TRI NUCLEAR CORPORATION

P.O. BOX 178 • BALLSTON LAKE, NEW YORK 12019
Telephone: (518) 399-1369

11/1/79

5 AND 10 CUBIC FEET DISPOSABLE DEMINERALIZER VESSELS

DESIGNED FOR IN-SITU CEMENT SOLIDIFICATION

MODELS - CS-510 and CS-1025

PURPOSE

The Models CS-510 and CS-1025 Demineralizer Vessels are designed for one time use; after use the contents are solidified with cement in-situ for waste disposal shipment and burial.

GENERAL DESCRIPTION

Basic characteristics of the vessels are as follows; additional technical data are covered in the attached sketches and data sheets.

	Model CS-510	Model 1025
Press. rating	100 psi	100 psi
Flow rating	10 gpm	25 gpm
Diameter	18 in.	24 in.
Height	58 in.	65 in.

The vessels can be procurred empty for charging by the customer, or can be furnished pre-charged ready for use with the following type media:

- Ion-exchange resi for removal of soluble activity.
- Activated carbon for removal of insoluble activity and small quantities of detergents and organic material.
- BIRM for removal of colloidal activity in the sub-micron particle range.

ACCESSORIES

Accessory equipment is available for performing the cement solidification operation, which can be reused from vessel to vessel. This equipment includes:

- Air motor gear drive unit for operating cement mixer blades in vessel, (same for both Models).
- A stainless steel funnel and pipe extention for adding dry cement to vessel, (same for both Models).
- A stainless steel pipe dip tube to dewater vessel to proper level prior to solidification.
- A flexible tube and spiral screw drive conveyor for [illegible] (same for both Models).
- On special request, sleeve type radiation shields for tanks.

ADVANTAGES

- Provides a simple, portable, and easily operated system for process treatment of waste water and cement solidification of expended media for waste disposal.
- Minimizes exposure to personnel and potential for release and spread of contamination.
- Provides flexibility for using different types of water processing media to treat various types of waste water.
- Economical and multiple use of vessel for:
  - original procurement and shipment of media
  - processing of waste water
  - solidification of expended media
  - packaging of waste for disposal
  - shipment to burial site
  - final burial of waste

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5 AND 10 CUBIC FEET DISPOSABLE DEMINERALIZER VESSELS
(see Sketches TN-911-1 and TN-911-6)

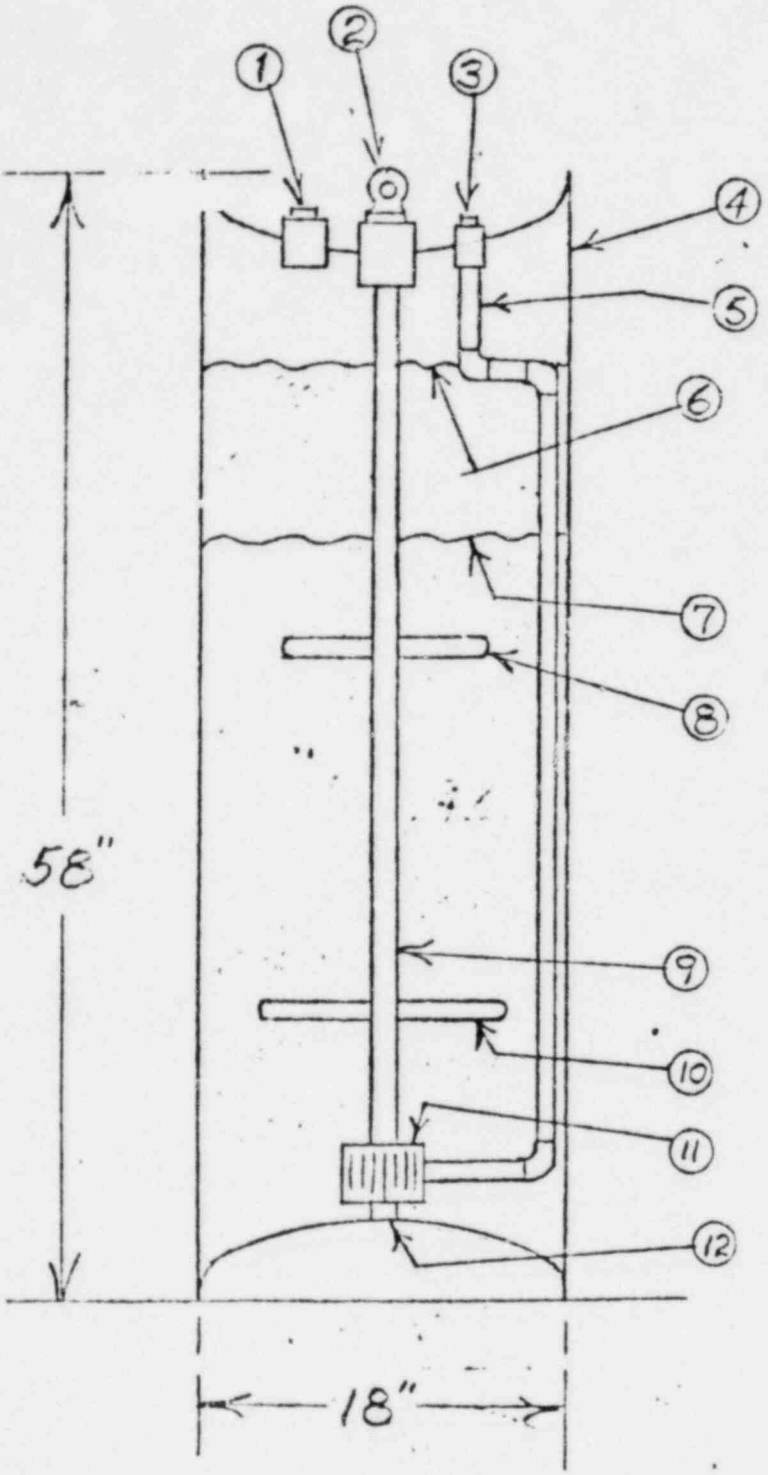
N BASIS

Designed to Section VIII of ASME Boiler Code (Code stamped if required).
Designed for in-situ cement solidification for waste disposal after use.
Basic characteristics of vessels:

	Model CS-510	Model CS-1025
a. Pressure ratings	100 psi	100 psi
b. Resin capacity	5 cu.ft.	10 cu.ft.
c. Flow rating	10 gpm	25 gpm
d. Vessel diameter	18 in.	24 in.
e. Vessel height	58 in.	65 in.
Vessel weights:		
a. Empty vessel	175 lbs.	260 lbs.
b. With dry resin	400 lbs.	710 lbs.
c. With resin & water	650 lbs.	1160 lbs.
d. Solidified with cement	710 lbs.	1330 lbs.

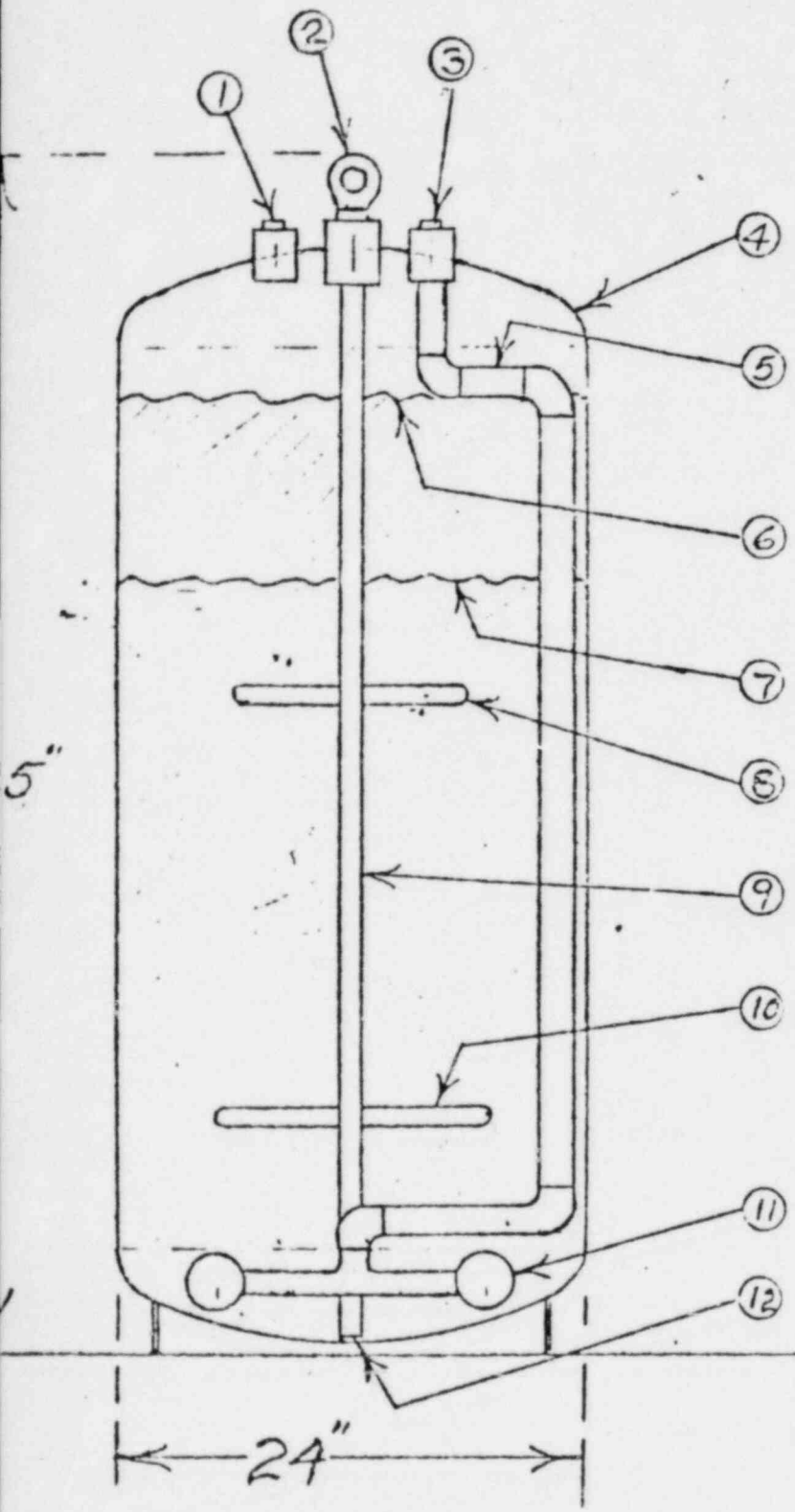
TS LIST

1-1/4" coupling with bushing for normal water inlet connection; also used without bushing for initial resin loading and dry cement loading for waste solidification.
1-1/2" coupling for air motor drive connection to cement mixer blades;
pad eye for lifting welded to pipe plug.
Coupling for water outlet connection from bottom retention elements;
Model CS-510 is 3/4", Model CS-1025 is 1-1/4".
Carbon steel vessel epoxy painted inside and out, heads torispherical code type.
PVC riser pipe for outlet water from bottom retention elements.
Level in vessel after cement solidification for waste disposal.
Level of resin or filter media in vessel during water processing.
Upper mixer blade welded to drive shaft.
Drive shaft 3/4" schedule 80 steel pipe.
0. Lower mixer blade welded to drive shaft (90° to as shown).
1. Bottom retention elements, PVC, 10 mil slot openings; Model CS-510 has two elements, Model CS-1025 has four elements.
2. Mixer drive shaft bottom pin bearing.



