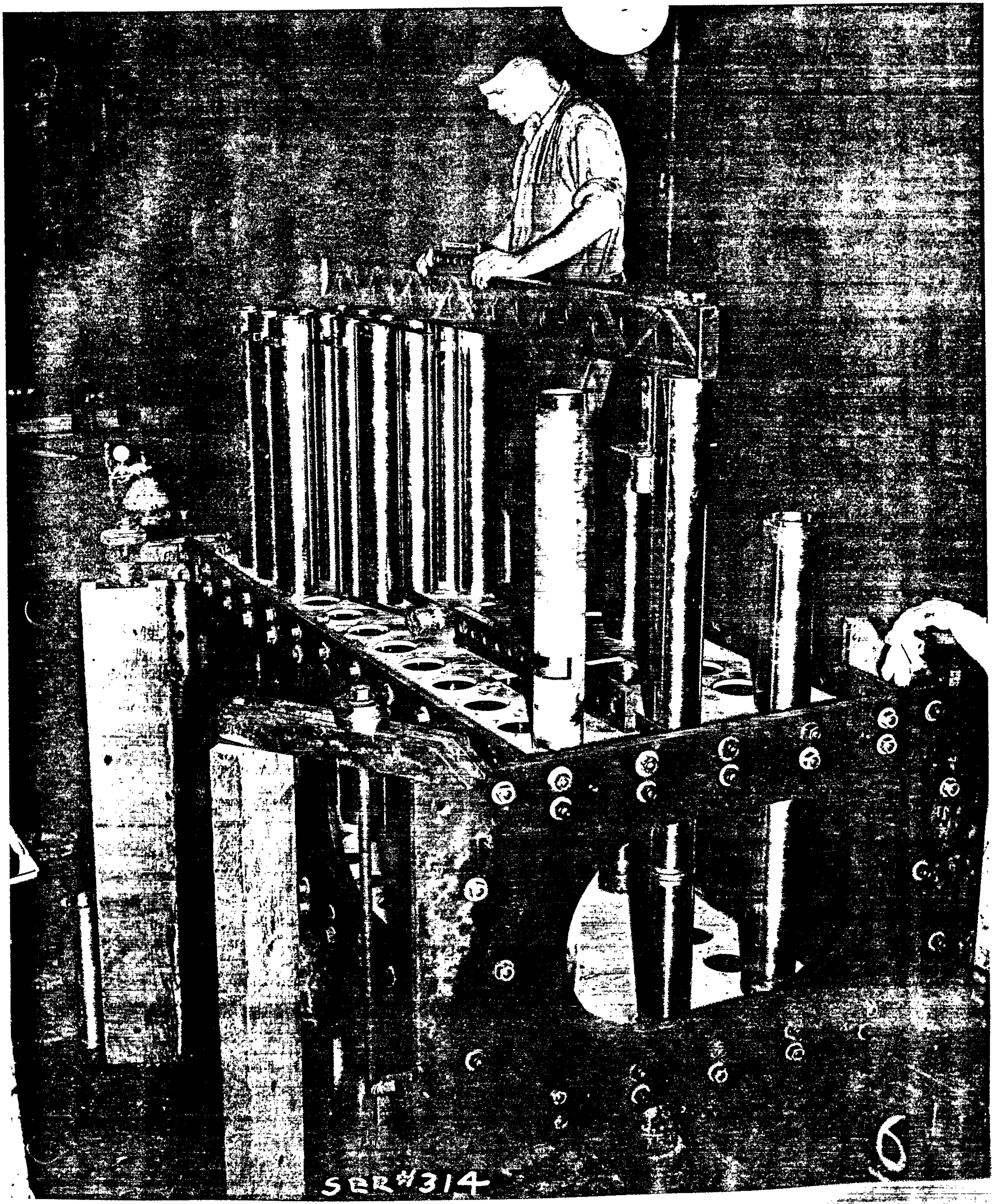
Serial Number 314

New York Shipbuilding Corporation
Camden, New Jersey
October 24, 1953

PROJECT 8980 - SAVANNAH RIVER PLANT

ASSEMBLING THE NEW UNIT BOTTOM [illegible] TUBE SHEETS AND TUBES

The tubes are fitted with the top ends in a level plane and are tacked to the inside of the bottom sheet. The tubes are welded to the outsides of the plate with 308 S/S coated electrodes.



SER#314

6

[redacted]

Serial Number 250

New York Shipbuilding Corp.
Camden, New Jersey
September 4, 1953

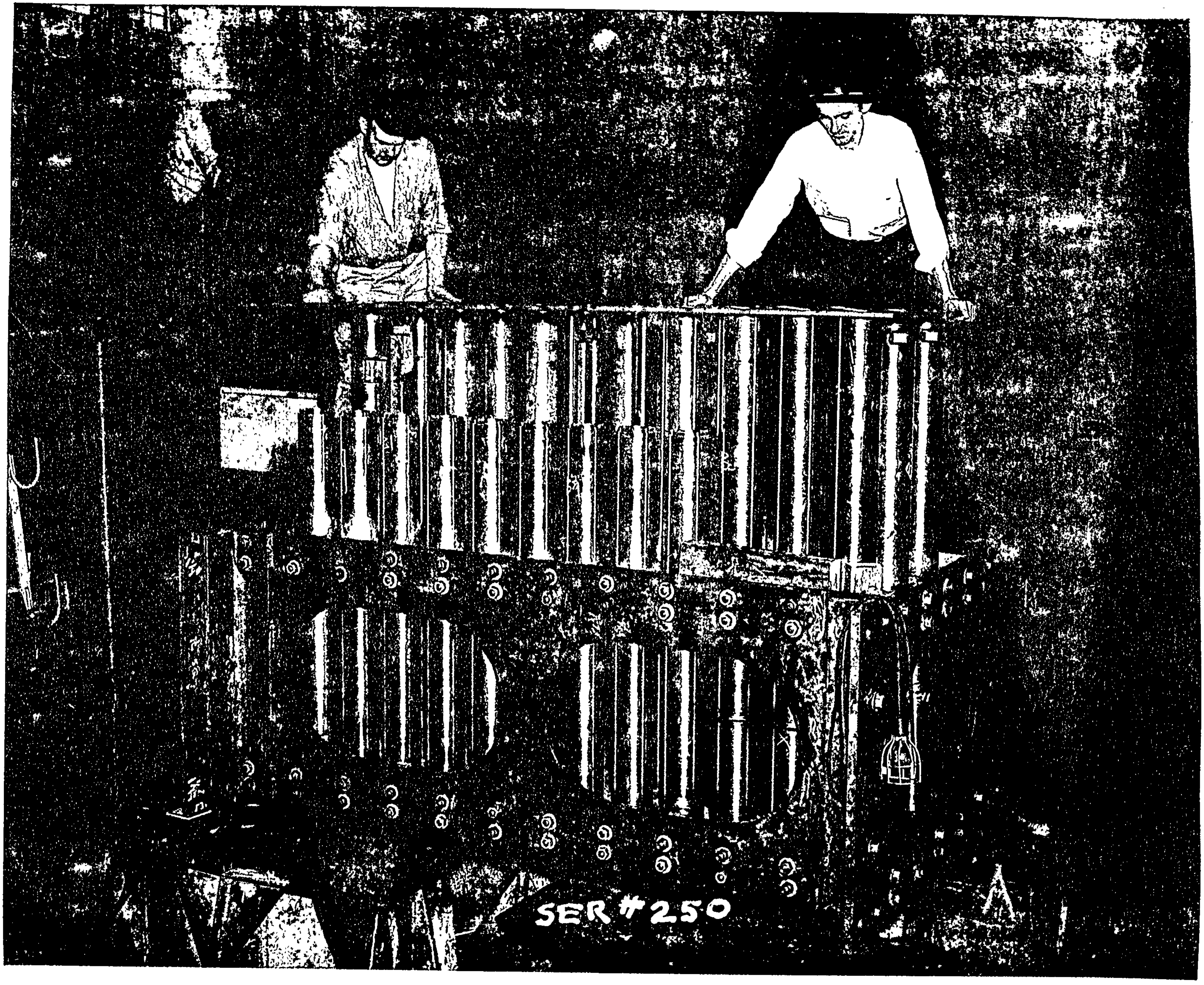
PROJECT 8980 - SAVANNAH RIVER PLANT

Holding Rack Tube Nest, "R" Unit

Tube Welding:

New York Ship mechanics are shown positioning a template for locating and holding tubes prior to tube welding. Before welding tubes to plates, the distance from top ends of all tubes to top rack plate was checked. Tubes were then tack welded and then fully welded to the top and bottom rack plates. Welds were examined visually for determination of cracks, pin holes and soundness of welds. The welding was considered satisfactory.

[redacted]


SER #250

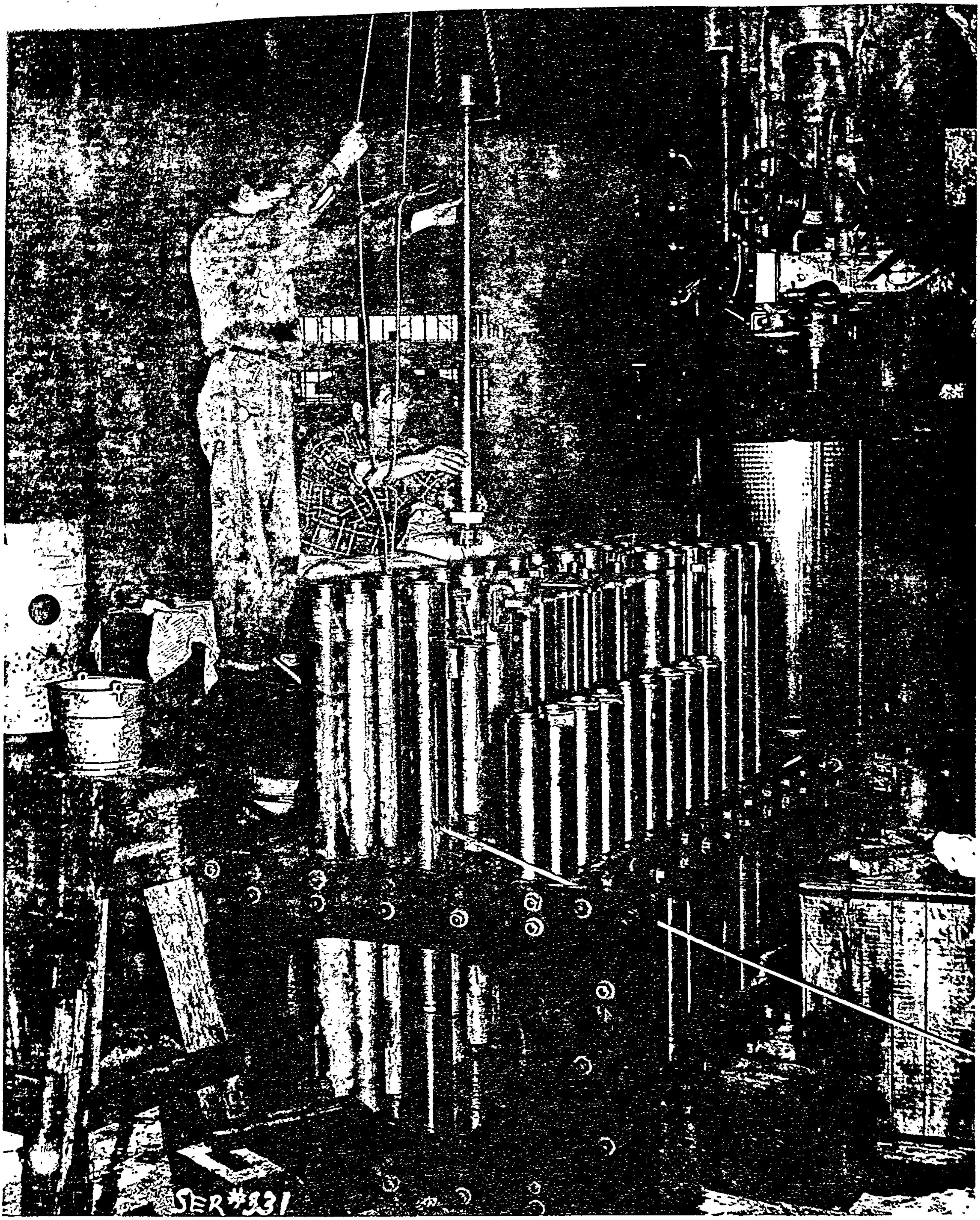
SERIAL #331

New York Shipbuilding Corp.
Camden, New Jersey
November 16, 1953

PROJECT 8930 - SAVANNAH RIVER PLANT

HOLDING RACK TUBE NEST [illegible] UNIT - NECK REAMING TUBE BORE

This view shows the holding rack tube nest and assembly jig set up to ream out the weld neck where tubes were welded to tube plates. The tubes are reamed with a Pratt & Whitney "Cam-lock" reamer on a long arbor driven by a radial drill through a floating coupling and held in alignment at the top of the tube with a Teflon bushing.



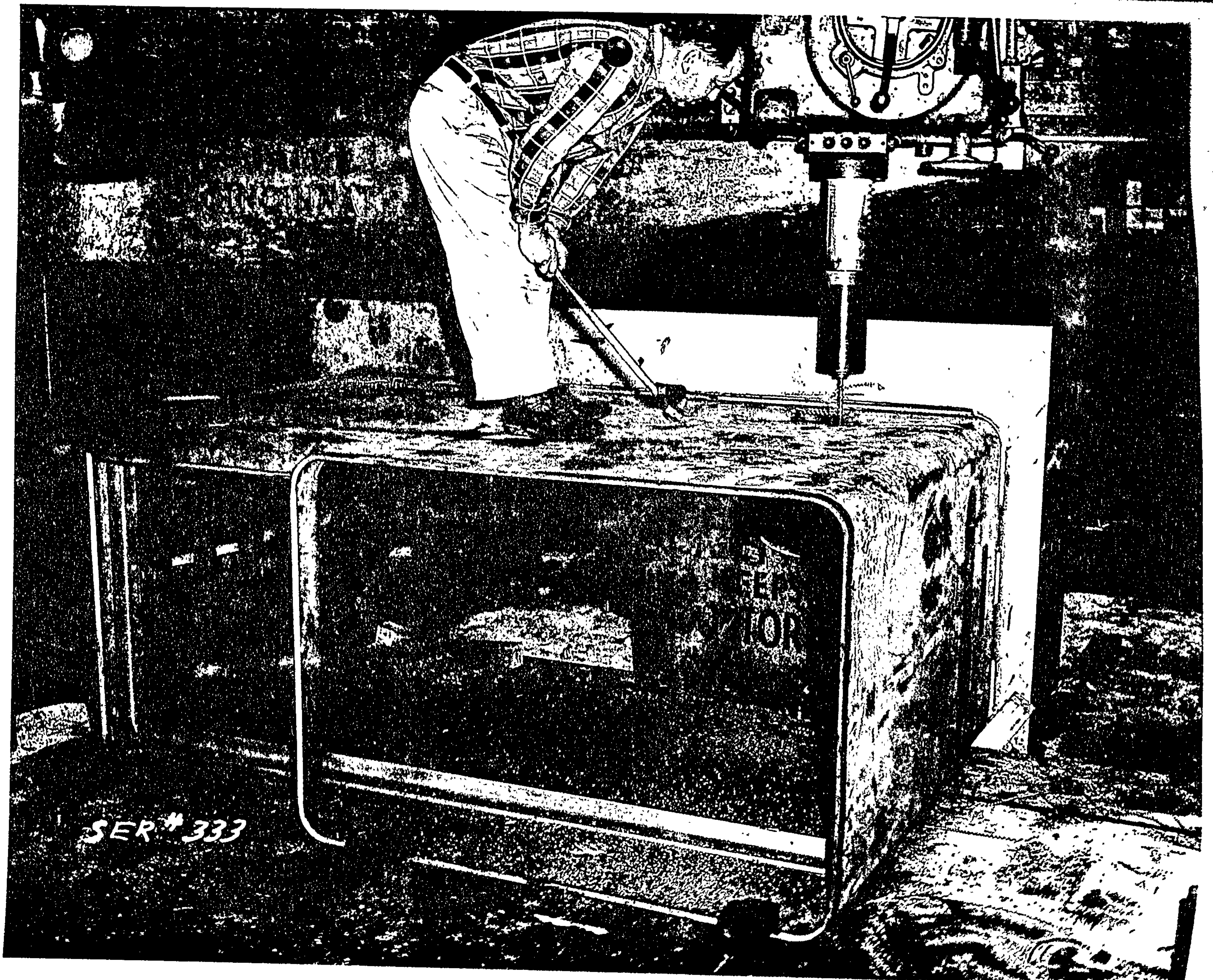
SER#331

Serial #333　　New York Shipbuilding Corp.
Camden, New Jersey
December 1, 1953

PROJECT 8980 - SAVANNAH RIVER PLANT

"K" UNIT HOLDING RACK TUBE NEST CONTAINER

The 7" X 1" slots are drilled and later chipped out.


SER # 333

accepted; however, tube bores were above minimum drawing size. Some tubes were .001" to .004" over bore size tolerance in one direction only (This latter statement pertains to "P" unit only.) "R" unit was satisfactory.

c. Bore sizes were taken on all other tubes for a depth of 18" (from top end of tubes) using a standard dial indicator bore gage and ring gage. All were found to be within drawing tolerance and accepted.

The probe pin holder plate was then installed, inspected, and found to be in proper location. This inspection was performed using a straight edge matched to the unit centerline and a scale graduated in 1/64". Using the straight edge as a reference line, the location of the probe pin holder plate edges were thus determined. Dimensional inspection of the plate itself was performed prior to installation and found satisfactory. This inspection has been previously covered in section 2 above.

Discharge process water tube and liquid level control tubes were dimensionally checked, visually inspected and examined for cleanliness. This inspection was performed using micrometers and a 100' stainless steel tape. The tubes were clean and welding was accepted. The tubes for "R" unit were 22'-1/4" long -- 4½" beyond drawing size. The tubes for "P" unit were 21'-10½" long -- 2½" beyond drawing size. This allowed the field in both cases to cut these tubes to the required length after the field weld is made.

6. Probe Pin Socket Inspection

As stated on NYS Dwg. No. 8212-7, all probe pin sockets were to be located with respect to the actual centerline of the tube it serves and not with respect to a coordinate. As calledfor on the drawing, welds for probe pin sockets were to be made with the "Nelson" stud welder.

A holding rack contains a total of thirty-seven (37) large tubes. Of these twenty-eight (28) were 5.000" in diameter and nine (9) were 4.500" in diameter. In addition to the large tubes, there were also four (4) rod tubes welded into the unit. For all tubes, both large and small, there was one probe pin socket located and welded at a stipulated distance properly oriented with respect to its companion tube (See photo Serial #353)

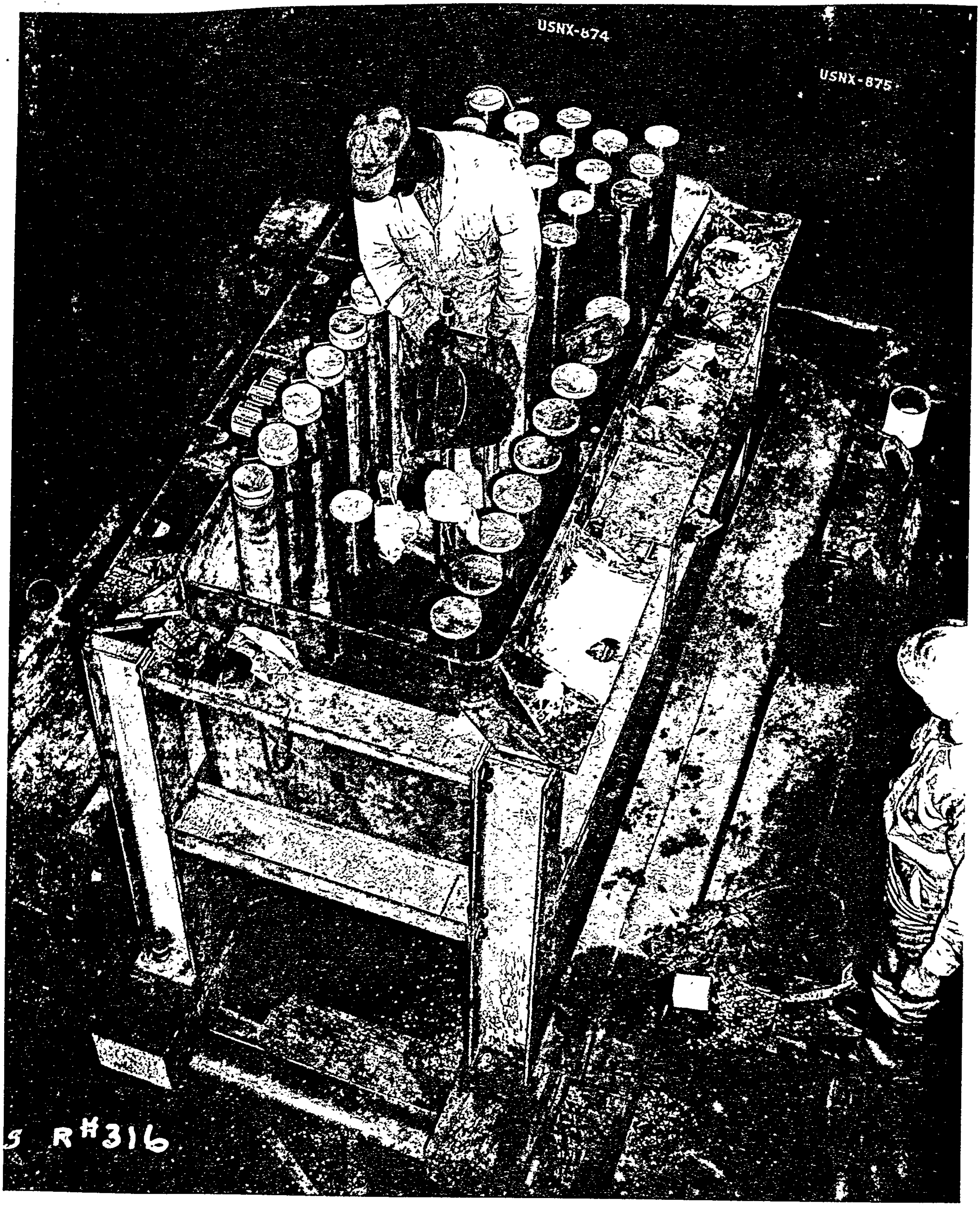
To check the location of the probe pin sockets serving large tubes required four (4) templates. Each template was made to conform with the probe pin socket pattern shown in Sketch #1.

Serial Number 316

New York Shipbuilding Corp.
Camden, New Jersey
October 24, 1953

PROJECT 8980 - SAVANNAH RIVER PLANT
POURING CONCRETE IN THE "L" UNIT HOLDING BACK UPPER TANK AND TUBE BUNDLE ASSEMBLY

The tube nest is filled between the top and bottom tube sheets with 1:2:3($\frac{1}{2}$" gravel) "High-Early" quick-setting concrete. The pour is made through a rectangular hole in the top sheet. After the concrete has set, 7" of lead is poured on top of the top sheet; vent holes through gas tubes are provided to allow moisture to escape from the concrete.



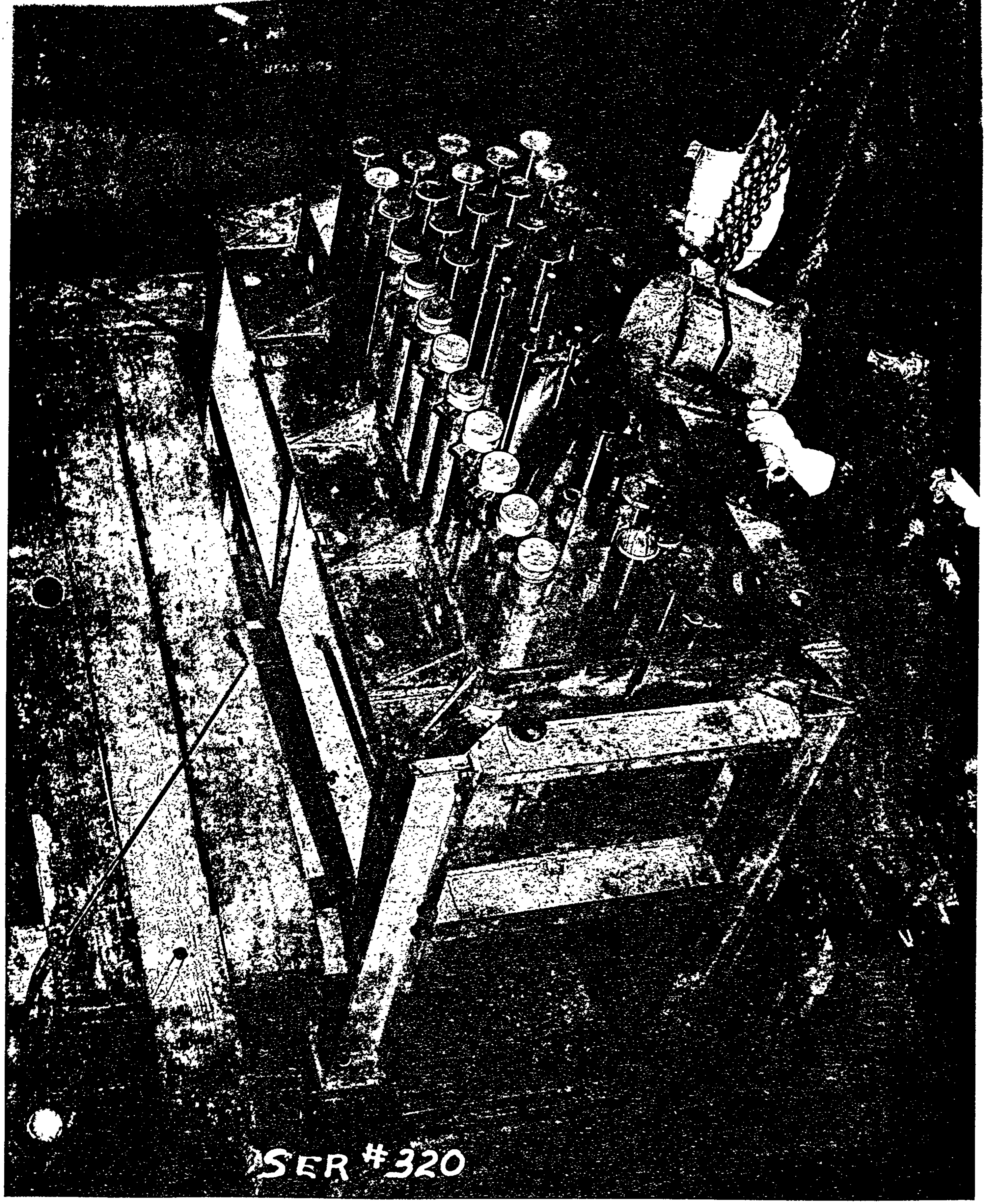
5 R#316

Serial Number 320

New York Shipbuilding Corp.
Camden 4, New Jersey
October 31, 1953

PROJECT 8980 - SAVANNAH RIVER PLANT
POURING MOLTEN LEAD IN "K" UNIT HOLDING RACK TUBE NEST

After the space between the top and bottom tube plates has been filled with concrete and has set for 48 hours, the top plate is covered with 7" of molten lead. The lead is kept molten with a gas torch until the full 7" is poured, then the heat is removed and the weldment is allowed to cool in still air.



