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Canister Disposition Plan

For the DWPF Integrated Cold Runs (U)

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CANISTER DISPOSITION PLAN
FOR THE DWPF INTEGRATED COLD RUNS

1.0 INTRODUCTION:

This plan on the disposition of the 126 canistered waste forms produced during the Integrated Cold Runs (ICR), describes the sequence of canister moves, the nature of the specific tests which will be carried out, the methods of access for glass sampling, and the locations for canister wasteform archiving (storage). The canister tests are the direct consequence of the Waste Acceptance Preliminary Specifications (WAPS[1]). The WAPS must be met before the canistered waste form is accepted by DOE for ultimate disposal at the Federal Repository. The tests are designed to provide evidence, as detailed in the Waste Form Compliance Plan (WCP[2]), that the DWPF product will comply with the WAPS. The results of these tests will be included in the Waste Form Qualification Report (WQR).

2.0 OBJECTIVES:

The objectives of the canister disposition plan are (1) to identify the method of glass sampling for each glass filled canister produced (2) to provide the sequence of tests to be performed for each canister in support of DWPF product acceptance and (3) to ensure that sealed canisters are available for unanticipated, future needs and that the remaining canistered waste forms are retrievably stored in case additional experimentation is required.

2.1 Canisters for Glass Sampling.

The objective here is to provide access to the waste glass within the canister for eventual glass sampling. This will be accomplished through sectioning by sawing or by removal of the canister wall. This will occur on most of the canisters in runs 2 through 5 and on six canisters from run 1 as detailed in Tables 1 - 5 (Tables 1-9 are taken from a report by C. H. Payne[3]). Subsequent characterization of the glass samples is

necessary to verify that this glass product has been controlled during production. The characterization of the glass is described in the Glass Sampling Program.[4]

2.2 Canister Free Volume Determination (DWPF-WP-21.0).

This test is to confirm that the free volume measured indirectly by the neutron detection system is in fact consistent with the actual free volume measured after filling, and is less than 20 % of the total canister volume (WAPS 3.5). The range of variability for canister free volume will also be determined.

2.3 Glass Removal From Canister Surfaces (DWPF-FA-42.0).

This test is to demonstrate that the remotely controlled needle gun is capable of removing waste glass that may have accidently adhered to the outside of the canister.

2.4 Inner Canister Closure Performance, Repair adn Leak Testing (DWPF-FA-12.0).

This test is to demonstrate the integrity of the temporary seal and repair plug in terms of water leaktightness (i.e., a helium leak rate of less than 2 x 10^{-4} atm-cc/sec does prevent the introduction of water into the canister). This test is also intended to show that the ICC station adequately performs its funtion of installing and removing the ICC seal and for measuring the leaktightness (facility acceptance).

2.5 Canister Free Liquid, Pressure and Gas Contents Determination (DWPF-WP-22.0).

This test is to demonstrate that no free liquid (WAPS 3.1), no free gas (WAPS 3.2) and no vapor phase organics (WAPS 3.4) are present in the canistered waste forms, and that the pressure within the sealed canister is less than 7 psig (~21 psia) (WAPS 3.2). The relative humidity

within the gas space of the canister will also be measured to ensure that no free liquid water is present.

2.6 Canister Temperature Profile Determination (DWPF-WP-23.0).

This test is to obtain the vertical and radial temperature profile of the canistered waste form prior to, during and after glass filling for (1) a normally cycled canister, (2) a canister which will be transferred to the insulated canister storage compartment after filling from the pour turntable, and (3) a canister filled from the drain turntable during the low viscosity run. This data is required to confirm previous testing at TNX, to validate models developed from those tests, and to characterize canisters filled on the drain turntable.

2.7 Canister Welding Performance (DWPF-WP-24.0).

This test is to establish that final upset resistance welds, made within the operating window defined during the parametric welding study, are leaktight (i.e., the helium leak rate must be less than 2 x 10^{-7} atm-cc/sec) (WAPS 2.2).

2.8 Canister Archival.

Although this is not a test, per se, it is important that the DWPF archive prototypic, glass-filled canistered waste forms to provide canisters for testing or analysis to resolve unanticipated concerns. Those canistered waste forms which have been opened for glass sampling or for the above-described tests will also be retrievably stored in case additional data is required. This period of interim storage at the DWPF is not well-defined and awaits further developments in terms of selection and licensing of a Federal Repository. In any event, interim storage will be at least tens of years and as such it is also important to archive non-radioactive canistered waste forms as controls. These canisters will be stored at both the Glass Waste Storage Building and TNX.