MODEL CS-510

NUCLEAR CORP.	SCALE 1" = 10"	5 Cu. Ft, DEMINERALIZER VESSEL FOR IN-SITU CEMENT SOLIDIFICATION
		SKETCH TN-911-1



MODEL CS-1025

CLEAR CORP.	SCALE	10 Cu. Ft. DEMINERALIZER VESSE
	1" = 10"	IN-SITU CEMENT SOLIDIFICATIO
		SKETCH TN-911-6

TRI NUCLEAR CORPORATION

P.O. BOX 178 • BALLSTON LAKE, NEW YORK 12019
Telephone: (518) 399-1389

11/1/79

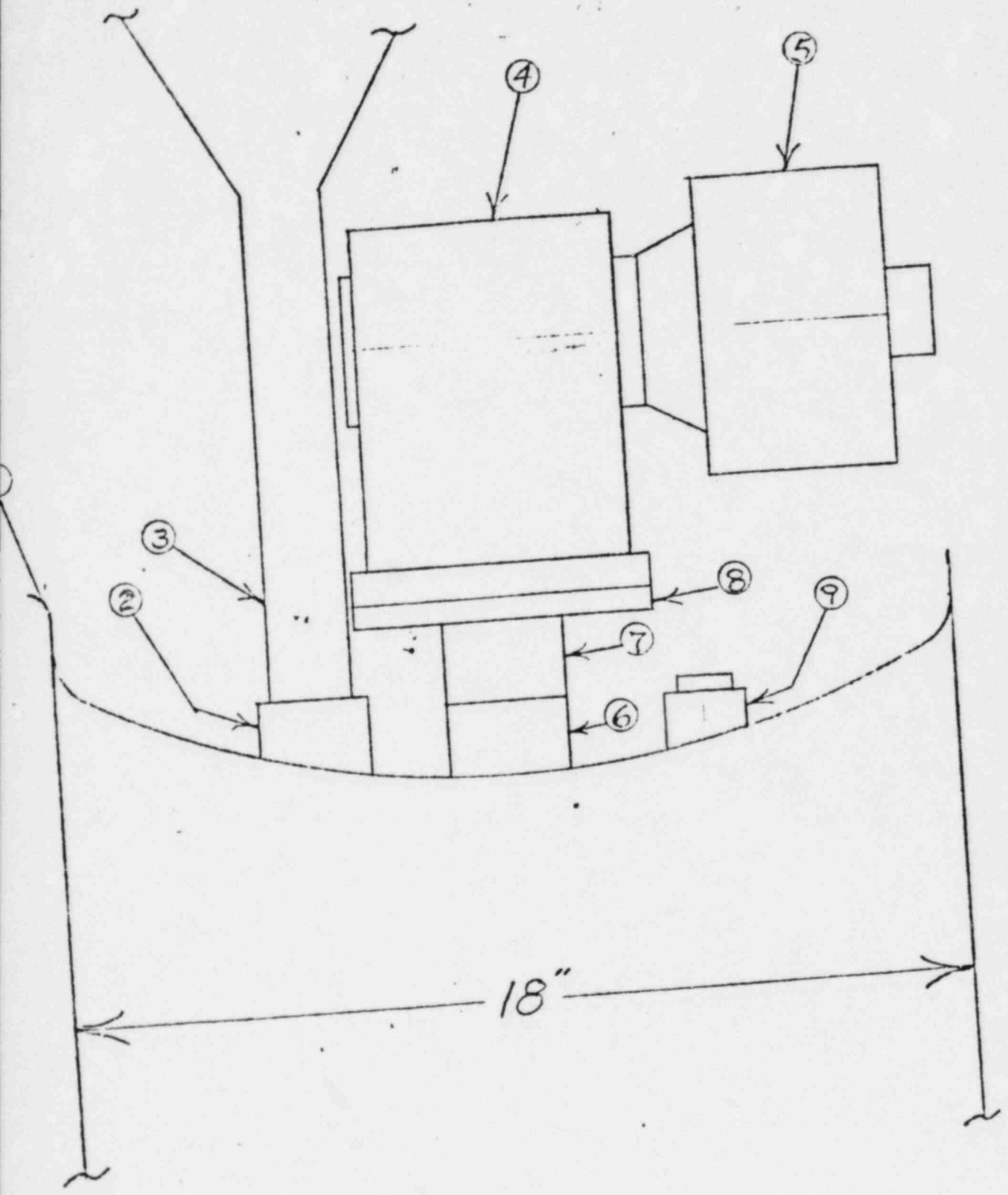
AIR MOTOR GEAR DRIVE FOR MIXER BLADES IN VESSEL
(see Sketch TN-911-2)

PARTS LIST

1. Top head of demineralizer vessel rigged for in-situ cement solidification.
2. 1-1/4" coupling welded to vessel for dry cement filling via funnel, normally used for process water inlet through bushing.
3. 1-1/4" pipe nipple with funnel screwed into 1-1/4" coupling to act as anti-rotation stop for air motor drive, and through which dry cement is added to vessel during solidification mixing.
4. Gear reducer for air motor drive.
5. Air motor drive, 100 psi air required.
6. 1-1/2" coupling welded to vessel for connection to drive motor and for top mixer shaft bearing.
7. 2" sch. 80 pipe sleeve welded to air drive foundation plate, Item 8, which slips over short 1-1/2" pipe nipple screwed into Item 6 coupling.
8. Foundation plate bolted to air motor gear drive unit.
9. Coupling with plug for normal water outlet connection.

CEMENT SOLIDIFICATION CONCEPT

1. For waste disposal the contents of the vessel are cement solidified "in-situ" for shipment and waste burial.
2. Dewater vessel down to top level of resin or filter media using a special length dip leg pipe temporarily screwed into the 1-1/4" connection, Item 2.
3. Install air motor gear drive assembly, Item 4,5, & 8, onto short pipe nipple temporarily screwed into the center 1-1/2" connection, Item 6. The drive unit slides onto the pipe nipple and is held in place by gravity; a hex socket attached to the drive unit vertical shaft fits over the hex head of a 3/4" bolt welded to the mixer drive shaft and extending into the bottom section of the 1-1/2" connection, Item 6.
4. Screw the 1-1/4" pipe nipple and funnel assembly, Item 3, into the 1-1/4" connection, Item 2.
5. Start up air drive mixer motor and add, (3 for Model CS-510 and 6 for Model 1025), 70 lb. bags of Masonry cement to the vessel through the top funnel, Item 3.
6. After all cement is added, continue to mix vessel contents for 10 minutes.
7. Stop mixing, remove external equipment, install vessel connection plugs, and allow to stand for 24 hours prior to movement for disposal shipment.



TO: NUCLEAR CORP 11/1/79 SW	SCALE 1" = 3"	AIR MOTOR GEAR DRIVE FOR MODELS CS-[illegible] & CS-1050 VESSEL SKETCH TN-911-2

UNCLASSIFIED	NAVSHIPS 389-0362 Radiological Work Practices Handbook
SOLIDIFICATION OF CONTAMINATED WASTE SOLUTIONS AND SLUICEOUT OF DEMINERALIZER CONTENTS	Section: 9 Part: 3 Revised: 2 July 1979 Preparing Activity: KAPL/CHASN

PURPOSE

To provide methods for the solidification of radioactive liquid, resin and carbon waste solutions generated as a result of radiological overhaul and repair work on nuclear ships. Included is a procedure for sluiceout of demineralizer contents.

BACKGROUND

Solidification of radioactive liquids is required by land burial sites and the solidification of processing bed media (resin and charcoal) might also be required in the future. These radioactive wastes must be immobilized such that the characteristic of fluidity is completely eliminated and the final solid product is monolithic of definite volume and shape (free-standing).

Three solidification methods are described in this work practice and consist of the following:

Method A - Radioactive liquid, resin, and carbon are solidified in 55-gallon - D.O.T. 17-H steel drums by preloading the drum with masonry cement and stones, adding a known volume of radioactive liquid or slurry, followed by mixing the contents using a portable drum roller. The method is simple and relatively inexpensive to use at facilities which generate a high volume of low-level radioactively contaminated waste solutions annually. For facilities which generate a small volume of radioactive waste or require a quick-semi-remote method because of high radiation dose concerns, consideration should be given to the use of Method B, which follows.

Method B - A 55-gallon - D.O.T. 17-H steel drum with an internal mixer paddle blade is preloaded with masonry cement. A portable air-driven motor is clamped to the shaft of the paddle blade and a known amount of radioactive liquid or slurry is added followed by the addition of silicate solution. The contents are mixed for a short period of time to achieve solidification.

This method is recommended for shipboard use because of space limitations and the fact that ships and tenders normally generate a small quantity of radioactive liquid and processing bed media.

Method C - This solidification method is useful for small volumes (2 gallons or less) of radioactive waste solutions in which it is desirable to quickly solidify the waste solution either because of high radiation level or to eliminate the transport of the liquid waste for subsequent cement solidification.

A non-toxic solid organic polymer is mixed vigorously with the radioactive waste and solidification occurs within minutes. The mixing operation can be accomplished in a plastic bottle and the final solidified product is disposed of in a 55-gallon drum filled with other miscellaneous solid radioactive waste. Solutions not compatible for the polymer method include oxidizing chemicals (e.g., permanganate) and concentrated detergents (> 0.1 oz/gal).

Suggested applications of the method may include the following:

(a) Small volumes of non-oxidizing or acidic chemical wastes that are segregated from drains.

(b) High dose rate radioactive water collected in poly bottles.

Sluiceout of demineralizer contents (e.g., resin or carbon) can be accomplished by gravity drain method as described in paragraph 4.0.

PRACTICE

1.0 Solidification Using Drum Roller Method

1.1 General Description

This method uses a portable drum roller to mix a known volume of radioactive waste solution, resin, or carbon slurry with masonry cement and stones. A predetermined amount of cement and stones are preloaded into a 55-gallon drum that has a removable top cover with two 2-inch bung cap penetrations. The preloaded drum is filled with a measured or known volume of radioactive water, resin, or carbon slurry and immediately rolled to achieve a homogeneous mixture. After rolling the drum for a specified period of time, the drum is vented immediately and allowed to stand until a solid and free standing mass is obtained. The procedure permits the addition of excess cement should there be a small volume of liquid left on the surface.

It is essential that the following important steps of the procedure be carefully implemented:

(a) Know the volume of waste solution to be added to the preloaded drum to preclude overfilling. The flow rate is important (3 - 8 gpm) to prevent premature set-up before mixing is started.

(b) Immediately after filling the drum, quickly remove the discharge line from the drum and begin the mixing step. Failure to do this will result in inadequate mixing due to premature hardening at the cement-liquid interface. Be sure that the vent valve is closed before tipping the drum over.

(c) After rolling the drum, upright the drum and open the vent valve slowly to eliminate the potential of pressure build-up.