SER #320

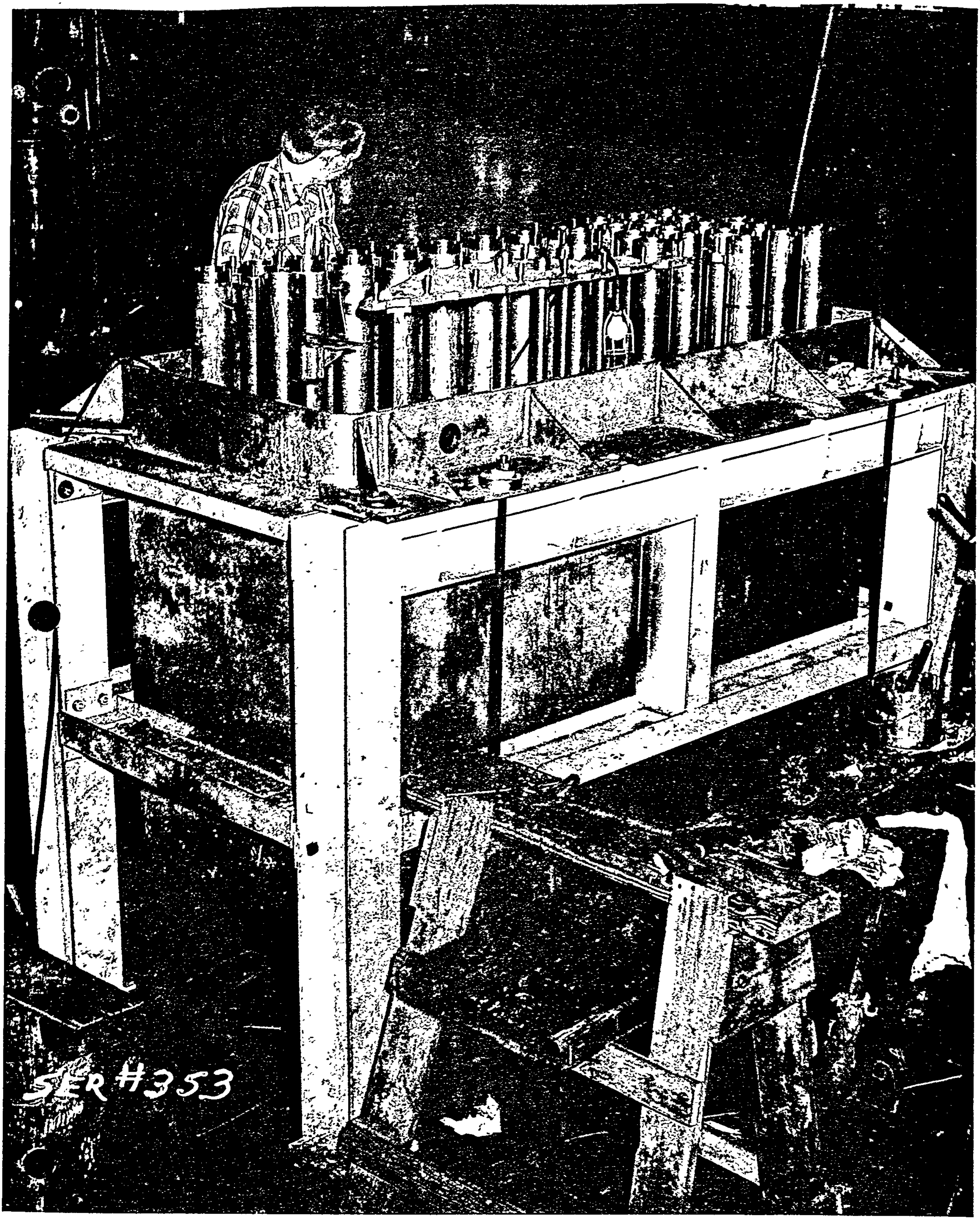
Serial No. 353

New York Shipbuilding Corp.
Camden 4, New Jersey
December 22, 1953

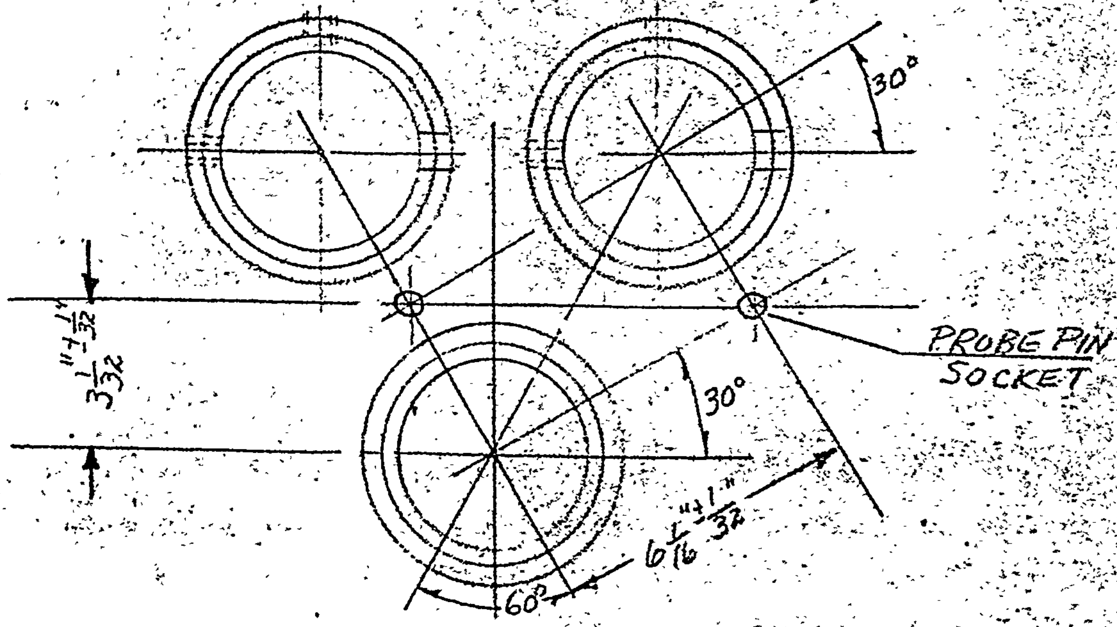
PROJECT 8980 - SAVANNAH RIVER PLANT - NYX

~~"K" UNIT~~ TUBE NEST FOR HOLDING RACK

Before shipment, the probe pin sockets are stud-welded. The locations are laid out from templates for the long tubes and from a functional gage extended from the short tubes.



SER #353



TYPICAL PROBE PIN SOCKET PATTERN
USED FOR TEMPLATE LAYOUT

SKETCH # 1

ENGINEERING SKETCH SHEET
E. I. DU PONT DE NEMOURS & CO.

PROJ. No.

SIGNATURE:

PROJ. TITLE

DATE

SUBJECT:

No. E-42452

One template was made with a 4½" inside diameter in order that it fit over all 4½" diameter tubes for visually checking the location of the tubes companion probe pin socket. (See Sketch #2) Also, an additional template of the same type, but with a 4-3/8" inside diameter, was required for use in conjunction with the 4.375" diameter functional gage. This template and the functional gage were used together to visually check probe pin sockets that served tubes designated 1, 2, 3, 4, 5, 6, 7, 8, and 9 as shown on Sketch #3. Sketch #4 illustrates how this was done. Another template, similar to the one shown in Sketch #2 was made with a 5" inside diameter for visually checking all probe pin sockets that served the remaining 5" diameter tubes.

The location of the probe pin sockets serving the four rod tubes were measured with a 12" scale graduated in 1/32". (See Sketch #2)

In all cases, probe pin sockets serving both large and rod tubes for "R" and "P" units were found to be within drawing tolerances and accepted.

B. Container (See Dwg. No. NYS 8212-2)

1. Inspection of Welding and Fit-up

All welds were visually examined for undercutting, cracks, pinholes, and other mechanical defects. After minor repairs, all welds were satisfactory.

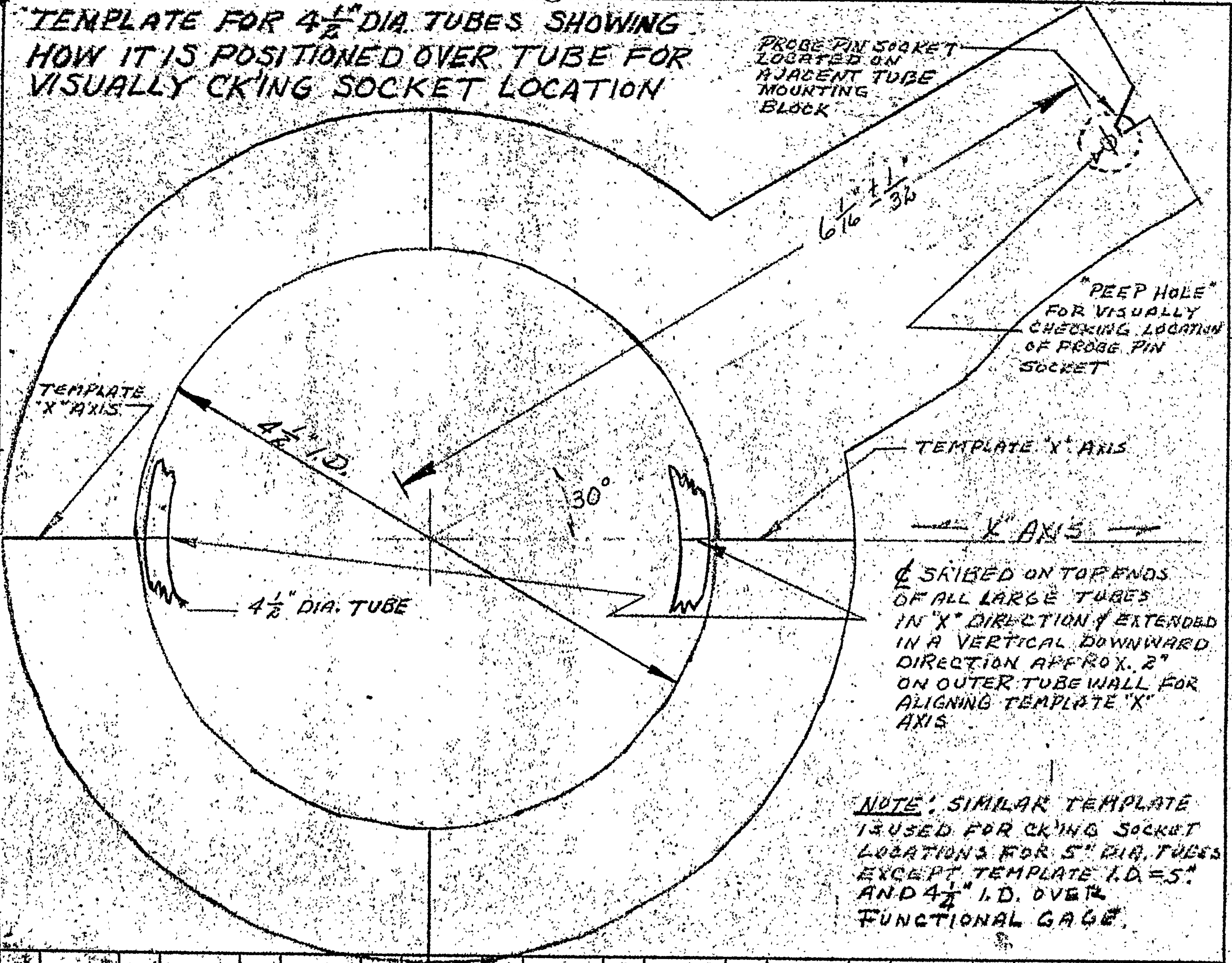
Fit-up of plates was in accordance with above listed drawing. In general, the fabrication procedure followed was in accordance with an outline prepared by vendor. (See Exhibit #1)

2. Overall Dimensions ("R")

All over-all dimensions of the container were checked and found to meet drawing tolerances with the exception of length of container. Length of container was 69-11/16" instead of the 70" drawing dimension. This deviation was compensated by making the tank bottom 5/16" longer than drawing dimensions. A standard 25' stainless steel tape graduated in 1/16" was used to take these measurements.

The flange plate around the top of the container for supporting the assembly was also given a dimensional inspection. (See photo serial #249) All anchor bolt holes were measured and found to be within the tolerances as determined by the anchor bolt pattern shown on drawing No. NYS 8212-4. The above measurements were taken using a 25' stainless steel tape graduated in 1/16".

TEMPLATE FOR 4½" DIA. TUBES SHOWING HOW IT IS POSITIONED OVER TUBE FOR VISUALLY CK'ING SOCKET LOCATION



℄ SKIBED ON TOP ENDS OF ALL LARGE TUBES IN "X" DIRECTION & EXTENDED IN A VERTICAL DOWNWARD DIRECTION APPROX. 2" ON OUTER TUBE WALL FOR ALIGNING TEMPLATE "X" AXIS

<u>NOTE</u>: SIMILAR TEMPLATE IS USED FOR CK'ING SOCKET LOCATIONS FOR 5" DIA. TUBES EXCEPT TEMPLATE I.D. = 5" AND 4¼" I.D. OVER FUNCTIONAL GAGE.

ENGINEERING SKETCH SHEET
E. I. DU PONT DE NEMOURS & CO.

PROJ. No.

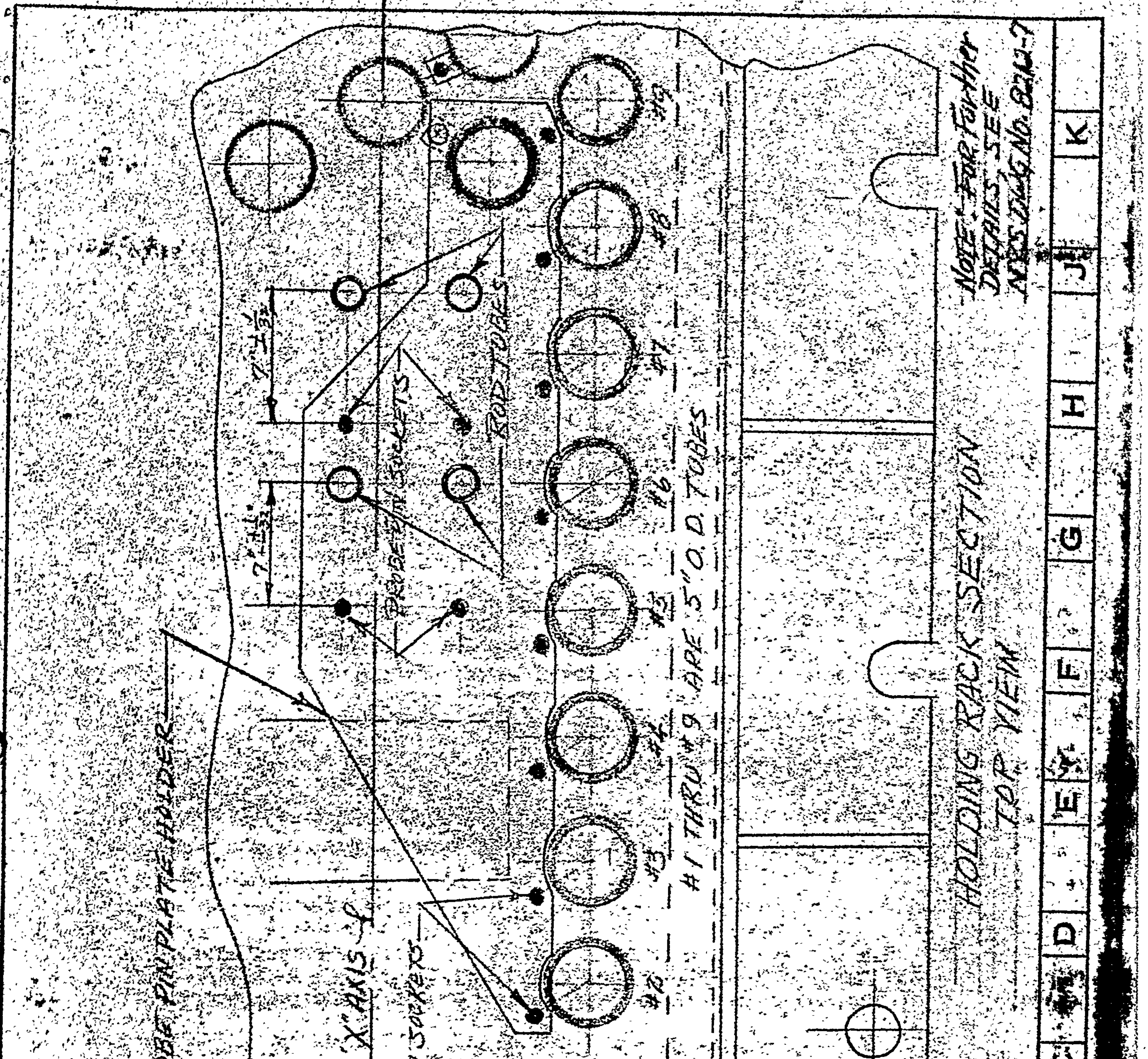
SIGNATURE

PROJ. TITLE SKETCH #2

DATE

SUBJECT

No. E 424.1



ENGINEERING SKETCH SHEET
E. I. DU PONT DE NEMOURS & CO.

PROJ. No.

SIGNATURE:

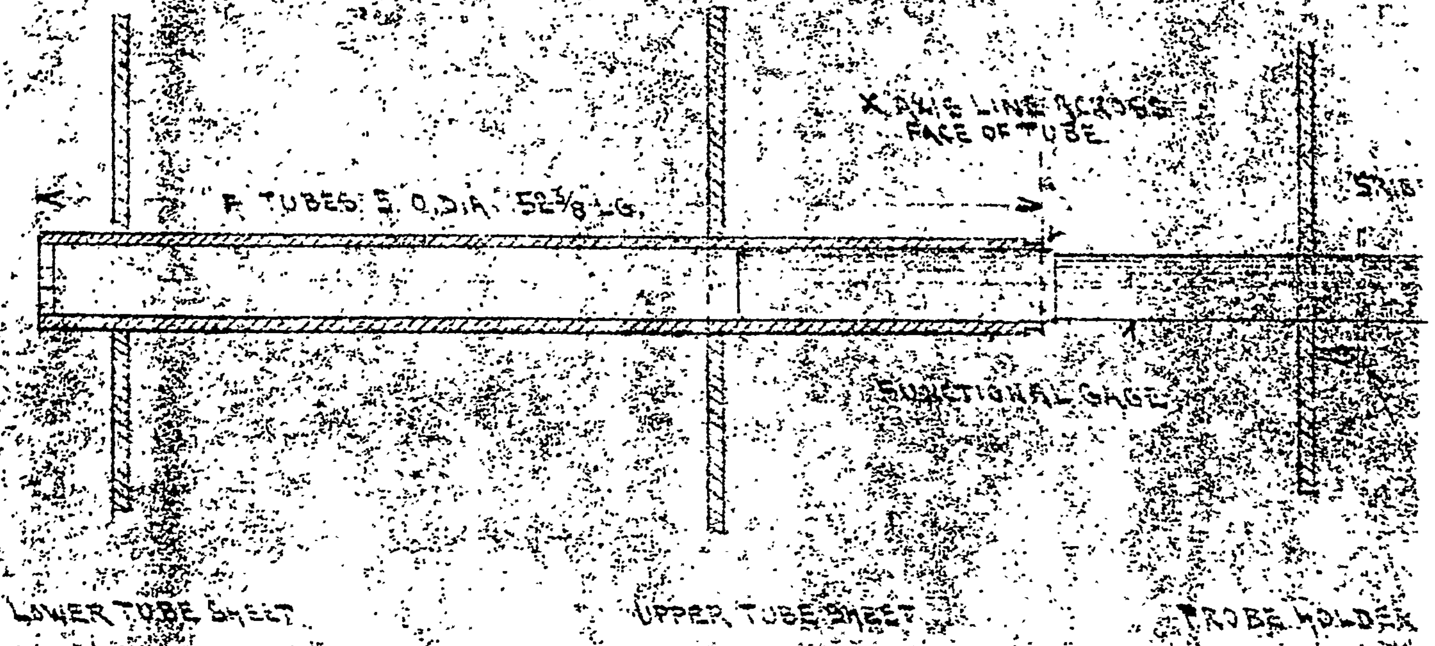
PROJ. TITLE SKETCH #3

DATE

SUBJECT:

No. E-42450

METHOD FOR LAY OUT AND CHECKING OF LOCATION OF [illegible]
FOR 9 - 5 O.DIA. A TUBES 52 3/8 LG. PROBE PIN SOCKETS ARE LOCATE
ABOUT [illegible] ABOVE END OF TUBES BY [illegible] FUNCTIONAL GAGE
WHICH HAS CENTER LINE SCRIBED AND 5 O.DIA. THIS CENTERLINE TO B
WITH X AXIS LINE ON END OF TUBE. THEN TEMPLATE SIMILAR TO TH
TO BE SCRIBED [illegible]
CENTERLINE ON FUNCTIONAL GAUGE



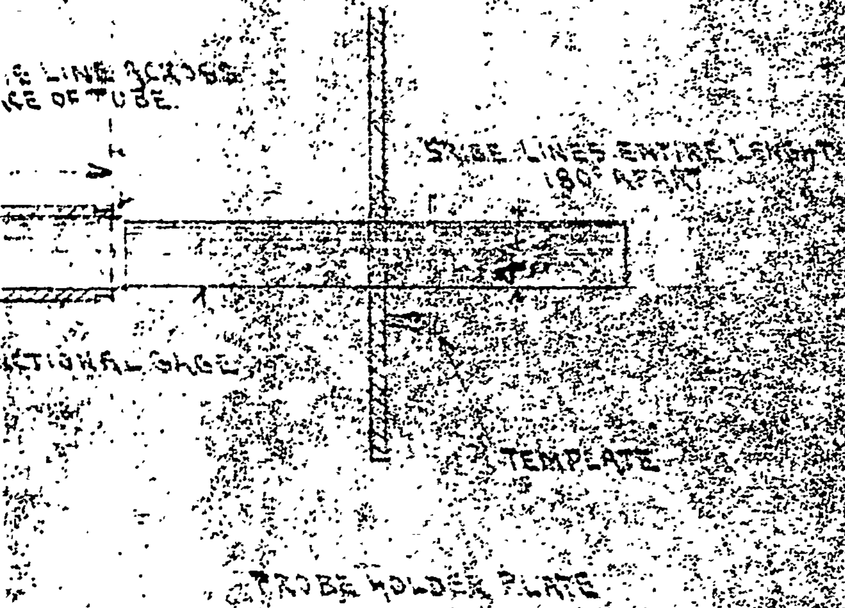
SKETCH #4

SK

NEW [illegible] BUILDING CORPORATION
CAM[illegible] NEW JERSEY U. S. A.
[illegible] LAYOUT AND CHECK

SCALE [illegible] MADE BY CHECKED BY DATE

[illegible] SOCKETS
SE P.N SOCKETS ARE LOCATED ON PROBE HOLDER
[illegible] HORIZONTAL [illegible] N TUBE
[illegible] THE CENTERLINE TO BE MATCHED [illegible]
N TEMPLATE SIMILAR TO THAT ON SKETCH [illegible] 4¼ HOLE
[illegible] TEMPLATE [illegible]



KETCH #4

APPROVED

FORM 27[illegible]

EXHIBIT #1

FABRICATION AND WELDING PROCEDURE

CONTRACT 8212

HOLDING RACK PROCES. ROOM

PRELIMINARY

N.Y.X. Project

Fabrication and Welding Procedure

Contract - 8212

4/15/53

Holding Rack Process Room

Index

Dr. No.	
8212-1	General Arrangement
8212-2	Container
8212-3	Tank Bottom
8212-4	Anchor Bolt Locations (No Schedule)
8212-5	Mounting Plate
8212-6	Rack Plate and Tube Assembly
8212-7	Holding Rack Assembly (see 8212-2)
8212-8	Rack Plate (see 8212-6)
8212-9	Probe Holder Long (No Schedule)
8212-10	Plug and Muff Tube
8212-11	"5" Rod Tube and Sleeve Tube
8212-12	Permanent Sleeve Weldment
8212-13	" " "
8212-14	" " "

N.Y.X. Project

4/15/53

Fabrication and Welding Procedure

Contract 8212

Holding Rack   Process Room

Dr. No. 8212-1 - General Arrangement.

Holding Rack to be worked approximately as follows:

1. Premachine all tubes to finish size and length including [illegible] slot and holes at top of tube after;

    (a) Butt welding tubes together to form full length tube.

    (b) Welding plug, where required, in bottom end of tubes

    (c) Welding lug, where required, at top end of tube.

2. Assemble Rack Plate and Tube Assembly in a manner similar to Tube Sheets on reactors but using an additional jig plate at top end of tubes to help setting of tubes to align vertically and to help hold verticality during tacking and welding.

    (a) During assembly, tubes to be tacked to both rack plates on outside, using coated electrodes.

    (b) Weld tubes to bottom rack plate with 1/4" fillet, using Aircomatic Tube Welders.

    (c) Weld tubes to top rack plate with 1/4" Fillet around tubes as far as possible to help maintain required verticality, using either Manual Aircomatic or coated electrodes.

3. Assemble Container complete, except for closing plate in throat which must be left loose until after Rack Plate and Tube Assembly is welded into Container.

4. Set Rack Plate and Tube Assembly in Container and weld [illegible] rack plate to bearing angle.

5. Test this assembly for tightness at bottom rack plate sufficient to hold against any leakage during pouring of concrete into Rack Plate and Tube Assembly.

(Sheet 1 of 2)

4/15/53

Dr. No. 8212-1 - General Arrangement (Cont'd)

6. Fit and weld closing plate in throat of Container.

7. Assemble and weld tank bottom complete, leaving 1" excess all around on top edge.

8. Fit and weld Container Assembly to Tank Bottom, leaving the 1" excess on top edge.

9. Test for water tightness

10. Cut Container Assembly and Tank Bottom apart and prepare edges for field welding from inside, using 75° included vee, 1/16" root face and 0 root opening. In cutting apart it will be permissable to use powder cutting from inside and thru center of excess followed by chipping to proper edge and bevel.

11. Fill Rack Plate and Tube Assembly with concrete.

12. Pour lead on top of Rack Plate and Tube Assembly.

13. Set Probe Holder in place.

14. Shoot Probe Pin Socket Studs.

15. Assembly welding to be by Manual Aircomatic Process where possible, except coated electrodes to be used for tight spots or where access is limited.

16. Detail Procedures are to be prepared for each assembly.

N.Y.L. Project

Fabrication and Welding Procedure

Contract 8212

4/15/53

Dr. No. 8212 - 2 - Container
Dr. No. 8212 - 7 - Holding Rack Assembly

1. Make up 1" side plate (23) with 1/2" shelf plate (14) and bracket plates (19).
   - (a) Leave shelf plate blank with no holes.
   - (b) Straighten after welding.
2. Make up 1" side plate (24) with 1/2" shelf plate (15) and bracket plates (19) similar to above.
3. Make up 1/2" shelf plate at corners no. (26), (27) (30) or (31) each with bracket plate (18) and doubler plate (17).
   - (a) Leave shelf plate and doubler blank.
   - (b) Straighten after welding if necessary.
4. Prepare butts on shell plates and assemblies above for welding from inside, using 75° included vee with 1/16" root face and 0 root opening, except joint for closing plate (13) to be prepared for welding from outside, using backing strip with 60° included vee, 1/32" root face and 1/8" root opening. Establish butts to suit material and to give complete periphery at bottom edge of Container with closing plate (13) removed.
5. Assemble side plates with flange plate stiffeners as follows, after first building up edge of plate and reversing weld bevel in way of stiffeners:
   - (a) Plate (5) with stiffener (4)
   - (b) Plate (1) with stiffener (20)
   - (c) Plate (6) with stiffener (12)
   - (d) Plate (9) with stiffener (21)
6. Tack and fit all 1/2" shell plates including corner pieces and closing plate.
7. Weld all butts from inside.

