SPECIFICATION NO. 3552

FOR

1,300,000 GAL. CAPACITY

WASTE STORAGE TANKS

200 AREA - BLDG. 241-F

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Specification No. 3552
200 Area - Bldg. 241-F
Sheets 1 to 47
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REVISIONS TO SPECIFICATION 3552

REV. NO.	DATE	PAGE NO.	DESCRIPTION	APPROVAL	DATE
1	12/19/55	3	13 was 15	E. R. Damon L	2/1/56
2	12/19/55	3	15 was 17	R. J. Christ by Hymanly	1/31/56
3	12/19/55	7	Added slab self drainage		
4	12/19/55	8	Primary Source Elec. Power		
5	12/19/55	21	" " " "		
6	12/19/55	22	Steel Plate Certification		
7	12/19/55	23	"Pipe" Omitted		
8	12/19/55	26	Bracing Tank to maintain roundness		
9	12/19/55	29	Omitted Welding Angle Stiffeners	E. R. Damon L	2/1/56
10	1/26/56	19	Lowering Frames added. Mobile equip. limit omitted.	R. J. Christ by Hymanly	1/31/56
11	1/26/56	20	Lowering Frames Note added.		
12	1/26/56	20	Cribbing added		
13	1/26/56	21	Cribbing required		
14	1/26/56	25	Knuckle Plates substituted for Flanged Plates.		
15	1/26/56	26	Lowering Frame added		

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REVISIONS TO SPECIFICATION 3552

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Specification No. 3552
200 Area - Bldg. 241-F
December 9, 1955
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1. GENERAL

1.1 Intent: This specification with the drawings cover the requirements for all primary materials and the construction, inspection, and testing of four 85 ft. diameter 1,300,000 gal. capacity low activity waste underground storage tanks designated as Building 241-F in the 200 Area.

For detailed process requirements, see Scope of Work dated August 29, 1956.

1.2 Scope: The work shall consist of excavation and subsequent backfill, and the construction, inspection and testing of liquid-tight steel tanks encased in domed topped prestressed shotcrete and concrete tanks, including manholes, pipe connections, riser openings and other adjuncts.

1.3 Definitions: The following shall supplement the definitions contained in Article I of the General Conditions:

1.31 The term "Steel Subcontractor" shall mean the subcontractor who shall furnish, fabricate and erect the steel tanks complete with all attachments affecting liquid tightness of the structures, and who shall also perform radiographic inspection of welds.

1.32 The terms "approved", "approval", "as specified", "as required", shall mean by du Pont or authorized representatives.

1. GENERAL

1.4 Division of Work:

1.41 Du Pont to do all work detailed in specification where not required by steel subcontractor.

1.42 The Steel Subcontractor shall furnish and construct the steel tanks and do other incidental work as specified, including radiographic inspection and interpretation of radiographic films of welding, in accordance with Section 6, Specification 3552.

1.5 Standards: Certain sections of Du Pont Specification 3557, revised June 18, 1956, specified herein and the requirements of all codes or other technical standards listed herein, including du Pont Radiation Hazard Control dated 3/23/55, and Specification 3548 "Rules for Interpreting X-Ray Films of Tank Welds" dated 6/22/55, revised 10/25/56, shall be part of this specification and shall be fully applicable unless specifically modified by this specification.

1. GENERAL

1.6 Construction Sequence:

SEQUENCE

1. Excavation
2. Wall Foundation, Tank Floor & Curing
3. Floor Cement Topping
4. Construction of Steel Tank Bottom (by Steel Contractor)
5. Radiographic Inspection of Bottom (" " ")
6. Vacuum Leak Test of Bottom (" " ")
7. Construction of Steel Tank Side Plates (" " ")
8. Welding Anchors for Concrete to Side Plates (by Steel ")
9. Radiographic Inspection of Tank Side Plates (by Steel ")
10. Tank Water Test (by du Pont & Steel Contractor)
11. Shotcrete Test Panels and Inspection Procedure
12. Sandblasting Steel (if necessary)
13. Place inner layer of wall reinforcing.
14. Place shotcrete to line of outer layer of reinforcing
15. Erect dome forms, and dome ring inside form.
16. Place outer layer of wall reinforcing and dome ring reinforcing
17. Finish shotcrete wall and dome ring with turnbuckle slots.
18. Place dome reinforcing and riser forms
19. Tension 11 bands on wall and dome ring to 25,000 p.s.i.
20. Pour dome slab.
21. Tension bands in first layer to 50,000 p.s.i.
22. Remove dome forms
23. Complete outer layers of bands on wall and dome ring including tensioning to 50,000 p.s.i.
24. Test tank by filling with water. *
25. Apply reinforcing mesh over wall and dome ring and final shotcrete cover
26. Backfill and install piping
27. Grading and surface treatment.

* Note: Tanks to remain filled with water until placed in operation.

2. EARTHWORK

2.1 General: The following sections of Standard Engineering Specifications shall be applicable to this work:

2.11 SC-3E Excavation, (Date of issue - January, 1950)

2.12 SC-4E Fill (Standard Compaction) (Date of issue - January, 1950)

2.13 SC-6E Borrow (Date of issue - January, 1950)

2.2 Backfill Around Tank: Fill shall not be placed against the tank walls until concrete has set for 28 days. Caution shall be exercised in placing fill to avoid damage to the tank walls. Fill material shall be placed dry in minimum 12" layers, maximum 24" layers without compaction other than that due to earth moving equipment distributing and placing fill except where provided otherwise.

Where compacted backfill is shown on Drawing W166430, compaction method shall be used as specified in Standard Engineering Specification SC4E.

Special care shall be taken to leave the fill within 4 feet of the tank walls in a dry, uncompacted state. To accomplish this, treads of earth moving equipment should not come within 8 feet of exterior surface of tank wall. The portion of fill within 4 feet of tank walls shall not weigh in excess of 95 lbs. per cu. ft. in place.

2.3 Fill Over Dome shall conform to Standard Engineering Specification SC-4E. A uniform cover of 2'-8" is required. Note that the design load for the dome includes the earth cover plus one D6 Caterpillar tractor with bulldozer (22,000 lbs.) OR the earth cover and one 8T roller (16,000 lbs.). Not both at same time.

Equipment cannot be operated on dome until a minimum of one foot of fill has been placed.

Equipment to be operated with due care to avoid damage to the dome, risers, and tank connections. All clearances must be carefully checked and established before operating earth moving and/or compaction facilities.

3. CONCRETE

3.1 General:

3.11 All concrete work shall be constructed in the sequence specified in Section 1.6, or as modified by Construction Schedules. Design is to be notified of such modification in order to properly schedule design work.

3.12 The terms "Pneumatic Mortar" and "Shotcrete" shall be synonymous.

3.13 Du Pont will construct all shotcrete and poured concrete

3. CONCRETE

3.2 Material Specifications:

3.21 The following Standard Engineering Specifications are part of this specification except as hereinafter modified:

SB1A	- Portland Cement	Feb. 1956
SB2A	- Dense Aggregates	Oct. 1955
SB4A	- Reinforcement	Feb. 1956
SB5A	- Testing	Feb. 1956
SB6A	- Proportioning, Batching and Mixing	Feb. 1956
SB7A	- Forms	Dec. 1955
SB8A	- Placing Reinforcement in Concrete	Feb. 1956
SB9A	- Placing Concrete	Oct. 1955
SB10A	- Finishing Concrete	Feb. 1956
SB11A	- Joints	Feb. 1956
SB12A	- Curing	Feb. 1956
SB13A	- Bonding & Grouting	Nov. 1955
SB14A	- Repairing & Patching	Nov. 1955
SB6K	- Plain Cement Topping	June 1953

3.22 Portland cement for poured concrete work shall be in accordance with SB1A.

Portland cement for use in shotcrete work shall be Type I and in accordance with SB1A and as noted below. Manufacturer shall furnish mill analysis which shall be approved for its suitability for shotcrete work. Brand shall not be changed without approval and analysis of further shipments shall be checked to guarantee uniformity of the cement furnished.