(d) Field testing and experience has shown that radiological problems can be avoided provided trained operating personnel perform the work. Trained personnel shall be used for the solidification work. As a minimum, their training shall include performing the work at least once using non-radioactive water.

(e) Procedural steps shall be performed in sequence unless otherwise indicated.

(f) Preloading of 55-gallon drums with masonry cement and stone shall be performed outside of a radiologically controlled area and kept dry.

(g) The formulations described herein are specific for certain waste solutions, carbon and resin slurries. To determine the cement to waste ratio for radioactive solutions not identified in this procedure, one to five-gallon bench tests should be performed and evaluated.

(h) New 55-gallon, D.O.T. Spec. 17-H, open-headed drums with two 2-inch bungs shall be used for the solidification work. Prior to leak testing of the drum, a visual inspection shall be performed. The lid shall contain a new gasket and locking ring of the proper size, shape and strength. The bung holes and caps shall be inspected, (gaskets, threads). Drums shall be leak tested prior to the addition of cement or waste material.

(i) Bags or containers of masonry cement should be stored indoors and cement that has hardened shall not be used.

(j) Anti-C clothing, dosimetry requirements and other radiological control requirements shall be specified by cognizant radiological control personnel or the local work document implementing this procedure. The radiological controls shall be based on the fact that the contamination is in a wetted form and that no indications of airborne contamination were ever detected during the tests to prove this method.

1.2 Material Requirements

(a) Drum Roller (mobile) - Suggested Source

Norton Company
P. O. Box 350
Akron, Ohio 44309

Bulletin DR-190 Fig. 860, 1/2 H.P. Motor, explosion proof 10-18 RPM variable speed, locking wheels or equal.

(b) 55-gallon drums - new D.O.T. Spec. 17-H steel drum, removable head with two 2-inch bungs and threaded caps. The top cover shall be 14 gauge and the body sheet 18 gauge. The 12 gauge bolted ring shall have a 15/16-inch bolt and nut. The two 2-inch threaded caps shall have a minimum of three threads and be positioned diametrically opposite and close to the outer lip of the top cover.

(c) Number two stone or equal - Two to four gallons of stone required per 55-gallon drum. The diameter of the stones should be in the range of 1-1/2" to 2-1/2".

(d) Masonry Cement - 70 lbs. per bag or drum. Meets ASTM specification C-91, Federal specification SS-C-1960/i, AASH to M-150. This masonry cement, when mixed according to ASTMC-270, will make Type N Mortar for masonry and stucco. Since the composition of masonry cement might vary from place to place, the above specification should be used for procurement action. In addition, portland cement shall not be substituted for masonry cement since the masonry cement contains hydraulic lime or limestone and mixtures of portland blast and slag materials necessary for the fast set-up of certain waste materials described in this radiological work practice.

(e) Wrenches for drum and bolt and bung caps. Pipe wrench for vent valve.

(f) Radiological Containments (Refer to figures). Vent valve, plastic sleeving, 2-3 CFM filters or equal, wood stick, plastic bag, lay down paper, vinyl tape, hose clamps, knife.

1.3 Formulations

The following waste solutions and required amount of cement and stone to achieve solidification should be used for the drum roller method.

Solidification Formulas (Drum Roller Method)

Waste Solution	Masonry Cement (lbs)	No. 2 Stones (gallons)	Maximum Volume of Waste Solution (gallons)
1. HOH Resin Slurry	210	2-4	35
2. Activated Carbon Slurry	210	2-4	35
3. Detergents (< 0.1 oz/gal)	245	2-4	28
4. Ammonium Hydroxide (pH 8-10)	245	2-4	28
5. Lithium Hydroxide (pH 8-10)	245	2-4	35
6. Citric Acid; Ammonium Citrate; EDTA - (Prior neutralization to greater than pH 7 required)	245	2-4	28
7. Alkaline Permanganate	210	2-4	28

NOTE: The flow rate of waste solution or slurry should not be less than 3 gpm or greater than 8 gpm.

1.4 Procedure (Drum Roller Method)

(a) Trained personnel shall gather and set up all necessary equipment to perform the work. Prior to start of work, operating personnel shall review the procedure to determine if all necessary equipment is working and containments are available. In addition, a review of the general requirements shall be made prior to start of work.

(b) Remove top cover of 55-gallon drum and add the required amount of cement followed by the stones in accordance with the appropriate formula.

(c) Replace top cover and bolt down. Tap the outside ring and retighten to about 1/4 of a turn. Do not overtighten the drum lock-ring bolt because pinching of the gasket can result in a leak.

(d) Remove two 2" bung caps and attach vent assembly (plastic sleeve and filter) per Figure 1. Attach sleeving to other bung opening for fill hose (Figure 2a).

(e) Move the drum to radiological control work area.

(f) Tape over clamp ring to cover inaccessible area (See Figure 3). This will ensure that an inaccessible surface will not become contaminated.

Install drum roller lip beneath the drum so that the radioactive discharge line can be connected to the remaining 2" bung opening. This will eliminate a delay for rolling the drum immediately after the drum is filled with waste.

Attach inlet discharge line per Figure 2a.

CAUTION - Do not overfill drum.

(g) Using the appropriate formula, discharge a known amount of radioactive solution or slurry to the drum at a rate of 3-8 gpm. The installed vent assembly may be used for visual inspection. Immediately after the discharge, remove the discharge hose (Figure 2b) and install the bung cap. Remove the vent assembly and install the vent valve assembly (Figure 4).

(h) Verify that the vent valve is fully shut. If necessary for contamination control, tape a containment bag over the cover (Figure 5). The time required to remove both the inlet discharge line and vent assembly plus the installation of the bung cap, vent valve, and drum liner, if required, should take no longer than 15 minutes. Tip the drum over and roll immediately after the vent valve assembly has been installed.

(i) Roll the drum for 20-30 minutes - stop and upright the drum. Immediately open the vent valve to relieve any pressure.

(j) Vent the drum for at least 36 hours or longer if heat is detected on the side of the drum. When no heat is detected by feeling the drum remove the vent valve assembly using damp rags around the threads of the valve and inspect for free liquid by installing containment shown in Figure 6.

(k) If no free liquid is found, remove inspection containment and tighten down bung cap.

(l) If free liquid is observed, sleeve in 10 lbs of cement/gal of water as shown in Figure 7.

After the addition of cement, tip the drum back and forth to spread out the added cement to achieve contact of the cement with the excess liquid. The drum should be permitted to stand for at least four hours before reinspecting for free liquid. Visually reinspect and seal when no free liquid is observed.

2.0 Solidification Using Cement-Silicate

2.1 General Description

This method may be used to solidify radioactive waste solutions or resin/carbon slurry in modified 55-gallon drums with cement and silicate solution. A D.O.T. 17-H 55-gallon drum with an internal disposable paddle is preloaded with masonry cement. A known amount of radioactive water or resin/carbon slurry is added while mixing the contents with an air-driven motor. Liquid silicate solution is added last to from a quick set solidified mass.

It is essential that the following important steps of the procedure be carefully implemented:

(a) The drum used for the solidification operation is procured from a vendor and requires no assembly. The air-driven motor is clamped to the drum by a motor support frame. The assembled drum, motor and support frame can be ordered in accordance with Figure 8. The assembled rig should be inspected to determine that ordering specifications are met and that the motor is operational. The motor requires a minimum air pressure of 90 psi.

(b) Drums shall be leak tested and inspected prior to the addition of cement or radioactive waste water.

(c) Field testing and experience has shown that potential radiological problems can be avoided provided trained operating personnel perform the work. Trained personnel shall be used for the solidification work. As a minimum their training shall include performing the work at least once, using non-radioactive water.

(d) Know the volume of waste to be added to the preloaded drum to preclude overfilling. The flow rate is important to assure adequate mixing.

(e) Masonry cement used for shipboard use should be stored in fiber or steel containers and kept dry. Cement that has hardened shall not be used.

(f) The silicate solution shall be stored indoors to prevent freezing.

(g) The formulations described herein are specifics for certain waste solutions, carbon and resin slurry. To determine the cement to waste ratio for radioactive wastes not identified in the procedure, one to five gallon bench tests should be performed and evaluated.

(h) Procedural steps shall be performed in sequence unless otherwise indicated.

(i) Anti-C clothing, dosimetry requirements and other radiological control requirements shall be specified and reviewed by the cognizant radiological controls personnel or the local work document implementing this procedure. The radiological controls shall be based on the fact that the contamination is in a wetted form and that no indications of airborne contamination were ever detected during the tests to prove this method.

2.2 Material Requirements

(a) Solidification Kit - Refer to Figure 8 - consisting of (1) 55-gallon drum with internal mixer blade and (2) air driven motor (3.5 hp - 95 psi) and support frame. It should be noted that submarine bases and tenders only solidify small volumes of radioactive waste solutions and it should not be necessary to order more than a few drums and the associated solidification materials at a time.

Suggested Sources

Delaware Custom Material, Inc.
444 East College Ave.
State College, Pa. 16801

or

Cortland Container
8806 Crane Ave.
Cleveland, Ohio 44105

(b) Silicate Solution - #NR-3

Suggested Source

Delaware Custom Material, Inc.

(c) Masonry Cement - 70 lbs. per bag or drum. Meets ASTM specification C-91, Federal specification SS-C-1960/i, AASH to M-150. This masonry cement, when mixed according to ASTMC-270, will make Type N Mortar for masonry and stucco. Since the composition of masonry cement might vary from place to place, the above specification should be used for procurement action. In addition, portland cement shall not be substituted for masonry cement since the masonry cement contains hydraulic lime or limestone and mixtures of portland blast and slag materials necessary for the fast set-up of certain waste materials described in this radiological work practice.

(d) Wrenches for drum and bolt and bung caps. Pipe wrench for vent valve.

(e) Radiological Containments (Refer to figures).
Vent valve, plastic sleeving, 2-3 CFM filters or equal, wood stick, plastic bag, lay down paper, vinyl tape, hose clamps, knife.

2.3 Formulations

The following waste solutions and required amount of cement to achieve solidification shall be used for the cement-silicate method.

Solidification Formulas (Cement-Silicate Method)

Solution	Masonry Cement lbs.	Vol. of Solution Gals.	Solution Addition Rate (GPM)
1. HOH Resin Slurry 10 to 70 v/o Resin to Water	175	35 - 40	2 - 10
2. Activated Carbon Slurry 10 to 50 v/o Carbon to Water	175	35 - 40	2 - 10
3. Ammonium Hydroxide (pH 8-10)	210	35	2 - 10
4. Lithium Hydroxide (pH 8-10)	210	35	2 - 10
5. Detergent Ionic (0.1 to 4 oz/gal)	210	25	2 - 10
6. Detergent Non-Ionic (0.1 to 1 oz/gal)	210	25	2 - 10
7. Citric Acid - EDTA Non-Ionic Detergent	210	35	2 - 10
8. Ammonium Citrate	210	35	2 - 10

Notes: 2-1/2 gallons of NR-3 to be added to each solution as described in procedure. Acidic solutions (citric acid or ammonium citrate) should be neutralized to a pH of 7-11 before mixing with cement.

2.4 Procedure (Cement-Silicate Method)

(a) Review general requirements, material requirements, formulations, and containments. Prepare checklist of materials required for the work. Ensure that personnel have been properly trained before work is started.