Dr. No. 8212 - 2 - Container 4/15/53
Dr. No. 8212 - 7 - Holding Racking Assembly

8. Fit, tack and weld 1" side plate assemblies.

9. Back Chip joints and weld from outside, except do not weld closing plate ⑬.

10. Fit and weld corner shelf plate assemblies and flange plate ②.

11. Drill holes to suit Mounting Plate Dr. No. 8212-5. Use jig to locate holes.

12. Remove closing plate ⑬.

13. Set Rack Plate and Tube Assembly in Container and weld to supporting angle.

14. Test assembly for tightness at bottom rack plate sufficient to hold against any leakage during pouring of concrete into Rack Plate and Tube Assembly.

15. Refit, tack and weld closing plate ⑬ in throat of Container.

16. Fit and weld Container to Tank Bottom so that entire unit can be tested for water tightness.

17. Cut unit apart and prepare bottom edge for field weld from inside using 75° included vee, 1/16" root face and 0 root opening.

18. Fill interior of Rack Plate and Tube Assembly with concrete.

19. Pour lead on top of Rack Plate and Tube Assembly.

20. Set Probe Holder, Dr. No. 3212-9, in place.

21. Shoot Probe Pin Socket Studs.

N.Y.K. Project

Fabrication and Welding Procedure 4/15/53

Contract 8212

Dr. No. 8212 - 3 - Tank Bottom

1. Prepare butts on shell plates for welding from inside using 75° included vee with 1/16" root face and 0" root opening. Leave 1" excess on top edge of in way of Container.

2. Cut 1" radius clearance hole in stiffeners in way of butt welds in shell plates.

3. Assemble side plates with stiffeners as follows:

   (a) Plate ① with stiffeners ⑩ and ⑫

   (b) Plate ② with stiffeners ⑧ and ⑭

   (c) Plate ③ with stiffeners ⑨

   (d) Plate ④ with stiffeners ⑪

4. Assemble bottom plate ⑤ with stiffener ⑬

5. Tack and fit all 1/2" shell plate assemblies and corner pieces.

6. Weld complete from inside.

7. Back Chip joints on outside.

8. Layout and cut manhole opening.

9. Shoot welding studs for manhole cover.

10. Make up manhole cover ⑦ with doubler ⑮

11. Fit and weld Tank Bottom to Container so that entire unit can be tested for water tightness. Note 1" excess to be left on top edge at this time.

12. Cut unit apart and prepare bottom edge for field weld from inside, using 75° included vee, 1/16" root face and 0 root opening. Powder cutting may be used to cut through center of 1" excess from inside followed by chipping to proper edge and bevel.

(Sheet 1 of 1)

N.Y.X. Project

Fabrication and Welding Procedure

Contract 8212

4/15/5

Dr. No. 8212 - 5 - Mounting Plate.

1. Machine and drill parts prior to welding.
2. Weld boss to plate.

4/15/53

N.Y.X. Project

Fabrication and Welding Procedure

Contract 8212

Dr. No. 8212 - 6 = Rack Plate and Tube Assembly
Dr. No. 8212 - 8 = Rack Plate

1. Layout Rack Plate to finish size to give 1/8" clearance all around in Container.

2. Layout tubes on 7" centers.

3. Make up carbon steel jig plate (1st unit only) to use at top end of tubes. Layout proper lines for orienting tubes with slots and holes.

4. Drill pilot holes in Rack Plates and jig plate for larger tubes and drill and ream hole for small tubes.

5. Trepan holes in each plate individually. No countersink required. Tolerance .005" - .000".

6. Tubes to be completely finished prior to assembly.

7. Assemble Rack Plates and tubes as follows:

   (a) Set bottom rack plate in pot chuck jig.

   (b) Set five (5) shoulder tubes in place.

   (c) Put top rack plate over shoulder tubes.

   (d) Clamp assembly together and align in pot chuck.

   (e) Tack shoulder tubes, except one with slot, on inside of both plates.

   (f) Assemble all remaining large tubes.

   (g) Set jig plate over tops of tubes.

   (h) Orient tubes with slots and holes, properly using layout lines on tubes and jig plate.

   (j) Tack all remaining large tubes on top side of top rack plate.

   (k) Set small tubes and tack to top side of rack plate.

Dr.No.8212-6 - Rack Plate & Tube Assembly (Cont'd)
Dr.No.8212-8 - Rack Plate

(l) Turn pot chuck with assembly over and tack all tubes on outside of bottom rack plate.

(m) Tacking to be done with coated electrodes.

8.Weld tubes to rack plates, using skip welding as required to maintain alignment and verticality.

(a) Weld tubes to bottom plate with 1/4" fillet, using either Aircomatic Tube Welder or Manual Aircomatic.

(b) Weld as much of each tube to top plate as can be reached with 1/4" fillet, using Manual Aircomatic and coated electrodes.

9.Remove jig plate at top of tubes.

10. Fit and weld support pieces ⑰ to "S" Rod Tubes. Contour end of piece ⑰ to radius of tubes.

11. Set Rack Plate and Tube Assembly in Container and proceed in accordance with schedule for Dr. No.8212-2.

N.Y.X. Project

Fabrication and Welding Procedure

Contract 8212

4/15/53

8212-10 - Plug and Muff Tube
8212-11 - "S" Rod Tube & Sleeve Tube Weldment
8212-12 - Permanent Sleeve Weldment
8212-13 - Permanent Sleeve Weldment
8212-14 - Permanent Sleeve Weldment

1. All tubes to be finished machined to size and length including vee slots and holes, where required and with lugs for probe pin socket and plugs in ends of tubes welded in place prior to assembly in tube sheet.

2. Tube weldments made at N.Y.S. as follows:

   (a) prepare butt weld for 75° included vee, 1/32" root face and 0 root opening.

   (b) Use suitable jig to maintain alignment during tacking and welding butt.

   (c) Weld as follows:

      (1) Fill inside of tube with Argon Gas.

      (2) Weld root pass with Heliarc without using filler metal.

      (3) Weld second pass with Heliarc using filler metal.

      (4) Complete weld using coated electrodes. Argon not required inside tube for this welding.

3. Fit and weld lugs to top ends of tubes where required.

   (a) Machine lug to have contour of tube.

   (b) Use jig to set and hold lugs during welding. Allow 1/16" for finish machining.

   (c) Cool inside of tube with water during welding.

4. Straighten tube, if required, by heating and quenching.

   (a) Determine trueness of tube in lathe and select side to be heated.

   (b) Heat required spot using Heliarc Torch.

   (c) Cool heated area with air or water.

5. Finish Machine tube

   (a) Machine off weld inside and outside.

   (b) Machine surface of lugs.

   (c) Machine ends of tube.

      (1) Bottom end of tubes Det. "A" & "C" Dr. No. 8212-11 to be beveled for 90° included vee, 1/8" deep.

   (d) Mill vee slot in top end of tube.

   (e) Drill and tap holes in top end of tube.

6. Weld plugs in bottom end of tubes Det. "A" & "C" Dr. No. 8212-11.

   (a) Plugs & tube to be beveled to give joint with 90° included vee 1/8" deep.

7. Weld assembly for supporting probe holder, Section B - B Dr. No. 8212-6, to one tube Det. "A" Dr. No. 8212-11.

   (a) Assembly, section B-B, Dr. No. 8212-6, to be made up as a unit prior to welding to tube.

The two mounting plates were tack welded to the container flanges and match drilled. (See Dwg. No. NYS 8212-5) Therefore, there was complete assurance of proper fitting of the pair. These plates were inspected using a scale of the required length graduated in 1/64" and found satisfactory. However, it was important that the proper mounting plate be fitted to the proper flange in the field. In view of this fact, flange plates were marked "A", "B", "C" and "D" on the end and was to be so assembled.

3. Overall Dimensions ("P")

The same method of checking this unit was followed as outlined above for "R". All overall dimensions of the container were checked and found to meet drawing tolerances with exception of length of container. Length of container was 69-3/8" instead of 70" ± 1/8" drawing dimension. This discrepancy was accepted by the Design Division.

The flange plate around the top of the container for supporting the assembly was also given a dimensional inspection as outlined in Section 3 above. All anchor bolt holes were measured using a 25' stainless steel tape graduated in 1/16" and found within drawing tolerance. (These holes were drilled from a jig on which all holes were within 1/64" of drawing dimension)

The two mounting plates were tack welded to the flanges and jig drilled, (See Dwg. No. NYS 8212-5) therefore, there was complete assurance of proper fitting of the pair. These plates were inspected using a scale of the required length graduated in 1/64" and found satisfactory. However, it was important that the proper mounting plate be fitted to the proper flange in the field. In view of this fact, flange plates were marked "A", "B", "C" and "D" on the ends and was to be so assembled.

C. "R" Tank Bottom (See Dwg. No. NYS 8212-3)

1. Inspection of Welding and Fit-up

All welds were visually inspected for determination of undercutting, cracks, pin holes and other mechanical defects. After minor repairs, all welds were satisfactory.

Fit-up of plates was in accordance with the above listed drawing. The same fabrication procedure as that followed in the container was adhered to during fabrication of the tank bottom.

2. Overall Dimensions

All overall dimensions of the tank bottom were checked and found to meet drawing requirements with the exception of overall length which was purposely made 5/16" long to compensate for the container being 5/16" too short. These inspections were made using a 100' stainless steel tape graduated in 1/16".

3. Fitting of Tank Bottom to Container

During the fitting of tank bottom to container, alignment of centerlines, mating of centering devices, and relative location of $1\frac{1}{4}$" plates and holes in same were checked. The fitting and alignment of container and tank bottom was satisfactory.

The location of the $1\frac{1}{4}$" plates (four on container and two on side of tank bottom at top) with respect to each other were measured using a 25' stainless steel tape graduated in 1/16". Hole locations were also checked using this tape.

4. Hydrostatic Testing

The tank bottom was properly supported in a vertical position and filled with deionized water. Static head was held four hours, then the assembly was visually inspected. No leaks were found.

5. Sandblasing

The entire tank bottom was sandblasted, acid washed, and ferroxyl tested. (See photo Serial #255 and #313) Results of ferroxyl testing and visual inspection indicated all surfaces were free of rust, free iron and surface defects. The entire assembly, tube nest container, and tank bottom was cleaned with a solution of FO-128 prior to shipment. Visual inspection showed the assembly to be free of dirt and oil.

The "R" Unit holding rack was shipped by truck to Savannah River Plant site on May 26, 1953

D. "P" Tank Bottom (See Dwg. No. NYS 8212-3)

1. Inspection of Welding and Fit-up

(Same as Section C-1 above)

2. Overall Dimensions

All overall dimensions of the tank bottom were checked and found to meet drawing requirements with exception of the following:

[redacted]

Serial Number 255

New York Shipbuilding Corp.
Camden, New Jersey
September 4, 1953

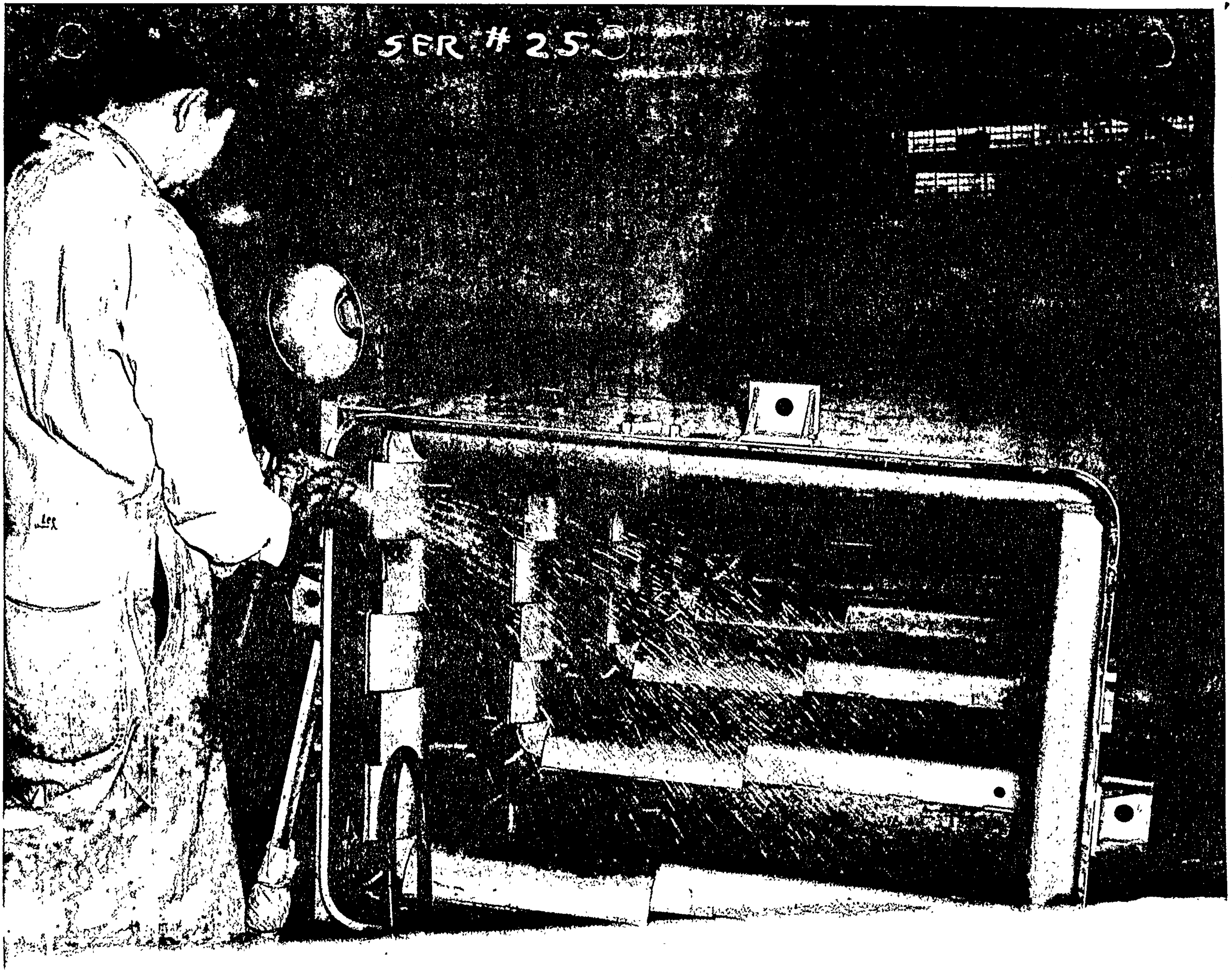
PROJECT 8980 - SAVANNAH RIVER PLANT

Holding Rack Tank - "P" Unit

The tank bottom is being passivated to remove dirt, oil, free iron, etc. after sandblasting. Results of ferroxyl testing and visual inspection indicated all surfaces were free of rust, free iron, and surface defects.

For fabrication details, see New York Ship drawing #8212-3.

[redacted]


SER #25

Serial Number 249 [redacted]

ew York Shipbuilding Corp.
amden, New Jersey
eptember 4, 1953

PROJECT 8980 - SAVANNAH RIVER PLANT

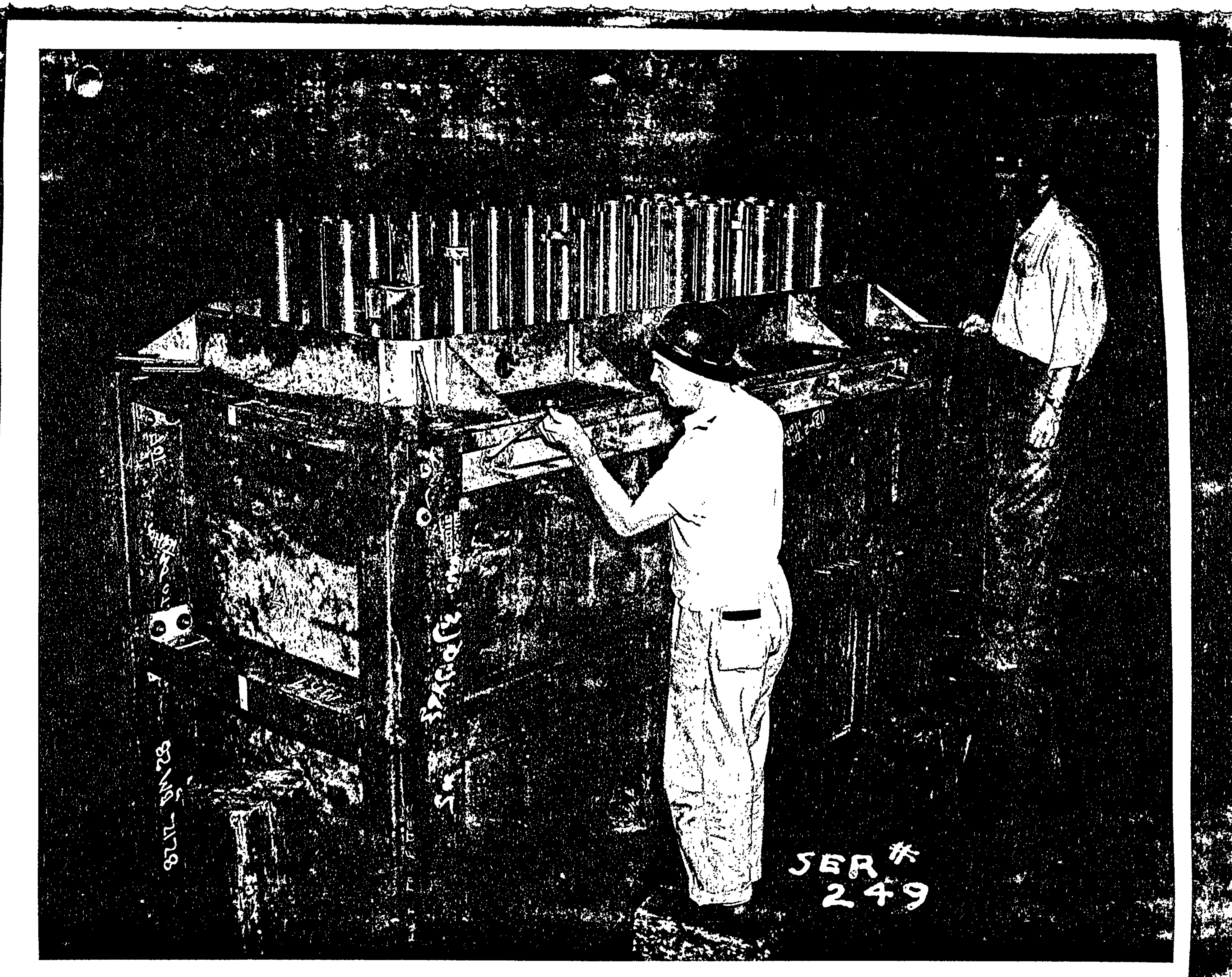
Holding Rack Container "P" Unit

This is a view of the holding rack container with tube nest assembled inside.

Inspectors are shown checking hole locations with a 25' S/S tape.

Drawings used in conjunction with inspections were supplied by vendor and approved by duPont Engineering Department. For fabrication details, refer to New York Ship drawings NYS 8212-1 through 8212-17.

[redacted]


82WS-2128
SER #
249

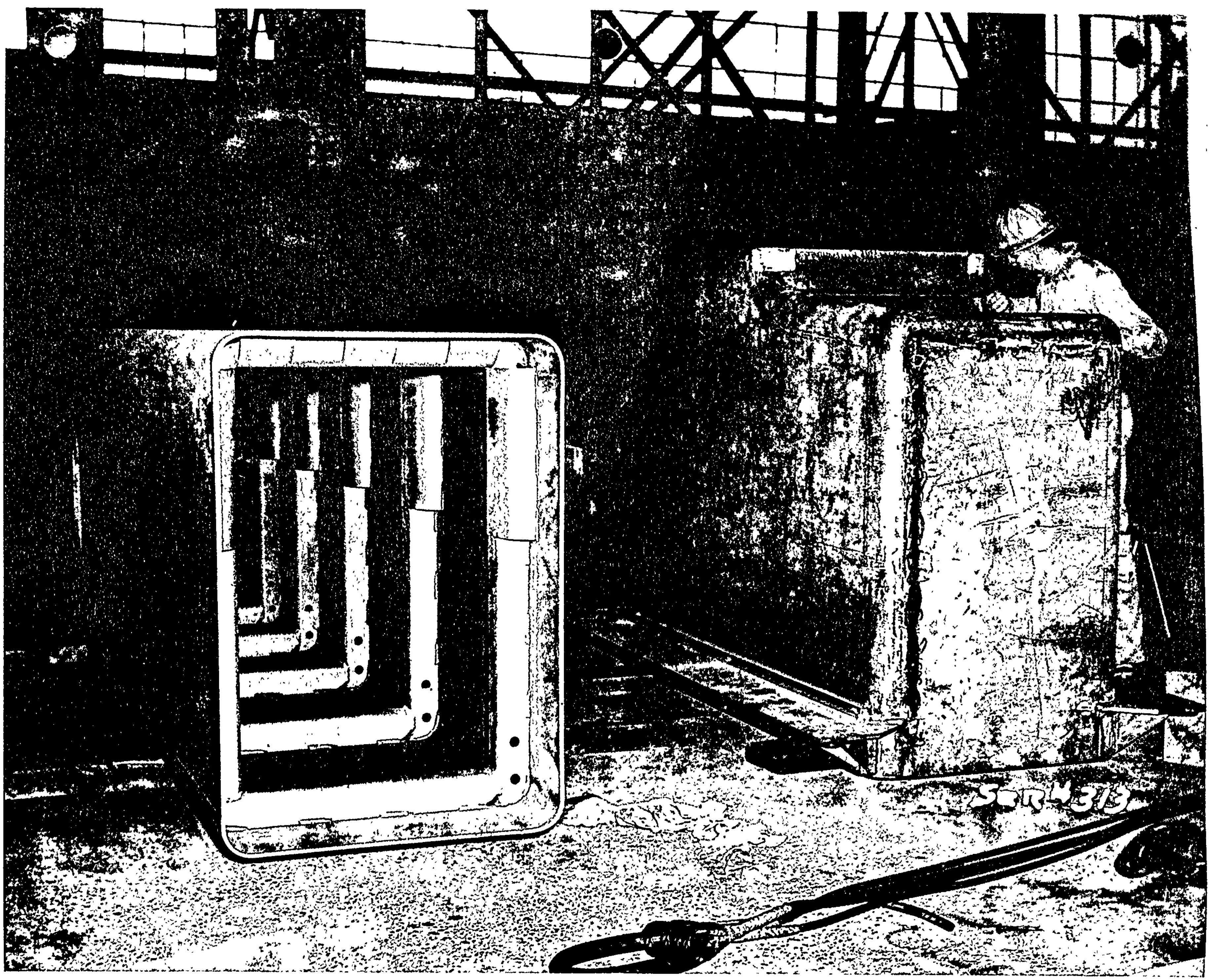
Serial Number 313

New York Shipbuilding Corp.
Camden, New Jersey.
October [illegible], [illegible]

[illegible] - [illegible]

[illegible]

The lower tank section [illegible] has been sandblasted and acid washed. The upper tank section [illegible] is ready for sandblasting and acid-washing. The outfit [illegible] ationed and welded into the tank [illegible] is installed.


S-R-4313

a. Dimension from field weld to bottom of container: 15' - 7-13/16", Dwg. size 15' - 7½" ± 1/8". (Section A-A).

b. Dimensions from field weld to bottom of container: 15' - 4-11/16", Dwg. size 15' - 4½" ± 1/8". (Section C-C).

c. Dimension from field weld to bottom of container: 14' - 10-5/8"; Dwg. size 14' - 9½" ± 1/8". (Section D-D)

These discrepancies were accepted by the Design Division on 6/12/53.

The above measurements were taken with a 25' stainless steel tape graduated in 1/16".

3. Fitting of Tank Bottom to Container

During the fitting of tank bottom to container, alignment of centerlines, mating of centering devices, and relative location of 1¼" plates and holes in same were checked. (See photo serial #349). All measurements were made using a 25' stainless steel tape graduated in 1/16". The fitting and alignment of container and tank bottom was satisfactory except as follows:

a. Center-to-center distance of holes in 1¼" plates on tank bottom measured 6-15/16" rather than 6-3/4" ± 1/16" as specified on drawings.

b. Vertical alignment of holes in 1¼" plates on container and tank bottom was 3/32" off.

c. Overall length - top of container to bottom of tank bottom measured 21' - 5-3/16"; dwg. size 21' - 5½" ± 1/4"

The above discrepancies were accepted by Design Division on 6/12/53.

4. Hydrostatic Testing

The tank bottom was properly supported in a vertical position and filled with deionized water. (See photo serial #251) Static head was held for (4) hours. Welds were subjected to hammer testing in accordance with the 1950 edition of the Unfired Pressure Vessels Code. No leaks were found upon completion of visual inspection.

[redacted]

Serial Number 251

New York Shipbuilding Corp.
Camden, New Jersey
September 4, 1953

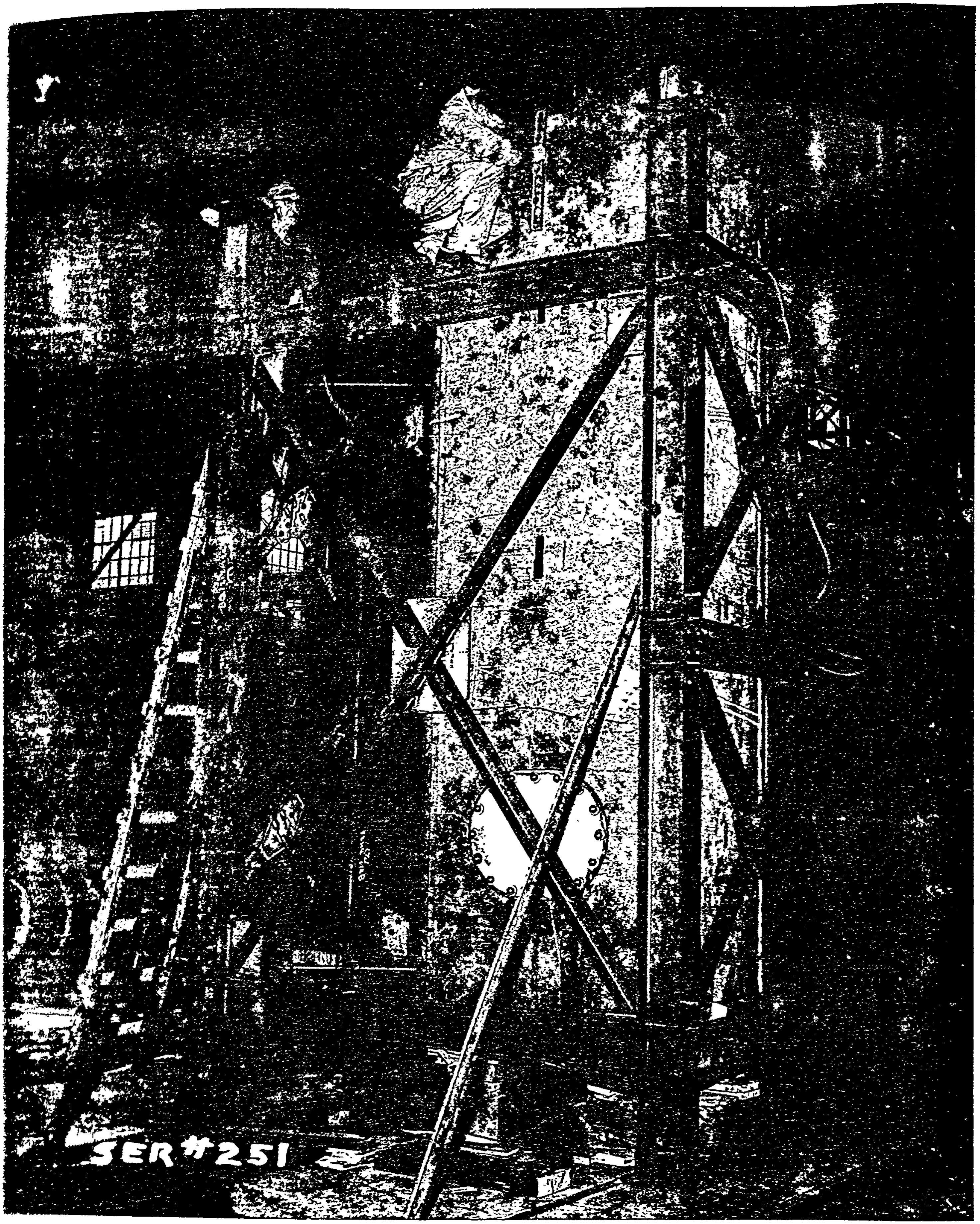
PROJECT 8980 - SAVANNAH RIVER PLANT

Hydrostatic testing of Holding Rack Tank, "P" Unit

Tank is shown properly supported in a vertical position and filled with de-ionized water. Static head was held four hours. Welds were subjected to hammer testing in accordance with the 1950 edition of the Unfired Pressure Vessels Code. No leaks were found upon completion of visual inspection.