3.23 Aggregate for use in concrete shall be in accordance with SB2A.

Sand to be used in shotcrete shall also conform to SB2A except that the gradation shall be modified as follows:

Size Screen	Required Percentage Passing	Desired Percentage Passing
3/8"	100	100
4	98-100	99.5
8	95-100	97.5
16	60-90	85
30	40-65	54
50	10-30	18
100	2-10	4
Fineness Modulus	2.30-2.60	2.42

3. CONCRETE

3.2 Material Specification - (continued)

3.23 (continued)

Sand for shotcrete shall be obtained from a single source unless otherwise approved. Each shipment shall be tested for gradation and shall not deviate from the fineness modulus of the sample by more than 0.10.

3.24 Testing of concrete, concrete materials and shotcrete materials shall be in accordance with SB5A except as modified by this specification. For testing of shotcrete, see section 3.44.

3.25 Concrete proportioning and mixing to be in accordance with SB6A. For preparation of shotcrete mix, etc., see paragraph 3.4410

3.26 All forms, except shooting strips for shotcrete work, to be in accordance with SB7A.

3.27 Placing of reinforcing for concrete work to be in accordance with SB8A except where otherwise shown on drawings. For placing of reinforcing for shotcrete work, see paragraph 3.449.

3.28 Construction joints in concrete work shall be placed where shown on the drawing in accordance with SB11A, but at no other places except as approved by the Design Division. For construction joints in shotcrete work, see paragraph 3.4414.

3.29 Curing of concrete to be in accordance with SB12A except where otherwise specified on drawings or in this specification.

3. CONCRETE

3.3 Concrete

3.31 Outline of Work: The work includes the floor and the foundations, cement topping, the dome roof, risers and foundations on the roof.

3.32 Foundation and Floor: The foundation and floor shall be constructed of Class C concrete. They shall each be placed without construction joints with an annular space between to be filled after curing. Foundations and floor shall bear on virgin soil at the elevations shown on the drawings, or on lean concrete fill where bearing is not suitable or has been carried below specified grade. The structural slab shall be 4" thick with a tolerance of plus 1/2" and minus 1/4", and shall have a screeded surface level within plus or minus 1/4" from a true plane. The sub-grade shall be covered over porous sub-grades.

3.33 Annular Space in Floor: After the structural floor and foundation have set and cured for a minimum of seven (7) days, the annular space between them shall be filled with a mixture of metallic non-shrink grout which has a twenty-eight (28) day minimum compressive strength not less than that of the floor concrete.

3.34 Cement topping shall be a pea gravel mix placed in accordance with SB6K. After screeding it shall have only the necessary float and trowel finishing necessary to produce a tolerance of plus or minus 1/8" from a true and level plane.

3.35 Foundation-Wall Dowels: Install foundation dowels bent down, to provide clearance for installation of the steel tank, and bend up into specified position when tank is completed.

3.36 Dome and center riser shall be constructed of Class A concrete. Six small risers at side, all plugs and any auxiliary foundation shall be Class D concrete unless otherwise shown on the drawings.

Bands as specified in par. 3.464c shall be in place and stressed to 25,000 p.s.i. prior to placing concrete on dome. Dome slab shall be placed monolithicly.

3.37 Dome slab and center riser shall be cured 14 days covered with burlap kept constantly wet.

3. CONCRETE

3.3 Concrete (continued)

3.38 Dome Forms: Dome forms shall be constructed true to dimension in accordance with the drawings and specification SB7A. The form surface shall be constructed to remain truly spherical in shape under the load of wet concrete and expansion of wood when wet. A deviation of not more than one inch at the center shall be considered satisfactory. Dome forms shall remain in place until the first layer of bands has been fully tensioned, provided the dome concrete has attained the full strength of 5000 p.s.i. and that 21 days have elapsed since pouring.

3. CONCRETE

3.4 Prestressed Pneumatic Mortar

3.41 Shotcrete work includes all labor, material and equipment necessary to make test panels, perform sandblasting as required and to construct, test and prestress the tank walls and dome rings in accordance with the drawings and this specification.

3.42 A clear space of 8'-6" minimum around each tank shall be provided by steel subcontractor during shotcreting and stressing of tensioning elements.

3.43 Preparation of Steel Tank Surface:

3.431 When the steel tanks are completed, du Pont shall inspect the reinforcing steel dowels, and plate surfaces and attachments for the purpose of establishing acceptable surfaces for good bond. An acceptable surface is defined as one from which loose rust, scale and all foreign matter have been removed by means of wire brushing or the equivalent. Oil and grease must be removed entirely.

3.432 In order to remove cause of rejection, sandblasting will be required where surfaces have not been found acceptable.

3.433 It is absolutely essential that all plate, reinforcing, and Nelson studs provide an acceptable bond with the shotcrete.

3.44 Shotcrete:

3.441 Materials shall be as specified in Section 3.2.

Gradation of sand shall be checked twice weekly, colorimetric test once a week. Moisture shall be checked and mix proportions adjusted daily. Batch plant operator shall be notified of same in writing.

3.442 Dry Mixing: Batch plant shall accurately proportion sand and cement according to quantities established by testing laboratory, at a proper rate to provide an uninterrupted flow of material to the shotcrete machine. Mixing truck shall thoroughly dry mix the sand and cement at proper time and rate required. Resulting mix shall be tested frequently to establish uniformity. Mixing drums shall be maintained in clean condition and mixing blades replaced when necessary to insure efficient and uniform mixing.

3. CONCRETE

3.4 Prestressed Pneumatic Mortar (continued)

3.443 Pneumatic mixing and delivering equipment shall be a well known make of proven performance and ability such that the required material delivered from the nozzle will be continuous in quality and quantity to satisfy job requirements.

This equipment shall be maintained in clean and good operating condition in order to insure the delivery of material of the required quality and quantity and at the pressure required.

Whenever the quantity of material delivered from the machine is reduced materially, operation shall be stopped and the machine cleaned out.

3.444 Supply of air shall be sufficient to maintain a constant pressure of 100 p.s.i. at each machine when all equipment is operating.

Air pressure used shall be regulated to produce a constant velocity between the nozzle and point of impact of the shotcrete. The line of flight of the particles shall be straight and hard and at approximately 90° to the surface rather than curved or lobbing up to the wall at a distance greater than three feet.

The above condition can be maintained with a nozzle velocity of 375 to 500 f.p.s. for 3/4 and one inch nozzles, and 425 to 550 f.p.s. for the 1-1/4 inch nozzle when operating in conjunction with a 100 ft. 2" hose.

3.445 Water Pressure shall be maintained steady and non-pulsating through adequate supply and by means of regulating equipment and at a pressure of 15 to 25 p.s.i. above the air pressure being used on the machine. Example, a pressure varying from 80 to 85 pounds will be satisfactory when the air pressure is held at 65 p.s.i.