(b) Set-up solidification kit, Figure 8, as follows:

- Remove top cover of the drum and position paddle over the pin such that it is free to rotate.

- Add required amount of masonry cement - ensure that the paddle does not become disengaged from the positioning pin on the bottom of the drum.

- Remove the three top bung caps.

- Replace top cover such that the rod of the paddle is inserted through the center bung opening. Bolt down and tap the outside ring and retighten to about 1/4 of a turn. Do not overtighten the drum lock-ring bolt because pinching of the gasket can result in a leak.

(c) Attach vent assembly (plastic sleeve and filter) per Figure 1.

(d) Attach sleeving to other bung opening for fill hose (Figure 2a).

(e) Move drum to radiological work area.

(f) Tape over clamp ring to cover inaccessible area (Figure 3).

(g) Locate drum next to the fill line and connect (Figure 2a).

(h) Clamp on motor and support frame. Attach air hose (95 psi) and start up to ensure proper operation.
CAUTION - Do not overfill drum.

(i) Just prior to the addition of a known amount of liquid or slurry - start up the motor stirrer. The liquid or slurry is added during mixing and should not be stopped until the required amount has been added.

  (1) The installed vent sleeve may be used as a view port during the fill operation.

  (2) Liquid or slurry may be added from a precalibrated drum to preclude overfill.

(j) Using the appropriate formula, discharge a known amount of liquid or slurry to the drum. Immediately after the addition, remove the discharge hose (Figure 2b), continue to mix, and proceed to the next step without delay.

(k) Place a sleeve over a five-gallon poly bottle filled with 2-1/2 gallons of silicate solution. The sleeve is taped to the top of the bottle and serves as a spout to pour the solution into the drum.

(l) Remove the taped portion of the fill hose sleeve and wipe down open area around bung hole with a damp rag. Dispose of rag into a plastic bag and pour in quickly the silicate solution. Stop stirrer within 20 seconds after the addition of the silicate solution. Prolonged stirring will result in breaking down of the gelation process. Cut sleeve from the poly bottle and place it into the drum. Remove air driven motor and replace bung caps.

(m) Allow drum to vent for 24 hours or longer if heat is detected on side of drum.

(n) When no heat is detected by feeling the drum, remove the vent assembly (Figure 1) and dispose of as solid radioactive waste.

(o) Visual inspection of the drum contents should reveal no free liquid. There might be some small amount of droplets due to condensation which is acceptable for shipment and disposal. Tighten down bung cap.

(p) If a significant amount of liquid is observed on the surface, then additional cement shall be added. Sleeve in excess cement as shown in Figure 7. The drum should be permitted to stand for at least four hours before reinspecting for free liquid. Reinspect and replace bung cap if no free liquid is observed.

3.0 Solidification Using an Organic Polymer

3.1 General Description

The method described provides a procedure to rapidly solidify small volumes of radioactive water (2 gallons or less). In certain instances, because of the radiation dose rate or nature of the waste solution, it might be desirable to solidify the waste solution at the source rather than transport the waste for subsequent cement solidification.

The method involves the addition of an organic polymer (solid) to the waste solution which requires solidification. The solid material is added to the waste by vigorous agitation for less than 30 seconds and the material hardens quickly and forms a solid within several minutes. It is recommended that several trial runs be performed with non-radioactive water before actually solidifying radioactive water. Waste solutions not compatible for the polymer method include oxidizing chemicals

(e.g., permanganate) and concentrated detergents (>0.1 oz/gal).

This procedure is applicable for the following types of waste solutions:

(a) Aqueous chemical wastes, non-oxidizing, inorganic, pH range 4-10.

(b) Reactor coolant water.

(c) Detergents (0.1 oz/gal or less).

3.2 Material Requirements

(a) Disposable plastic bottle or container.

(b) Suitable stirring rod.

(c) Organic polymer - "SAFE-T-SET" as manufactured by:

Todd Research & Tech. Div.
P. O. Box 1600
Galveston, Texas 77553

or

Oil Research, Inc.
P. O. Box 51871
Lafayette, La. 90501

Shipped in 50 lb. fiber drums.

(d) Shipping Container - Normally the disposable container or bottle is placed in a drum of radioactive solid waste to fill any void area.

(e) Neutralizing Chemicals (NaOH, CaO) if necessary to adjust the pH.

3.3 Prerequisites

(a) Any strong tight poly or metal container may be used for the solidification operation.

(b) The organic polymer should be stored in a dry area and protected from water vapor.

(c) Radiological control requirements shall be specified.

3.4 Procedure

(a) Determine the volume of radioactive water to be solidified (2 gallons or less per container).

(b) Determine the amount of solid organic polymer required for solidification. The ratio to use is one pound of polymer per gallon of solution.

(c) As an example - A 5-gallon poly bottle with a screw cap is filled with two gallons of radioactive waste water.

The contents may be solidified in the following manner:

A damp rag is used to remove the cap and a piece of paper is folded to make a funnel for the polymer addition. The polymer is added quickly through the funnel and is mixed either by stirring with a disposable paddle or the cap can be replaced and hand shaken for 10-20 seconds.

It should be noted that the paper funnel is pushed into the bottle and if a paddle is used for mixing, the paddle is of sufficient length such that the entire paddle and shaft will fit into the bottle.

The time required to add the polymer and mix the contents should not exceed one minute and the container contents should be inspected one hour after mixing. If free liquid is observed, dry polymer should be added to absorb the free liquid.

4.0 Sluiceout of Demineralizer Contents

4.1 General Description

A method is described to sluiceout radioactively contaminated ion exchange resin or charcoal from an XP-15 demineralizer to a 55-gallon drum prepared for subsequent cement solidification. The sluiceout method can be used in conjunction with either of the solidification methods described in paragraph 1.0 and 2.0 of this radiological work practice.

An XP-15 demineralizer and associated hardware is set up as shown in Figure 9. If the drum roller method is used, the drum roller is attached to the preloaded drum containing cement and stones prior to the sluiceout operation and the two-bung supply drum is filled with 13 gallons of controlled pure water (CPW) or processed waste water, if CPW is not available. The resin or carbon slurry is gravity drained to the receiving drum (~10 minutes) followed by a 13-gallon flush from the supply drum (~5-10 minutes). The receiving drum containing about 35 gallons of slurry is tipped over and rolled until complete mixing has been achieved, then tipped upright for final solidification. If the cement-silicate method is used, the setup is similar except the receiving drum has the stirring motor clamped to the top of the drum and the supply drum contains 16 gallons of CPW or processed waste water.

4.2 General Requirements

(a) Determine the specific solidification method to be used and review the procedure (paragraphs 1.0 or 2.0) to determine material and training requirements.

(b) Refer to Figure 9 for the general arrangement of equipment for the sluiceout operation.

(c) The slurry drained to the receiving drum and processed waste water from the supply drum (Figure 9) are potentially contaminated or contaminated; therefore, all operations must be conducted under the supervision of radiological controls personnel.

(d) Radiation levels during this operation can be significant and personnel should monitor the area to prevent unnecessary radiation exposure.

4.3 Material Requirements

(a) Refer to paragraphs 1.2 or 2.2 for solidification drum, material and containment requirements.

(b) Nylobrade hoses and hose clamps adaptable to XP-15, pump.

(c) One 3-10 gpm Jabsco pump to flush XP-15 demineralizer or equal.

(d) Two stainless steel quick disconnect couplings for inlet and outlet of pump.

(e) One 55-gallon supply drum with two 2-inch bung openings or equal.

(f) Plastic sleeving, 2-3 CFM filters, lay down paper, vinyl tape.

4.4 Sluiceout of XP-15; Drum Roller Method

(a) Prepare receiving/solidification drum in accordance with the instructions of section 1.4 (a) (b) (c) (d) (e), but do not attach discharge line per 1.4 (f) - Figure 2a at this time.

(b) The sluiceout equipment should be placed in a manner similar to that shown in Figure 9.

(c) Prepare pump by attaching quick disconnects and hoses. Do not hook up to system as yet. Verify that the pump is working properly.

(d) Prepare supply drum by filling with a measured volume of controlled pure water (13 gallons) or processed waste water (13 gallons), if CPW is not available. Attach vent assembly to bung opening (Figure 1).

(e) Place suction line of hose into the bottom of the drum using containment described in Figure 2a.

(f) Connect discharge hose of pump to top sluiceout connection of XP-15 using hose clamp.

(g) Connect discharge line of XP-15 demineralizer to receiving/solidification drum per Figure 2a.
Caution - Drum must be rolled as soon as possible after adding slurry and flush water.

(h) Open bottom sluiceout valve of XP-15. Crack open inlet on top of XP-15 to permit draining of demineralizer contents. After draining (~10 minutes), immediately close inlet of XP-15 and open top sluiceout valve of XP-15.

(i) Start pump for about 15 seconds, stop and then allow demineralizer to drain. Repeat, except use 10-second pumping intervals until the supply of water is exhausted.

(k) Close lower sluiceout valve on demineralizer. Close upper sluiceout valve.

(l) Allow discharge hose to drain to receiving drum. Elevate hose as necessary.

(m) Bunch and tape the sleeve at the discharge hose, then cut sleeve through the taped section (Figure 2b). Do not cut hose.

(n) Remove containment materials on both bung ports of the solidification drum. Install vent valve assembly on one bung opening (Figure 4) and a drum port plug on the other. Use thread compound (pipe dope) on threads of bung plug.

(o) Verify that the valve on vent assembly is shut and all fittings are tight.

(p) Place drum liner over top of drum (Figure 5). Place a 6 inch x 6 inch herculite sheet or equivalent between the handle of drum roller and drum liner to protect liner from tearing.

(q) Tip drum, remove handle and roll for 20 to 30 minutes. Check for leaks while rolling. If leaks develop, upright drum and take necessary corrective action. Caution - Failure to open vent valve will result in pressure build up in drum.

(r) After rolling drum for 20-30 minutes, upright drum and remove roller from drum. Remove drum containment and slowly open vent valve on the drum and allow drum to stand for 36 hours.

(s) Follow steps 1.4 (j) (k) (l) of paragraph 1.0.

(t) Disconnect hoses from XP-15 demineralizer and pump. Store and reuse materials for subsequent sluiceout operations.

4.5 Sluiceout of XP-15; Cement-Silicate Method

(a) Prepare receiving/solidification drum in accordance with the instructions of paragraphs 2.4(a) through (h), but do not attach discharge line per 2.4(g) - Figure 2a at this time.

(b) The sluiceout equipment should be placed in a manner similar to that shown in Figure 9.

(c) Prepare pump by attaching quick disconnects and hoses. Do not hook up to system as yet. Verify that the pump is working properly.

(d) Prepare supply drum by filling with a measured volume of controlled pure water (16 gallons) or processed waste water (16 gallons), if CPW is not available.

(e) Place suction line of hose into the bottom of the drum using containment described in Figure 2a.

(f) Connect discharge hose of pump to top sluiceout connection of XP-15 using hose clamp.

(g) Start the motor stirrer. The slurry and flush water is added while mixing and should not be stopped until the required amount has been added.