For fabrication details, see New York Ship drawing #8212-3.

[redacted]


SER #251

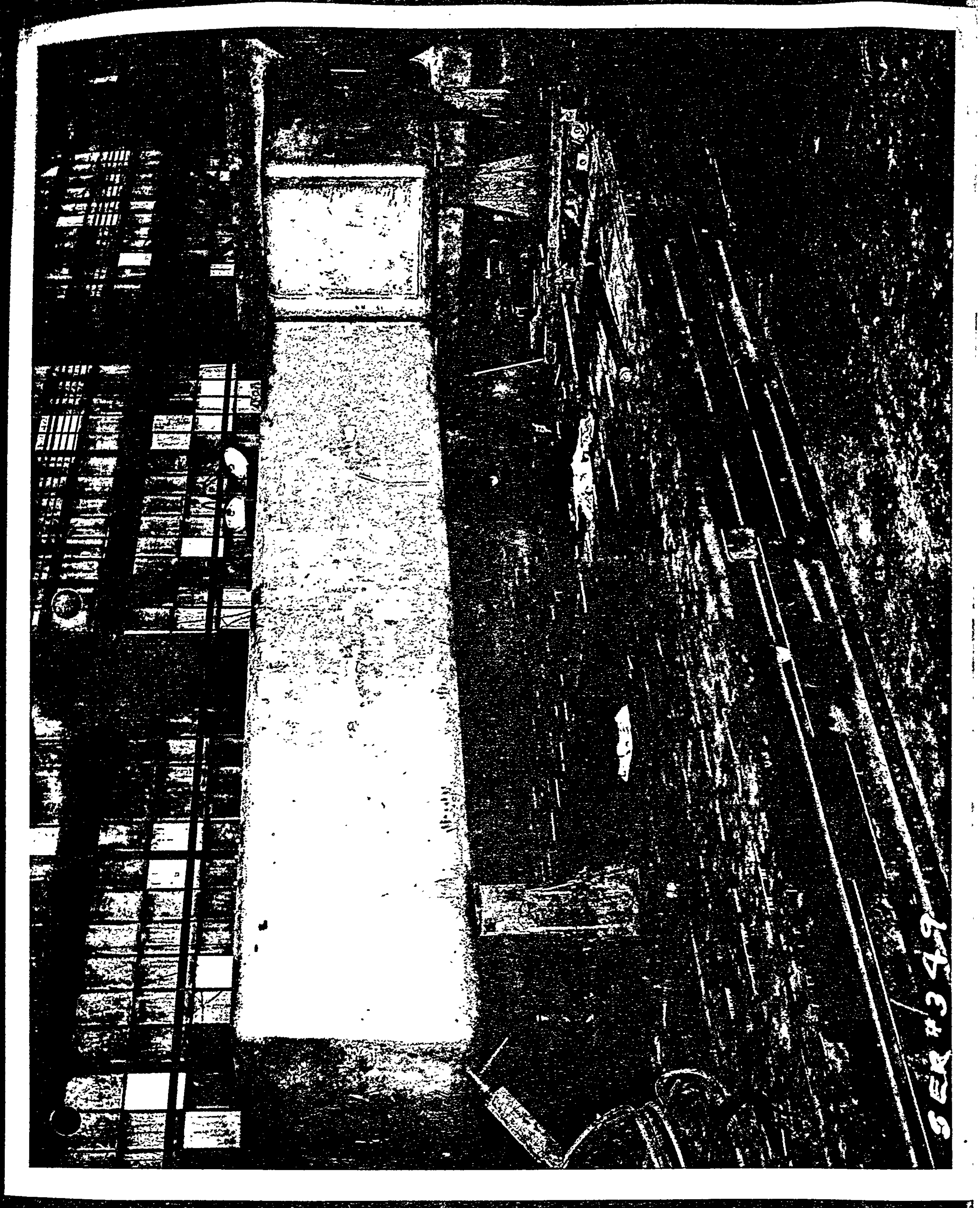
Serial Number 349

New York Shipbuilding Corp.
Camden, N. J.
December 7, 1953

PROJECT 8980 - SAVANNAH RIVER PLANT

"K" UNIT HOLDING RACK

The tank and the tube nest and enclosure assembly are lined up for checking the vertical centerlines and for fitting the field joint.



SER #349

5. Sandblasting

The entire tank bottom was sandblasted, acid washed and ferroxyl tested. Results of ferroxyl testing and visual inspection indicated all surfaces were free of rust, free iron, and surface defects. The tube nest and container was cleaned with a solution of FO-128 prior to shipment. Visual inspection showed the assembly to be free of dirt and oil.

The "P" Unit holding rack was shipped by truck to Savannah River Plant site on June 17, 1953.

III. Salvaging of Large Tubes and Rod Tubes at New York Ship For Use in "L", "K" and "C" Holding Rack Assemblies

Tubes required for "L", "K" and "C" holding rack assemblies had not been ordered either by du Pont or the original vendor. Since tubing was not a stock size, it would have required a mill order with a four to six month delivery.

Top tube sheet tubes from the 100 Area process units, which had been declared scrap by the du Pont Inspection Department, were re-inspected and found to be acceptable for the large tubes and were utilized. This was possible due to the fact that tolerances for finish and size for the holding racks were much more liberal than on the process units, and in addition, these tubes did not require O-ring seating areas.

Rod tubes required were also not a stock item size. Quantity required did not justify a mill schedule, and delivery would not have met requirements. The vendor for the rod tubes was National Forge and Ordnance Co., Irvine, Pa. Material was furnished by New York Ship on order AXC 167½ and was bar stock 2-1/8" diameter x 66" long, AISI, type 304 S/S. The tubes were machined to a length of 65" ± 1/16". The O.D. was 1.875" + .000 - .004", and the I.D. was 1.057" ± .013". The maximum permissable camber was 0.030" in 3' or .010" per foot. All surfaces were to have 125 RMS micro-inch finish.

All tubes were stenciled at any point on the circumference one inch below the top end of the tube, and stenciled with the tube letter (see Dwg. #160300) and also with the corresponding building number. In the case of the 4-1/2" diameter tubes, the designated New York Ship number was also stenciled on the same plane.

The O.D. of 4-1/2" diameter tubes reclaimed varied in size. In order to make the most efficient use of these tubes, they were grouped according to size for each unit. For listing of large tubes for "L", "K" and "C" units, see Exhibit #2 presented herewith.

Du Pont Design Division agreed to accept the rejected tubes

8214 - 8215 - 8216

HOLDING BACK TUBE MARKING AND ASSEMBLING DATA

After lathe work is finished and before tubes are submitted to du Pont Inspectors for checking, each tube shall be marked with a number (or series of numbers), indicating:

1st - Inspectors reference number

2nd - (Building number (L, K or C as the case may be)
(and Tube letter. (See Drawing #160300).

3rd - N.Y. Ship Designation number. (Used on 4½" dia. tubes only).

Marking shall be by 1/4" stencil and shall be located at any point on the circumference, about 1/2" below any reduction of cross section at top end of tube.

Especially numbered tubes have been assigned to given assemblies and those tubes must be used in the assemblies indicated.

For 8214 - "L" use the following tubes 5" dia.

1 - LA
2 - LA
3 - LA
4 - LA
5 - LA
6 - LA
7 - LA
8 - LA
9 - LA
10 - LE
11 - LE
12 - LE
13 - LF

14 - LC
15 - LC
16 - LC
17 - LC
18 - LC
19 - LC
20 - LC
21 - LC
22 - LC
23 - LC
24 - LC
25 - LC
26 - LC

27 - LD
28 - LD
29 - LB - 7
30 - LB - 3
31 - LB - 1
32 - LB - 10
33 - LB - 13
34 - LB - 17
35 - LB - 19
36 - LB - 24
37 - LB - 27

For 8215 - "K" use the following tubes.

38 - KA
39 - KA
40 - KA
41 - KA
42 - KA
43 - KA
44 - KA
45 - KA
46 - KA

47 - KB - 6
48 - KB - 8
49 - KB - 11
50 - KB - 12
51 - KB - 15
52 - KB - 18
53 - KB - 20
54 - KB - 21
55 - KB - 25

56 - KC
57 - KC
58 - KC
59 - KC
60 - KC
61 - KC
62 - KC
63 - KC
64 - KC
65 - KC
66 - KC
67 - KC
68 - KC

69 - KD
70 - KD
71 - KE
72 - KE
73 - KE
74 - KF

EXHIBIT #2

For 8216 - "C" use the following tubes.

75 - CA
76 - CA
77 - CA
78 - CA
79 - CA
80 - CA
81 - CA
82 - CA
83 - CA

84 - CB - 2
85 - CB - 4
86 - CB - 5
87 - CB - 9
88 - CB - 14
89 - CB - 16
90 - CB - 22
91 - CB - 23
92 - CB - 26

93 - CC
94 - CC
95 - CC
96 - CC
97 - CC
98 - CC
99 - CC
100 - CC
101 - CC
102 - CC
103 - CC
104 - CC
105 - CC

106 - CD
107 - CD
108 - CE
109 - CE
110 - CE
111 - CF

EXHIBIT #2 (con'T)

that New York Ship had available to fabricate the holding racks for "L", "K" and "C". Some tubes could not be held to I.D. tolerance of ± .005" with 125 RMS micro-inch finish, so permission was given to use + .032" and -.005" to be acceptable with the 4.385" tubes.

One hundred and five (105) welded tubes, which were not acceptable for use in the main 100 Area process units and six (6) seamless tubes were re-inspected and accepted for fabricating into the "L", "K" and "C" holding rack assemblies. (See Section V-I of this manual for further information concerning tube salvaging operation.

IV. Major Fabrication Changes on "L", "K" and "C" Process Room Holding Racks

A. "L" Unit

1. A revision was received from Design relocating the two 1-21/64" drain holes to the position shown on du Pont drawing D114244.

2. Other minor changes are covered in the revised drawings listed for "L", "K" and "C" Units in the front of this manual.

B. "K" Unit

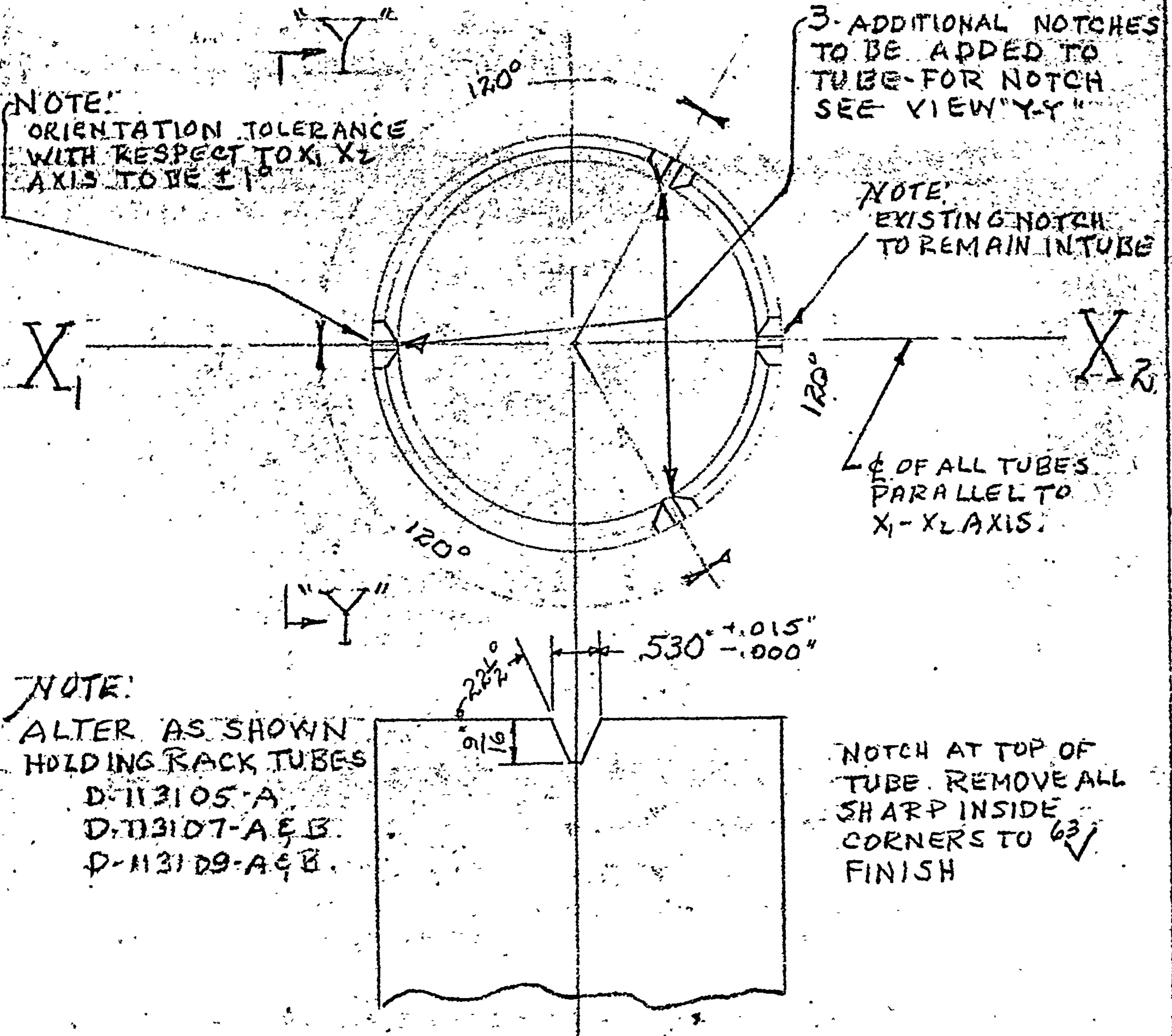
Same as "A" above.

C. "C" Unit

Same as "A" above, except as follows:

1. Three additional Vee slots were added to the top of items 10 to 14 inclusive shown on tube arrangement W160300. The existing Vee slot machined in tube ends on the X_2 side before the revision was received at the du Pont Inspection Department remained in the tube ends. See Sketch #5 presented herewith covering this revision. Also, see photo serial #369 showing the machining of these three additional Vee slots.

2. Container drawing D114246 and tank drawing D113111: A member of the Design Division requested that the vertical weld seams adjacent to the field joint on both container and tank be x-rayed for a distance of six inches from the field joint. The resulting films were judged with the same stringency as required under



3-ADDITIONAL NOTCHES TO BE ADDED TO TUBE-FOR NOTCH SEE VIEW "Y-Y"

NOTE:
ORIENTATION TOLERANCE WITH RESPECT TO X1 X2 AXIS TO BE ±1°

NOTE:
EXISTING NOTCH TO REMAIN IN TUBE

℄ OF ALL TUBES PARALLEL TO X1 - X2 AXIS.

NOTE:
ALTER AS SHOWN HOLDING RACK TUBES
D-113105-A
D-113107-A & B
D-113109-A & B.

NOTCH AT TOP OF TUBE. REMOVE ALL SHARP INSIDE CORNERS TO 63√ FINISH

VIEW "Y-Y"

NOTE:
3-ADDITIONAL NOTCHES AS SHOWN ARE TO BE ADDED TO TOP OF ITEMS 10 TO 14 INCLUSIVE SHOWN ON TUBE ARRANGEMENT W160300. THIS WORK TO BE DONE BY FIELD IN BLDGS. 105 L & K, BUT BLDG. 105-C HOLDING RACK TO BE ALTERED BY NEW YORK SHIP

SKETCH # 5

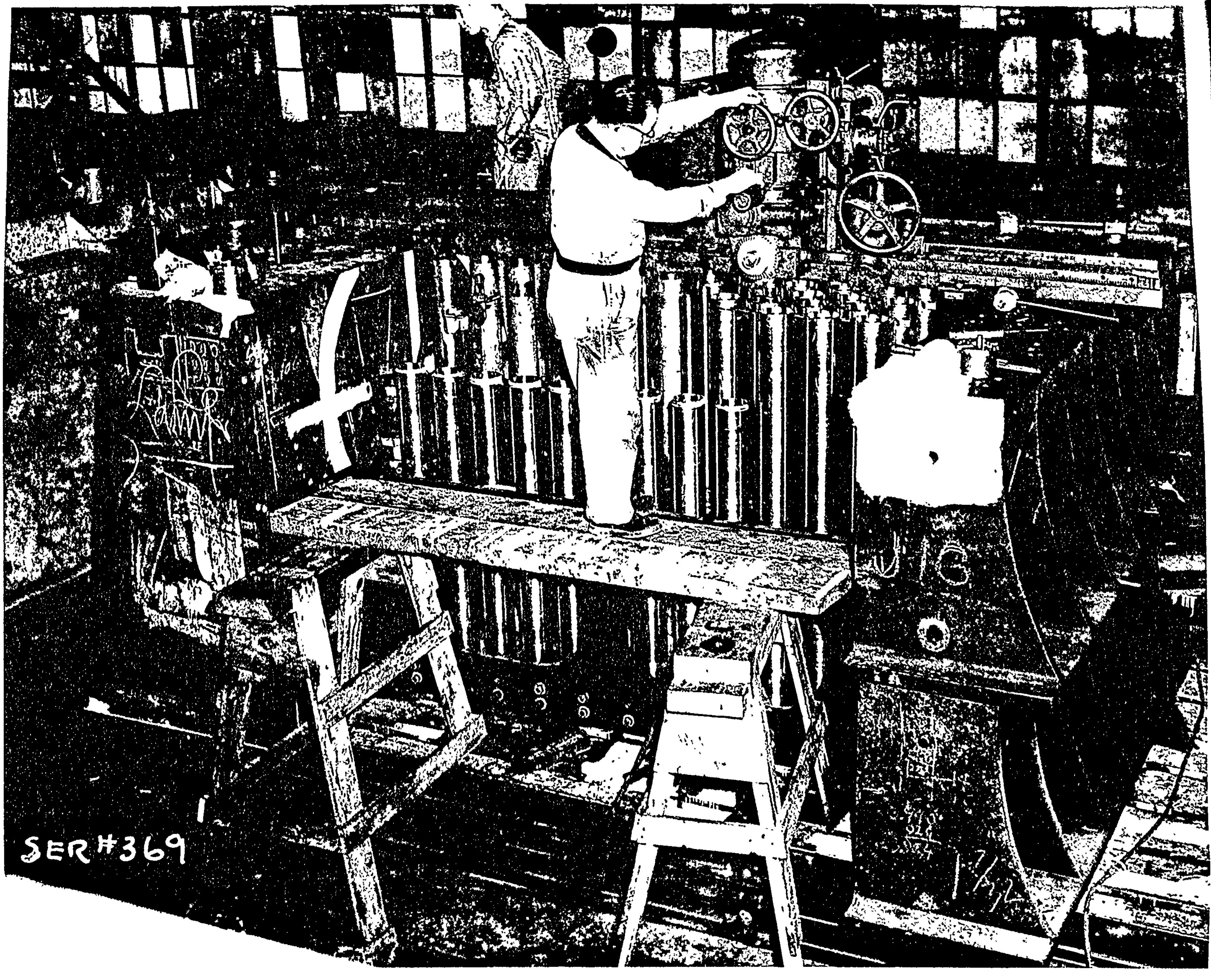
Serial Number 369

New York Shipbuilding Corp.
Camden, New Jersey
May 19, 1954

PROJECT 8980 - SAVANNAH RIVER PLANT

"C" Unit Holding Rack Assembly

Machining of three additional Vee slots in top ends of tubes designated as items 10 to 14 inclusive on the tube arrangement W-160300. Also, see Sketch #5.


SER#369

Paragraph U68 of the 1949 edition of the ASME Code. All radiographs were acceptable. (This request came about as a result of complaints received from the field that L & K units were x-rayed at the field joint and defects were found in the vertical joints adjacent to the field joint.)

V. Inspections Performed on the "L" Holding Rack Assembly

A resume of all inspections performed on the "L" holding rack assembly are covered in Exhibit #3 presented herewith.

VI. Inspection Performed on the "K" Holding Rack Assembly

A resume of all inspections performed on the "K" holding rack assembly are covered in Exhibit #4 presented herewith.

VII. Inspections Performed on the "C" Holding Rack Assembly.

A resume of all inspections performed on the "C" holding rack assembly are covered in Exhibit #5 presented herewith.

EXHIBIT #3

RESUME OF ALL INSPECTIONS PERFORMED ON THE "L" HOLDING RACK ASSEMBLY

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

Construction Division

[redacted]

Report Number 764-L

CC: J. B. Johnson
R. K. Mason-D.A.Hauser-SRP (3)
R. K. Mason-W.P.Duncan-SRP
H. L. Bunker- J.G.Brewer
J. G. Brewer
H. B. Gage
F. C. Breuninger
L. J. Carroll
R. H. Barto - NYS (3)

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

FIELD INSPECTOR'S REPORT

TO C. J. VEITH - M & E FILE

FROM A.J.Piatek - O.R.Frandsen DATE October 31, 1953

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

EQUIPMENT Holding Rack EQ.PC.NO. 179.3-L

DRAWING NOS. Listed below JOB RATING

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

This report supersedes report number 763-L which was issued incorrect.

The following is a summary of all inspections made on "L" unit holding rack. Inspections were performed during the period Aug.10, 1953, through October 29, 1953, by Du Pont inspectors assigned to New York Ship. Drawings used in conjunction with inspections were supplied by Du Pont Engr. Dept. Drawings referred to in this report are drawing numbers W-160289, W-160291, W-160300, W-160307. D-110320, D-113105, D-113106, D-113107, D-113108, D-113109, D-113110, D-113111, D-114244 and D-114246.

A. Tube Nest - inspections performed

1. Pre-assembly inspection of tubes: All tubes (a total of 41 tubes identified by drawings D-113105, D-113106, D-113107, D-113108, and D-113109), were inspected prior to assembly. Inspection consisted of a complete dimensional check, determination of surface finish, and examination of circumferential butt welds on those tubes which were welded.

   All tubes checked were found to be in "As Made" conditions and bores of all tubes were undersize. These tubes were put into unit and welded. After welding all tube bores were then machined to B/P sizes. This procedure omitted one machining operation. On previous units tube bores were machined out to B/P specs. prior to installation into sheets. After welding tubes into unit, tube bores were again machined out. This second machining operation was to remove excess metal in the tube bores (necking in of metal caused by welding tubes into sheets.

RESTRICTED
SECURITY INFORMATION

After machining, all tubes met dimensional and surface finish specs. Visual examination of all tube welds revealed that welds were completely penetrated and of sound quality.

2. Rack plates and probe holder - see dwg. no. D-114244 & D-113110

The holes in the rack plates were jig drilled two at a time; therefore, one plate only was given an overall and detailed dimensional inspection. All dimensions were within b/p tolerances and the inspected plate was positioned over the second rack plate. Alignment of the two plates was checked visually and considered satisfactory.

The probe holder plate was likewise given an overall and detailed dimensional inspection followed by a secondary inspection during assembly of probe holder to tube nest. Results of these dimensional inspections were in accordance with b/p.

Upon completion of the above dimensional inspections, the rack plates and probe holder were sandblasted, passivated, and ferroxyl tested. Results of ferroxyl, testing and visual inspection indicated plates were free of rust, free iron, and surface defects.

3. Assembly of tubes in tube nest

Shoulder tubes were first placed in the rack plates thereby maintaining proper spacing between rack plates. The top plate was then leveled with a Wild NIII Level and the plates were adjusted in such fashion as to provide optimum verticality of shoulder tubes.

The top plate was level within a range of .005", based on readings taken at each corner of the plate.

Verticality of three representative tubes ranged from .001" to .010" per ft. and fabrication was continued.

The remaining tubes were assembled in the plates and the location of tubes was checked to make certain each type tube was placed in proper position. All tubes were in proper location.

The parallelism of vee slots on the "C", "D", "E", and "F" tubes was checked. This inspection was made by first establishing the fact that two tubes on the centerline were oriented such that the vee slots were in the 1/32" parallelism alignment tolerance. This was accomplished after some adjusting. Size of slots was also checked. All were within b/p tolerance.

Before welding tubes to plates, the distance from top ends of all tubes to top rack plate was checked. These dimensions met b/p requirements.

Tubes were tack welded and then fully welded to the top and bottom rack plates. Welds were examined visually for determination of cracks, pinholes, and soundness of welds. The welding was considered satisfactory.

The top plate was then re-leveled within .008" and verticalities of 8 representative tubes were taken. Verticalities were found to be within a range of .0005" to .024" per ft.

All tube bores were reamed after welding was completed. This was done to produce a round bore of proper size as welding tends to shrink the tube in the area adjacent to the tube weld and all tube bores were small when first inserted into nest as explained in a previous paragraph.

4. Fitting of tube nest to container

With the tube nest placed in the container and the assembly resting on a level platen, level readings were obtained on the top edge of the container at each corner by means of a Wild NIII Level. Results showed the container to be level within .008". Verticality readings were taken on 5 representative tubes. Results of these readings showed verticalities ranging from .005" to .024" per ft.

After these checks, the 2 1/2" x 3" x 1/2" flange plates, (for supporting the tube nest), were tack welded into the container. The tube nest was then removed and the flange plates were tack welded at top and fillet welded at bottom around the entire container. Welds were examined visually for cracks, pinholes, and soundness. Welds were considered satisfactory and the tube nest was replaced in the container and the following inspections were made:

A. The fillet tack weld joining the top rack plate to container and the fillet weld joining the flange plate to the bottom rack plate were visually inspected for cracks, pinholes, and soundness. The welds were considered satisfactory.