These canistered waste forms also provide non-radioactive test canisters for testing any operations which will be carried out prior to shipping. This includes final smear testing, additional decontamination (if required), and canister transfer from interim storage to the shipping vessel.

3.0 TESTS

The specific tests affected [illegible] this plan are indexed in Section IV - Test Index of [illegible] report. These tests and their index numbers are given below. The details of the specific tests will be found in the individual Test Plans and their corresponding Procedures. Flow diagrams (Figures 1-7) showing the sequencing of tests, are given for those canisters for which multiple tests will be performed.

3.1 Canister Free Volume Determination (DWPF-WI 21.0).

The free volume will be determined by measuring the amount of water which can be accommodated by the open volume of the canister. The free volume determination will be done on the same canisters that are tested for free liquids and other foreign materials, and for interna pressure. This free volume measurement will be done subsequent to these other tests.

3.2 Glass Removal From Canister Surfaces (DWPF-FA-42.0).

The needle gun will be tested at least once pric to hot startup in the vitrification building. A test canister will be created at TNX and directed by SRL in order to demonstrate the operability of this system. In the event that spillage or overflow occurs during the Integrated Cold Runs resulting in a canister with glass adhering to the outside, then this canister will also be cleaned by the needle gun.

3.3 Inner Canister Closure Performance, Repair and Leak Testing (DWPF-FA-12.0).

The integrity of the inner canister closure seal will be monitored prior to decontamination for each canister of the Integrated Cold Runs (ICR) as part of normal operating procedures. The ICC seal for each canister must have a helium leak rate less than 2×10^{-4} atm-cc/sec to ensure leaktightness to water. By measuring the relative humidities within 5 canistered waste forms (all of which passed this helium leak test), the ability of the ICC seal to preclude water inleakage will be demonstrated.

During the ICR, five of the canisters will forego the final closure by upset resistance welding. These canisters will be tested both prior to and after decontamination to ensure that the leaktightness of the temporary seal (as determined by the helium leak test) has not been compromised by the decontamination process or subsequent handling. These results, combined with the results from the relative humidity measurements within the canister, will be used to demonstrate that the ICC seal is water-tight.

This test will also ensure that the ICC station adequately performs its function of installing and removing the ICC plug and measuring the leaktightness.

3.4 Canister Free Liquid, Pressure and Gas Contents Determination (DWPF-WP-22.0).

Specially designed canisters will be fabricated by insertion of a thin-walled tap into the wall above the glass line of existing canisters.[5] This tap will be pierced subsequent to glass filling and closure to determine the internal pressure and contents.[6] This will be carried out at TNX by TNX Operations under the direction of SRL.

A system has been designed to measure the pressure of the gas inside the canister without equilibration with the outside atmosphere. The gas will then subsequently be analyzed for water content, organics,

gas components such as oxygen and carbon dioxide, and any other species which might be present. This will be accomplished with an on-line mass spectrometer. The presence of free liquids will be determined indirectly by the presence of the corresponding vapors in the gas phase

3.5 Canister Temperature Profile Determination (DWPF-WP-23.0).

Prior to filling, thermocouples will be installe in three canisters in a manner similar to that used for experiments at TNX[7]. In the first case, the temperture profile within a canister will be monitored as the canister is filled from the pour turntable and subsequently cooled. The second canister will be monitored during filling from the pour turntable and ther as the canister is transferred to the insulated canister storage compartment. This mimics the case where a problen arises requiring that the canister be temporarily placed in a shielded environment. The third monitored canister will be filled from the drain turntable during the low viscosity run. This reflects a situation in which problems are encountered with the melter and draining is required to remove the molten waste glass. The use of t drain turntable will also be required at the end of the melter's lifetime when the melter is emptied. The canisters filled from the drain turntable will be subjected to a shorter time of filling which will generat a different temperature profile. Dimensional measurement will also be made on these canisters to ensure that they still meet specifications.

3.6 Canister Welding Performance (DWPF-WP-24.0

As part of the normal operating procedures for the Weld Test Cell, the parameters of each upset resistance weld will be automatically measured and recorded. These parameters include duration in seconds the actual welding, dc current in amps and force in poun for each weld (included here is the timing of the application of the the load and the current discharge). In order to be acceptable, these parameters must be with a three-dimensional operating window defined by a separa welding parametric study.[8]

In order to confirm the acceptability of the welds, five canisters from the integrated cold runs will have the top portion of the canister containing the seal removed. Tests on these sectioned tops will include helium leak tests, tensile tests and burst tests to ensur that these welds, produced within the operating window, meet specifications.