3.446 Qualification of Operators - Operators of pneumatic mixing equipment, nozzle men and clear-away men shall have the general qualification recommended in ACI 805-51, "Recommended Practice for the Application of Mortar by Pneumatic Pressure". It is essential that both nozzle men and operator of pneumatic machine have a working knowledge of job requirements and understanding of each others equipment and operation in order to work efficiently together.

3. CONCRETE

3.4 Prestressed Pneumatic Mortar: (continued)

3.44 Shotcrete: (continued)

3.447 Preliminary Tests: Prior to commencement of shooting on the wall, all nozzlemen shall shoot test panels as described below. Operators shall be trained until the desired degree of efficiency is attained and shotcrete of the required quality is achieved.

The test panel shall be 3 feet by 3 feet by 4 inches thick. It shall be built up in multiple layers in a near vertical position. After completion, it shall remain in place undisturbed for 24 hours and covered with burlap for protection. It shall then be moved to laboratory where core cylinders will be cut and cured in accordance with standard testing procedure. Tests shall be made at 2, 7 and 28 days. Full sections of the samples shall be maintained for future reference. These samples when approved shall establish the following

a. Proportions and ultimate strengths of the shotcrete made from the materials proposed to be used for the work.

b. Representative samples demonstrating acceptable limits of operating procedure and results.

3.448 Preparation of Surface and Bond: All surfaces to which shotcrete is to be applied shall be sound, free from loose particles and thoroughly clean. Unsound concrete shall be removed and surface scoured with water and compressed air jet. Steel tank shell shall be prepared as specified in Section 3.43.

3.449 Placing Reinforcing Steel: Care must be taken in placing reinforcing steel for later shotcreting that bars are placed so as to least interfere with shotcreting. No parallel bars shall be placed closer than 1-1/2" and at the maximum spacing permitted by the design. No bars shall be closer than 3/4" to forms or 1/2" from shotcrete surfaces. Where short pieces of bar are used for bar supports, they shall be kept as short as possible so as not to impair the continuity of the shotcrete. Outer layers of reinforcing may be placed later, so as not to interfere with shooting layers underneath.

3. CONCRETE

3.4 Prestressed Pneumatic Mortar: (continued)

3.44 Shotcrete (continued)

3.449 (Cont'd)
No bars or wires shall project completely through the shotcrete wall. Where tie wires are set for future use in tying on reinforcement, single wires shall be used. Twisted tie wire ends must be cut back close to reinforcement.

3.4410 Proportioning: The dry mix shall be one part of cement to 3-1/2 to 4 parts of sand by volume and shall be checked by the tests in Paragraph 3.447. The proportions selected for use shall be based on maximum density as determined by a specific gravity test, minimum water content in terms of shotcrete placed and a minimum compressive strength of 5000 p.s.i. in place after 28 days. It is recognized that strength in tests of sample material will generally be higher than core tests and subject to variation and liberal allowance for this decrease shall be made in selecting the proportions. See Section 3.4418 for tests during shooting and Section 3.4419 for core cylinder tests.

3.4411 Water Content: A practical minimum water content shall be used and shall be between 4.5 and 7 gallons of water per bag cement as confirmed by tests in Paragraph 3.447. Shotcrete will need to be more moist to bond behind reinforcing bars, and this can be dried out by shooting a little dryer mix on top. The water content as established by test panels shall be that used on the walls. The surface of the shotcrete shall be smooth, creamy and without runs, sloughs or dark unhydrated spots on the surface.

3.4412 Application: In order to eliminate the tendency to form horizontal cracks around the tank, the wall shall be shot in vertical strips. The vertical joints thus made, shall be staggered in subsequent layers so that planes of weakness will not be formed.

Means shall be provided for accurate check of shotcrete dimensions at all stages of construction. Surfaces to which bands will be applied shall be

3. CONCRETE

3.4 Prestressed Pneumatic Mortar: (continued)

3.44 Shotcrete (continued)

3.4412 (Cont'd)
uniformly smooth and free from depressions or projections exceeding ±1/4 inch, to assure uniform contact of bands with the shotcrete surface.

Before placing subsequent layers of shotcrete, the surface must be wet down thoroughly and scoured with an air jet. The surface shall be given a final check to avoid covering over any weak spots in previous layers before proceeding with shotcreting operation.

Shotcrete shall be applied in layers 3/4 inch to 1-1/2 inch in thickness with a maximum of 2 inches to build up thickness to the dimensions shown on the drawings. Where deficiencies occur, they shall be corrected. Excess shall be removed where it interferes with intended design. All sloughs and trapped rebound shall be removed immediately and reshotcreted. Layers of shotcrete on wall shall continue up into dome ring in order to provide a monolithic bond.

Additional layers may be applied on the wall once in 3 days and on dome ring, once every 2 days. This is intended to allow time for the heat in the cement to dissipate, some wet curing, inspection and removal and repair of unsound material.

The space below the knuckle plate shall be filled out to the wall line and allowed to set up before starting the wall so as to eliminate pockets of rebound forming in this space.

A record shall be kept of the portion of the wall shot each day with the name of the nozzle operator.

3.4413 Suspension of Shotcreting: Work shall be suspended when:

a. High wind occurs which separates the cement from the sand at the nozzle.

b. Weather approaches freezing and shotcrete cannot be protected.

c. Rain occurs which would wash the cement from the mix or add moisture to the dry mix which would prevent proper shotcreting.

3. CONCRETE

3.4 Prestressed Pneumatic Mortar (continued)

3.44 Shotcrete (continued)

3.4413 (continued)

d. High temperatures cause excessive drying and shrinkage of the fresh shotcrete.

e. Tests conducted on material shot on wall show that wall will not attain required 5000 p.s.i. strength.

f. Cement-sand mix delivered to machine arrives in condition not suitable for shotcrete operation.

3.4414 Construction Joints: Joints at the end of a work period shall be trimmed back to good material and tapered to a thin clean regular edge with a slope not to exceed 1 to 2. On resumption of shooting, these edges must be wet and scoured with the air jet before applying additional shotcrete.

3.4415 Forms and Shooting Strips: An inside form must be provided for portion of dome ring projecting above the top of the steel lining.

To obtain alignment and to form a true surface, shooting strips shall be used for upper and lower horizontal surfaces of dome ring.

Block-out forms or shooting strips may be used to form notches for turnbuckles or notches may be formed by cutting with a sharp trowel.

3.4416 Rebound Sand: Proper sequence of the operation will avoid covering up pockets of rebound in the work. Prior to placing additional shotcrete any accumulations of loose shotcrete or rebound sand must be removed from the wall. Rebound shall be promptly collected and removed from the vicinity of the tank. Rebound shall not be reused in the mix.

3. CONCRETE

3.4 Prestressed Pneumatic Mortar (continued)

3.44 Shotcrete (continued)

3.4417 Curing: Shotcrete shall be sprayed with a fine spray of water as soon as the shotcrete has had time to take final set or about 24 hours after application. Surface should be kept wet 7 days minimum, or until covered with another layer of shotcrete applied in accordance with this specification. In warm weather, surface should be kept moist until bands are tightened.