5. Pouring of concrete and lead and subsequent operation and inspections

Prior to pouring of concrete and lead the interior of the tube nest and container was inspected for cleanliness. Upon satisfaction of this inspection, the concrete was poured and care was taken to provide vibration in order that honey combing would not result. The concrete was permitted to set approximately 36 hours before pouring lead.

The container in the area in which lead was to be poured was preheated with torches. This was done to prevent lamination due to thermal shock. Lead was then satisfactorily poured.

ASTM-B29 Grade A common de-silverized lead was used in this unit instead of ASTM-B29 chemical lead as specified on b/p. Use of this type of lead was accepted by Mr. H. G. Hey of Du Pont Design.

After pouring of concrete and lead, the tube nest was functional gaged and final bore sizes were obtained as follows:

A. Tubes in positions 2, 3, 4, 5, 8, 9, and 10, (see dwg. no. W-160300), were functional gaged with a 4.375" dia. gage. All accepted the gage for the entire length after minor repairing.

B. Tubes in positions 1, 6, 7, and 9 were checked with a bore gage. These tubes were accepted and readings indicated tube bores were above minimum drawing size. Some tubes were .001" to .004" over bore size tolerance in one direction only.

C. Bore sizes were obtained on all other tubes for a depth of 18". All were within b/p tolerance.

The probe holder plate was then installed, inspected and found to be in proper location. Probe pin sockets were welded to probe holder plate and brackets. All probe pin sockets were checked for size, location, and elevation. All met drawing specifications.

Fitting of "L" unit solenoid to unit tube nest was inspected. The solenoid assembly operated mechanically according to drawing specifications.

Discharge process water tube and liquid level control tubes were dimensionally checked, visually inspected, and examined for cleanliness. The tubes were clean and welding was accepted.

B. Container - Dwg. No. D-114246

1. Inspection of welding and fitup.

All welds were visually examined for cracks, pinholes, and soundness. After minor repairs all welds were satisfactory.

Fit-up of plates was in accordance with above listed drawing. In general, the fabrication procedure followed was in accordance with an outline prepared by vendor and identified as follows:

NYK Project
Fabrication and Welding Procedure
Contract 8212
Dated: 4/15/53.

2. Overall dimensions

All overall dimensions of container were checked and found to meet drawing tolerances.

Length of container was 70 1/16".

The flange plate around the top of the container for supporting the assembly was also given a dimensional inspection. All anchor bolt holes were within drawing tolerance. (These holes were drilled from a jig on which all holes were within 1/64" of drawing dimension.)

3. Sandblasting

The entire container was sandblasted, passivated and ferroxyl tested. Results of ferroxyl testing and visual inspection indicated assembly was free of rust, free iron, and surface defects.

C. Tank bottom - dwg. no. D-113111

1. Inspection of welding and fit-up.

All welds were visually inspected for determination of cracks, pinholes, and soundness. After minor repairs all welds were satisfactory.

Fit-up of plates was in accordance with the above listed drawing. The same fabrication procedure as that followed in the container was adhered to during fabrication of the tank bottom.

2. Overall dimensions

All overall dimensions of the tank bottom were checked and found to meet b/p requirements.

3. Fitting of tank bottom to container.

During the fitting of tank bottom to container - alignment of centerlines and mating of centering devices were checked. The fitting and alignment of container and tank bottom was satisfactory.

a. Overall length - top of container to bottom of tank bottom measured 21' - 5 1/4"; B/P 21' - 5 1/2" ±1/4".

Tubes were checked to find if they are in a plane of ± 1/32". Two tubes were found to be 1/32" under B/P specs. Mr. Hoy of Design accepted this condition 10/20/53.

4. Hydrostatic testing

The tank bottom was properly supported in a vertical position and filled with de-ionized water. Static head was held 4 hrs. Welds were subjected to hammer testing in accordance with the 1950 edition of the Unfired Pressure Vessels Code. No leaks were found upon completion of visual inspection.

Repot
Report #764-L
Page 6 of 6

FIELD INSPECTOR'S REPORT
FROM: Piatek/Frandsen

5. Sandblasting

The entire tank bottom was sandblasted, passivated, and ferroxyl tested. Results of ferroxyl testing and visual inspection indicated all surfaces were free of rust, free iron and surface defects. The tube nest and container, was cleaned with a solution of "FO-128" prior to shipment. Visual inspection showed the assembly to be free of dirt and oil. The assembly was shipped by truck October 29, 1953.

6. Heat Numbers

Heat numbers are as follows:

Top Hold Rack Container

62807 Side plates
62757 End plates
62759 End plates
43092} Flanges
49092)
62797) Angle plates
62653)

Tank Bottom

62807 Side Plates (2)
62759 Bottom plate

lmw

EXHIBIT #4

RESUME OF ALL INSPECTIONS PERFORMED ON THE "K" HOLDING RACK ASSEMBLY

E. I. DU PONT DE NEMOURS & CO.

Construction Division

[redacted]

HED

Report Number 831-K

CC: 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
H. G. Hey
R. H. Barto - NYS (3)
J. B. Johnson - File

December 31, 1953
New York Ship - Camden, N. J.

FIELD INSPECTOR'S REPORT

TO C. J. VEITH - M & E FILE

FROM A. J. Piatek DATE 12/28/53

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

EQUIPMENT Holding Rack EQ.PC.NO. 179.3K

DRAWING NOS. Listed below JOB RATING

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

The following is a summary of all inspections made on "K" unit holding rack. Inspections were performed during the period Oct. 29, 1953 through Dec. 24, 1953, by Du Pont Inspectors assigned to New York Ship. Drawings used in conjuction with inspections were supplied by Du Pont Engineering Dept. Drawings referred to in this report are drawing numbers W-160289, W-160291, W-160300, W-160307, D-110320, D-113105, D-113106, D-113107, D-113108, D-113109, D-113110, D-113111, D-114244, and D-114246.

A. Tube Nest- Inspections performed

1. Pre-assembly inspection of tubes: All tubes (a total of 41 tubes) indentified by dwgs (D-113105, D-113106, D-113107, D-113108 and D-113109), were inspected prior to assembly. Inspection consisted of a complete dimensional check, determination of surface finish and examination of circumferential butt welds on those tubes which were welded.

   All tubes checked were found to be in "As Made" conditions and bores of all tubes were undersize. These tubes were put into the unit and welded. After welding, all tube bores were machined to B/P size. After machining, all tubes met dimensional and surface finish specifications. Visual inspection of all tube welds revealed that welds were completely penetrated and of sound quality.

RESTRICTED
SECURITY INFORMATION

[redacted]

FIELD INSPECTOR'S REPORT
FROM: A. J. Piatek

2. Rack plates and probe holder - see dwg. no. D-114244 and D-113110

The holes in the rack plates were jig drilled two at a time; therefore, one plate only was given an overall and detailed dimensional inspection. All dimensions were within B/P tolerance and the inspected plate was positioned over the second rack plate. Alignment of the two plates was checked visually and considered satisfactory.

The probe holder plate was likewise given an overall and detailed dimensional inspection followed by a secondary inspection during assembly of probe holder to tube nest. Results of these dimensional inspections were in accordance with B/P.

Upon completion of the above dimensional inspections, the rack plates and probe holder were sandblasted, passivated, and ferroxyl tested. Results of ferroxyl testing and visual inspection indicated plates were free of rust, free iron, and surface defects.

3. Assembly of tubes in tube nest.

Shoulder tubes were first placed in the rack plates thereby maintaining proper spacing between rack plates. The top plate was then leveled with a Wild NIII Level and the plates were adjusted in such fashion as to provide optimum verticality of shoulder tubes.

The top plate was level within a range of .005", based on readings taken at each corner of the plate.

Verticality of three representative tubes ranged from .001" to .005" per ft. and fabrication was continued. The remaining tubes were assembled in the plates and the location of tubes was checked to make certain each type tube was placed in proper position. All tubes were in proper location.

The parallelism of vee slots on the "C", "D", "E", and "F" tubes was checked. This inspection was made by first establishing the fact that two tubes on the centerline were oriented such that the vee slots were in the 1/32" parallelism alignment tolerance. This was accomplished after some adjusting. Size of slots was also checked. All were within B/P tolerance.

Before welding tubes to plates, the distance from top ends of all tubes to top rack plate was checked. These dimensions met B/P requirements.

Tubes were tack welded and then fully welded to the top and bottom rack plates. Welds were examined visually for determination of cracks, pinholes, and soundness of welds. The welding was considered satisfactory.

The top plate was then re-leveled within .008" and verticalities of eight (8) representative tubes were taken. Verticalities were found to be within a range of .000" to .010" per ft.

All tube bores were reamed after welding was completed. This was done to produce a round bore of proper size as welding tends to shrink the tube in the area adjacent to the tube weld and all tube vanes were small when first inserted into nest as explained in a previous paragraph.

4. Fitting of tube nest to container

With the tube nest placed in the container and the assembly resting on a level platen, level readings were obtained on the top edge of the container at each corner by means of a Wild NIII Level. Results showed the container to be level within .008". Verticality readings were taken on five (5) representative tubes. Results of these reading showed verticalities ranging from .000" to .009" per ft.

After these checks, the 2 1/2" x 3" x 1/2" flange plates (for supporting the tube nest), were tack welded into the container. The tube nest was then removed and the flange plates were tack welded at top and fillet welded at bottom around the entire container. Welds were examined visually for cracks, pinholes, and soundness. Welds were considered satisfactory and the tube nest was replaced in the container and the following inspections were made:

(a) The fillet tack weld joining the top rack plate to container and the fillet weld joining the flange plato to the botton rack plate were visually inspected for cracks, pinholes and soundness. The welds were considered satisfactory.

5. Pouring of concrete and lead and subsequent operations and inspections.

Prior to pouring of concrete and lead the interior of the tube nest and container was inspected for cleanliness. Upon satisfaction of this inspection, the concrete was poured and care was taken to provide vibration in order that honey combing would not result. The concrete was permitted to set approximately 24 hours before pouring lead.

[redacted]

The container in the area in which lead was to be poured was preheated with torches. This was done to prevent lamination due to thermal shock. Lead was then satisfactorily poured.

ASTMB29 chemical lead P.O.376 was used as specified on B/P Two cubic yards 2500 lbs central mix, 1/2" stone, 8" slump P.O.412 concrete was used in this unit.

After pouring of concrete and lead, the tube nest was functional gaged and final bore sizes obtained. These were all found to be satisfactory. The overall (center to center) dimensions of tubes in X and Y directions was found to be 1/8" under B/P dimensions. Mr. Hey of Design verbally accepted this condition via telephone conversation 12/23/53.

The probe holder plate was then installed, inspected and found to be in proper location. Probe pin sockets were welded to probe holder plate and brackets. All probe pin sockets were checked for size, location and elevation. All met drawing specifications.

Fitting of "K" unit solenoid to unit tube nest was inspected. The solenoid assembly operated mechanically according to drawing specifications.

Discharge process water tube and liquid level control tubes were dimensionally checked, visually inspected, and examined for cleanliness. These tubes were found to be clean and welding was accepted.

B. Container - Drawing number D-114246

1. Inspection of welding and fit-up.

   All welds, after minor repairs, were satisfactory. Fit-up of plates was in accordance with above listed drawing.

2. Overall dimensions

   All overall dimensions of container were checked and found to be within drawing tolerance.

   The flange plate around the top of the container for supporting the assembly was also given a dimensional inspection. All anchor bolt holes were within drawing tolerance. (Those holes were drilled from a jig on which all holes were within 1/64" of drawing dimensions.)

3. Sandblasting

   The entire container was sandblasted, passivated and ferroxyl tested. Results of ferroxyl testing and visual inspection indicated assembly was free of rust, free iron and surface defects.

RESTRICTED

[redacted]

FIELD INSPECTOR'S REPORT
FROM: A. J. Piatek

C. Tank Bottom - drawing number D-113111

1. Inspection of welding and fit-up

All welds were visually inspected for defects. After minor repairs all welds were satisfactory.

Fit-up of plates was in accordance with the above listed drawing.

2. Overall dimensions

The slope of bottom plate was found to be 1" short. Overall dimensions met B/P specifications.

3. Fitting of tank bottom to container

During the fitting of tank bottom to container-alignment of center-lines and mating of centering devices were checked and found satisfactory.

Overall length-top of container to bottom of tank bottom measured 21' 5 13/16". B/P dimension- 21' 5 1/2 ± 1/4".

In process of lifting container to match with tank bottom, top ends of some tubes were damaged. The vendor used a flaring tool to round out the tubes and honed bores of these tubes for a better finish. Reinspection of these tubes after repairing showed that tubes were found satisfactory and all met drawing specifications.

Tubes were checked to find if they were in a plane of ± 1/32". All tubes were found to be in a plane of ±1/64".

4. Hydrostatic testing

The tank bottom was properly supported in a vertical position and filled with de-ionized water. Static head was held four (4) hours. Welds were subjected to hammer testing in accordance with the 1950 edition of the Unfired Pressure Vessels Code. No leaks were found upon completion of visual inspection.

5. Sandblasting

The entire tank bottom was sandblasted, passivated and ferroxyl tested. Results of ferroxyl testing and visual inspection indicated all surfaces were free of rust, free iron and surface defects. The tube nest and container were cleaned with a solution of FO 128 prior to shipment. Visual inspection showed the assembly to be free of dirt and oil. The assembly was shipped 12/28/53.

RESTRICTED

6. Heat Numbers

Top Container

43002-2A 43092-2A	flanges
62797-2B	End Plates
62574-2A	Cover plate
62737 -	End plates
62757 62653	Angle plates

Tank Bottom

62751-1C 62653-2B	End plates
53457-1A	Bottom plate
62822-2A	Man hole plate

lmw

EXHIBIT #5

RESUME OF ALL INSPECTIONS PERFORMED ON THE "C"

HOLDING RACK ASSEMBLY

E. I. DU PONT DE NEMOURS & CO.

Construction Division

Report Number 945-C

CC: R.K.Mason-D.A.Hauser-SRP (3)
R.K.Mason-E.W.Bolin-SRP
H.L.Bunker-J.G.Brewer
J.G.Brewer
H.G.Hey
F.C.Breuninger
L.J.Carroll
R.H.Barto-NYS (3)
J.B.Johnson-File

May 20, 1954
New York Ship-Camden,N.J.

FIELD INSPECTOR'S REPORT

TO C. J. VEITH - M & E FILE

FROM O.R.Frandsen DATE May 18, 1954

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

EQUIPMENT Holding Rack EQ.PC.NO. 179.3 C

DRAWING NOS. Listed Below JOB RATING

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

The following is a summary of all inspections on "C" unit holding rack. The following drawings were used in conjuction with inspections and are referred to in this report; W-160289, W-160291, W-160300, W-160307, D-110320, D-113105, D-113106, D-113107, D-113108, D-113109, D-113110, D-131111, D-114244, D-114246, and sketch E 45238.

A. Tube Nest - Inspections Performed

1. Pre-assembly inspection of tubes: All tubes identified by drawings (D-113105, D-113106, D-113107, D-113108 and D-113109), were inspected prior to assembly. Inspection consisted of a complete dimensional check, determination of surface finish and examination of circumferential butt welds on those tubes which were welded.

   All tubes checked were found to be in "As Made" condition and bores of all tubes were undersize. These tubes were put into the unit and welded. After welding, all tube bores were machined to B/P size. After machining, all tubes met dimensional and surface finish specifications. Visual inspection of all tube welds revealed that welds were completely penetrated and of sound quality.

2. Rack plates and probe holder - drawings D-114244 and D-113110.

   The holes in the rack plates were jig drilled two at a time; therefore, one plate only was given an overall and detailed dimensional inspection. All dimensions were within B/P tolerance and the inspected plate was positioned over the second rack plate. Alignment of the two plates were checked visually and considered satisfactory.

The probe holder plate was likewise given an overall and detailed dimensional inspection followed by a secondary inspection during assembling of probe holder to tube nest. Results of these dimensional inspections were in accordance with B/P.

Upon completion of the above dimensional inspections, the rack plates and probe holder were sandblasted, passivated, and ferroxyl tested. Results of ferroxyl testing and visual inspection indicated plates were free of rust, free iron, and surface defects.

3. Assembly of Tubes in Tube Nest

Shoulder tubes were first placed in the rack plates thereby maintaining proper spacing between rack plates. The top plate was then leveled with a Wild NIII Level and the plates were adjusted in such fashion as to provide optimum verticality of shoulder tubes.

The top plate was level within a range of .005" based on readings taken at each corner of the plate.

Verticality of three representative tubes ranged from .001" to .005" per ft. and fabrication was continued. The remaining tubes were assembled in the plates and the location of tubes was checked to make certain each type tube was placed in proper position. All tubes were in proper location.

The parallelism of Vee slots on the "C", "D", "E", and "F" tubes was checked. This inspection was made by first establishing the fact that two tubes on the centerline were oriented such that the Vee slots were within the 1/32" parallelism alignment tolerance. This was accomplished after some adjusting. Size of slots was also checked. All were within B/P tolerance.

Before welding tubes to plates, the distance from top ends of all tubes to top rack plate was checked. These dimensions met B/P requirements.

After welding the tubes to the plate, a drawing revision was received from Design as shown on sketch #E45238. This revision required the addition of three additional "V" slots as shown on the above mentioned sketch. The alteration was accomplished by leveling the tube nest and laying out the X1 centerline, using this centerline to set the Cincinnati Milling machine, designed for cutting the plenum chamber "V" slots, the three additional slots were cut at 120° intervals in each tube. The original "V" slot located on the X2 axis was left in the tube; therefore, each tube now has four (4) "V" slots.

The top plate was then re-leveled within .008" and the verticality of (8) representative tubes was taken. Verticalities were found to be within a range of .000" to .010" per ft.

All tube bores were reamed after welding was completed. This was done to produce a round bore of proper size as welding tends to shrink the tube in the area adjacent to the tube weld and all tube bores were small when first inserted into nest as explained in a previous paragraph.

4. Fitting of Tube Nest to Container

With the tube nest placed in the container and the assembly resting on a level platen, level readings were obtained on the top edge of the container at each corner by means of a Wild NIII Level. Results show the container to be level within .005". Verticality readings were taken on five representative tubes. Results of these readings show verticalities ranging from .000" to .008" per ft.

After these checks, the 2½" x 3" x 1/2" flange plates (for supporting the tube nest), were tack welded into the container. The tube nest was then removed and the flange plates were tack welded at top and fillet welded at the bottom around the entire container. Welds were examined visually for cracks, pinholes, and soundness. Welds were considered satisfactory and the tube nest was replaced in the container and the following inspections were made:

> The fillet tack weld joining to top rack plate to container and the fillet weld joining the flange plate to the bottom rack plate were visually inspected for cracks, pinholes and soundness.

5. Pouring of Concrete and Lead and Subsequent Operations and Inspections.

Prior to pouring of concrete and lead, the interior of the tube nest and container was inspected for cleanliness. Upon satisfactory inspection, the concrete was poured and care was taken to provide vibration in order that honey combing would not result. The concrete was permitted to set approximately 24 hours before pouring lead.

The area in the container in which lead was to be poured was preheated with torches. This was done to prevent lamination due to thermal shock. Lead was then satisfactorily poured.

ASTMB29 chemical lead P.O. 376 was used as specified on B/P. Two cubic yards 2500 lbs central mix, 1/2" stone, 8" slump P.O. 412 concrete was used in this unit.

After pouring of concrete and lead, the tube nest was functional gaged and final bore sizes obtained. These were all found to be satisfactory.

The probe holder plate was then installed, inspected and found to be in proper location. Probe pin sockets were welded to probe holder plate and brackets. All probe pin sockets were checked for size, location and elevation. All met drawing specifications.

Fitting of "C" unit solenoid to unit tube nest was inspected. The solenoid assembly operated mechanically according to drawing specifications.

Discharge process water tube and liquid level control tubes were dimensionally checked, visually inspected, and examined for cleanliness. These tubes were found to be clean and welding was accepted.

B. <u>Container</u> - Drawing number D-114246

1. Inspection of Welding and Fit-up.

Fit-up of plates was in accordance with the aforementioned drawing. All welding was accepted after visual examination. Following this inspection, a request was received from Mr. H.G.Hey of Design, that the vertical weld seams adjacent to the field joint, on both the tube nest container and the tank, be radiographed for a distance of six inches from the field joint. The restulting films were judged with the same stringency as required under Par. U68 of the 1949 edition of the ASME Code. All x-rays were accepted.

2. Overall Dimensions

All overall dimensions of container were checked and accepted.

The flange plate around the top of the container for supporting the assembly was also given a dimensional inspection. All anchor bolt holes were within drawing tolerance. (These holes were drilled from a jig on which all holes were within 1/64" of drawing dimensions.)

3. Sandblasting

The entire container was sandblasted, passivated and ferroxyl tested. Results of ferroxyl testing and visual inspection indicated assembly was free of rust, free iron and surface defects.

C. <u>Tank Bottom</u> - Drawing number D-113111

1. Inspection of Welding and Fit-Up.

Fit-up of plates was in accordance with the aforementioned drawing. All welding was accepted after visual examination and x-ray examination as described in Section B-Par. 1.

2. Overall Dimensions

The slope of the bottom plate was found to be 1" short. Overall dimensions met B/P specifications.

3. Fitting of tank bottom to container

During the fitting of tank bottom to container, alignment of centerlines and mating of centering devices were found to be satisfactory.

Overall length of the top of the container to the bottom of the bottom container measured 21'5 1/8". B/P dimension-21'5 1/2" ±1/4".

The profile of the tops of all tubes was checked to establish their plane. All tubes were found to be in a plane of ±.015".

4. Hydrostatic Testing

The tank bottom was properly supported in a vertical position anf filled with deionized water. Static head was held for one hour. Welds were subjected to hammer testing in accordance with the 1950 edition of the ASME Unfired Pressure Vessels Code. No leaks were found upon completion of visual inspection.

5. Sandblasting

The entire tank bottom was sandblasted, passivated and ferroxyl tested. Results of ferroxyl testing and visual inspection indicated all surfaces were free of rust, free iron and surface defects.

lmw.

777M PHYSICS LABORATORY TANK AND GRID BEAM ASSEMBLIES

PART VI

REPORT
OF
MATERIAL & EQUIPMENT
SECTION'S
ACTIVITIES
AT
NEW YORK SHIPBUILDING CORP.
DURING FABRICATION
OF
AXC 167 1/2
STARTING MAY 18, 1951
PART VI

BY: JAMES RAY STEWART

JAN. 11, 1954

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PART VI

INSPECTIONS PERFORMED BY DU PONT ON THE 777M PHYSICS LABORATORY PROCESS UNIT

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CHRONOLOGICAL LIST OF ILLUSTRATIONS

16. Exhibit #10 - Inspection report covering the x-raying of all tank butt welds

17. Photograph Serial #104 - P.D.P. Tank

18. Exhibit #11 - Design specification covering 1/4" weep hole located in the top of the P.D.P. tank

19. Exhibit #12 - Inspection report covering inspecions made after sandblasting interior and eterior tank surfaces

20. Exhibit #13 - Inspection report covering ferroxl testing and inspection of tube centering mat for P.D.P. tank

21. Exhibit #14 - Inspection report covering hydrostatic test of P.D.P. tank

22. Exhibit #15 - Inspection report covering the final inspection and dimensional check of the P.D.P. tank

777M PHYSICS LABORATORY PROCESS UNIT DRAWING LIST

The following list covers all du Pont drawings pertaining to fabrication released to the M & E Group at New York Shipbuilding Corporation, Camden, N. J.

This list was prepared from existing drawing files located in the M & E Office at New York Ship on November 6, 1953. For reference purposes and convenience, all drawings are listed by drawing number, revision number and title.

Du Pont Dwg. #	Revision #	Title
W131476	26	Tank Arrangement
W131488	53	Grid Beam Arrangement
W131489	107	Cover Plates
W131490	49	Diaphragm Arrangement
W131956	42	Grid Beam Support Arrangement
W132452	40	Bottom Plate Arrangement, Sheet #2
W132453	42	Cover Plate Arrangement, Sheet #2
W157317	21	Tube Centering Mat
D112748	1	Laboratory Bldg. Tank Bot. Unit
D139824	41	Bottom Plate Details

PART VI

INSPECTIONS PERFORMED BY DU PONT ON THE 777M PHYSICS LABORATORY PROCESS UNIT

I. General

A. Design

1. Voorhees, Walker Foley and Smith

After reviewing the basic design of the 777M Physics Laboratory P.D.P. process unit with AEC and the du Pont Company, an Architectural and Engineering Firm in New York City was awarded the contract to design the P.D.P. unit based on du Pont Specifications. This firm was Voorhees, Walker, Foley and Smith. Due to the fact that du Pont had fabrication work in process similar to the P.D.P. unit, they were designated by AEC to arrange for the fabricating and assembling of this unit assigned equipment piece number 770. Voorhees, Walker, Foley and Smith were retained as consulting engineers for the P.D.P. project.

2. New York Shipbuilding Corporation

At an early date AEC granted approval for du Pont to include the 777M Physics Laboratory unit in contract AXC-167½. This decision was reached after du Pont requested that New York Ship review the Voorhees, Walker, Foley and Smith design and consider negotiating for the fabrication of the unit. In turn, New York Ship indicated that they could fabricate the unit and meet the required shipping date if du Pont would purchase and expedite the materials required for the subject unit. Du Pont replied to this proposal by stating that they would procure all of the major materials required for the job. However, du Pont pointed out to New York Ship that they anticipated minor changes in design details. It was agreed by du Pont and New York Ship that less shop fabrication delay would be incurred if these minor design changes were turned over to New York Ship with the request that they procure the unforeseen items locally.

It was finally concluded by du Pont and New York Ship that all work and materials would be covered by contract AXC-167½.

B. Procurement

1. Material Suppliers

Orders covering the supply of material for the fabrication of the 777M Physics Laboratory process unit were placed on G. O. Carlson, Morris Wheeler, J. T. Ryerson, H. M. Harper, Anti-Corrosive Metal Products, Camden Copper Works, Aluminum

Company of America, U. S. Steel Co., and the Lukens Steel Co. Materials were inspected and accepted by M & E field inspection personnel prior to shipping to New York Ship.

C. Inspection Procedure

1. Special Meeting

To clarify the final steps required in the inspection of the 777M P.D.P. process unit, a special meeting was held on December 12, 1952, by representatives of du Pont Design, du Pont Construction, du Pont M & E Inspection Section, Voorhees, Walker, Foley and Smith and the New York Shipbuilding Corporation. The following information was developed:

(a) All stainless steel parts must be suitably cleaned and pass the ferroxyl test.

(b) Prior to shipping all parts will be inspected for loose dirt and other foreign matter and be steam cleaned. Surgical cleanliness will not be required since some assembly and adjustment of parts must be done in the field.

(c) Hole locations in each grid beam must be dimensionally checked with respect to each other and with respect to the center hole of the beam. Tolerance on distance from any hole to adjoining hole will be ± .020". Tolerances on other distances will be the same as those specified for tube sheet assemblies. Hole locations from beam to beam will not be required. However, these locations will be checked between 3 or 4 beams in order to see if desired distances can be obtained by using shims of the proper thickness.

(d) Distance from center grid beam to beam at each end must be checked. Tolerance on this distance will be ± 1/32".

(e) Vertical alignment of cover plates and corresponding bottom plates will be checked. Tolerance will be ± 1/16".

(f) All cover plates do not have to completely seat on beam side plates. This will be done in the field by tapping lightly with a lead hammer.