(h) Open bottom sluiceout valve of XP-15. Crack open the inlet on top of XP-15 to permit draining of demineralizer contents. After draining (~10 minutes), immediately close inlet of XP-15 and open top sluiceout valve of XP-15.

(i) Start pump for about 15 seconds, stop and then allow demineralizer to drain. Repeat, except use 10-second pumping intervals until the supply of water is exhausted.

(k) Close lower sluiceout valve on demineralizer. Close upper sluiceout valve.

(l) Allow discharge hose to drain to receiving drum. Elevate hose as necessary.

(m) Bunch and tape the sleeve at the discharge hose, then cut sleeve through the taped section (Figure 2b). Do not cut hose.

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(n) Place a sleeve over a five-gallon poly bottle filled with 2 1/2 gallons of silicate solution. The sleeve is taped to the top of the bottle and serves as a spout to pour the solution into the drum.

(o) Remove the taped portion of the fill hose sleeve and wipe down open area around bung hole with a damp rag. Dispose of rag into a plastic bag. Quickly, pour in silicate solution into the drum. Stop stirrer within 20 seconds after the addition of the silicate solution. Cut sleeve from the poly bottle and place it into the drum. Replace bung cap.

(p) Allow drum to vent for 24 hours or longer if heat is detected on side of drum. Remove motor and cap bung opening. Disconnect hoses from XP-15 demineralizer and pump. Store materials for future use.

(q) When no heat is detected by feeling the drum, remove the vent assembly (Figure 1) and dispose of as solid radioactive waste.

(r) Visual inspection of the drum contents should reveal no free liquid. There might be some small number of droplets due to condensation which is acceptable for shipment and disposal. Tighten bung cap.

(s) If free liquid is observed, sleeve in 10 lbs of cement/gal of water as shown in Figure 7. After the addition of the cement, reinspect and replace bung cap if no free liquid is observed.