3.4418 Test Specimen and Sampling:

a. During the application of the shotcrete on the tank wall, samples shall be taken from the wall in such a manner that they represent the quality of the shotcrete being placed on the structure by each nozzleman. Each sample shall be dated, numbered and the name of the nozzleman noted with the stage of the work on the tank.

b. From the same mix from which the wall samples were made, test panels shall be made by shooting to a thickness of 2" on a 2 ft. x 2 ft. wood panel placed in a nearly vertical position adjacent to the application area. One such panel shall be made by each operator for each day's work. After initial set, the panels shall be covered with damp burlap and remain undisturbed for 24 hours.

c. Nine 2" cubes shall be cut from each test panel. Three cubes each shall be tested at 2, 7 and 28 days respectively. The following test results are considered favorable for the periods noted:

At 2 days - 2000 p.s.i.
7 days - 3500 p.s.i.
28 days - 5000 p.s.i.

Storage and testing shall be in accordance with ASTM C109-54T.

d. Samples shall be taken daily from each nozzleman's work area to determine the water, sand and cement contents of the applied material.

3. CONCRETE

3.4 Prestressed Pneumatic Mortar (continued)

3.44 Shotcrete (continued)

3.4418 (continued)

e. The holes made in the shotcrete by sampling shall be properly beveled and reshotcreted during the same workday.

f. If the results of any of the above tests indicate that shotcrete material will be unacceptable, shotcreting shall be discontinued until an adjustment in the mix indicates an acceptable material will be obtained.

3.4419 Core Cylinders:

a. After core wall and dome ring are completed and ready for addition of prestressing bands, 4" diameter core cylinders shall be cut therefrom to confirm that shotcrete is of uniformly sound quality throughout the tank.

b. A minimum of one core cylinder shall be cut from each 150 square feet of wall surface and one for each 25 linear feet of dome ring. These cores shall be staggered so as not to form planes of weakness in the tank.

c. These cores must be stopped 2 inches back from steel liner to avoid cutting inner layer of reinforcing or steel liner. In taking samples, the outer layer of reinforcing bars shall not be cut.

d. The number of cores specified above is the minimum number required. Whenever a layer of shotcrete is suspected of containing weak material or whenever additional data is desired without waiting until tank wall is finished, additional core cylinders shall be cut as required.

e. These holes shall be repaired by dry packing with a 1-1-2 mixture of metallic non-shrink grout. If such hole extends all the way to the steel lining, non-shrink metallic grout must not be placed in contact with such plate but a protective layer of plain cement grout 1" thick shall first be inserted in the hole.

3. CONCRETE

3.4 Prestressed Pneumatic Mortar (continued)

3.44 Shotcrete (continued)

3.4419 (continued)

f. These core cylinders shall be cured as required by standard testing procedure and tested 28 days after final layer is shot.

3.4420 Inspection: While placing shotcrete, work shall be constantly inspected to detect points of weakness which may require cutting out and reshotcreting.

After set, wall shall again be inspected by sounding wall surface with a hammer at frequent intervals to detect inclusion of rebound sand or hollow spots.

As the work progresses, cores may be cut from the wall as described in par. 3.4419d to detect unsound material.

Any imperfections, slough cracks or other indications of weakness in the shotcrete material shall be cut out and repaired promptly as it is essential that no fresh shotcrete be applied over rebound, hollow spots or other unsound material.

3.4421 Protection: Accepted normal practices in shotcreting operations shall be followed at all times to avoid damage of other contractors or subcontractors equipment. Operational sequences which result in dust and wind blown spray are to be considered normal and the protection of work area, tools and equipment of other contractors or subcontractors resulting from same shall not be the responsibility of du Pont.

Scheduling of other operations shall be planned as far as possible to avoid interference from shotcrete, dust or spray.

When shooting additional layers on dome ring, wall of tank can be protected from shotcrete and rebound by use of duck boards placed on platform and leaning against tank.

At pneumatic machine, tarpaulin over mix hopper may be used as protection of dry mix against drying out by sun and addition of moisture from light rain during which shotcreting may be performed.

Protection against exhaust from machine may also be required.

3. CONCRETE

3.4 Prestressed Pneumatic Mortar (continued)

3.45 Summary of Laboratory Testing on Shotcrete

3.451 Sieve analysis and wash on sand twice weekly and on new shipments. Also colorimetric test once each week and on each new shipment.

3.452 Daily moisture check on sand and mix proportions to batch plant operator daily in writing.

3.453 Spot check dry mix in truck frequently to confirm established uniformity.

3.454 Make a determination of cement, sand, and water content in the tank wall and rebound samples as specified in paragraph 3.4418 d. Sieve analysis weekly and as required.

3.455 One 2' x 2" test panel per day for each operator. Record air and water pressure.

3.456 Break 3 - 2" cubes from each panel at 2, 7, and 28 days.

3.457 Density checks as required.

3.458 Cores from wall as specified in section 3.4419.

3. CONCRETE

3.4 Prestressed Pneumatic Mortar (continued)

3.46 Horizontal Prestressing (continued)

3.462 Tensioning Elements: (continued)

c. Turnbuckles, hexagonal ends, 1" for use with 7/8" diameter rods, one end left-hand female thread, opposite end right-hand female thread to fit the 7/8" bars; 1-1/4" for use with 1" diameter rods, one end left-hand female thread to fit the 1" bars. Turnbuckles to have 6" opening. Threads to be American National Form type, oversize and of a diameter to pull the full strength of rod without stripping, galling or freezing the threads of the rods.

3.463 Materials of Construction

a. Bars shall conform to Grade AISI C 1055 for 7/8" diameter and to AISI C 1060 for the 1" diameter. Three verified copies of the Mill Chemical and Physical Test Reports shall be furnished Design to confirm this specification. These reports are required on all heats from which the bars are fabricated.

These bars shall be fabricated into Type P tensioning elements with the following physical properties.

Ultimate Tensile Strength	105,000 p.s.i. min.
Yield Point	60,000 p.s.i. min.
Ductility	20% elongation in 2" (full section)
Hardness	262 Brinnell max.

Bars shall conform to the best mill practice to produce the physical properties specified. Finishing temperature shall be a minimum of 1650°F. In production, the bars shall be air cooled for sufficient time to produce the equivalent of a normalized bar.

3. CONCRETE

3.4 Prestressed Pneumatic Mortar (continued)

3.46 Horizontal Prestressing (continued)

3.463 Materials of Construction (continued)

b. The carbon steel, hexagonal end, 6-inch opening, turnbuckles shall conform to forging grade AISI C-1045. Three verified copies of the Mill Chemical and Physical Test Reports shall be furnished Design to confirm this specification. These reports are required on all heats from which the turnbuckles are fabricated.

Turnbuckles shall be oil quenched and tempered to produce the physical properties such that under tensioning test to failure the breaking point will occur in the rod, not the buckle and the buckle will be free turning at time of failure. The ultimate tensile strength for the composite test shall be 105,000 p.s.i. minimum.

c. Physical tests shall be conducted at steel fabricators plant, on two bars and buckles from each heat to ensure the rods, buckles, and threads meet specifications. These physical tests to be called for and elaborated on in the purchase order and shall be witnessed and reported by du Pont inspection.

d. Rods to be bundled by size, and cut length, not over 4500 lbs. to a bundle with turnbuckles fitted on the left-hand threaded end of each rod. Turnbuckles to be placed at alternate end of bundle and the open end of each rod wrapped in burlap, a sufficient number of wraps to insure thread protection during shipment. Threads and rods prior to packing shall be protected in accordance with Lubrication Engineering Standard L 2 A Class III-b.

e. Each bundle to be tagged to show rod diameter and cut length.

f. No substitution or alterations to be made to the requirements outlined in 3.461 through 3.463 without written approval of Design.