(g) Grid beam height from 1" plate supporting beams at end to top of 3/8" side plates of beam must be within 1/16" from beam to beam.

(h) Bolt holes near each end of the 2" x 2" x 1/4" angles may be elongated to permit bolting of 1/4" deck plate.

D. Assembly and Shipment

1. Assembly Inspection

The grid beam assembly, cover plates, diaphragm assembly, grid beam support assembly, tank and "I" beam framing assembly were visually inspected and checked for dimensions and alignment by the M & E Inspection Department prior to shipment. The various steps required for covering the inspection of all component parts of the 777M Physics Laboratory process unit have been discussed in detail in the sections that follow.

2. Shipment

After all component parts of the 777M process unit had been inspected and accepted, they were packed in wooden boxes and shipped to the Savannah River Plant site on January 15, 1953.

II. Grid Beam and Grid Beam Support Assemblies

A. Grid Beam Assembly Inspections

1. Material Inspections

a. Stainless Steel Type 304

The type 304 stainless steel material for fabrication of the grid beams, support plates, and diaphragm assembly were given a 100% inspection upon receipt at New York Ship. This inspection consisted of the following steps:

1. All plates were checked with a magnet to determine if the material was of austenitic structure.

2. All plates were inspected for surface condition, imbedded iron, mechanical defects and dimensions.

3. 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.

4. All heat numbers and mill markings were recorded for each plate. In most cases when a section of a plate was cut from the original, heat numbers were transferred.

All of the material inspected was accepted after minor repairs and released for fabrication.

b. Aluminum Material Inspection

All aluminum bar stock, plates and angles received at New York Ship were given the usual visual inspection. After inspecting this material, it was found satisfactory and released for fabrication.

2. Side Plates for Assembling Grid Beams

a. Inspections After Sandblasting and Acid Washing

After fabricating each grid beam support plate and before assembly into a grid beam, it was sandblasted and acid washed according to the established cleaning procedure. Since two support plates are required for each grid beam, and there were a total of thirty-one (31) grid beams in the assembly, the above operation involved the cleaning and inspection of sixty-two side plates.

The following resume covers inspections made on these grid beam support plates (3/8" thick type 304 stainless steel) after sandblasting and acid washing:

(1) All plates were sandblasted before assembly for purposes of:

   a. Removing scale
   b. Freeing surfaces of iron contamination, or any other surface contamination

(2) Following sandblasting, the plates were visually inspected. All were accepted (See "Grid beam sandblasting problem" at end of this section)

(3) All plates were then acid washed using a standard acid wash solution developed for this job, and followed by a clean water wash (deionized or distilled water). Plates were then visually inspected; all were accepted. (See Part I-A, section 3, paragraph c, for acid wash formula)

(4) Support plates were ferroxyl tested using the standard ferroxyl test solution; all were accepted. (See Part I-A, Section 3, paragraph "C" for ferroxyl test formula).

b. Grid Beam Sandblasting Problem

Four grid beam support plates were mistakenly sandblasted without having protective masking tape over the bevels on top and bottom edges of the plates. Blue print specifications for surface finish on these edges was 125 RMS micro-inches. This finish was destroyed by sandblasting; however, subsequent reworking restored the finish and plates were acceptable by Design.

3. Cover Plate Inspection (Pre-assembly)

Prior to assembly of grid beams, all cover plates were dimensionally and visually inspected after fabricating at New York Ship. Du Pont drawings W131469 and D139824 show the dimensions on the twenty (20) different type cover plates for the grid beam assemblies. All of these were machined from aluminum plate stock.

Since there were twenty (20) different type cover plates fabricated for the grid beam assembly, the inspection of each type cover plate from the standpoint of tools and gages used will be treated in a general discussion. It will be presented in this manner rather than outlining a detailed inspection procedure, since all gages and tools used were of the commercial type.

As shown on du Pont drawing W131489, each of the twenty cover plates is identified by an appropriate cover plate identification number; namely, P1, P2, P3, P4, P5, P6, P7, P8, P9, P10, P11, P12, P13, P14, P15, P16, P17, P18, P19 and P20. A breakdown of these different type cover plates and the inspections performed on each is presented in the following paragraphs.

a. Type P1 Cover Plates (See Detail #1 on du Pont Drawing W131489)

(1) Length, Width and Thickness Check

These dimensions were measured using a surface gage and surface plate. (See photo serial #109) Since the length and width dimensions as shown on the drawing are in decimals, this method of measuring was necessary from the standpoint of accuracy. The thickness of each cover plate was measured at each of the four corners using a 0-1" outside micrometer.

(2) Hole Diameters

The 4.033" hole diameter was measured using a dial indicator bore gage and ring gage. The location of the hole with respect to the periphery of the cover plate was checked with a surface gage and surface plate. The method of measuring the location of the hole was similar to that shown in photo serial #109.

The four 9/16" diameter holes were spot checked using a 6" scale graduated in 1/64". The location of these holes with respect to the sides of the plate was also checked using this scale.

Serial Number 109

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

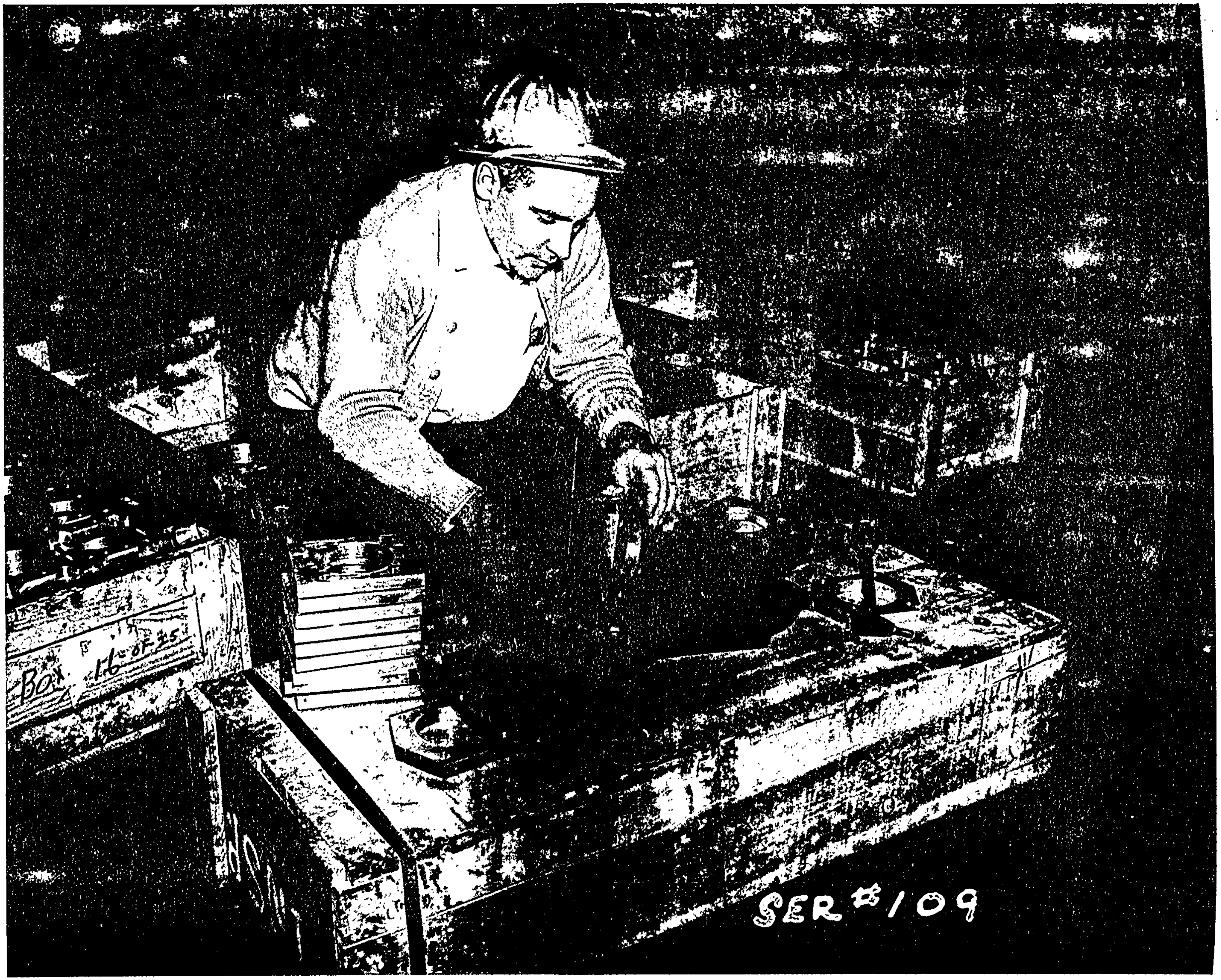
PROJECT 8980 - SAVANNAH RIVER PLANT

Process - 777M Physics Assembly Laboratory Building.

This view shows the inspection of cover plates for the grid beam assembly. The inspector is measuring the width of the cover plate using a surface gage and surface plate. Other dimensions checked are (1) Bore (2) Clamping bolt holes (3) groove check.

See du Pont drawing number W-131489.

R[redacted]ED
SECURITY[redacted]N



SER #109

(3) Cover Plate Locating Grooves

A snap gage was machined to the profile of the cover plate locating groove. This gage was used to check each type cover plate before removing it from the mill fixture, thus insuring that each groove was properly milled before leaving the machining location.

Runout on the grooves was then checked with a depth micrometer from the parallel side of the plate to the respective straight side of the groove on one end and repeated on the opposite end. Readings were compared to determine if they were the same or within the allowable tolerance.

(4) All other dimensions were measured using a 6" scale graduated in 1/64".

b. Type P2 Cover Plates (See Detail 2 on du Pont Drawing W131489)

(1) Length, Width and Thickness Check

These inspections were performed as outlined above in paragraph 1-a.

(2) Hole Diameters

These inspections were performed as outlined above in paragraph 1-b, except as follows:

(1) The additional four 5/16" tape drilled 16-NC-2 holes were checked using a standard thread gage. The relative location of these holes with respect to each other, and the plate edge was measured using a 6" scale graduated in 1/64".

(2) The four cutouts on each end of the cover plates were measured using outside micrometers, inside micrometers and a pair of outside transfer calipers.

(3) Cover Plate Locating Grooves

Inspection was performed for these plates as outlined above in paragraph 1-c.

(4) All other dimensions were measured using a 6" scale graduated in 1/64".

c. Type P3, P4, P5, P6, and P7 Cover Plates (See Details on Du Pont Drawing W131489 and D139824)

All fractional dimensions as shown on the drawing for these type cover plates were measured using a 6" scale graduated in 1/64". All decimal dimensions were measured using outside micrometers, inside micrometers, bore gage and ring gage, surface gage and surface plate and outside transfer calipers. Tapped holes were checked using a standard thread gage of the appropriate size as shown on the drawing.

Cover plate locating grooves on the above type plates were checked as outlined above in paragraph 1-c.

All other dimensions were measured using a 6" scale graduated in 1/64".

d. Type P8 Through P20 Cover Plates (See Details on du Pont Drawing W131489)

Where applicable a 6" scale graduated in 1/64" was used for measuring fractional dimensions less than 6". Dimensions greater than 6" were measured using a 6' scale graduated in 1/64". All other decimal dimensions were measured using the methods outlined above in paragraphs 1-a, 1-b, 1-c, 2-b, and 3.

4. Inspections Performed During Grid Beam Assembly

a. The following inspections were performed on the grid beam assemblies:

(1) All cover plates and end castings were steam cleaned and visually inspected before assembling them into any one of the thirty-one (31) grid beams.

(2) Grid beam structures (type 304 stainless steel) were ferroxyl tested at random prior to assembling of cover plates. Any indication of free iron or other obvious defects was removed by grinding and followed by acid washing and re-testing.

(3) All tie bolt assemblies were checked to determine if the material was of austenitic structure. These were also steam cleaned and ferroxyl tested prior to assembling into a grid beam.

(4) Visual inspection by du Pont inspectors was concurrent with assembling of each grid beam to determine if the various type cover plates were assemblied in their correct location.

(5) After any one grid beam was assembled, a 100% dimensional inspection was performed to determine if the finished piece was within required tolerance. Also, a final check was made to determine if top and bottom cover plates were in their correct location.

For a view of the grid beam assembly operation, see photo serial number 110.

b. Discrepancies Found in Grid Beams:

After inspecting all grid beam assemblies, it was found that two grid beams were cut 0.001" undersize on the end bearing area.

Design Division was contacted for their comments. The grid beams were acceptable to Design, providing the following conditions were met:

1. Place shim stock on the under cut area.
2. Heliarc weld this shim stock to the 3/8" stainless steel plate (grid beam support framing).
3. Grind or file to common plane with tops of adjacent beams.

New York Ship compensated for the above error by following Design's request as outlined above. Inspection revealed that this was satisfactory.

c. Discrepancies Found in 300-1/2" tie bolts:

The 300 - 1/2" tie bolts with a 1½" high hex nut called for on order number AXC 6721½ were inspected by field inspectors and accepted prior to shipping to New York Ship. However, at the time of use at New York Ship it was discovered that the weld joining the bolt and nut did not meet specifications.

Drawing number D-139824 indicates that each bolt and nut was to be joined together with minimum circumferential welds between (1) bolt stem and bottom of nut and between (2) top of bolt stem and threaded portion of nut after nut was assembled on bolt.

Weld number (1) on each tie bolt was of poor quality and entirely too large. Each weld was approximately 1/8" wide and from 1/8" to 3/16" in depth which permitted bearing at only one point on the weld instead of full surface bearing of the nut as indicated on drawing. The outer edges on the bottom portion of the hex nut shoulders had also been melted when this weld was put on.

To provide a maximum amount of bearing surface, it was necessary to machine this weld until a 1/16" wide flat surface on the entire circumference was obtained. After the above situation was corrected on all tie bolt assemblies, inspection revealed that re-machining was satisfactory.

This completed all inspections on assembled grid beams prior to assembling into the grid beam support assembly.

B. Grid Beam Support Structure and Diaphragm Assembly

After assembling the "I" beam framing or grid beam support structure (See photo serial #111), the length, width and diagonals were measured using a 100' stainless steel tape to determine if the

Serial Number 110

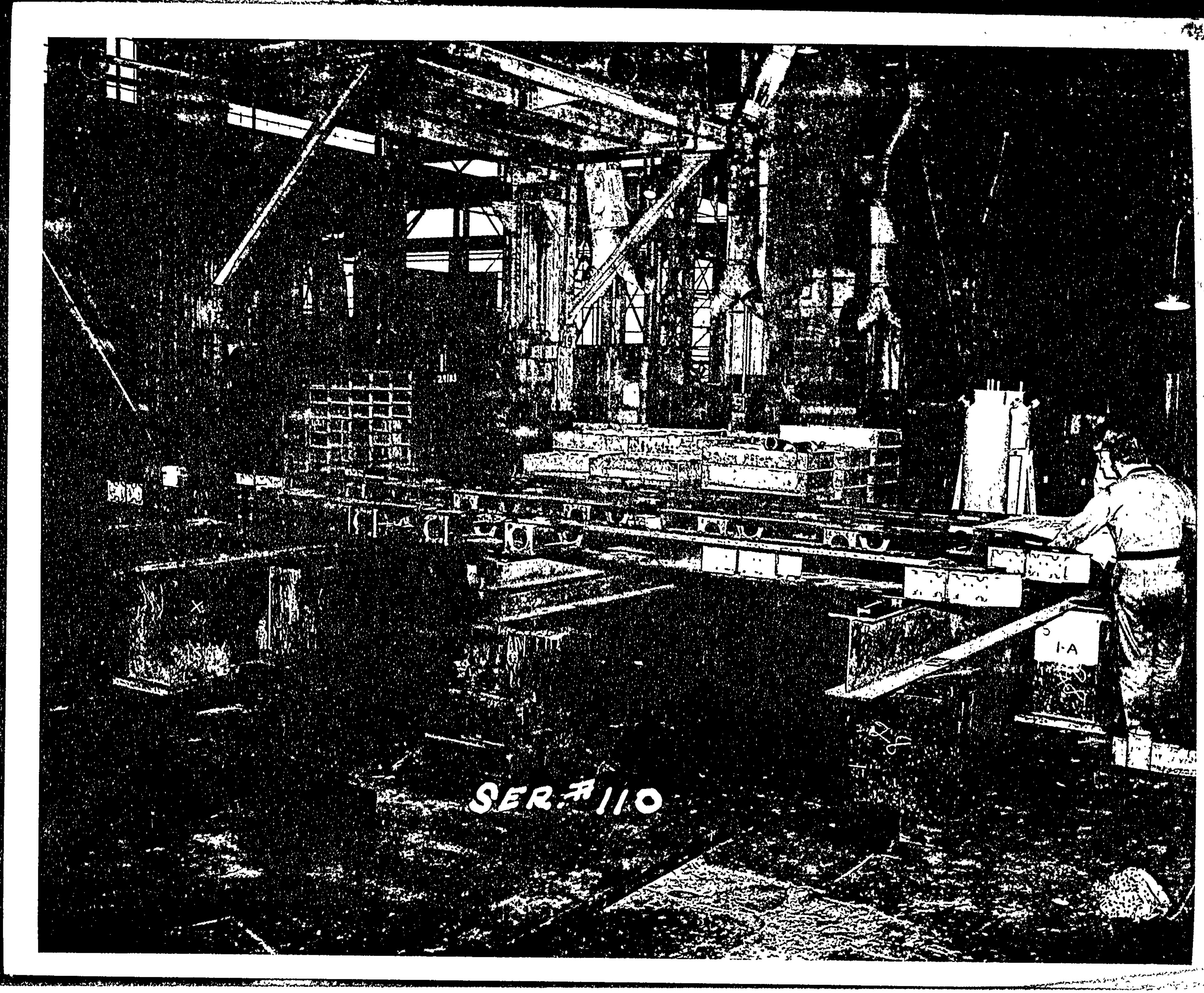
[redacted]

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

PROJECT 8980 - SAVANNAH RIVER PLANT

This view shows the assembly of the grid beams for the 777M Physics Lab Building.

[redacted]

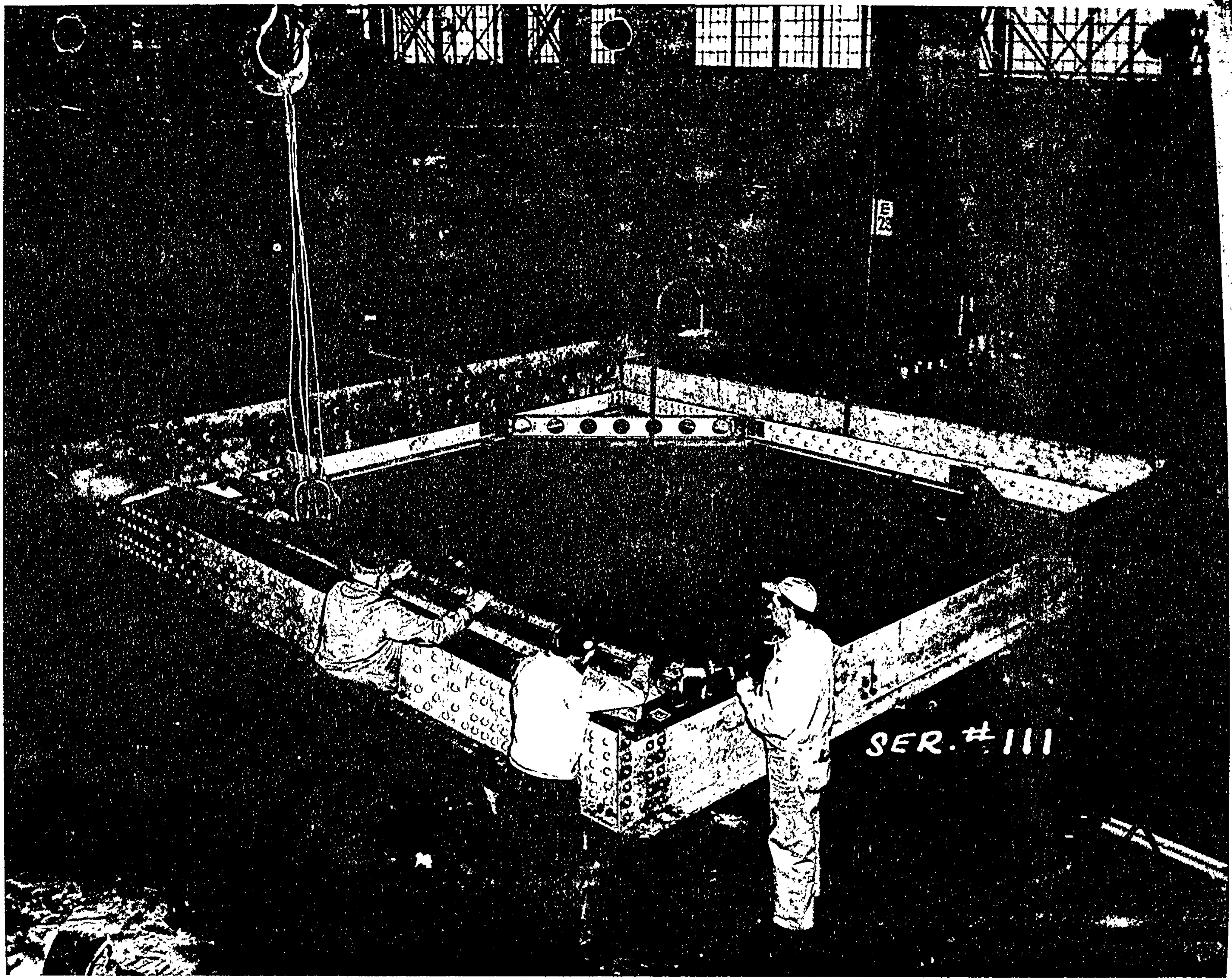

1-A
SER.#110

Serial Number 111

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

PROJECT 8980 - SAVANNAH RIVER PLANT

This view shows the assembling of the grid beam support structure for the 777M Physics Lab Tank.



SER. #111

frame was square. All component parts (excluding the diaphragm) were then fit and bolted or welded to the "I" beam frame. (For details, see du Pont drawing W131956). It should be pointed out that the "I" beam frame (carbon steel) was covered with plates and angles fabricated from type 304 stainless steel material in order that bearing between the grid beams and carbon steel frame was impossible. (Assembling of grid beams into this structure is discussed later).

When the grid beam support structure was completely assembled (excluding diaphragm assembly), a final dimensional and visual check was made by du Pont Inspectors before dismantling for sandblasting and acid washing stainless steel parts. Fit-up and dimensional checks were satisfactory, and then the assemoly was dismantled for cleaning.

All stainless steel plates, angles, bolts and other miscellaneous stainless steel parts that comprise the skeleton grid beam support structure were sandblasted and acid washed to remove traces of iron. All pieces were ferroxyl tested, and after minor grinding to remove iron inclusions and other mechanical defects, they were accepted. These pieces were again assembled into the "I" beam support structure for final fit-up and welding.

Next the diaphragm assembly (See du Pont drawing W131490) was fabricated and assembled into the frame. It was fabricated from ¼" thick, type 304 stainless steel plates. The assembly was fabricated in four sections. All material was inspected prior to fabrication. For report covering this inspection, see Exhibit #1. Each of the four plates were sandblasted and ferroxyl tested before assembling into the "I" beam structure. After this the four plates were fit and welded into the frame.

At this stage of fabrication two major inspections were performed by the du Pont Inspection group. The first major inspection was to determine if the top surface of the diaphragm plate was within the required distance from the top surface of the grid beam support plate; and the second, to determine out-of-roundness of the hole cut in the diaphragm plate. These inspections are covered in detail in Exhibits 2 and 3 presented herewith.

Metallic arc welding was used to join the diaphragm assembly to the plates and angles covering the "I" beam structure. All welding was then visually inspected for undercutting, cracks, and other surface defects. Necessary repairs were made, re-inspected and found satisfactory.

Before assembling and aligning grid beam assemblies into the grid beam support structure, all stainless steel material in this structure was visually inspected for cleanliness and then ferroxyl tested. This test revealed that the diaphragm assembly was not satisfactory. The entire assembly was then moved under a sandblasting hood, and the diaphragm and mating parts were again sandblasted and acid washed. After visual inspecting and ferroxyl testing, it was found satisfactory and released for assembling of grid beams into the structure. However, at a later date it was discovered by inspection that two stainless steel angles (See detail 7 on du Pont drawing W131490) and four stainless steel

EXHIBIT #1

INSPECTION REPORT COVERING MATERIAL INSPECTION PERFORMED ON $\frac{1}{4}$" THICK TYPE 304 STAINLESS STEEL PLATES FOR THE DIAPHRAGM ASSEMBLY

[redacted]

Report Number 358-M

CC: H. W. Gosney, F.P.M.
R. K. Mason, F.P.M.-SRP (3)
M. Matsen
C. P. Kidder - R. O. Waugh
E. W. Bolin - J. Schaeffer
H. B. Gage
F. C. Breuninger
S. R. Cochran (2)
J. B. Johnson - File

December 16, 1952
New York Ship - Camden, N. J.

[illegible] REPORT

[illegible] DATE December 12, 1952

[illegible] River ORDER NO. AXC-5327

[illegible] 777M Bldg. EQ.PC.NO. 770.01

[illegible] JOB RATING

[illegible] Shipbuilding Corporation LOCATION Camden, N. J.

Scope: Visual inspection of 4-108"x90"x½", type 304 S/S plates to be used for diaphragm assembly for 777M physics assembly [illegible]. This inspection was made at New York Ship [illegible].

Procedure: All plates were visually inspected for defects, and heat numbers and mill markings were recorded.

Results: All plates were free from defects and were acceptable. Following is a list of inspected plates identified by heat number and mill markings. This material was made by U. S. Steel's Homestead Works.

No. of Plates	Heat Nos.	Mill Markings
[illegible]	X27289	1-P-1
[illegible]	X46052	1-E-1

lmw

EXHIBIT #2

INSPECTION REPORT COVERING MEASUREMENTS MADE ON CONTOUR OF DIAPHRAGM PLATE WITH RESPECT TO THE GRID BEAM SUPPORT PLATE

E. I. DU PONT DE NEMOURS & CO., INC.　　　　Report Number 377-M

Construction Division

[redacted]

CC: H. W. Gosney, F.P.M.
F. H. Mason, F.P.M.-SRP (3)
M. Matsen
C. F. Kidder - R. O. Waugh
E. W. Bolin - J. Schaeffer
H. B. Gage
F. C. Breuninger
S. R. Cochran (2)
J. E. Johnson - File

January 15, 1953
New York Ship - Camden, N. J.

FIELD INSPECTOR'S REPORT

TO C. J. VEITH - M & E FILE

FROM R. E. Chaney, C. E. Frandsen & C. H. Nesbit　　DATE January 8, 1953

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

EQUIPMENT Diaphragm Arrangement for 777A Physics Lab Building　　SQ.PO.NO. [illegible]

DRAWING NOS. W-131490　　JOB RATING

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

Scope: To determine if top surface of diaphragm plate is the proper distance (13½" + 1/16" - 0") from the top surface of the grid beam support plate. Inspection performed 1/5/53.

Procedure:

The measurements were made with an 18' steel rule from the top surface of the diaphragm plate to the bottom of a wire (at 2½# tension) stretched across the two 1" grid beam support plates. (See attached sketch.)

Results:

The contour of the diaphragm plate and location of wire with respect to the two 1" grid beam support plates was found satisfactory - see attached sketch.

Imr
Attach.