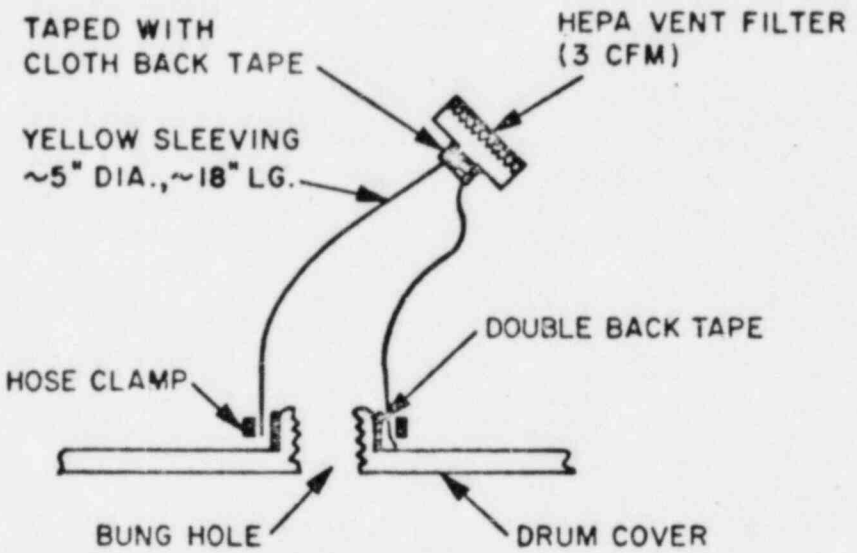

Figure 1. Vent Assembly

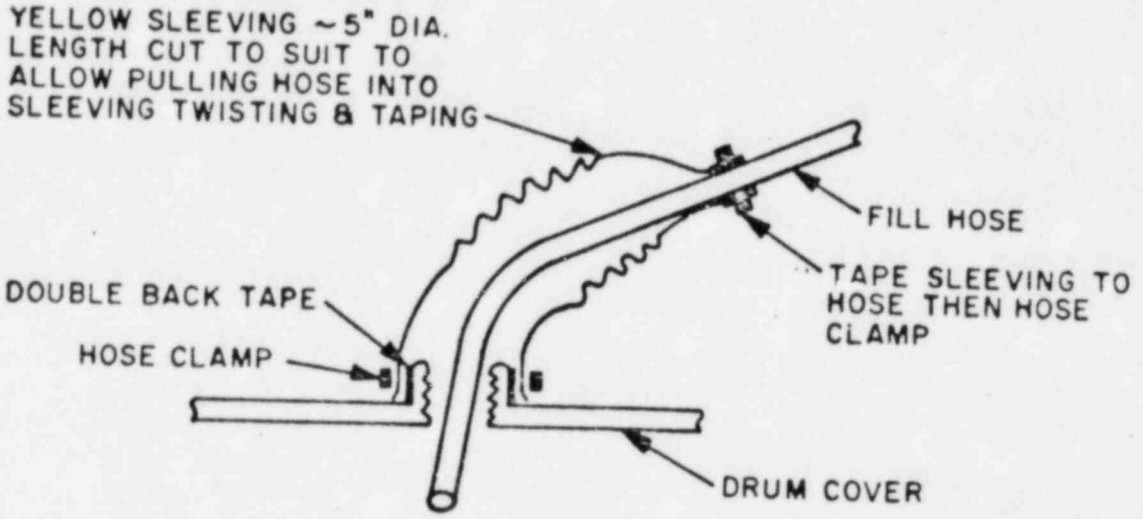

Figure 2a. Sleeving/Hose Assembly

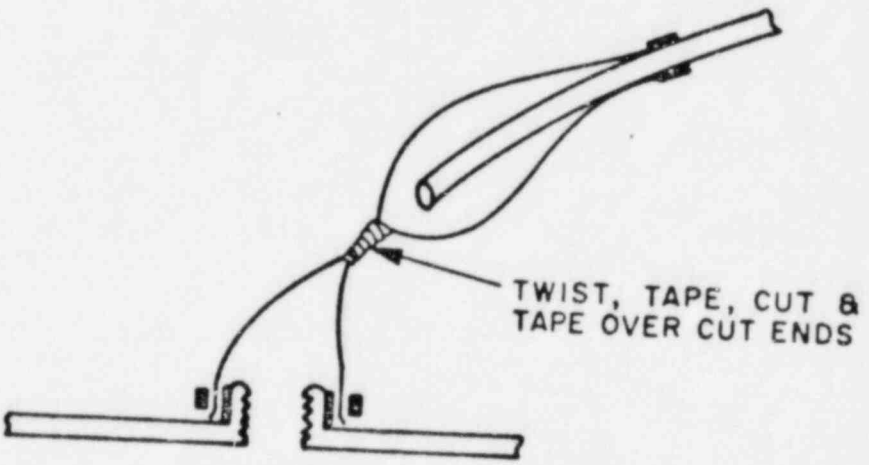

Figure 2b. Removal - Sleeving/hose Assembly

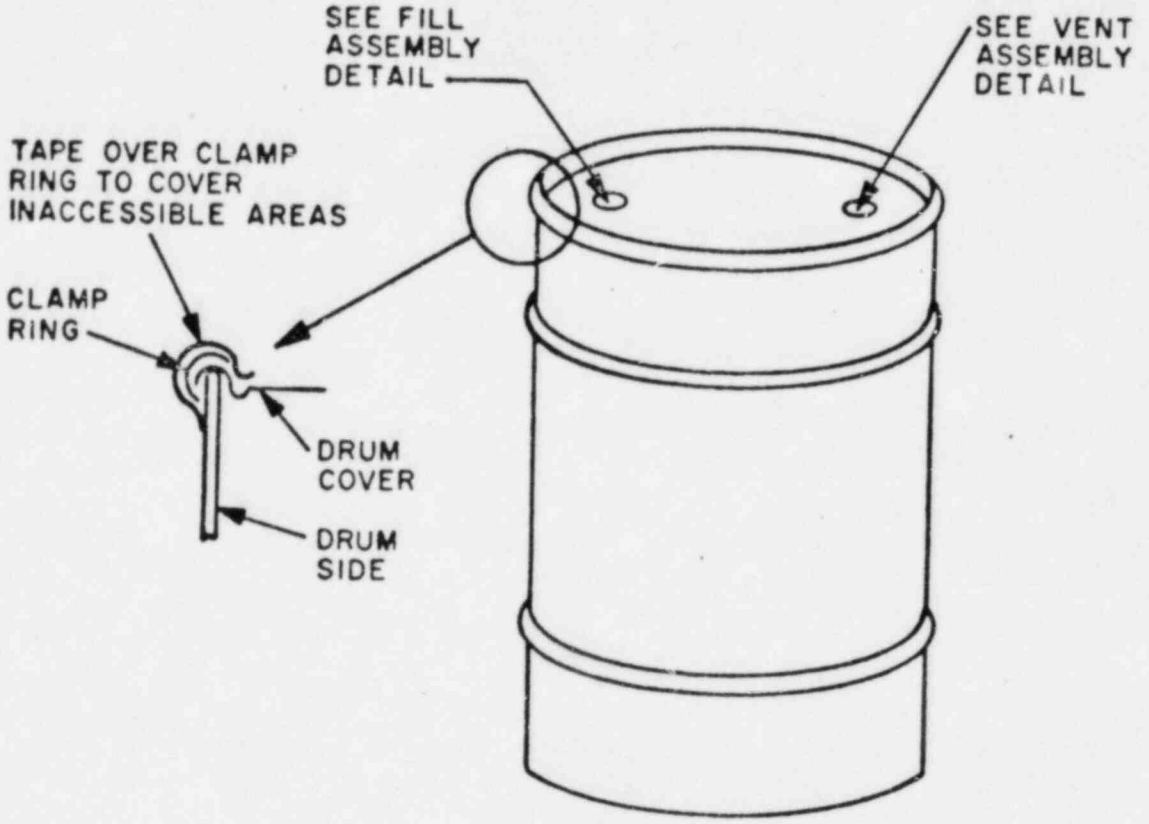

Figure 3. Clamp Ring Covering

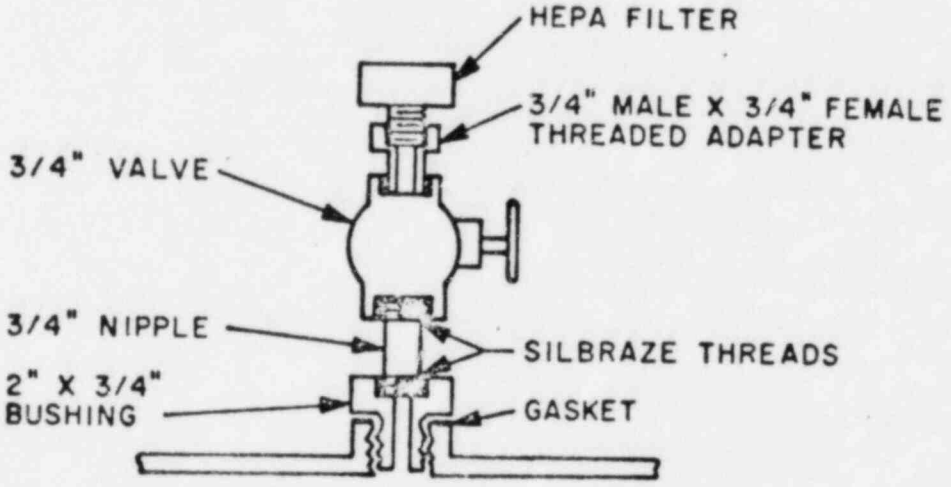

Figure 4. Vent Valve Assembly

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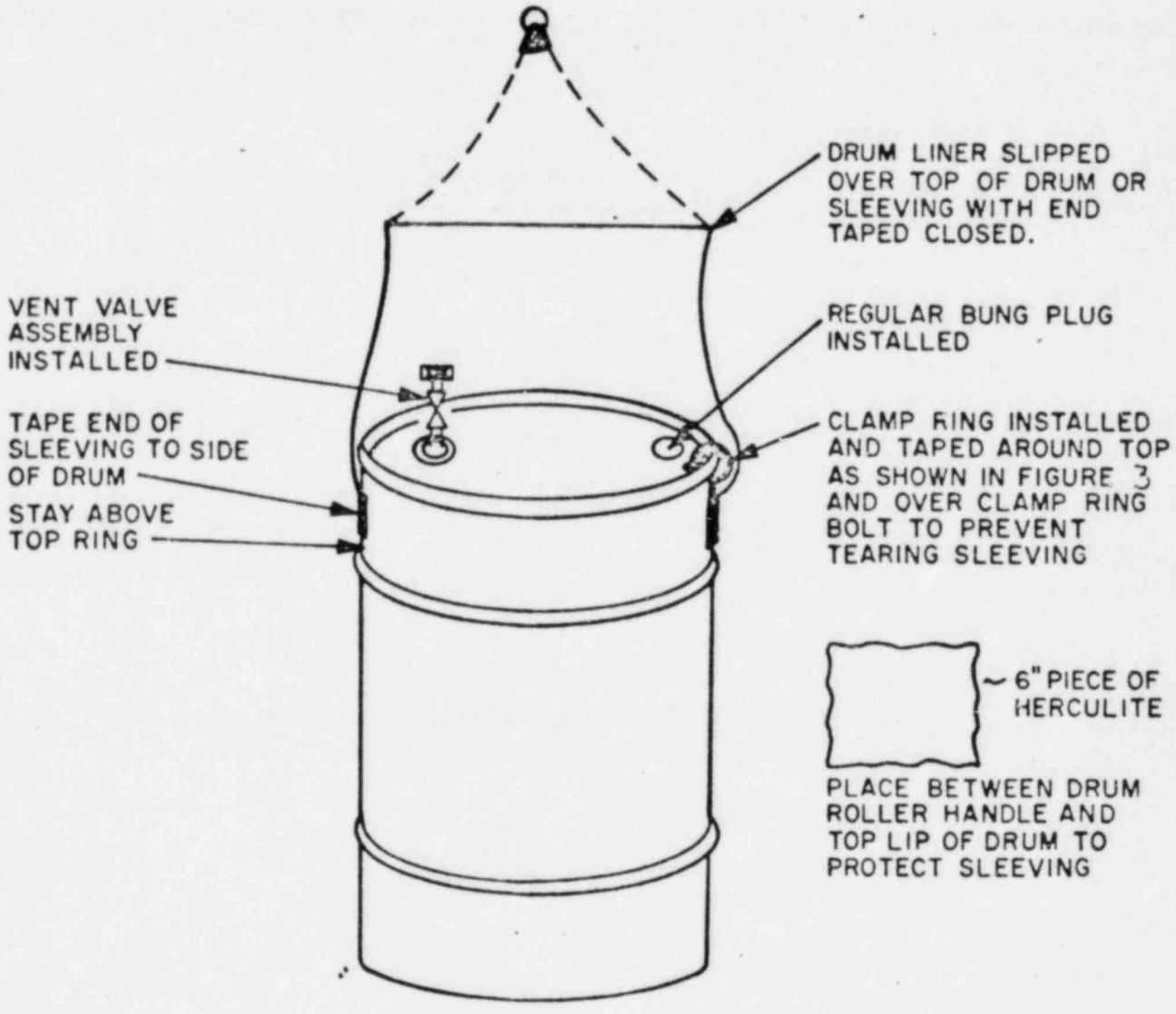