4.0 SPECIAL NEEDS

Complete details of the equipment and special needs for the tests will be found in the individual test plans and corresponding procedures. However, a general listing is given here for these tests as well as a listing of special needs for glass sampling and canister archiving.

4.1 Special Needs for Glass Sampling.

Glass samples will be taken from the canisters a listed in Tables 1-5. Access for glass sampling will be achieved by either sectioning or by removal of the canister wall. In the case of sectioning, a large band saw located in building 673-T at TNX will be used. This is discussed in more detail in the Glass Sampling Plan appended to the test program and in reference 9. For removal of the canister wall, a welding torch will be required to cut a window at least 12 inches wide over the entire length of the canister (see Glass Sampling Plan).

Transportation of the canistered waste forms fr the DWPF to TNX (Building 673-T) will be required. Syster to load the canistered waste form onto the truck at the DWPF, and to unload it at TNX, will be needed. The overhead crane in building 673-T will be used to lift th canister off the truck and to move canisters as required within the building.

4.2 Special Needs for the Six Tests.

For a detailed account of the special needs see the individual Test Plans and corresponding Procedures.

4.2.1 Free Volume Determination. A method of delivering and measuring an amount of water necessary to fill the entire free volume is required. Five canisters will require the insertion of a thin-walled tap into the canister wall above the defined glass line. EES (W. D. Thompson) will design and fabricate the canister taps. Welding of the tap into the canister will be handled by DWPF.

4.2.2 Glass Removal from Canister Surfaces Performance. A canister with glass adhering to the outer surface will be required in order to test the performance of the needle gun. SRL/DWPT will be responsible for providing the test canister. Design, fabrication, testing and installation of a remote needle gun are needed prior to performing this test.

4.2.3 Inner Canister Closure, Repair and Leak Testing Performance. A helium leak detection system will be required to test the integrity of the ICC seal.

4.2.4 Free Liquid, Pressure and Gas Contents Determination. A system is required for the measurement of the pressure and relative humidity, organics, free liquid and gas constituents without equilibration with the outside atmosphere. The details of this pressure measuring and mass spectrometric analysis system can be found in the SRL Task Plan for this test.[6]

4.2.5 Canister Temperature Profile Determination. This test will require installation of thermocouples in three canisters prior to the test in order to follow the vertical as well as radial temperature profile of the canister and waste glass during pouring and cooling. The capability to make and break thermocouple connections, and to receive and record the data from all three canisters within the melter cell is required. The thermocouples of the canisters to be monitored during storage in the insulated storage compartment and on the drain turntable must be designed so that they can be easily connected and disconnected. For the canister on the drain turntable, special consideration must be given to whether redundant level detection is needed during the

test, to avoid overfilling the canister (During normal operation, this is provided by the gamma level detection system. This system will not be operative for the ICR's, since the glass will not contain gamma emitters.).

4.2.6 Canister Welding Performance. The tensile strength, burst strength, helium leaktightness, and microstructure of the final welds must be determined. EES has equipment in place to perform these tests.

4.3 Special Needs for Canister Archiving.

The canisters which will be archived in the Glass Waste Storage Building will need to be transported by the shielded canister transporter. It is recommended that five canisters from run 1 be emplaced in the GWSB in a manner which ensures that the range of expected storage conditions is adequately represented. All portions of the sectioned canisters will be retrievably stored in shelters at TNX by SRL/TOS. Requirements for the storage of these sectioned canistered waste forms need to be developed.

5.0 DATA COLLECTION

The Integrated Cold Runs will produce 126 filled canisters (124 from the pour turntable and 2 from the drain turntable) during six separate runs as listed in the Tables 1-6. All of the glass sampling and testing activities scheduled for each canister are presented in matrix format. Data collection will therefore be driven as disclosed in these six matrices, figures 1 -7, and as discussed below.

On the other hand, some flexibility in data acquisition is useful in obtaining compelling evidence for compliance with the WAPS. For example, a particular canister may be selected for final weld evaluation based on the welding parameters for the canister being at the very edge of the operating limits. In this section, such opportunities for flexibility in data acquisition are also detailed.