1/3/52 777M Diaphragm Arrangement

Distance Measured: From bottom of wire to top surface of plate

[redacted]

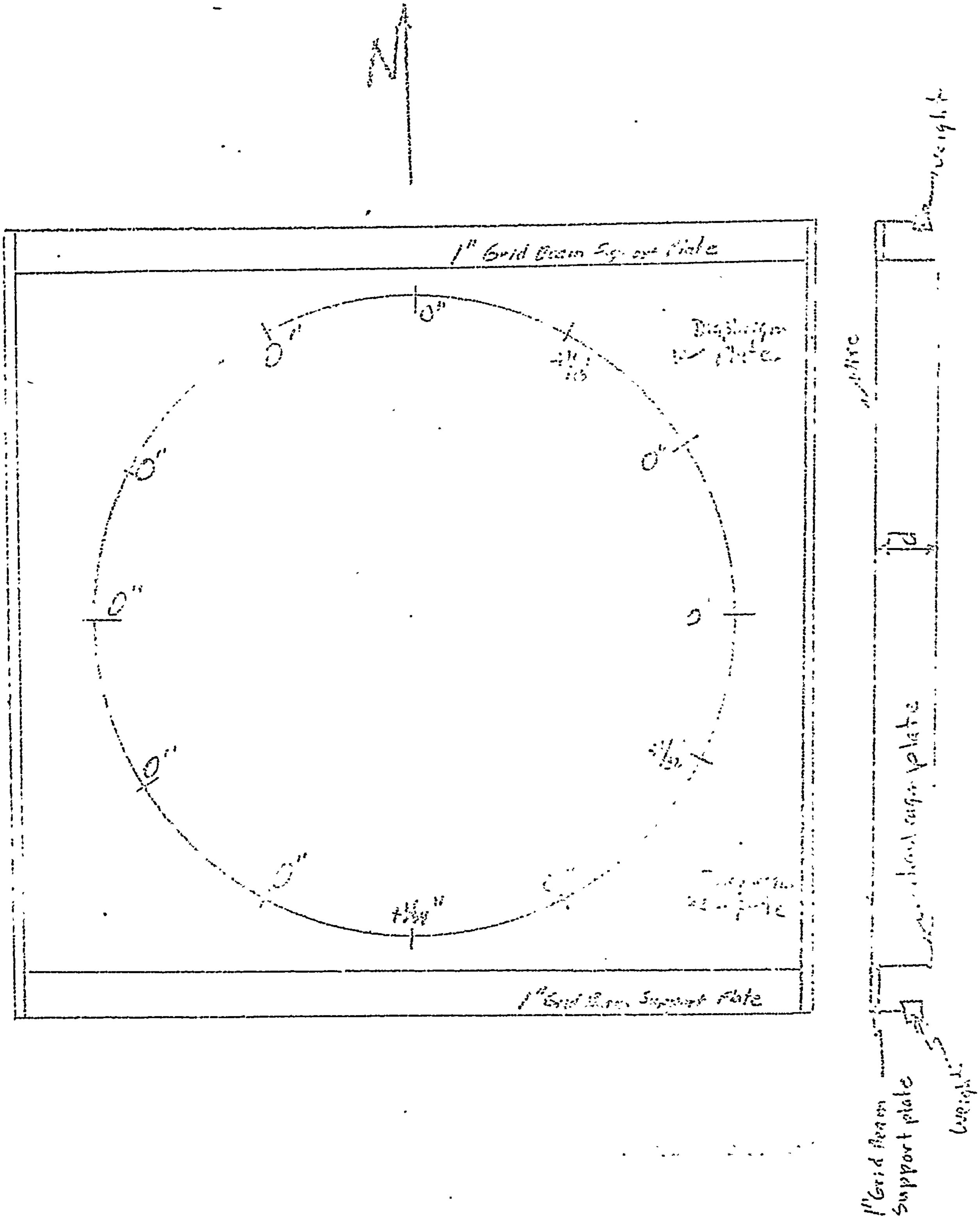


EXHIBIT #3

INSPECTION REPORT COVERING INSPECTION MADE TO DETERMINE OUT OF ROUNDNESS OF THE HOLE CUT IN THE DIAPHRAGM PLATE

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

Construction Division

[redacted]

Report Number 380-M

CC: H. W. Gosney, F.P.M.
R. K. Mason, F.P.M.-SRP (3)
M. Matson
C. P. Kidder - R. O. Waugh
E. W. Bolin - J. Schaeffer
H. B. Gage
F. C. Breuninger
S. R. Cochran (2)
J. B. Johnson - File

January 15, 1953
New York Ship - Camden, N.J.

102

FIELD INSPECTOR'S REPORT

TO C. J. VEITH - M & E FILE

FROM R. E. Chaney & C. R. Frandsen DATE January 3, 1953

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

EQUIPMENT Diaphragm Arrangement for 777M Physics Lab Building ENG. NO. 770.01

DRAWING NOS. W-131490 JOB RATING

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

Scope: To determine out-of-roundness of hole cut in diaphragm plate. Inspection performed 1/3/53.

Procedure:
A stainless steel 35' foot tape was used to measure the hole across four (4) diameters as listed below.

Results:

Blueprint spec. 16'5¼"

N	NE	E	SE
16'5-1/8"	16'5-3/16"	16'5-5/16"	16'5-5/16"

Maximum out-of-roundness - 1/16"
Maximum deviation from tolerance = 1/8"
Plate accepted "as is".

lmw

[redacted]

~~SECURITY INFORMATION~~

Serial Number 112

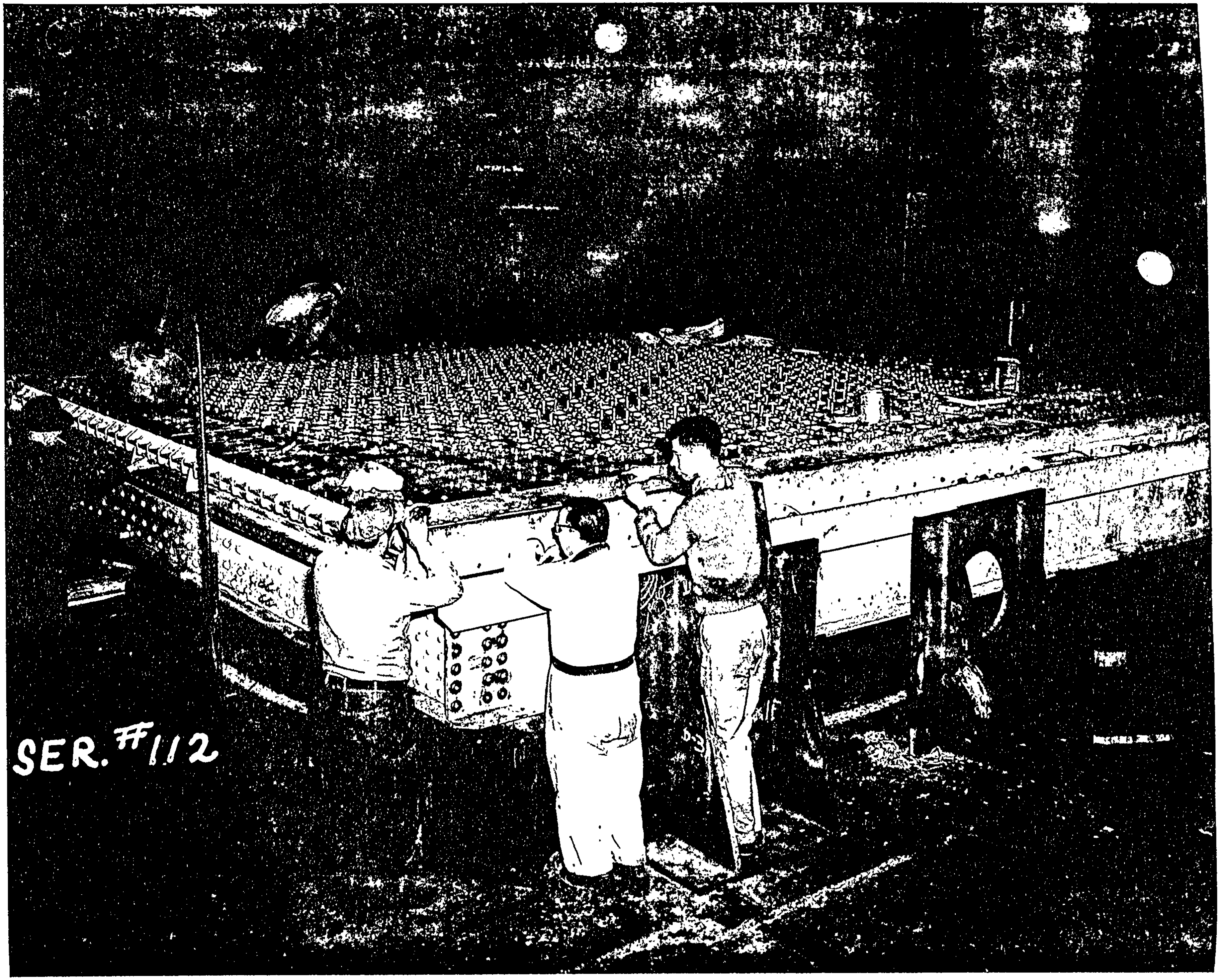
New York Shipbuilding Corporation
Camden, New Jersey
December 22, 1952

PROJECT 8980 - SAVANNAH RIVER PLANT

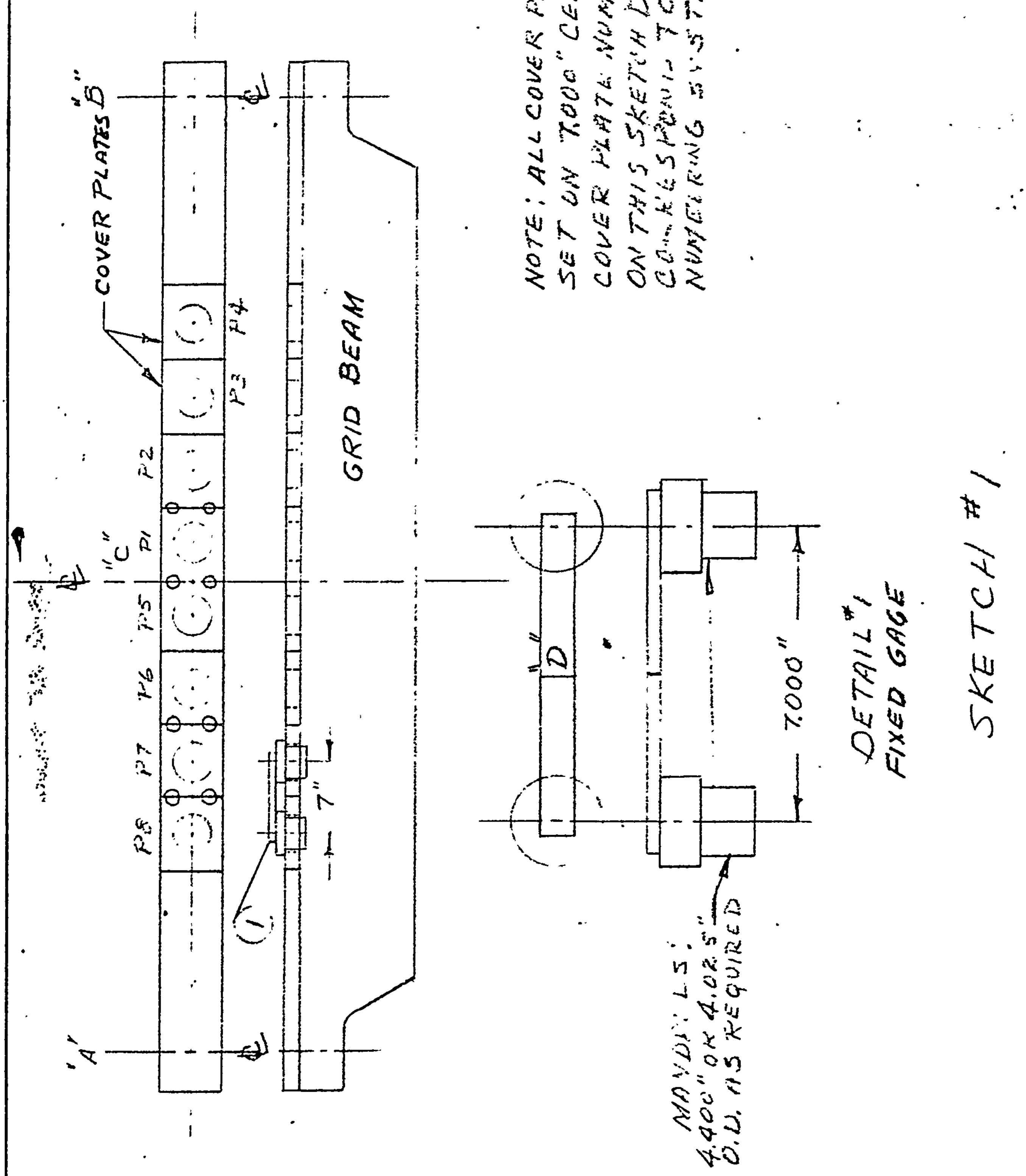
This view shows the grid beam structure with grid beams in place for the 777M Physics Lab Tank.

[redacted]

[redacted]



SER. #112



DETAIL #1 FIXED GAGE

SKETCH #1

NOTE: ALL COVER PLATES SET ON 7.000" CENTERS. COVER PLATE NUMBERS ON THIS SKETCH DO NOT CORRESPOND TO PLATE NUMBERING SYSTEM

~~ENGINEERING SKETCH SHEET~~
~~E. I. DU PONT DE NEMOURS & CO.~~

~~PROJ. No.~~

~~SIGNATURE:~~

~~PROJ. TITLE~~

~~DATE~~

~~SUBJECT:~~

~~No.~~ E-42443

EXHIBIT #4

INSPECTION REPORT COVERING MEASUREMENTS MADE ON EACH
GRID BEAM COVER PLATE HOLE WITH RESPECT TO EACH OTHER

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

onstruction Division

[redacted]

Report Number 379-N

CC: H. W. Gosney, F.P.D.
R. K. Mason, F.P.M.-SRP (2)
M. Hassen
C. F. Kidder - R. C. Waugh
E. W. Bolin - J. Schaeffer
H. B. Gage
F. C. Breuninger
S. R. Cochran (2)
J. B. Johnson - File

January 15, 1953
New York Ship - Camden, N. J.

702

FIELD INSPECTOR'S REPORT

TO C. J. VEATH - M & E FILE

FROM W. J Laughlin, H. Dahlke, [illegible] DATE December 30, 1952

PROJECT NO. 8980 PLANT Savannah River ORDER NO. [illegible]

EQUIPMENT Grid Beam Cover Plate Assembly for 777-A Physics Lab Building EQ. SP. NO. [illegible]

RAWING NOS." W-132453 JOB RATING

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

Scope: This report covers the checking, by the use of a fixed gauge, of the center to center distance of the cover plates, on the above unit, parallel to the axis of the grid beams.

Procedure: A fixed gauge with 7.000" center to center [illegible] 1.100" mandrels for the P_2, P_3, P_5, P_7, P_9 details and a .625" mandrel was used for the P_1 details.

Results: The distance between adjacent holes parallel to the grid beam axis was checked and found to be accurate. [illegible] accepted on 12/30/52.

lmw

As stated in #1 above, each hole in a beam was to be measured with respect to the center hole in the beams. This additional inspection was waived due to the method used for aligning cover plates. As shown in Sketch #1, centerlines "A" and "B" were established by New York Ship, and from these lines, centerline "C" was established. After establishing centerline "C" across the entire assembly, cover plates P1 and P5 were set using a fixed gage as shown in Sketch #1. The gage was inserted into the two cover plate holes and centerline "D" was made to coincide with centerline "C". Cover plates P1 and P5 were then firmly bolted. Working out from centerline "C" in any direction, adjacent cover plates were set to previous cover plates just aligned using the 7.000" center-to-center plug gage. It can now be readily seen that measurements from the center hole in a beam to all other holes in the beam was not necessary and, therefore, this inspection was waived.

The inspection required in #2 above was performed in the following manner:

As stated in #2 grid beam height from the 1" plate supporting beams at end to the top of 3/8" side plates of the beam must be within 1/16" from beam to beam. As an alternate to taking physical measurements, a visual inspection of the 3/8" side plates in conjunction with a dimensional check of the cover plates was made. It was physically impossible to measure the required dimension without dismantling the end cover plates on each beam. For the resume of this inspection, see Exhibit #5.

The inspection required in #3 is covered in an inspection report presented herewith as Exhibit #6.

The inspection required in #4 is covered in an inspection report presented herewith as Exhibit #7.

The inspection required in #5 prior to shipping is covered in an inspection report presented herewith as Exhibit #8. For steam cleaning of grid beams, see photo serial #105.

III. 777M Physics Laboratory Tank

1. Cleaning Specifications

In conjunction with the design of the 777M - P.D.P. physics laboratory tank (equipment piece number 770) specifications were written pertaining to the amount and type of inspection required.

One phase of this program was the degree of cleanliness required during the fabrication of the unit. Du Pont cleaning

EXHIBIT #5

INSPECTION REPORT COVERING MEASUREMENTS MADE FROM THE
1" SUPPORTING PLATE ON THE GRID BEAM STRUCTURE. TO THE
TOP OF THE 3/8" THICK GRID BEAM SUPPORT PLATES

[illegible] Division

[redacted]

[illegible]

E. W. Bolin - J. [illegible]

[illegible] S. Gage

[illegible] C. [illegible]

[illegible]

EXHIBIT #6

INSPECTION REPORT COVERING VERTICALITY CHECK AND COVER PLATE ARRANGEMENT INSPECTION

E. I. DU PONT DE NEMOURS & CO., INC. [illegible]

Construction Division

cc: [illegible]
[illegible]
[illegible]
[illegible]
E. W. Bolin - [illegible]
H. B. Gage
F. J. [illegible]
[illegible] (2)
J. E. [illegible]

January [illegible]
New York City - Camden, N. J.

FIELD INSPECTION REPORT

TO C. J. VEITH - M & E FILE

FROM R. A. Chaney - C. R. [illegible] FILE [illegible]

PROJECT NO. 8980 PLANT Savannah River ORDER NO. [illegible]
[illegible]

EQUIPMENT [illegible] Building [illegible]

DRAWING NOS. W-131458 [illegible]

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

Scope: Verticality check and cover plate arrangement inspection. Inspection performed 12/29/52.

Procedure:

(1) Verticality - [illegible] the tolerance of [illegible] tightened in place. All [illegible] this installation.

(2) Cover Plate Arrangement - A visual [illegible] the [illegible]

[illegible]

(1) Verticality - satisfactory.

(2) Cover Plate Arrangement - satisfactory.

EXHIBIT #7

INSPECTION REPORT COVERING MEASUREMENTS TAKEN FROM THE CENTER GRID BEAM TO THE OUTSIDE GRID BEAM AT FIVE LOCATIONS

[illegible]

Construction Division

[illegible]

cc: [illegible]
[illegible]
[illegible]
[illegible]
E. W. Bolin - J. [illegible]
[illegible] Gage
[illegible] Brauninger
[illegible]
[illegible] - File

[illegible]
[illegible]

[illegible]

TO [illegible]

FROM [illegible]

[illegible]

[illegible]

DRAWING NOS. [illegible]

VENDOR [illegible]

Scope: [illegible]

[illegible]

[illegible] cover plate [illegible]

[illegible]

All [illegible]

EXHIBIT # 8

INSPECTION REPORT COVERING FINAL CLEANING OF DIAPHRAGM PLATE, GRID
BEAMS - INCLUDING ALUMINUM COVER PLATES AND BOTTOM PLATES, AND
OTHER STAINLESS STEEL PARTS SUCH AS BOLTS AND NUTS PRIOR TO SHIPPING

[illegible]

Construction Division

[illegible] Cooney, F.P.M.
R. F. Mason, SRP (3)
[illegible]
[illegible]
[illegible] - [illegible]
F. R. Gage
F. [illegible] Steeninger
[illegible] Cochran (2)
[illegible] Johnson - [illegible]

[illegible] 1953
New York Ship - Camden, N. J.

[illegible]

TO C. J. White - [illegible]

FROM S. L. [illegible]

[illegible]

PERMIT NOS. [illegible]

BLDGS New York Ship [illegible]

This report covers [illegible] num copper rubber and [illegible] broken [illegible] such as [illegible]

[illegible]

[illegible]

FIELD INSPECTOR'S REPORT

Report Number 393

[illegible] S. R. Cochran

All stainless steel bolts and [illegible] cleaned. [illegible] bolts and nuts were found to have a black [illegible] the welds. Upon this discovery the [illegible] brush and emery cloth followed by [illegible] ferroxyl tested and accepted. (The [illegible] testing.)

Note: The cleaning procedure listed in this [illegible] meeting between du Pont Construction, [illegible] Jackson, Walker, Foley & Freitag [illegible] (See memo concerning this meeting [illegible]
To: [illegible] Smith - [illegible]
From: R. M. Potts - [illegible]

Serial Number 105

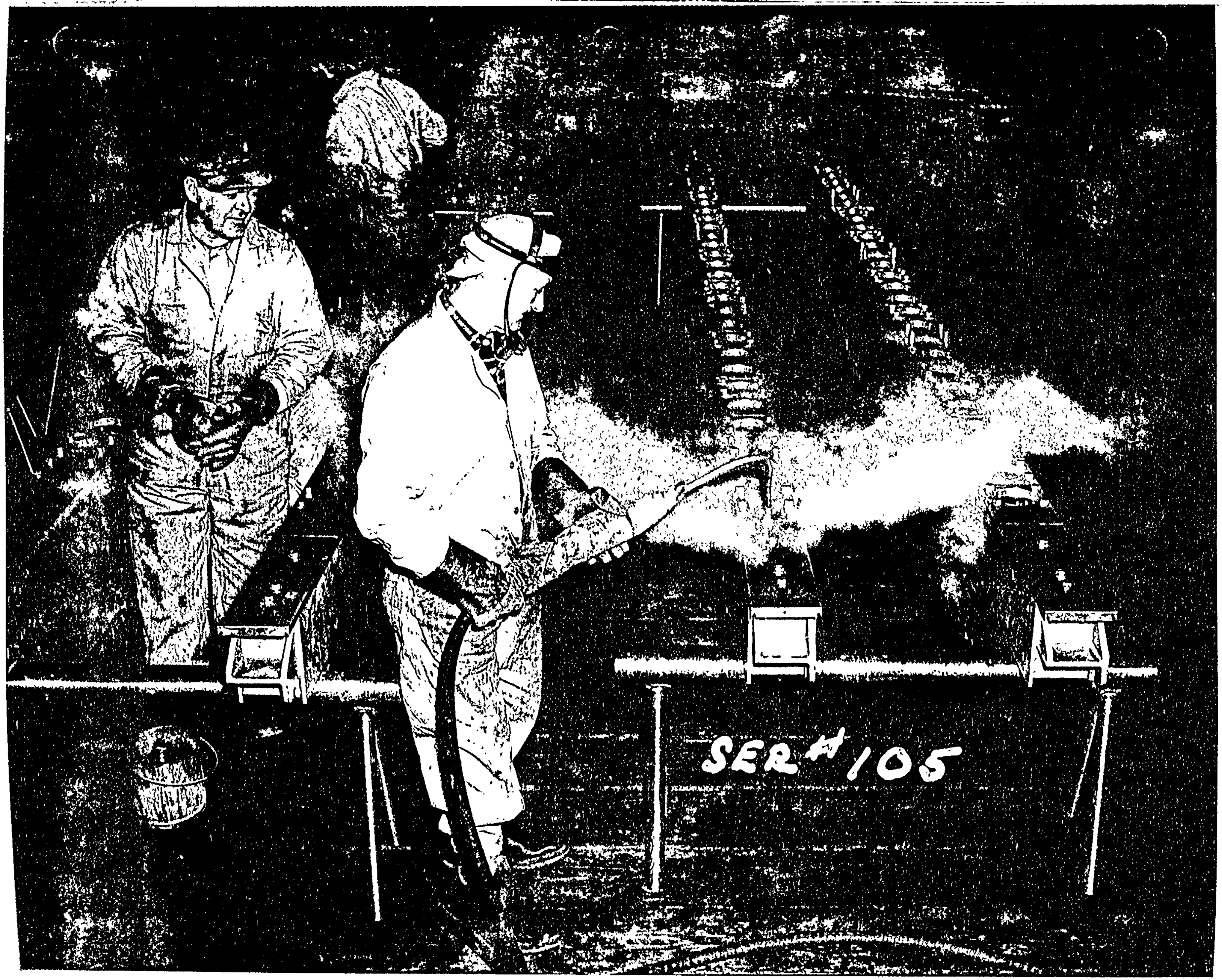
[redacted]

[redacted] York Shipbuilding Corporation
den, New Jersey
December 22, 1952

PROJECT 8980 - SAVANNAH RIVER PLANT

This view shows the steam cleaning of grid beams to remove dirt, etc., prior to assembly into the grid frame top.

[redacted]



SER #105

specification no. 3228 entitled, "Project 8980 - Savannah River Plant, Austenitic stainless steel material, parts, subassemblies and fabricated products, 300 area, 777-M bldg., P.P. . process equipment and piping" was written, approved and dated July 29, 1952.

Due to the nature of the process for which this tank was designed, only some sections of the above referenced specification applied to the physics laboratory tank. However, this statement must not be construed with the fact that a high degree of cleanliness was required in the fabrication and handling of the tank. Special instructions were written for procuring the material used to fabricate the tank.

Two of the standards for cleanliness were the ferroxyl test for free iron and the "white cloth" test for organic contamination and dust.

It was specified that the du Pont inspector had to spot check at least 10% of the total internal and external area of the tank for the presence of free iron. The ferroxyl (ferricyanide) test (See Part II-A, Section 3C for the percentages of potassium ferricyanide, nitric acid, and distilled water required to make up the ferroxyl solution) was specified for locating those areas where embedded iron and scale was present. In addition a white lintless cloth was specified for picking up or locating the areas where oil, grease, or smudge was present.

For the tank the specification indicated that the ferroxyl test solution should be applied with a swab or with a plastic, glass, or non-ferrous atomizer. The presence of free iron was determined with the appearance of a deep blue color within 1 to 2 minutes. Iron contamination could be removed by any convenient means, providing the stainless steel surface was not damaged. In any case the contaminated area was to be retested until clear of free iron. After each ferroxyl test, any blue stain was to be removed with a solution made up of 10% acetic acid and 3 to 4% of oaxlic acid. After any type of test all areas were to be hot water rinsed free of test reagent and acetic acid.

Wire brushes, steel wool, etc., were recommended for cleaning welds and other surfaces subject to ferroxyl test. Grinding was to be done with aluminum oxide wheels. Oil, grease, paint, dirt, etc., was subject to removal by a detergent, solvent washing, vapor degreasing, or other cleaning methods approved by the du Pont inspector prior to acid cleaning. It was further specified that weld film, weld flash, and surface iron contamination should be removed to secure bright metal. Blasting with sand or alundum grit was recommended for all surfaces that had to pass the ferroxyl test.

In the case of embedded iron acid cleaning was highly recommended. One of the commerical solutions proposed was a pickling solution of

10-16% HNO_3 - 2% HF at a temperature of 120° - 140°F. However, the du Pont inspector was not allowed to permit the surface of the stainless steel to be pitted or inter-granularly attacked to a degree that was considered harmful. As in the case of the ferroxyl solution the pickling acid had to be thoroughly washed from the surface of the stainless steel with clean water.