Figure 5. Containment Bag For Drum Roller Method

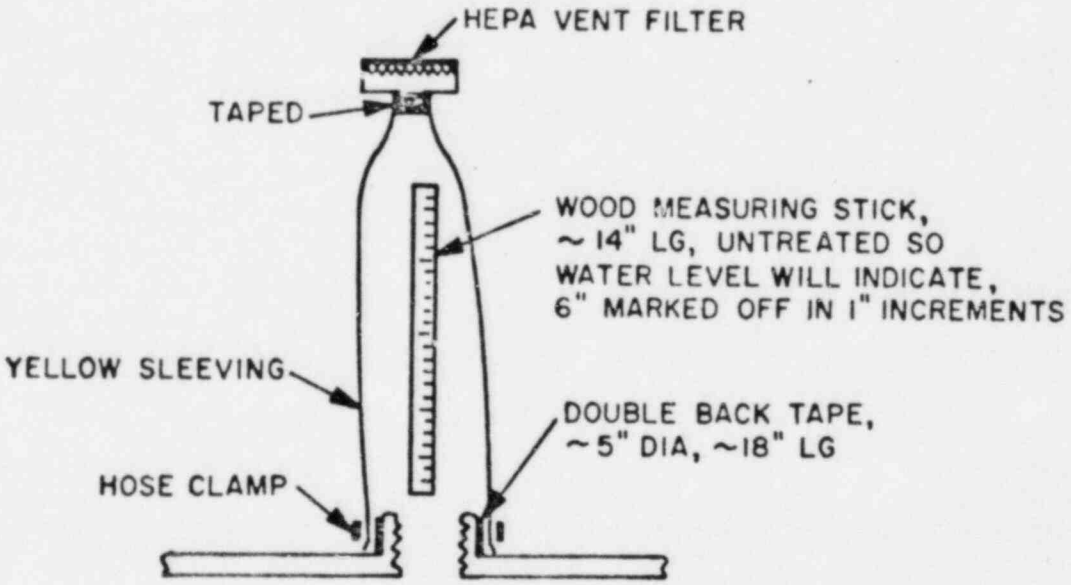

Figure 6. Inspection Containment

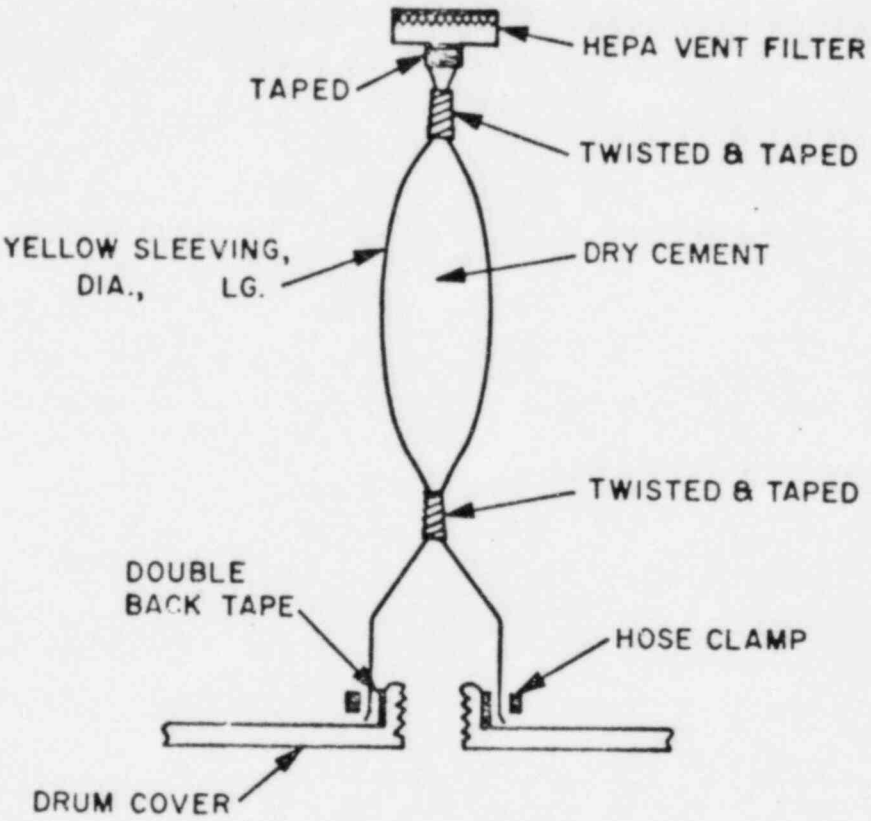

Figure 7. Cement Addition

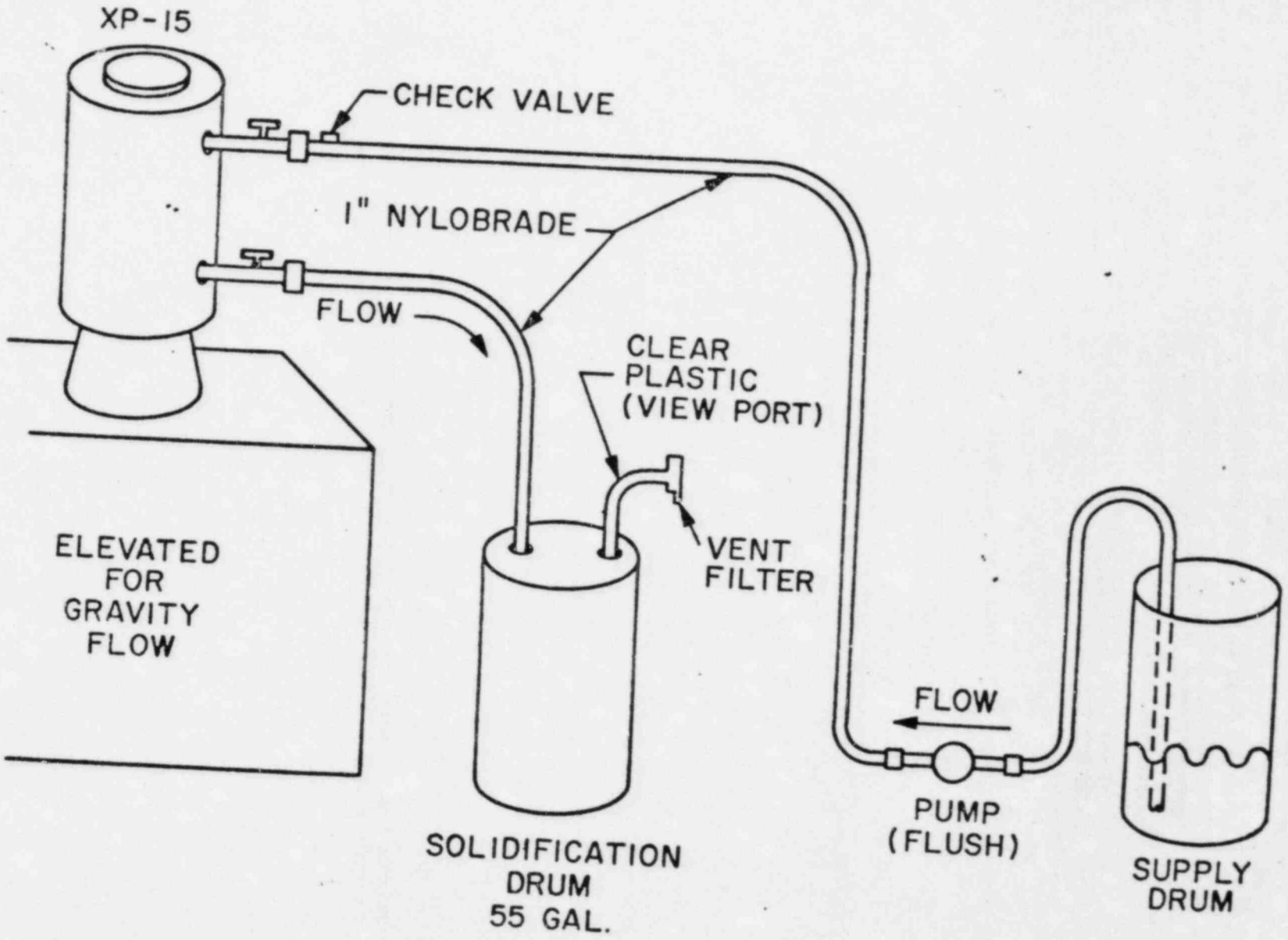

Figure 9. Sluiceout of Demineralizer Contents

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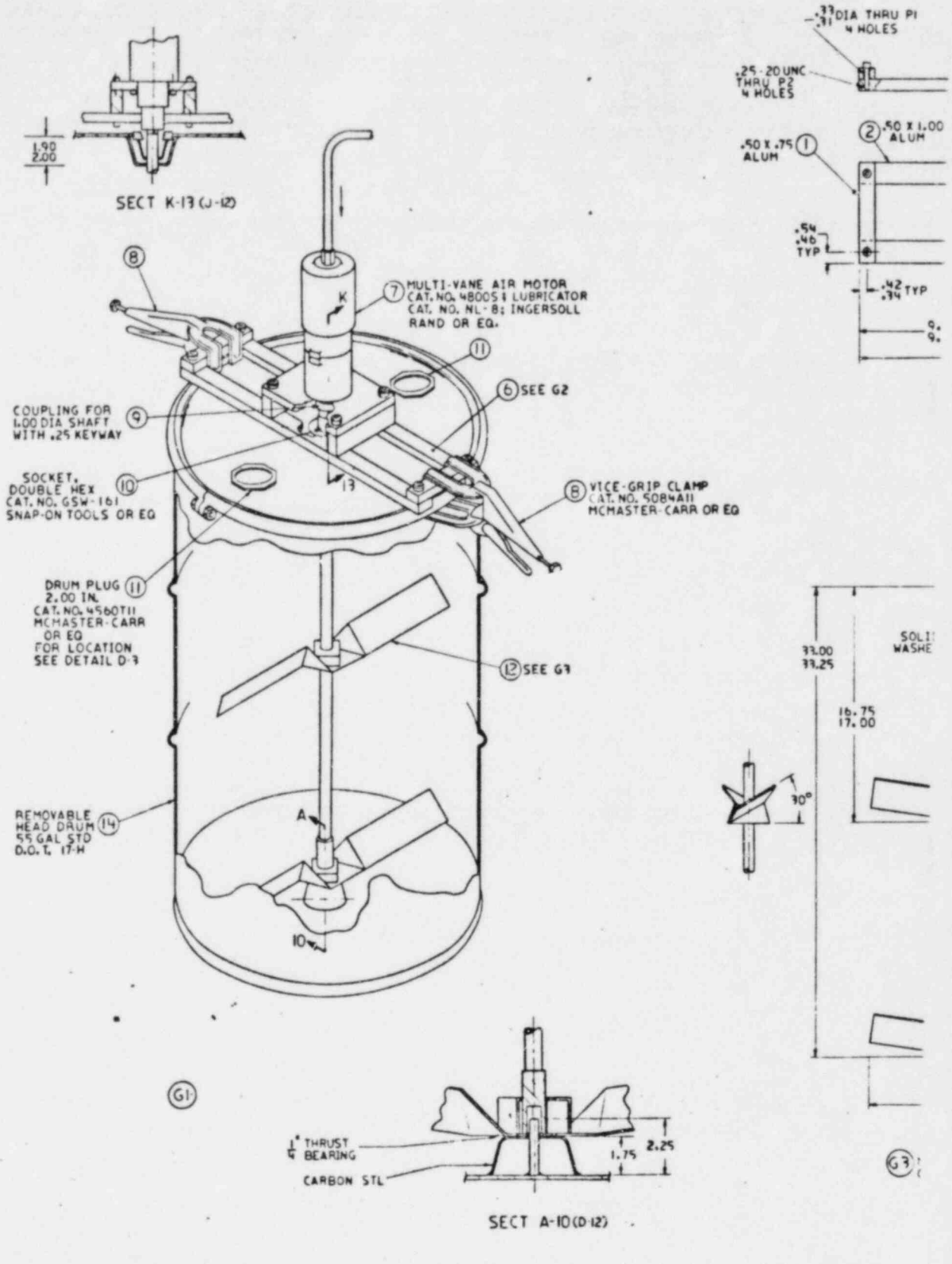
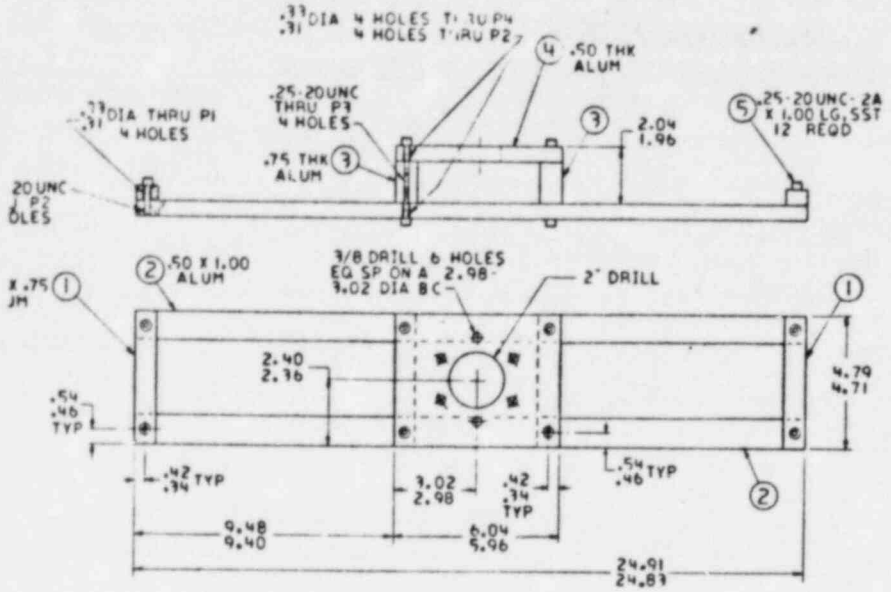
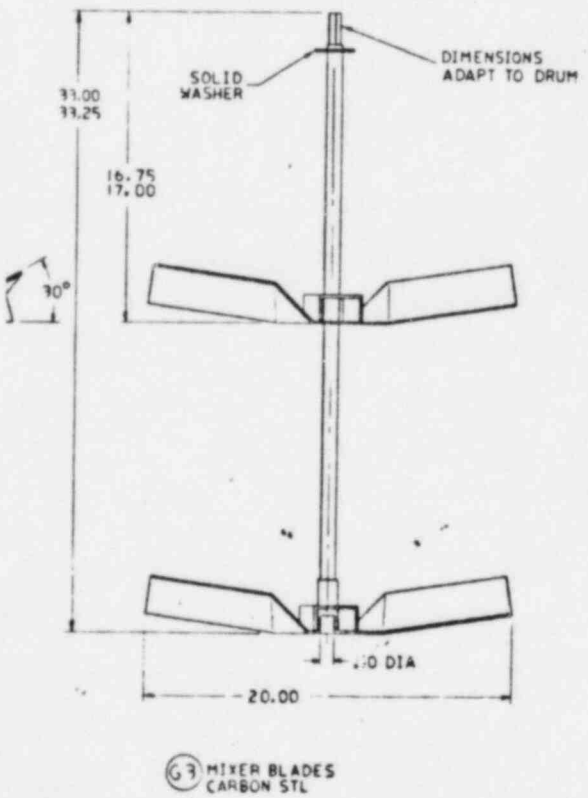
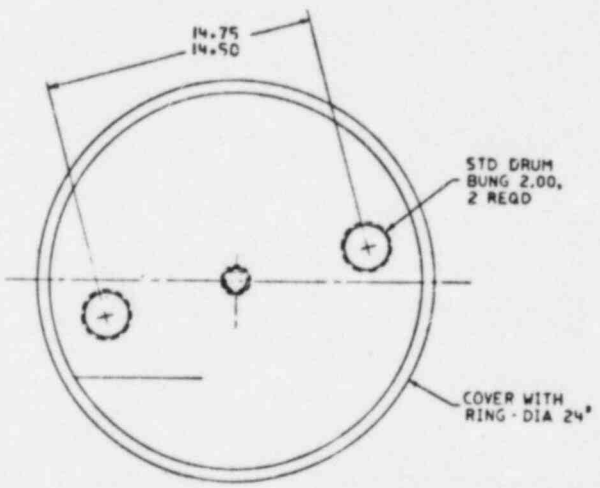

1.90
2.00
SECT K-13 (J-12)
.33
.31 DIA THRU P1
4 HOLES
.25-20 UNC
THRU P2
4 HOLES
.50 X 1.00
ALUM
.50 X .75
ALUM
.54
.46
TYP
.42
.34 TYP
8
7 MULTI-VANE AIR MOTOR
CAT. NO. 4800S1 LUBRICATOR
CAT. NO. NL-8; INGERSOLL
RAND OR EQ.
K
11
6 SEE G2
COUPLING FOR
1.00 DIA SHAFT
WITH .25 KEYWAY
9
SOCKET,
DOUBLE HEX
CAT. NO. GSW-161
SNAP-ON TOOLS OR EQ
10
13
8 VICE-GRIP CLAMP
CAT. NO. 50BWAII
MCMASTER-CARR OR EQ
DRUM PLUG 11
2.00 IN.
CAT. NO. 4960T11
MCMASTER-CARR
OR EQ
FOR LOCATION
SEE DETAIL D-7
12 SEE G3
REMOVABLE
HEAD DRUM 14
55 GAL STD
D.O.T. 17-H
A
10
33.00
33.25
16.75
17.00
30°
G1
1" THRUST
BEARING
CARBON STL
1.75
2.25
SECT A-10 (D-12)
G3