3. CONCRETE

3.4 Prestressed Pneumatic Mortar (Continued)

3.46 Horizontal Prestressing (Continued)

3.464 Prestressing

a. After core wall and dome ring have attained a strength of 5000 p.s.i. and have set a minimum of 14 days, 7 bands on the wall and 4 on the dome ring shall be tensioned to at least 25,000 p.s.i. before dome slab is poured. No relaxation can be permitted from the 25,000 p.s.i.

b. These 7 bands on the wall shall be selected at approximately 5 foot intervals starting one foot from bottom of tank. Select 2 bands in upper 12 inches of dome ring and 2 in lower 12 inches.

c. Strain gage readings shall be taken on these bands to determine when they are stressed to 25,000 p.s.i.

d. Procedure for tensioning these bands shall be as hereinafter described for the other bands.

e. After dome slab has attained a strength of 5000 p.s.i. and has set a minimum of 14 days, all the bands on the wall and dome ring may be brought up to the final stress of 50,000 p.s.i. in accordance with the procedure outlined in par. 3.465.

3.465 Prestressing Procedure: The procedure for assembling and tensioning bands on the tank wall and dome ring shall be as follows unless changes are approved by the Design Division.

a. Apply cup grease to threads.

b. Starting at the bottom, assemble bands on wall at spacing shown on drawings. Note that two sets of turnbuckle slots have been provided, approximately 17 feet apart so that only turnbuckles on alternate rods fall in the same slot.

c. Turnbuckles shall be centered in the proper slot and arranged so that tightening lever will move downward.

d. Supports shall be provided so that bands will not be displaced in tensioning operation.

3. CONCRETE

3.4 Prestressed Pneumatic Mortar (continued)

3.46 Horizontal Prestressing (continued)

3.465 (continued)

e. All wires, support bars or other devices for holding rods in place must be removed before applying the shotcrete cover to the rods.

f. Clamps shall be provided which are strong enough to keep rods from twisting when maximum torque is applied to band. Safety chains at each clamp are recommended to restrain any rod which might break in stressing operation.

g. No lugs, bars on other devices may be welded to tensioning rods.

h. Holes required for mounting strain gages shall be staggered by at least one inch if more than one set is used so as not to reduce the cross section of the bar by more than the area of one hole. Such holes shall not be drilled and/or reamed deeper than necessary to mount gage.

i. No clamps, wrenches or other tools may be used which cut into the rods or turnbuckles or displace material on their surface without prior approval of Design. No tools may be approved which remove material from the surface of bars or displace the material in a longitudinal direction. Slight indentations in a longitudinal direction may be approved if area of cross section remains unchanged.

j. It is essential that shotcreting operations be completed before assembling bands on the tank wall. Shotcrete and rebound on the rods, between rods and wall, and in the threads shall be removed before tensioning. Any departure from this procedure shall be referred to Design for approval.

k. Before applying tension to a band an operator should be stationed at each turnbuckle in the band.

l. The band should then be "snugged up" to the side of the tank so that rod just touches the wall for the entire circumference of the tank (not necessary to touch low spots on wall).

3. CONCRETE

3.4 Prestressed Pneumatic Mortar (continued)

3.46 Horizontal Prestressing (continued)

3.465 (continued)

m. Each of the following operations shall be performed simultaneously at a given signal:

All turnbuckles shall be tightened one half turn.

All turnbuckles are then given a second half turn.

Full turns may now be applied stopping at the end of each turn.

Note: During tensioning of the band, each rod should be struck with a heavy non-metallic hammer frequently along its length.

The required number of turns will be determined according to the method described in par. 4.14.

n. All bands on wall shall not be tensioned at once. To distribute the stress over the wall more evenly, only every other band shall be tensioned to 50,000 p.s.i. and then each alternate band shall be brought up to this required stress.

o. When tightening dome ring bands, alternate the tightening of a band near the bottom with one near the top of the dome ring in order to keep the dome ring stressed symmetrically.

p. Since stress readings will not be taken on all the bands, all the bands on the wall and all the bands on the dome ring shall be tensioned by the same number of turns. The average stress readings that are taken will then indicate the average stress in the bands of that area.

q. When all bands are tensioned the full number of turns directed, stress readings shall be taken to determine if average value of stress in bands is 50,000 p.s.i. If not, additional half turns may be required until average stress in bands passes the 50,000 p.s.i. required. In evaluating these results, stresses varying from 48,000 to 55,000 p.s.i. will be acceptable. If wider variations occur, approval of Design must be obtained.

3. CONCRETE

3.4 Prestressed Pneumatic Mortar: (continued)

3.46 Horizontal Prestressing (continued)

3.465 (continued)

r. Prior to placing of additional layers of bands as shown on the drawings, the rods, threads, turnbuckles, and wall shall be freed of grease and oil. Shotcrete cover shall then be applied. Tensioning of the bands on the additional cover can proceed after 7 days if the shotcrete has attained a minimum strength of 3500 psi.

3.466 Tank Testing: Before final shotcrete cover is applied, the tank shall be water tested by filling to invert of the tank inlet. Water shall remain in the tank after testing until the tank is placed in operation.

3.47 Time Schedule for Shotcreting, Pouring Dome and Prestressing

3.471 Minimum time between shotcrete layers on walls 3 days, and one dome ring 2 days, providing shotcrete meets specification.

3.472 When core wall and core dome ring are completed core cylinders should be cut.

3.473 If wall and dome ring attain a strength of 5000 p.s.i., 14 days after completion, 11 bands shall be tensioned to 25,000 p.s.i. making strain gage readings to check the stress.

3.474 Dome slab can be poured after 11 bands are tensioned to 25,000 p.s.i.

3.475 Bands on wall may be tensioned to 50,000 p.s.i., if dome slab attains 5000 p.s.i. in 14 days after pouring. Strain gages are applied to 9 bands for checking purposes.

3.476 After first layer of bands is tensioned as required, shotcrete cover as shown on drawings shall be applied for additional layers of rods.

3.477 After first layer is tensioned, dome forms shall be removed 21 days after pouring.

3. CONCRETE

3.4 Prestressed Pneumatic Mortar (continued)

3.47 Time Schedule for Shotcreting, Pouring Dome & Prestressing (continued)

3.478 Bands may be tensioned in next layer, seven days after application of shotcrete if test cubes attain a strength of 3500 p.s.i. Strain gage readings corresponding to first layer are used for checking.

3.479 After final tensioning on all layers, tank is filled with water for testing and repairs made if necessary.

3.4710 Mesh and final shotcrete cover complete the tank wall.

4. STRESS MEASUREMENTS:

4.1 Measurement of Stress in Tensioning Bands:

4.11 Stresses in bands shall be determined by use of Whittemore Strain Gages (10" gage length) or equal applied according to manufacturer's directions.

4.12 Enough stress readings shall be made to determine that all bands are uniformly stressed to 50,000 p.s.i. The following minimum readings shall be taken but additional readings may be required if readings are not conclusive.

4.121 Readings shall be taken at the center of each rod in each band selected for stress readings plus additional readings at both ends of one rod in the band.