5.1 Data from Glass Sampling.

This is discussed in the Glass Sampling Program.[4]

5.2 Data Collection from Specific Tests.

Free Volume. Data acquired here will be the amount of water (at a specified temperature) needed to completely fill the void space of the canister. Five scheduled free volume tests will be performed as presented in Tables 1-7. However, this test may also be performed if a problem is encountered with the neutron detection system or if glass coning is suspected.

Glass Removal. The data required here is photographic evidence that all of the adhered glass on the canister outside surface has been removed as a result of blasting the canister using the needle gun.

ICC Seal. The measurement of the relative humidity within five canistered waste forms will demonstrate that a helium leak rate of the ICC seal of less than 2 x 10^{-4} atm cc/sec is sufficient to preclude water inleakage into the canister.

In addition, five canisters will forego final upset resistance welding and be subjected to a helium leak test after the decontamination process. This will be an additional demonstration that decontamination process does not destroy the integrity of the temporary seal. The five canisters to be tested are listed in Tables 1-7.

In the event that the ICC seal does not meet the specification (a helium leak rate of less than 2 x 10^{-4} atm cc/sec), the canister throat will be heated to cause the ICC plug and sleeve to fall into the canister. A larger diameter plug (the repair plug) is then shrink fit into the throat and then tested for leaktightness. If any canisters require use of the repair plug, one of these canisters will also be tested for leaktightness after undergoing decontamination. This particular canister may then undergo final closure by upset resistance welding.

Canister #12 in run #1 (melter characterization) will replace the ICC seal with a repair plug even if the the leak rate specification is met. This will ensure that at least one canister with a repair plug is tested. This canister will have the repair ICC seal checked for leaktightness after decontamination. It will subsequently undergo final closure by upset resistance welding. This canister will also be checked for free liquids and will have its final weld examined.

At least one canister with an ICC which fails the leaktightness criterion (if any are produced) will be allowed to proceed through the normal DWPF path without the introduction of the repair plug. This canister will subsequently be tested for relative humidity and internal pressure.

Free Liquid, Contents and Pressure. The data collected here will be the internal gas pressure of the closed canister, the relative humidity, the oxygen and carbon dioxide concentrations, and identification of any other species detected in the gas phase of the closed canister. Five canisters (which are the same canisters which will subsequently be tested for free volume) are scheduled to undergo these tests (see Tables 1-7).

As discussed above for the ICC, if the leaktightness specification is not met, some canisters will require a repair plug for replacement of the ICC temporary seal. One of these canisters (if any are produced) containing the repair plug will be tested for free liquid, foreign materials and pressure. (Examination of the final weld will also be carried out with this canister. See Welding Performance below). Canister #12 of run #1 will use a repair plug even if the ICC seal meets the leaktightness specification. It will be tested for free liquid, foreign materials and pressure.

Temperature Profile. The data to be collected are the vertical and radial temperature profiles of three canisters, and the waste glass as a function of time (Tables 1-8). The three canisters will be (1) a normally processed canister (2) a canister which will be transferred to the insulated canister storage compartment

after filling from the pour turntable, and (3) a canister filled from the drain turntable during the low viscosity run.

Welding Performance. The final seals for five canisters will be tested to demonstrate the leaktightness, burst strength and tensile strength of the welds achievable during normal production. These five canisters are listed in Tables 1-7. During normal operations, the force, time and current parameters for every final closure will be measured and recorded. If a weld is found that is close to the edge of the operating window, or a weld is made in a non-routine manner (e.g. two passes), this weld will also be tested. In a case where a repair plug replaces the temporary seal, an evaluation of the final welds from at least one of these canisters will be performed. Also canister #12 of Run #1, which has a repair plug, will also be tested here.

6.0 HOLD POINTS

Hold points for this plan refer to points at which sectioning or removal of the canister wall must await completion of certain tests.

6.1 Removal of the canister wall for subsequent glass sampling must not proceed on canisters 49,74 and 92 until after the "free liquid" and free volume tests have been performed on these canisters.

6.2 Sectioning by sawing or removal of the canister wall must not be carried out on the first canister where a repair plug is required until the "free liquid", pressure and gas analysis tests have been performed.

6.3 Sectioning by sawing or removal of the canister wall must not be carried out on canisters 32, 40, 56, 70 and 101 until they have been tested for leaktightness as described in the Test Plan for ICC Performance.

6.4 Sectioning by sawing or removal of the canister wall must not be carried out on the canister which failed the ICC leaktest and did not receive a repair plug until

the " e liquid", pressure and gas analysis tests have been performed.