All component parts, such as the stainless steel tube centering mat, were to be cleaned prior to assembling in the tank.

Before shipping the tank, all surfaces were to be free of contamination and finally inspected by the du Pont inspector using the above prescribed methods. Where necessary, to prevent contamination during shipment, the tank and its component parts were to be protected with a suitable wrapping material free of oil, lint, etc. Closure devices for the tank nozzles, etc., were wood or metal with full face rubber gaskets and had to be sufficiently sturdy to stand the abuse of shipment and handling. It was intended that all closures would remain in place until the tank was rigged into place for permanent installation at the plant site. It was further specified that the du Pont inspector make certain that all such closure devices would not leave any contamination after they were removed at the plant site.

2. Drawing Specifications

Special notes were added to the drawings when the 777M P.D.P. physics laboratory tank was designed.

Since the tank shell, bottom, top flange and nozzles were of welded construction, all weld quality and workmanship had to be in accordance with A.S.M.E. code for unfired vessels, paragraph U-68, 1949 edition. In addition, all welding procedures and operators had to be qualified in accordance with the ASME boiler code, Section IX, 1949 edition. It was specified that all welding be by inert gas, shielded arc welding, either non-consumable tungsten electrode or consumable stainless steel electrode.

All butt welds had to be radiographically examined throughout their entire length and interpreted in accordance with the nondestructive test as specified in paragraph U-68, section H - (2 to 10) inclusive of the ASME code for unfired vessels, 1949 edition.

All material for the tank and its component parts had to be type 304 with .008-C max. stainless steel in accordance with du Pont engineering spec. S-W-304-M (unless specifically noted otherwise). In addition, the tank shell had to be sufficiently true-to-round, so that the difference between the maximum and minimum diameters (measured on inside of tank) at any cross section, did not exceed 0.0250" of inside diameter - 16' - 2 3/4". The top bearing surface of the 3/4" thick top flange had to be finished in the same horizontal plane within ± 1/8". To be sufficiently true to round, the differences between the maximum and minimum diameters measured on the outside of the ring at any cross-section did not exceed 0.250" of the outside diameter 16' - 9 3/4".

As mentioned above the stainless steel mats and chairs were considered component parts of the tank. The mat was designed and fabricated in three sections. The three sections had to be welded together in the field after the tank was erected on the plant site. Drawing specifications indicated that the top and bottom of the mat be in a level plane after final assembly within ± 3/16" at any point.

3. Fabrication Inspection

After receiving the eight type 304 stainless steel plates measuring 1/2" x 94" x 154" from G. O. Carlson, Coatesville, Pa., at New York Ship, the plates were visually inspected for the presence of free iron, laminations, cracks, and surface blemishes. The heat numbers and mill marking numbers stenciled on the eight plates designated for the tank shell were recorded at the time of the visual inspection. The standard ferroxyl test was employed for detecting free iron.

After removing the surface defects by grinding, etc., the plates were re-inspected using a standard ferroxyl solution. Other stainless steel plates, angles, ring, and other shapes were received at New York Ship and inspected in a similar manner.

One special stainless steel plate 1" x 210" in diameter was procured from G. O. Carlson on purchase order AXC 615[illegible]. It was shipped to Lukens Steel Company, Coatesville, Pa., and assigned to order number AXC 6454½.

In turn, the Lukens Steel Company formed the dished or bottom head (see photograph serial #10[illegible]) of the physics laboratory tank in accordance with detail drawing E-11274[illegible].

As noted on arrangement drawing [illegible]-131476 all welding had to be by inert gas, shielded arc welding, either non-consumable tungsten electrode or consumable stainless steel electrode. However, the diametric weld on the bottom head was made with coated electrodes instead of with arc welding as prescribed. The du Pont Design Division was contacted in regard to this discrepancy. They said this type of welding was satisfactory providing the x-ray examination indicated a solid weld containing no slag or flux. Any such defects had to be ground out and rewelded using the inert arc process. This decision was reached after it was reported that 75% of the weld had been examined with no defects found.

[redacted]

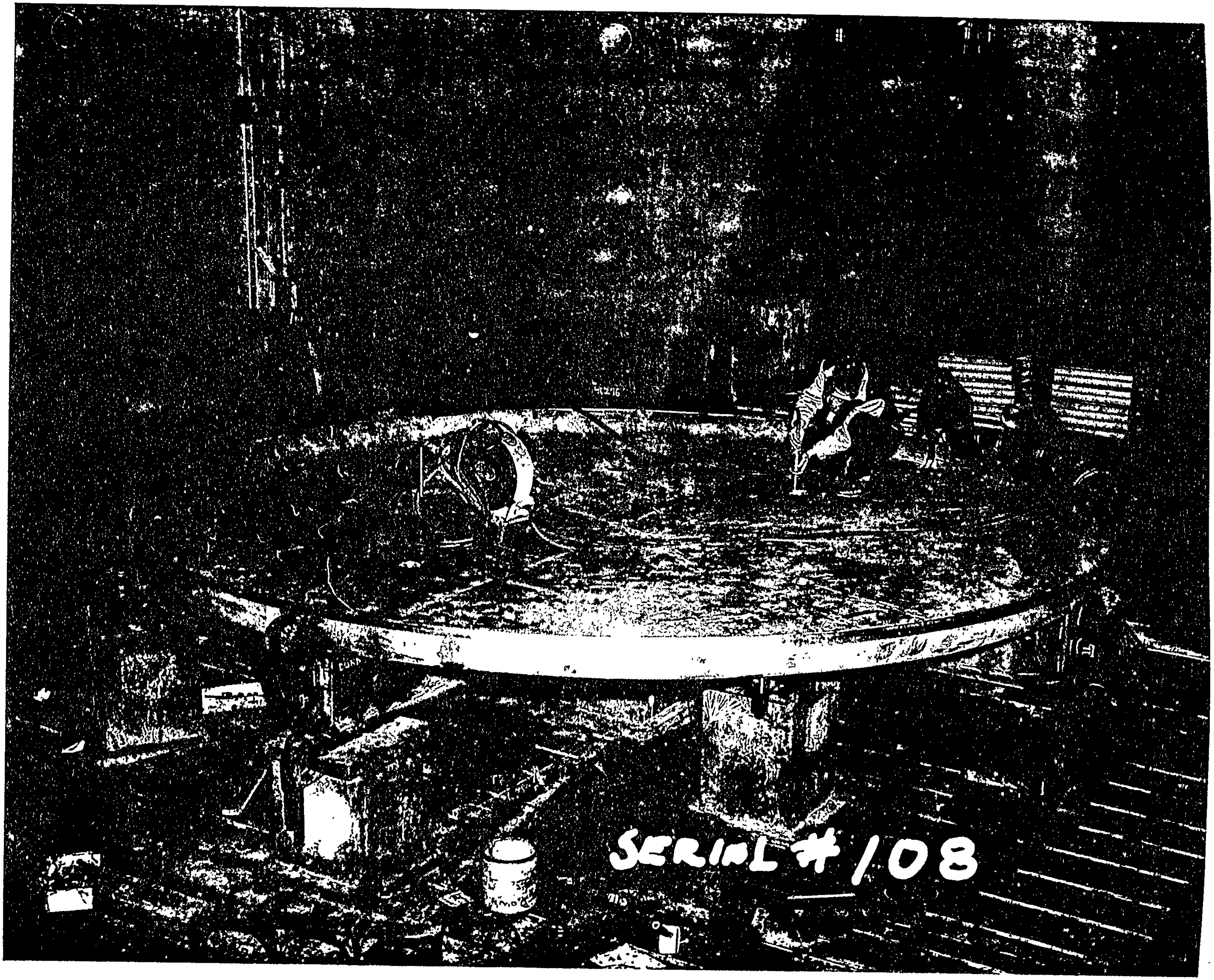
Serial Number 108

[redacted] York Shipbuilding Corporation
den, New Jersey
November 28, 1952

PROJECT 8980 - SAVANNAH RIVER PLANT

This is a view of the "head" for the 777M Physics Lab Tank. The grinder is finish grinding the inside of a drainage hole drawing number W-131476.

[redacted]



SERIAL #108

After all welding was complete, the diametric weld (see Exhibit #9) was visually inspected. In conjunction with this all x-rays were checked. The weld seam and all x-rays were accepted.

In the process of checking the bottom head for dimensions it was discovered that the slope did not meet drawing specifications. Detail drawing D-112748 called for a 1/2" uniform slope to the centerline (bottom of tank) for any radial position. This uniform slope was necessary to make for proper drainage when the tank was in operation. The "As Built" dimensions revealed that this slope was either greater or less than that specified. To make the slope conform to drawing specifications it was decided that weld metal would be added to the low spots and the high spots ground down. In the final analysis, it was necessary for New York Ship to blend in the high spots and the weld surfaces through more grinding than was originally contemplated. A final check was made on the slope of the bottom head using a standard straight edge. After the bottom head had been placed on a platen the straight edge was located in a vertical plane common to the radii of the tank bottom head. The distance from the bottom face of the straight edge to the inside surface of the tank bottom head was measured with a steel scale along the radii and the slope was judged uniform and acceptable.

After the plates for the tank shell had been laid out and prepared using a 1/4" bevel for all vertical and horizontal seams, the plates were visually inspected and checked with the standard ferroxyl solution. When found acceptable they were welded together. Next, the welded plate sections were rolled to meet the dimensions called for on drawing W-131476. After rolling, the surfaces of the rolled sections and the beveled edges of the plate were visually inspected and checked for the presence of free iron, oil, etc., with the aid of ferroxyl solution. Next, these sections were fitted together and welded to form the tank shell. At all times inspection covered preparation and fit-up of all seams prior to welding. The tank shell was checked dimensionally for maximum out-of-roundness, height, and diameter.

After the centerlines had been located on the tank shell and tank bottom head the nozzle openings in both were located and cut out. In turn, the du Pont standard nozzle necks or sections of standard schedule stainless steel pipe were welded to the subject two main components of the tank. This was followed by setting the tank shell on the bottom head. The seam or juncture between the two main sections was checked for fit-up, preparation, and cleanliness prior to tack welding and welding.

All butt welded joints (See Exhibit #10) both vertical and circumferential were x-rayed and examined according to A.S.M.E. boiler code for 1949 under paragraph U-68. The films were examined, repairs made, re-x-rayed, and the weld seams were found acceptable.

EXHIBIT #9

INSPECTION REPORT COVERING INSPECTION OF THE DIAMETRIC WELD ON THE BOTTOM HEAD OF THE P.D.P. TANK

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

Construction Division

[redacted]

Report Number 334-M

CC: H. W. Cooney, F.P. .
R. K. Mason, F.P.M.-SRP (2)
M. Mabson
C. P. Kidder - R. C. Wo
E. W. Bolin - J. Schaeffer
H. B. Gage
F. C. Breuninger
R. H. Potts (2)
J. E. Johnson - File

November 20, 1952
New York Ship - Camden, N. J.

7023

FIELD INSPECTOR'S REPORT

TO C. J. VEITH - M & E FILE

FROM R. H. Potts DATE October 17, 1952

PROJECT NO. 8980 PLANT Savannah River ORDER NO. AXC-1674

EQUIPMENT PDP Tank EQ.SC.NO. 770

DRAWING NOS. W-131,476 JOB RATING

VENDOR Lukens Steel Company LOCATION Coatesville, Pa.

Scope: To check the diametric weld on the bottom head of subject unit.

Procedure: All X-rays of questionable weld made with coated electrodes were inspected, and weld seam was visually inspected.

Results: The weld seam and all X-rays were accepted.

[illegible]

EXHIBIT #10

INSPECTION REPORT COVERING THE X-RAYING OF ALL TANK BUTT WELDS

[illegible]

[illegible] Division

[illegible]
[illegible] Mason, F.P.M. SRP [illegible]
[illegible] Matsen
C. P. [illegible] [illegible]augh
E. W. [illegible] [illegible]aeffer
H. B. Gage
F. C. [illegible]
S. R. [illegible]
J. B. [illegible]

[illegible] 19, 1953
[illegible] Ship - Camden, N.J.

[illegible]

TO [illegible]

[illegible]

PROJECT NO. [illegible]

[illegible]

[illegible]

VENDOR [illegible]

Scope: [illegible]

[illegible]

[illegible]

Since New York Ship had No. 25-12 welding rod in stock they contacted du Pont for their opinion regarding the use of 25 (chromium percentage) - 20 (nickel percentage) welding rod for welding the medium carbon steel hot rolled 5" x 3½" x 5/8" angles to the type 304 stainless steel tank shell. Based on the fact that 25-20 welding rod had a greater percentage of nickel in it than 25-12 rod called for on the drawing, du Pont approved the use of 25-20 for this particular application. The flange-type angles were bent to conform to the contour of the tank shell and fabricated in three pieces to run continuously around the tank. There were two flanges fabricated for welding to the tank shell at elevations from the bottom of the angles amounting to 3'-6" and 14'-6" respectively. Before welding the angle-type flanges to the shell of the tank, the shell surface areas in and adjacent to the above referenced elevations were visually inspected for cleanliness with the aid of standard ferroxyl solution. The carbon steel angles were inspected for the presence of mill scale, rust, oil, grease, paint or other deleterious material.

After completing the welding of the 5" x 3½" x 5/8" angle type flanges to the outer surface of the tank (See photograph, serial #104), the weld seams were visually inspected using a standard flashlight. Some weld overlapping was found and removed by grinding until deemed acceptable. At the same time the three welded joints in each 5" x 3½" x 5/8" angle flange were checked for location in relation to the centerlines of the tank as shown on the plan view of the tank - arrangement drawing W-131476.

Before welding the 3/4" x 3" carbon steel ring to the tank shell with the top surface of the steel ring 2½" from the top edge of the tank shell, a decision was reached by the Design Division pertaining to the ¼" weep holes. (See Exhibit #11). It was decided that the top fillet weld joining seal ring to tank must be ground down flush with the top surface of the ring in the vicinity of each weep hole in order to provide good drainage from the seal ring. This was not necessary between weep holes.

As in the case of the top and bottom 5" x 3½" x 5/8" angles, this ring was welded to the tank shell using 25-20 welding rod. Before welding the angle to the shell, the tank surface in and adjacent to the area designated to be covered by the ring was visually inspected for cleanliness with the aid of ferroxyl solution. The carbon steel ring was inspected for the presence of mill scale, rust, oil, grease, paint, or other deleterious material. After the ring was welded to the tank shell the weld was visually inspected using a standard flashlight. Some weld overlapping was found and removed by grinding until deemed acceptable.

No major difficulties were encountered in fabricating the balance of the tank assembly. The four 24" x 24" x 1/2" stainless steel baffles located over the four outer tank bottom head nozzles were checked for location, dimensions and welding. Prior to welding the baffle plates, the interior nozzle welds were ground down and inspected.

Serial Number 104

[redacted]

New York Shipbuilding Corporation
Camden, New Jersey
December 30, 1952

PROJECT 8980 - SAVANNAH RIVER PLANT

This is a view of the 777M Physics Lab Tank. The inspector is visually inspecting welding between the head and main tank section.

[redacted]

[redacted]


SER #104

<u>EXHIBIT #11</u>

DESIGN SPECIFICATION COVERING ¼" WEEP HOLES LOCATED IN THE TOP OF THE P. D. P. TANK

[illegible] 202

[illegible] Division

[illegible], F.P.M.
[illegible] Tucker - J. G. Brewer
[illegible]
[illegible]
[illegible] R. Cochran (2)
J. B. Johnson - File

December [illegible], 1952
New York Ship - Camden, N. J.

MEMORANDUM

TO: R. H. [illegible] - J. [illegible]
NEW YORK SHIPBUILDING CORP.

FROM: [illegible]

[illegible]

[illegible] filled [illegible] the top surface of the [illegible]

[illegible]

[illegible]

Next, the tank and all of its components, including the centering mat and chairs were sandblasted (See Exhibit #12) and passivated. All surfaces were inspected for cleanliness using the standard ferroxyl and white cloth tests. Where necessary the surfaces were re-sandblasted and re-passivated. In any event the tank had to meet the requirements outlined in du Pont cleaning specification Number 3228. The tube centering mat, mentioned above (See Exhibit #13) was checked for dimensions and cleanliness at the same time. Each of the three sections of the tube centering mat was visually inspected for cleanliness and sprayed with ferroxyl solution to test for free iron. Layout and chairs and height dimensions were checked to drawing W-157317. Dimensions fell within the allowable tolerance of ± 1/16". The tank pockets located at the top of the tank were also visually inspected using the ferroxyl test and checked for dimensions.

After it was determined that the tank and its components were acceptable for dimensions quality of weld and workmanship, along with cleanliness, it was hydro tested. The tank (See Exhibit #14) was filled with water containing 20 gallonsof "Glim" detergent to an inside height of 15'-3" and allowed to stand for eight hours. Theoretically, the "Glim" detergent reduced the amount of surface tension of the water, thereby made it possible for the inspector to detect more leaks. All weld seams were visually inspected for leaks, and no leaks were detected.

After draining the water from the tank, it was re-passivated and flushed with de-ionized water to remove the detergent.

Before shipping, all tank outlets were measured (See Exhibit #15) for proper orientation with the aid of a calibrated steel tape. All nozzles were inspected for location and orientation. The nozzle flanges were checked for du Pont standards including the diameter of the bolt circle, flange face finish, hole size and orientation and neck size. Tank height and girth measurements were checked using a calibrated steel tape, 6" and 20" scales.

Shipment of the tank and its components took place after the nozzles were blanked off to meet shipping specifications. Other parts of the tank were protected to prevent contamination in shipment. A review of the "as built" dimensions indicated that all dimensions were within the allowable blue print tolerances. The unit was accepted for dimensions and cleanliness on January 10, 1953. It was shipped to the Savannah River Plant site on January 15, 1953.

EXHIBIT #12

INSPECTION REPORT COVERING INSPECTIONS MADE AFTER SANDBLASTING INTERIOR AND EXTERIOR TANK SURFACES

[illegible]

Confidential [illegible]

cc: [illegible] Gearey, F.P.S.
[illegible] Mason, F.P.S. [illegible]
[illegible] Inman
[illegible] P. Kidder - R. C. [illegible]
[illegible] Bollin - J. Schaefer
[illegible] E. Gage
[illegible] Breuninger
[illegible] Cochran (2)
J. B. Johnson - File

January 15, 1953
New York Ship - Camden, N. J.

FIELD INSPECTOR'S REPORT

TO G. J. VEITH - M & E FILE
C. H. [illegible], [illegible], [illegible] Nelson

FROM A. J. Piasch, [illegible] Schultz DATE January 14, 1953

PROJECT NO. 8980 PLANT Savannah River ORDER NO. AXC-[illegible]
Item [illegible] 777A

EQUIPMENT Thimble Assembly [illegible] Building ITEM NO. [illegible]

DRAWING NOS. W-131476 JOB RATING

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

Scope: (1) Visual inspection of interior and exterior surfaces including all welds.
(2) Ferroxyl testing of tank interior, inside surface of [illegible] nozzles, and exterior [illegible] of [illegible] nozzles.
These inspections were made from 12/15/52 to 1/14/53.

Procedure:
After tank interior had been [illegible], it was visually inspected for foreign matter and appearance of welds and ferroxyl tested for free iron. Area of tank under [illegible] nozzles and interior of these [illegible] also ferroxyl tested prior to assembly of these nozzles on tank. The tank exterior including welds was also visually inspected.

Results:
All interior and exterior surfaces including welds were satisfactory as to visual inspection. Ferroxyl testing of interior surfaces was satisfactory and no signs of free iron were indicated.

EMJ

EXHIBIT #13

INSPECTION REPORT COVERING FERROXYL TESTING AND INSPECTION OF TUBE CENTERING MAT FOR P.D.P. TANK

E. I. DU PONT DE NEMOURS & CO., INC. [illegible]

Construction Division

Report Number [illegible]-M

CC: H. [illegible]
[illegible]
[illegible]
[illegible]
[illegible] - J. [illegible]
H. B. Gage
F. C. Brachinger
[illegible] (2)
[illegible]

[illegible] 1951
[illegible]

FIELD INSPECTOR'S REPORT

TO C. J. VEITH - M & E FILE

FROM C. R. Frandsen, L. J. [illegible] [illegible]

PROJECT NO. 8980 PLANT Savannah River [illegible] [illegible]
777-M Physics Lab [illegible]

EQUIPMENT Tube Centering [illegible] [illegible]

DRAWING NOS. W-157217 [illegible]

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

Scope: To test mesh for free iron and dimensionally check height of chairs.

Procedure:
Each of the three [illegible] of tube [illegible] inspected for cleanliness and [illegible] test for free iron. [illegible] dimensions of [illegible] checked [illegible]

Results:
Cleanliness was satisfactory and [illegible] within the tolerance of [illegible]

[illegible]

EXHIBIT #14

INSPECTION REPORT COVERING HYDROSTATIC TEST OF P.D.P. TANK

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

Construction Division

Wilmington 98, Del.

Report Number 391-[illegible]

CC: H. W. Gosney, F.P.M.
F. K. Mason, F.P.M.-SUP [illegible]
L. Patton
C. P. Kidder - R. O. Waugh
E. W. Bolin - J. Schaeffer
K. B. Gage
F. C. Breuninger
S. R. Cochran (2)
J. B. Johnson - File

January 16, 1953
New York Ship - Camden, N. J.

FIELD INSPECTOR'S REPORT

TO C. J. [illegible] - M & E FILE

FROM R.E. Cheney, H.E. Dills, C.H. [illegible] DATE January 9, 1953

PROJECT NO. 8980 PLANT Savannah River ORDER NO. [illegible]

EQUIPMENT 7774 Tank for [illegible] Bldg. EQ.PC.NO. 770

DRAWING NOS. W-131A76 JOB RATING

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

Scope: Hydrostatic test of tank. Inspection performed 1/9/53.

Procedure:
Tank was filled with water containing 20 gal of "[illegible]" detergent to an inside height of 15' 2" and allowed to stand 8 hours. All seams were then visually inspected for leaks.

Results:
No leaks were observed.

Dispostion:
Water to be drained from tank, tank flushed with de-ionized water, and tank to be Ferroxyl tested inside.

lmw

EXHIBIT #15

INSPECTION REPORT COVERING FINAL INSPECTION AND DIMENSIONAL CHECK OF THE P.D.P. TANK

Report Number 405 [illegible]

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

Construction Division

CC: H. W. Gosney, F.P.M.
R. K. Mason, F.P.M.-SRP-3
[illegible] Watson
C. P. Kidder - R.O. Waugh
E. W. Bolin - J. Schaeffer
H. B. Gage
F. C. Breuninger
S. R. Cochran (2)
J. B. Johnson - File

February 4, 1953
New York Ship - Camden, N. J.

FIELD INSPECTOR'S REPORT

TO C. J. VEITH - M & E FILE

FROM N. J. Laughlin DATE January 29, 1953

PROJECT NO. 8980 PLANT Savannah River ORDER NO. AXC-1673

EQUIPMENT 777m Tank for the Physics Lab Building DU PONT [illegible] 999

DRAWING NOS. W-131473 R-26 JOB RATING

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

Scope: This report covers the dimensional check on the above tank.

Procedure: Measurements were taken with the aid of a 100' steel tape, 6" scale and a 48" scale.

Results: Tank shell (see attached sheet).
6" sight nozzle (see attached sheet)
1" nozzle in center of bottom head.

	Actual	Drawing
Distance from [illegible]	[illegible]	[illegible]
Distance from [illegible]	[illegible]	[illegible]

1" nozzle located 45° from south position

	Actual	Drawing
Distance from edge of shell	3-5/32	3-7/32
Distance from center (radially)	96-5/[illegible]	96-9/32

4 - 4" nozzles in bottom head

Nozzle 1 (on north position)

	Actual	Drawing	
Distance from E-W ℄	52"	52"	
" " Nozzle 4	73-27/32	73-17/32	(Calculated Dimension)
" " Nozzle 2	73-1/2"	73-17/32	"

Nozzle 2 (on east position)

Distance from N-S ℄	52"	52"	
" " Nozzle 1	73-1/2"	73-17/32	(Calculated Dimension)
" " " 3	73-1/2"	73-17/32	

Nozzle 3 (on south position)

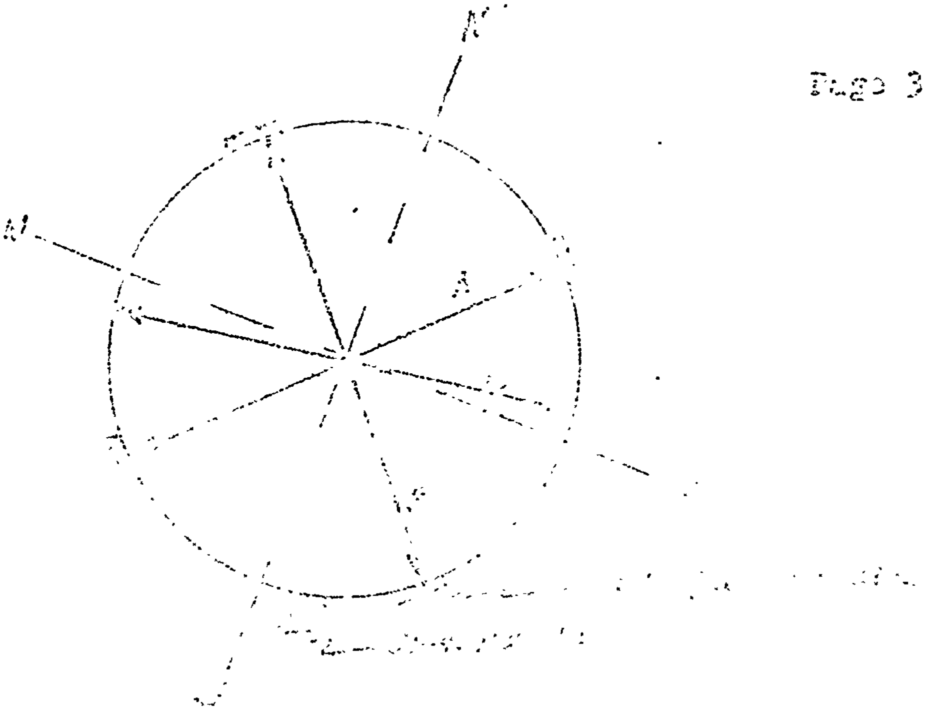
Distance from E-W ℄	52"	52"	
" " Nozzle 2	73-27/32	73-17/32	(Calculated Dimension)
" " " 4	73-1/2	73-17/32	"

Nozzle 4 (on west position)

Distance from N-S ℄	[illegible]	52"	
" " Nozzle 1	[illegible]	[illegible]	[illegible]
" " " 3	[illegible]	[illegible]	

Unit was accepted for dimensions [illegible]

lmw
attach.



[illegible]			
I.D.(T.C)	Actual	Drawing	[illegible]
Taken [illegible]			
A	[illegible]	11' 6 [illegible]	[illegible]
B	[illegible]		
C	11' 8 [illegible]		
Taken at center of Tank			
A	[illegible]	11' [illegible]	[illegible]
B	11' [illegible]		
C	11' [illegible]		
Taken [illegible]			
A	[illegible]		
B	[illegible]	[illegible]	[illegible]
C	[illegible]		

[illegible]	[illegible]	Drawing
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]

[illegible] Nozzle		
Dimension	Actual	Drwg.
Height	7'7"	7'7"
C?	15 1/2"	15 [illegible]"
T.P	[illegible] 12"	——