4.122 Select one band within a foot of the bottom of the wall.

4.123 Select 6 additional bands at 5-foot intervals on the wall of the tank.

4.124 Select 2 bands on the dome ring, one within 12 inches of bottom and one within 12 inches of the top of the dome ring.

4.125 A corresponding number of strain gage readings shall be taken in subsequent layers of rods.

4.13 Any reduction in the number of strain gage readings indicated above must be approved by Design.

4.14 The following procedure shall be used unless changes are approved by Design.

4.141 After selected band has been "snugged up" so that it just touches wall as previously described, gage holes shall be placed at locations indicated, tagged with identification mark and the zero reading taken.

4. STRESS MEASUREMENTS

4.1 Measurement of Stress in Tensioning Bands (continued)

4.14 (Continued)

4.142 Bands shall be tightened in accordance with paragraph 3.465.

4.143 Strain gages shall be read after each turn or half turn as predetermined until a stress of 50,000 p.s.i. is obtained.

4.144 From the number of turns of the turnbuckle obtained thus, the other bands on the wall and dome ring shall be tensioned by the number of turns so determined.

4.145 After all bands on tank have been tensioned, strain gage readings shall be checked to determine if additional turns or half turns may be required to obtain the stress of 50,000 p.s.i.

4.146 Records shall be made of final stresses in all bands tested and shall include the number of turns of the turnbuckles.

4.147 After first tank is completed, the number of turns used on first tank may be used to tighten bands on subsequent tanks and stress readings may be taken only after all the bands are tensioned.

4.148 In order to facilitate counting turns of the turnbuckle and eliminate possible error, one side of each turnbuckle should be marked by colored paint, lacquer or other material which will make it easily identified.

4.15 Alternate Method: Methods described herein for tensioning bands will result in a certain amount of variation in stress in individual rods.

Torque measuring or limiting wrenches may be used to indicate the resultant stresses applied by each turnbuckle provided the torque wrench has been indexed to the strain gages specified and may be substituted for the method of counting the turns which has been specified herein.

4. STRESS MEASUREMENTS

4.2 Test Reports: The data collected during the required testing under Section #3 paragraph 3.4 and Section #4 shall be maintained in permanent form. Three copies of these records shall be forwarded, one week after collection of data, to the

E. I. du Pont de Nemours & Co., Inc.
Engineering Department
Design Division
200 Area Project Manager
Wilmington, Delaware

5. STEEL TANKS

5.1 General:

Tanks and attachments shall be of all welded construction, absolutely liquid tight. All welds in tanks will be rigidly inspected visually, and by radiographic techniques in accordance with procedures and standards of the "A.S.M.E. Boiler Construction Code, 1952", (Herein after referred to as "the code"). Interpretation of radiographic films shall be in accordance with Spec. 3548, "Rules for Interpreting X-Ray Films of Tank Welds", dated 6/22/55 - Revised 10/25/56. The tanks will be tested by filling with water up to a designated safe height, and by vacuum leak test above this elevation and after completion as specified herein by filling again with water up to the top of the concrete encasement tanks.

5.2 Outline of Steel Subcontractors' Work:

5.21 The Steel Subcontractor shall furnish all materials, labor, tools and equipment and other services necessary for the steel tank installation in accordance with the drawings, this specification, and mutually agreed construction schedules.

5.22 Incidental items of work to be performed by the Steel Subcontractor are:

5.221 The installation of steel raising and lowering frames and hydraulic equipment, provided by du Pont, on foundations provided by du Pont, to be used for the tank bottoms.

5.222 Provide facilities, equipment, and qualified personnel for radiographing welds, and for all radiograph inspection operations including interpretation of films of tank welds.

5.223 Before beginning operations the steel subcontractor shall submit to du Pont for approval a radiation hazard control procedure based on du Pont's Hazard Control Procedure, dated 3/23/55.

5. STEEL TANKS

5.2 Outline of Steel Subcontractors' Work

5.22 Incidental items of work - (continued)

5.224 Maintain the tank dry until acceptance by du Pont, or as previously agreed with du Pont. Du Pont will remove all other casual or sub-surface water. Water collected in tanks shall be directed to points as agreed with du Pont. Du Pont will dispose of the water.

5.225 Furnish shop details and erection diagrams of all plate work and structural steel.

5.226 Locate and arrange tank erection equipment so that a clearance around the tank concrete walls of 8 ft. 6 in. is provided during tensioning operations by du Pont.

5.227 Pneumatic mortar or shotcrete operations will be in progress at the site of the tanks after one tank is completed and accepted by du Pont, and during the erection of the balance of the tanks. Normal precautions will be taken by du Pont to avoid damage to the contractor's and/or other subcontractor's equipment; however, dust and wind blown spray are considered normal to shotcrete operational sequences and each Contractor and/or subcontractor shall protect his own equipment and work from damage due to normal shotcrete operational sequences.

5.228 After tank bottom is in final position on the foundation, trim the vertical edge of knuckle plates to a level line and prepare the edge for welding.

5.229 The Steel Subcontractor shall furnish all labor, material, and equipment necessary for vacuum leak testing, which shall be done only under the inspection of du Pont.

5.2210 All operations requiring raising, lowering or adjusting the Raising-Lowering Frame.

5.2211 Furnishing, erecting and removing cribbing to support the pan and tank bottom. Sufficient cribbing to be provided to meet the requirements of construction schedules.

5. STEEL TANKS

5.2 Outline of Steel Subcontractors' Work

5.22 Incidental items of work - (continued)

5.2212 Du Pont approval shall be obtained before workmen will be permitted under the tank bottom. Cribbing shall be installed to satisfy du Pont safe practice.

5.23 Exceptions: Furnished by du Pont and/or others

5.231 All concrete and grout work will be furnished by du Pont.

5.232 Electric power supply for welding, lighting and radiographing, but not lighting fixtures or other connections from the source of power. Du Pont will furnish the primary source of power to the Subcontractor at or near the welding machines as located and described in the bidders documents. Hook up shall be by the Steel Subcontractor. Du Pont will make every effort to supply continuous service; however, power outages shall not be a basis of claim for damage.

5.233 Water for the Steel Subcontractor's use and for tank testing including facilities for filling and emptying.

5.234 Internal and external piping connections to the nozzles or pipe inserts in the tank.

5.235 Installation of any permanent equipment in, on, or adjacent to the tank.

5.236 Flashing (if any).

5.237 Painting (if any).

5. STEEL TANKS

5.2 Outline of Steel Subcontractors' Work

5.23 Exceptions: Furnished by du Pont and/or others (cont'd.)

5.238 Bend projecting foundation vertical reinforcing steel dowels, which are adjacent to the steel tank, down for clearance during tank erection, and bend back into specified position after clearance is no longer required.

5.239 Provide, if necessary for safety temporary protective cover and access stairs over projecting reinforcing steel at perimeter of foundation.

5.3 Materials:

5.31 Steel Plates for Tanks: Plate material shall be basic open hearth carbon steel, ASTM designation, A 285-54-T, Grade B, firebox quality, suitable for submerged arc welding. The steel shall not be made by the rimmed process. The analyses of steels, submission of reports, testing and marking shall be as prescribed in ASTM Designation: A 285-54-T. Copies of all mill tests and ladle analysis shall be submitted to du Pont Design Division for approval before fabrication. Mill test reports or a letter from the steel supplier must certify that the steel was not made by the rimmed process.