7.0 ACCEPTANCE CRITERIA

The acceptance criteria presented here derive mainly from the WAPS specifications.

7.1 <u>Free Volume</u> The WAPS states that "the free volume within the canistered waste form shall not exceed 20 percent of the total internal volume of an empty canister". Since the total internal volume is 26 ft^3, the maximum amount of free volume allowed by the specification is 5.2 ft^3 or 38.9 gallons. Hence the total amount of water must be less than 38.9 gallons to meet the WAPS specification.

7.2 <u>Glass Removal</u> The method of glass removal must remove all visible glass which has adhered to the surface of the canister. When glass is no longer visible on the surface, this area will be photographed for records requirements.

7.3 <u>ICC Demonstration</u> The inner canister closure must be leaktight such that the leak rate for helium gas does not exceed 2×10^{-4} atm cc/sec. For these tests the second measurement of leaktightness must also meet this same specification to demonstrate that the decontamination process does not compromise the integrity of the seal (i.e., the seal remains water-tight). The same specification holds when a repair plug is used.

7.4 <u>Free Liquid, Contents and Pressure</u> The WAPS requires that no free liquid and no organics be present in the closed canisters. It also requires that the internal gas pressure not exceed 7 psig. The pressure will be measured to ensure that it is less than 7 psig. The relative humidity will be measured to ensure that liquid water is not present (i.e., that the vapor space is not saturated with water). Mass spectrometric data will be obtained for molecular weights less that 200 to ensure that no organic compounds are present.

7.5 Temperature Profile The temperature profiles will be generated from the temperature data measured at the various locations by the thermocouples.

7.6 Welding Performance The final weld will be leak tested to ensure that the helium leak rate is less than 1 x 10^{-7} atm cc/sec as required by the WAPS. The burst strength, tensile strength and optical examination of the welds will be performed and the results compared to those obtained from the reference welds made during the parametric welding study.

8.0 QUALITY ASSURANCE REQUIREMENTS

Each participating group will follow their own QA Program. All relevant aspects of these QA Procedures will be followed. The specific details of the quality assurance requirements as they apply to each of the six tests can be found in the individual Test Plans. The specific quality assurance requirements for sectioning by sawing or canister wall removal are given in the Appendix on Glass Sampling. Transfer of canisters for archival storage at the Glass Waste Storage Building will be accomplished through the operating procedures in place for movement of the canister from the weld cell, onto the shielded canister transporter and into the canister supports of the Glass Waste Storage Building. Procedures will be required for the transfer of the canisters to TNX from the DWPF, and for eventual archival storage at TNX.

9.0 REFERENCES

1. Office of Civilian Radioactive Waste Management, **Waste Acceptance Preliminary Specifications of the Defense Waste Processing Facility High-Leve Waste Form,** USDOE Report OGR/B-8, Revision 1, February, 1988.

2. A. L. Applewhite, "**Revised Draft Waste Form Compliance Plan for the Defense Waste Processin Facility,**" DPST-86-746, Revision 7, July 15, 1988.

3. C. H. Payne, "**Cold Run Canister Testing Outline**", OPS-DTA-890006, October, 1989.

4. M. J. Plodinec, "**Glass Sampling Plan**", this report.

5. S. L. Goudelock and C. H. Payne are currently developing the design of this system with EES.

6. J. R. Harbour, "**Thermogravimetric Analysis Measurements of SRL Waste Glass Samples**", WSRC-RP-89-1220, November, 1989.

7. R. E. Edwards et al, "**Summary of Campaign SG 8 of the DWPF Scale Glass Melter**", DPST-87-850, December, 1987.

8. "**Canister Welding Parametric Study Test Plan**", DWPF-WP-25.0.