(G2) MOTOR SUPPORT

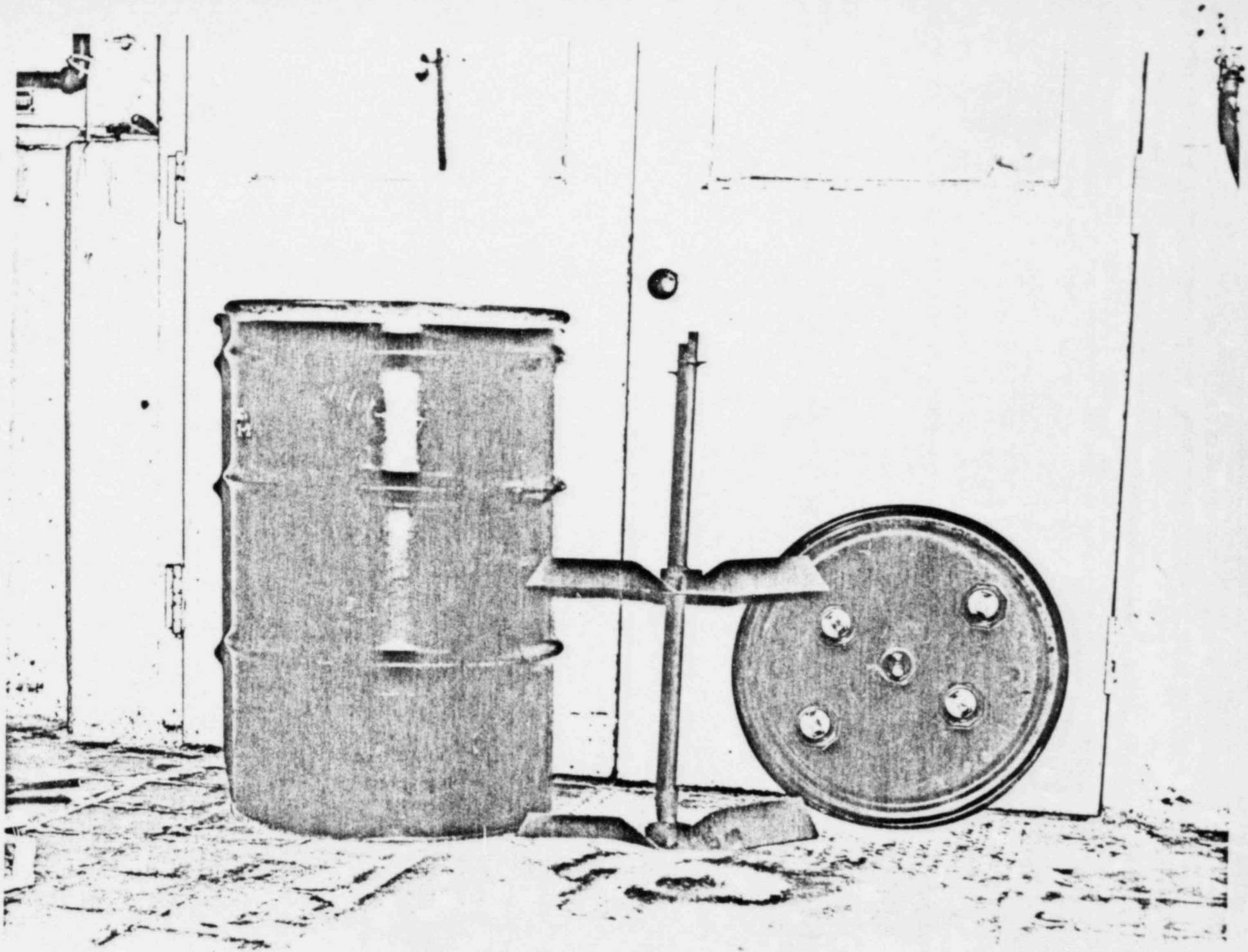


(G3) MIXER BLADES CARBON STL



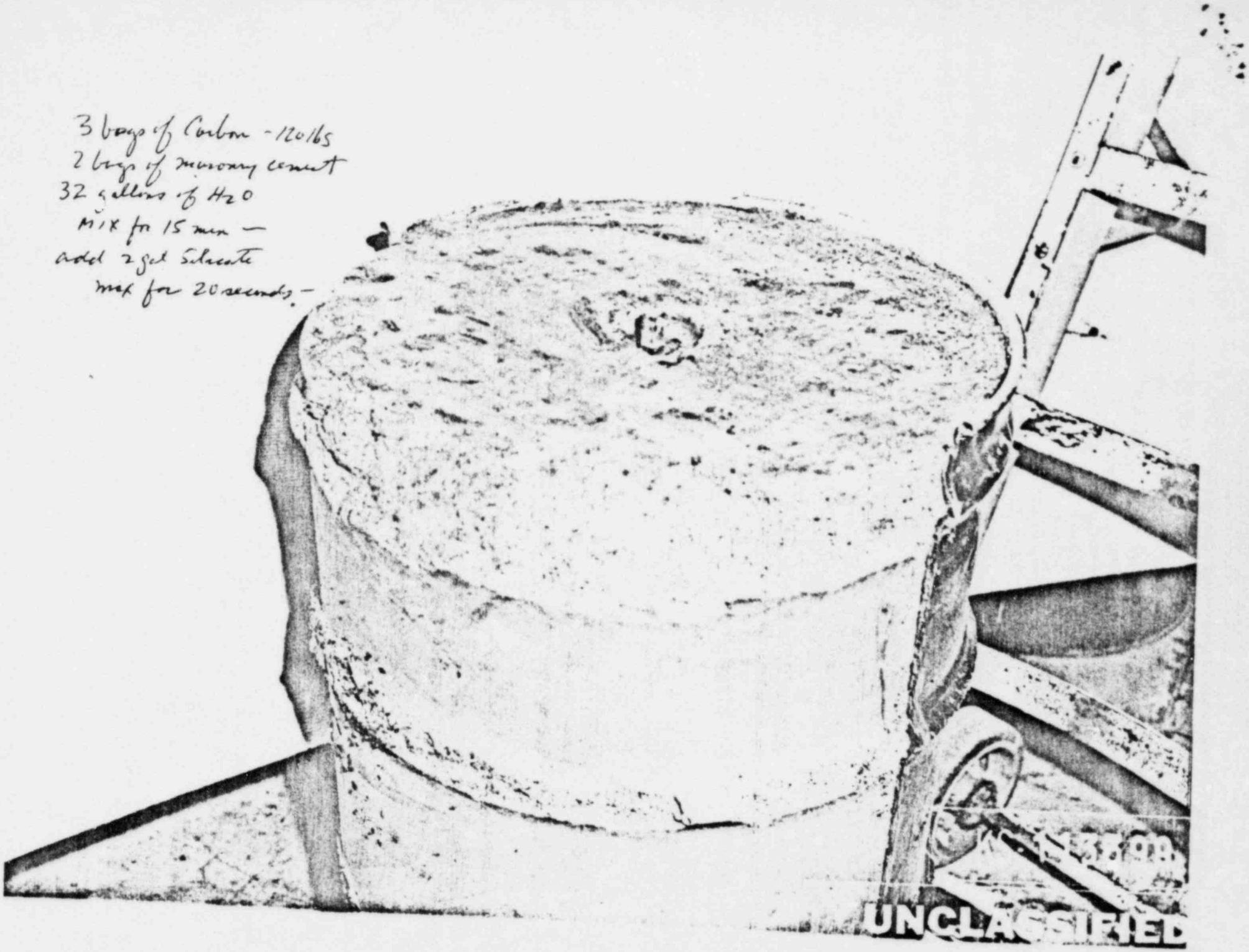
DETAIL D-3

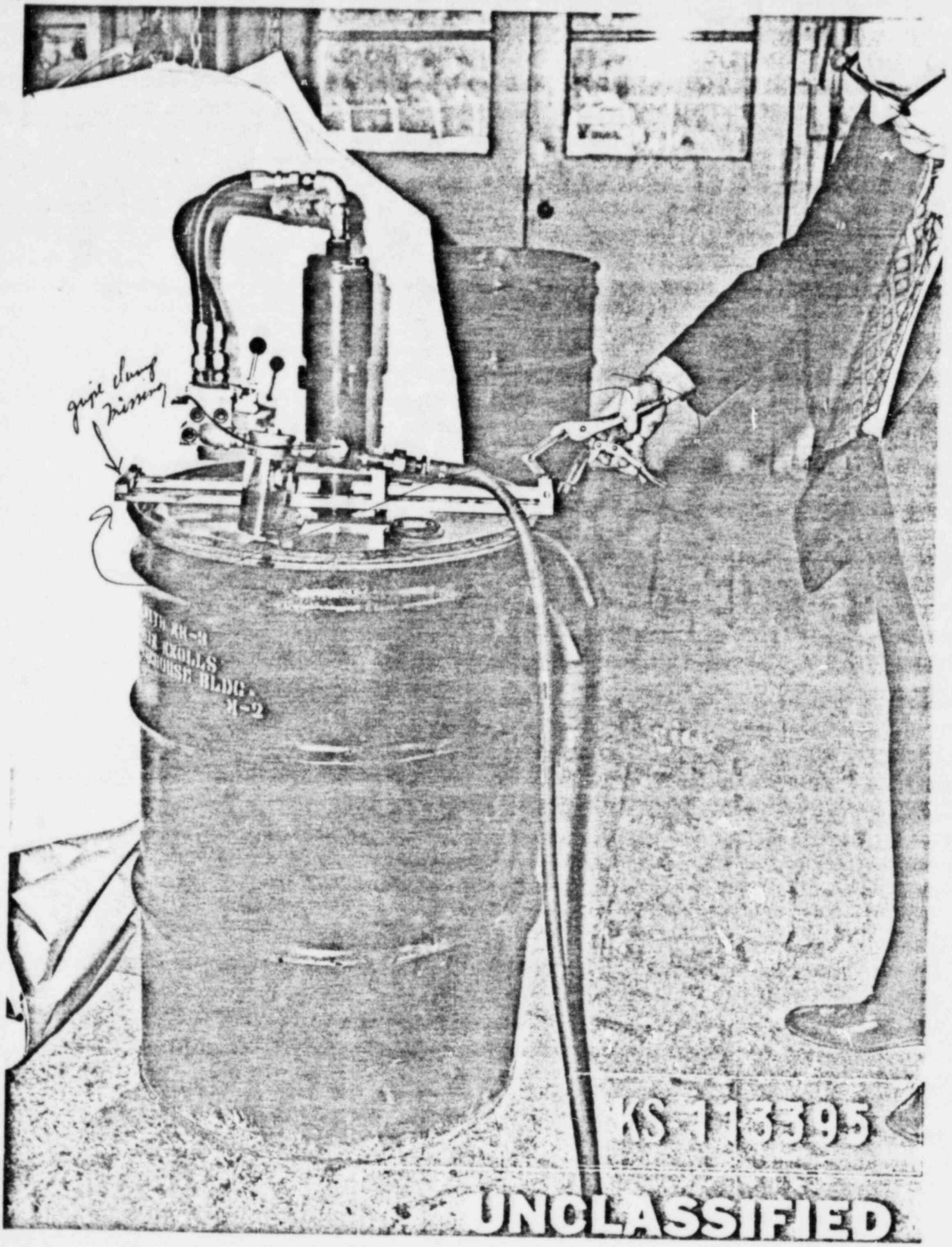
Figure 8. Solidification Drum



KAPL 7/17/77

3 bags of Carbon - 120 lbs
2 bags of masonry cement
32 gallons of H_2O
Mix for 15 min —
added 2 gal Silicate
mix for 20 seconds —

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