5.32 Structural Shapes: Structural shapes shall be open hearth steel suitable for fusion welding. The steel shall conform to the specification: ASTM Designation: A 7-55-T.

5.33 Electrodes: Electrodes shall comply with AWS-ASTM- "Specifications for Iron and Steel Arc Welding Electrodes". The classification number selected must be suitable for the electric current characteristic and also for the position of welding. In addition to the foregoing requirements, the electrodes shall be an approved type for welding ASME Code pressure vessels under insurance specifications. Electrodes used must have approval before starting work.

5. STEEL TANKS

5.4 Welding:

5.41 General: Tank plate sub-assemblies and assemblies shall be sub-merged arc welded, in accordance with the code where applicable, and also in strict accordance with this specification. Vertical seams and other seams which have insufficient clearance for submerged arc welding such as flanged edge of bottom may be expected. All defects requiring correction, as determined by radiographic inspection, shall be repaired and made to meet the requirements of this specification.

5.42 Welding Requirements: The welding procedure and welding operator qualifications for strength welding shall comply with Section IX of the Code. The Steel Subcontractor shall submit operator's qualification test reports and welding procedure for all types of welded joints, positions, sub-assemblies, and assembly of each tank. Operator qualifications or re-qualifications and procedure specifications or subsequent modifications there of shall be approved by du Pont before any welding is undertaken. It is the Steel Subcontractor's responsibility to obtain and qualify his own welders.

5.43 Welder's Limitations: Tests conducted by one manufacturer or Subcontractor shall not qualify a welding operator to do work for any other manufacturer or subcontractor. Only an operator who has been qualified for welding on welds to be radiographed will be permitted to perform the incidental structural shape welding required in the fabrication and attachment of tank appurtenances.

5.44 Preparation of Welding Surfaces: Surfaces to be welded shall be free from loose scale, slag, heavy rust, grease, paint, and any other foreign material. Joint surfaces shall be smooth surfaces, uniform, and free from fins, tears, and other defects which might adversely affect proper welding.

5. STEEL TANKS

5.5 Fabrication: (continued)

5.53 Tank Bottom: All plates shall be laid out and joined by welding using a sequence that will provide minimum buckling of the plates, and for the bottom assemblies insure minimum variation in slope and/or elevation. (After the bottom assemblies are completed, the circumference is to be trimmed to size and the edges prepared for welding.) No buckle shall be greater than 1-1/4" nor shall the slope of a buckle be greater than 0.33" per foot. This flatness tolerance shall be non-accumulative. It shall apply for any area, in its as-fabricated condition for the tank bottom. The offset on adjoining plates shall not exceed 10% of the plate thickness.

5.54 Knuckle Plates: The knuckle plates shall be carefully curved in two directions by hot forming to the radii shown on the drawings. Welded assemblies of the knuckle plates may be made in the fabricating plant at the option of the Steel Subcontractor. Whether or not shop welding of the knuckle plates is employed, the knuckle plates shall be sub-assembled or fitted in assemblies of not less than four pieces and checked for alignment with the curvature of the top and bottom and the radius of the side plates. Deformation in curvature shall be controlled to the extent that the deviation on the horizontal circumference in a two-foot long arch shall not exceed 5/16" as formed and before welding to other sections. The matching edges of adjoining plates shall not be offset from each other at any point in excess of 10% of plate thickness.

5.55 Side Plates: The side plates shall be assembled with a welding procedure designed to result in the least distortion due to shrinkage and which will eliminate kinks at seams and vertical joints. Permissible deformation and offsets of plates shall be the same as those specified for flanged plates, except deviation from a true circle shall not exceed 1" in 80" length of arch.

5. STEEL TANKS

5.5 Fabrication: (continued)

5.55 Side Plates: (continued)
Just prior to the application of shotcrete to the walls of the steel tank, the deviation from true diameter of the tank shall not exceed 2". The steel tanks shall be built and maintained within this tolerance until the tank walls have been covered with the full dimensioned finished thickness of seven (7) day strength shotcrete to a minimum height of five (5) ft. below top of tank.

The steel subcontractor shall provide a system of adequate adjustable bracing, satisfactory to du Pont, as an auxiliary to the circumferential angles, and by means of this bracing shall maintain the roundness of the tanks within the specified tolerances until the tanks are accepted by du Pont just prior to the beginning of concrete operations. During concrete operations du Pont will have full responsibility concerning the tanks and will make the necessary out-of-roundness adjustments with the bracing provided; however, the subcontractor shall consult with and advise du Pont concerning the method of making such adjustments.

Upon completion of the concrete work, the steel subcontractor shall remove the temporary bracing but the circumferential angles will be left in place. If the concrete work on any tank has not been completed prior to completion of the steel subcontractor's work at the plant site, du Pont will remove the temporary bracing which must be left in the tank, and will ship to the subcontractor collect.

5.56 Shop Fabrication: Fabrication of plates for the tanks and the welding of tank plates to form assemblies or subassemblies, if any, shall be in accordance with these specifications, and applicable portions of the referenced code.

5.57 Temporary Attachments: Before acceptance of tanks by du Pont, the steel subcontractor shall remove, without gouging burning or tearing the plates, all temporary attachments which were welded to the tank for erection purposes, except those permitted to remain by specific agreement with du Pont.

5. STEEL TANKS

5.5 Fabrication: (continued)

5.58 Welding Studs: Hook anchors furnished and welded to the outside of the tank wall by the Steel Subcontractor shall be equal to Neweld as manufactured by Nelson Stud Welding Division of Gregory Industries, Inc., and shall be installed according to the manufacturer's directions using one NEMA 400-amp. rated generator. Stud bolts for stiffener angles shall be Neweld or equal, installed with the manufacturer's recommended amperage.

5.59 Raising-Lowering Frames: Two existing raising-lowering frames will be altered by du Pont in accordance with the drawings. Existing hydraulic systems consisting, for each frame, of 4 Hannifin Model HJ2N jacks, 8" bore x 48" stroke (manufacturer's design capacity 1500 p.s.i.) will be overhauled and placed in good operating condition by du Pont. Hydraulic pumps, together with piping with capacity for the work intended (1500 p.s.i. min.), will be furnished by du Pont. Hydraulic jacks and hydraulic systems will be delivered with the raising-lowering frames to a storage site in the vicinity of the tank working area. The Steel Subcontractor shall check the frames and complete hydraulic systems for strength, capacity, adequacy for the purpose and condition, and shall be responsible for their use in all operations during erection, raising, lowering and dismantling.

The Steel Subcontractor shall erect and remove the frames and hydraulic equipment to meet the requirements of the job, and upon completion of the work, deliver them with all hydraulic equipment to the storage site, in the same condition as received, less normal wear and tear.

The Steel Subcontractor shall set raising-lowering frames and hydraulic equipment on foundations provided by du Pont.

6. INSPECTION

6.1 General: All inspection and final acceptance of all work shall be by du Pont or conducted under their supervision.

6.2 Visual Inspection: of all welds will be made upon completion of the weld and/or after each pass if requested. The Steel Subcontractor shall correct any defects indicated by visual inspection and all must have approval before radiographic inspection.

6.3 Radiographic Inspection:

6.31 Responsibility for Radiographic Inspection: The Steel Subcontractor shall furnish all radiograph equipment, films, material, transportation, and labor necessary to perform the radiograph operation and to provide qualified interpretation of radiographs.