9. C. H. Payne, "**Cutting of Glass Filled Canisters**" OPS-DTH-890003, September, 1989.

ATTACHMENT #1

	GLASS SAMPLING			CANISTER MODIFICATION						
CAN. NUMBER	GRAB SAMPLE	REMOVE WALL	SAW 3 CUTS	FREE LIQUID	FREE VOLUME	TEMPER. STUDY	ICC DEMO	DTT POUR	WELD DEMO	ARCHIVE CAN.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	NO	NO	[illegible]	[illegible]	[illegible]	[illegible]
2	YES	NO	NO	NO	NO	NO	NO	NO	NO	TNX
[illegible]	[illegible]	[illegible]	[illegible]	NO	NO	NO	NO	[illegible]	[illegible]	[illegible]
4	YES	NO	NO	NO	NO	NO	NO	NO	NO	TNX
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	NO	NO	NO	[illegible]	[illegible]	[illegible]
6	YES	NO	NO	NO	NO	NO	NO	NO	NO	TNX
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	NO	NO	NO	[illegible]	[illegible]	[illegible]
8	YES	NO	NO	NO	NO	NO	NO	NO	NO	TNX
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	NO	NO	NO	[illegible]	[illegible]	[illegible]
10	YES	NO	NO	YES	YES	NO	NO	NO	YES	TNX
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	NO	NO	NO	[illegible]	[illegible]	[illegible]
12 **	YES	NO	NO	YES	YES	NO	YES	NO	YES	TNX
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	NO	NO	[illegible]	[illegible]	[illegible]	[illegible]
14	YES	NO	NO	NO	NO	NO	NO	NO	NO	TNX
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	NO	NO	[illegible]	[illegible]	[illegible]	[illegible]
16	YES	NO	NO	NO	NO	NO	NO	NO	NO	TNX
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	NO	[illegible]	[illegible]	[illegible]	[illegible]
18	YES	NO	NO	NO	NO	NO	NO	NO	NO	GWSB
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
20	YES	YES	NO	NO	NO	NO	NO	NO	NO	TNX
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
22	YES	NO	YES	NO	NO	NO	NO	NO	NO	TNX
[illegible]	[illegible]	[illegible]	[illegible]	NO	NO	NO	[illegible]	[illegible]	[illegible]	[illegible]
24	YES	NO	YES	NO	NO	NO	NO	NO	NO	TNX
TOTALS: 24	24	3	3	3	3	0	1	0	2	5-GWSB 19-TNX

TABLE 1: MELTER CHARACTERIZATION

** - REPAIR PLUG USED ON ICC

ATTACHMENT #1 (cont.)

		GLASS SAMPLING			CANISTER MODIFICATION						
	CAN. NUMBER	GRAB SAMPLE	REMOVE WALL	SAW 3 CUTS	FREE LIQUID	FREE VOLUME	TEMPER. STUDY	ICC DEMO	DTT POUR.	WELD DEMO	ARCHIVE CAN.
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	26	YES	NO	YES	NO	NO	NO	NO	NO	NO	TNX
	[illegible]	[illegible]	[illegible]	[illegible]	NO	NO	NO	[illegible]	[illegible]	[illegible]	[illegible]
	28	YES	NO	YES	NO	NO	NO	NO	NO	NO	TNX
	[illegible]	[illegible]	[illegible]	[illegible]	NO	NO	NO	NO	NO	NO	TNX
	30	YES	YES	NO	NO	NO	NO	NO	NO	NO	TNX
	31	[illegible]	[illegible]	NO	NO	NO	NO	NO	NO	NO	TNX
	32	YES	YES	NO	NO	NO	NO	YES	NO	NO	TNX
	33	YES	YES	NO	NO	NO	NO	NO	NO	YES	TNX
	34	YES	YES	NO	NO	NO	NO	NO	NO	NO	TNX
	35	YES	YES	NO	NO	NO	NO	NO	NO	NO	TNX
	36	YES	YES	NO	NO	NO	NO	NO	NO	NO	TNX
	37	YES	YES	NO	NO	NO	NO	NO	NO	NO	TNX
	38	YES	YES	NO	NO	NO	NO	NO	NO	NO	TNX
	39	YES	YES	NO	NO	NO	NO	NO	NO	NO	TNX
	40	YES	YES	NO	NO	NO	NO	YES	NO	NO	TNX
	41	YES	YES	NO	NO	NO	NO	NO	NO	NO	TNX
	42	YES	NO	YES	NO	NO	NO	NO	NO	NO	TNX
	43	YES	NO	YES	NO	NO	NO	NO	NO	NO	TNX
	44	YES	NO	YES	NO	NO	NO	NO	NO	NO	TNX
TOTALS:	20	20	14	6	0	0	0	2	0	1	20-TNX

TABLE 2: DOPED TEST

ATTACHMENT #1 (cont.)