6.32 Methods: The radiographic technique employed must meet the accuracy required by the Code, and the Steel Sub-Contractor shall prove to the satisfaction of du Pont his ability to meet these standards before being awarded the contract. Fine grain film shall be used.

Radiographs judged as acceptable by the Steel Sub-Contractor's interpreter will be checked by a qualified representative of du Pont to determine if compliance with the code is being obtained. Where differences of opinion exist and cannot be resolved, the decision of the du Pont representative will be final and the Steel Subcontractor shall make such additional repairs as the du Pont representative might request. Films checked by du Pont will be returned to the Steel Subcontractor within sixteen (16) working hours.

6.33 Scope:

6.331 Included: All welds affecting the ability of the tank to retain liquids shall be radiographed. These shall include welds to nozzles, sleeves or couplings attached to, or penetrating the steel shell, and other welds which might become a source of leakage for liquids, and shall also include all welds having through penetration whether or not the same are so shown on the drawings. It should be noted, however, that it is possible to radiograph only butt welds, and then only if the reinforcement of the joint is not excessive or is ground to a smooth contour.

6. INSPECTION

6.3 Radiographic Inspection

6.33 Scope: (continued)

6.332 Excepted: The welds specifically exempt from radiographic examination are:

(a) Attachment clips or hangers to the tank plates providing the weld does not fully penetrate any such plate.

6.34 Division of Work:

6.341 Electric Service: Power to outlets but not fixtures will be supplied by du Pont for radiographic inspection. While du Pont will make all reasonable efforts to keep a constant supply of electric service for power, lights, and radiographic work, it is understood that such service may be interrupted for short periods of time and that such interruptions shall not entitle the subcontractor to a claim of extra compensation. Du Pont will furnish flood lighting but the Steel Subcontractor shall provide any additional illumination he requires.

6.342 Movement of Equipment: The Steel Subcontractor shall provide for the transport and movement of all equipment at the site together with stagework or other means of access required to obtain the best possible analysis of the welding.

6. INSPECTION

6.3 Radiographic Inspection (continued)

6.35 Procedure:

6.351 General: The location of each radiographic exposure shall be accurately marked on both the top and bottom of plates comprising tank bottom and on the inside of plates prising the tank sides so that any radi can be matched with the corresponding lo tion either on the inside or outside surfa of the tank.

The length of weld covered by each radiograph shall not exceed 15". A center punch mark shall be made at each end of each radiographic exposure location and the identifying letters or numbers shall be stenciled in the base metal adjacent to the weld at the center of each exposure location on one side of plate only. Lead arrows shall be placed on each center punch mark lead letters or numbers shall be placed adjacent to the weld identification numbers during exposure so that their locations will be shown on the resulting radiographs.

In addition to the identification marks specified above, it is recommended that two marks be placed adjacent to the weld in each exposure length on the opposite side of the plate. These may be X's or clusters of punch marks and shall be so placed as not to be superimposed in the radiograph on any identification marks on the opposite side of the plate.

The interpreter shall make a tissue paper tracing from each radiograph that contains defects of rejectable size. This tracing shall show the position of the defect with respect to identification marks on both sides of the plate and will enable repair crews to work from either side of the plate. When a weld is found to contain a defect of rejectable size, the radiograph of that weld shall be retained until the radiograph of the repair weld has been received. A comparison shall be made

6. INSPECTION

6.3 Radiographic Inspection (continued)

6.35 Procedure: (continued)

6.351 (continued)

between the two radiographs to insure that the same areas has been re-radiographed. If a repaired area is sufficiently close to the end of an exposure that a portion of the repair weld extends into the next exposure location, that additional location must be re-x-rayed even though it was originally free from rejectable defects.

6.352 Tank Bottom: The tank bottom assembly will be radiographically inspected while resting on cribbing over an erection pit 42" deep adjacent to the tank pad. Proper clearance shall be provided by du Pont. All welds are to be inspected and the Steel Subcontractor will be directed to move the cribbing as necessary to obtain completed radiographs of all welds. Defective welds will then be corrected and a recheck made to determine the acceptability of the repair. This will be repeated as often as necessary until all welds are approved. The vacuum leak test on the tank bottom will then be made and any defects found will be rewelded and the procedure for defective welds repeated including radiographing and vacuum leak testing. When the tank bottom has been accepted, a vacuum leak test will be made on the sides of the tank bottom flanged plates. Defective welds shall be treated as previously described.

6. INSPECTION

6.3 Radiographic Inspection (continued)

6.35 Procedure: (continued)

6.353 Tank Sides and Attachments: Radiographing of the welds in the remaining portions of the tank shall be done as they become available. Defective welds shall be treated as previously described for the bottom. The tank will then be water tested. The procedure for defective welds after the water test will be the same as previously specified for rewelding and retesting.

6.36 Reports: The Radiographic interpreter employed by the Steel Subcontractor shall issue a report daily indicating the total number of exposures made, welds radiographed (by identification number), and his analysis of each radiograph (whether it is acceptable or rejected). When the report lists radiographs of welds which have been repaired, it shall indicate that the weld is a repair weld and shall indicate how many times the weld has been repaired. The Steel Subcontractor shall furnish du Pont with a drawing of each tank which will indicate the location of each weld and the locations of the individual radiographic exposures. The du Pont representative will use this chart to keep a check on the progress of the radiographic examination by checking off the individual exposure locations as he receives reports from the interpreter. All radiographs including both rejected and acceptable films shall be retained by the Steel Subcontractor for the length of time that they are of value to him. They shall then be turned over to du Pont in numerical order.

6.37 Safety: Du Pont Construction Radiation Hazard Control shall be followed by the Steel Subcontractor when performing radiographic inspection.

6. INSPECTION

6.4 Leak Testing

6.41 The completed steel tank will be subjected to a water test to determine leakage, by filling with water to a height not to exceed that shown on the drawings. Above this elevation, the tank will be vacuum leak tested, using 6 P.S.I. gauge differential pressure. The water and pumping facilities for filling and emptying will be furnished by du Pont. Du Pont shall be notified in writing seven (7) days in advance of the desired date for the initial test on each tank and two (2) in advance for each subsequent test if required. The water will be retained in the tank a minimum of twenty-four (24) hours before inspection for leaks can be made, provided the time limit is applied after the possibility of tank sweating has passed or the steel is dry following any rain.

6.42 The tank bottom and flanged edge at perimeter of tank will be vacuum leak tested using 6 P.S.I. gauge differential pressure.

6.43 The Steel Subcontractor shall correct any defects detected by this testing, and retest will follow the procedures of this section until final acceptance.

6.44 Steel tank shall be checked for out-of-roundness from time to time while waiting for concrete encasement and steps shall be taken to keep tank in dimension.

6.45 After concrete encasement and dome roof of each tank are completed in accordance with section 3 of this specification, it shall be tested by filling the steel tank with water to the elevation of the invert of the tank inlet. See par. 3.466.

6. INSPECTION

6.4 Leak Testing (continued)

6.46 Any defects in the shotcrete and prestressing work, detected by the water test, shall be corrected and retesting and correction shall follow until acceptance of the work.

6.47 The tank will be filled with water to its permanent storage level and left full until such time as the tanks are put into operations in order to maintain the full design compression in the prestressed concrete.

7. OPTION

7.1 Procedure Method: Subcontractors may submit proposals based on alternate methods of procedure but such methods of procedure must be guaranteed to meet the requirements specified herein, and will be subject to approval.