	GLASS SAMPLING			CANISTER MODIFICATION						
CAN. NUMBER	GRAB SAMPLE	REMOVE WALL	SAW 3 CUTS	FREE LIQUID	FREE VOLUME	TEMPER. STUDY	ICC DEMO	DTT POUR	WELD DEMO	ARCHIVE CAN.
45	[illegible]	[illegible]	[illegible]	NO	NO	NO	NO	NO	NO	TMX
46	YES	NO	YES	NO	NO	NO	NO	NO	NO	TMX
47	[illegible]	[illegible]	[illegible]	NO	NO	NO	NO	NO	NO	TMX
48	YES	NO	YES	NO	NO	NO	NO	NO	NO	TMX
49	[illegible]	[illegible]	[illegible]	NO	YES	NO	NO	NO	NO	TMX
50	YES	YES	NO	NO	NO	NO	NO	NO	NO	TMX
51	[illegible]	[illegible]	[illegible]	NO	NO	NO	NO	NO	NO	TMX
52	YES	YES	NO	NO	NO	NO	NO	NO	NO	TMX
53	[illegible]	[illegible]	[illegible]	NO	NO	NO	NO	NO	NO	TMX
54	YES	YES	NO	NO	NO	NO	NO	NO	NO	TMX
55	YES	[illegible]	NO	NO	NO	NO	NO	NO	NO	TMX
56	YES	YES	NO	NO	NO	NO	YES	NO	NO	TMX
57	YES	[illegible]	NO	NO	NO	NO	NO	NO	NO	TMX
58	YES	YES	NO	NO	NO	NO	NO	NO	NO	TMX
59	YES	YES	NO	NO	NO	NO	NO	NO	NO	TMX
60	YES	YES	NO	NO	NO	NO	NO	NO	YES	TMX
61	YES	[illegible]	NO	NO	NO	NO	NO	NO	NO	TMX
62	YES	NO	YES	NO	NO	NO	NO	NO	NO	TMX
63	YES	NO	YES	NO	NO	NO	NO	NO	NO	TMX
DTT-1	NO	NO	YES	NO	NO	YES	NO	FILL	NO	TMX
64	YES	NO	YES	NO	NO	NO	NO	NO	NO	TMX
TOTALS: 21	20	14	7	1	1	1	1	1	1	21-TMX

TABLE 3: LOW VISCOSITY

ATTACHMENT #1 (cont.)

		GLASS SAMPLING			CANISTER MODIFICATION						
	CAN. NUMBER	GRAB SAMPLE	REMOVE WALL	SAW 3 CUTS	FREE LIQUID	FREE VOLUME	TEMPER. STUDY	ICC DEMO	BTT POUR	WELD DEMO	ARCHIVE CAN.
	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
	66	YES	NO	YES	NO	NO	NO	NO	NO	NO	TNX
	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
	68	YES	NO	YES	NO	NO	NO	NO	NO	NO	TNX
	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
	70	YES	YES	NO	NO	NO	NO	YES	NO	NO	TNX
	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
	72	YES	YES	NO	NO	NO	NO	NO	NO	NO	TNX
	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
	BTT-1	NO	NO	NO	NO	NO	NO	NO	PART.	NO	
	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
	75	YES	YES	NO	NO	NO	NO	NO	NO	NO	TNX
	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
	77	YES	YES	NO	NO	NO	YES	NO	NO	NO	TNX
	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
	79	YES	YES	NO	NO	NO	NO	NO	NO	NO	TNX
	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
	81	YES	YES	NO	NO	NO	NO	NO	NO	NO	TNX
	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
	83	YES	NO	YES	NO	NO	NO	NO	NO	NO	TNX
	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
	84	YES	NO	YES	NO	NO	NO	NO	NO	NO	TNX
TOTALS:	21	20	14	6	1	1	1	1	2	1	20-TNX

TABLE 4: HIGH VISCOSITY

ATTACHMENT #1 (cont.)

		GLASS SAMPLING			CANISTER MODIFICATION						
	CAN. NUMBER	GRAB SAMPLE	REMOVE WALL	SAW 3 CUTS	FREE LIQUID	FREE VOLUME	TEMPER. STUDY	ICC DEMO	DTT POUR	WELD DEMO	ARCHIVE CAN.
	[illegible]	[illegible]	[illegible]	[illegible]	NO	NO	NO	NO	[illegible]	[illegible]	TNX
	86	YES	NO	YES	NO	NO	NO	NO	NO	NO	TNX
	[illegible]	[illegible]	[illegible]	[illegible]	NO	NO	NO	NO	NO	NO	TNX
	88	YES	NO	YES	NO	NO	NO	NO	NO	NO	TNX
	[illegible]	[illegible]	[illegible]	[illegible]	NO	NO	NO	NO	[illegible]	[illegible]	TNX
	90	YES	YES	NO	NO	NO	NO	NO	NO	NO	TNX
	[illegible]	[illegible]	[illegible]	[illegible]	NO	NO	NO	NO	NO	NO	TNX
	92	YES	YES	NO	YES	YES	NO	NO	NO	NO	TNX
	[illegible]	[illegible]	[illegible]	[illegible]	NO	NO	NO	NO	NO	NO	TNX
	94	YES	YES	NO	NO	NO	NO	NO	NO	NO	TNX
	[illegible]	[illegible]	[illegible]	[illegible]	NO	NO	NO	NO	NO	NO	TNX
	96	YES	YES	NO	NO	NO	NO	NO	NO	NO	TNX
	[illegible]	[illegible]	[illegible]	[illegible]	NO	NO	YES	NO	NO	NO	TNX
	98	YES	YES	NO	NO	NO	NO	NO	NO	NO	TNX
	[illegible]	[illegible]	[illegible]	[illegible]	NO	NO	NO	NO	NO	NO	TNX
	100	YES	YES	NO	NO	NO	NO	NO	NO	NO	TNX
	[illegible]	[illegible]	[illegible]	YES	NO	NO	NO	NO	[illegible]	NO	TNX
	101	YES	YES	NO	NO	NO	NO	YES	NO	NO	TNX
	[illegible]	[illegible]	NO	YES	NO	NO	NO	NO	NO	NO	TNX
	103	YES	NO	YES	NO	NO	NO	NO	NO	NO	TNX
	[illegible]	YES	NO	YES	NO	NO	NO	NO	NO	NO	TNX
TOTALS:	20	20	14	7	1	1	1	1	1	1	21-TNX

TABLE 5: MERCURY PLUS BLEND 1

ATTACHMENT #1 (cont.)

		GLASS SAMPLING			CANISTER MODIFICATION						
	CAN. NUMBER	GRAB SAMPLE	REMOVE WALL	SAW 3 CUTS	FREE LIQUID	FREE VOLUME	TEMPER. STUDY	ICC DEMO	DTT POUR	WELD CLOSE.	ARCHIVE CAN.
	105	[illegible]	NO	NO	NO	NO	NO	NO	NO	NO	GW/SB
	106	YES	NO	NO	NO	NO	NO	NO	NO	NO	GW/SB
	107	[illegible]	NO	NO	NO	NO	NO	NO	NO	NO	GW/SB
	108	YES	NO	NO	NO	NO	NO	NO	NO	NO	GW/SB
	109	YES	NO	NO	NO	NO	NO	NO	NO	NO	GW/SB
	110	YES	NO	NO	NO	NO	NO	NO	NO	NO	GW/SB
	111	YES	NO	NO	NO	NO	NO	NO	NO	NO	GW/SB
	112	YES	NO	NO	NO	NO	NO	NO	NO	NO	GW/SB
	113	YES	NO	NO	NO	NO	NO	NO	NO	NO	GW/SB
	114	YES	NO	NO	NO	NO	NO	NO	NO	NO	GW/SB
	115	YES	NO	NO	NO	NO	NO	NO	NO	NO	GW/SB
	116	YES	NO	NO	NO	NO	NO	NO	NO	NO	GW/SB
	117	YES	NO	NO	NO	NO	NO	NO	NO	NO	GW/SB
	118	YES	NO	NO	NO	NO	NO	NO	NO	NO	GW/SB
	119	YES	NO	NO	NO	NO	NO	NO	NO	NO	GW/SB
	120	YES	NO	NO	NO	NO	NO	NO	NO	NO	GW/SB
	121	YES	NO	NO	NO	NO	NO	NO	NO	NO	GW/SB
	122	YES	NO	NO	NO	NO	NO	NO	NO	NO	GW/SB
	123	YES	NO	NO	NO	NO	NO	NO	NO	NO	GW/SB
	124	YES	NO	NO	NO	NO	NO	NO	NO	NO	GW/SB
TOTALS:	20	20	0	0	0	0	0	0	0	0	20-GW/SB

TABLE 6: RADIOACTIVE SPIKE

TEST	RUN #1	RUN #2	RUN #3	RUN #4	RUN #5	RUN #6	TOTALS
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
GRAB SAMPLE	24	20	20	20	20	20	124
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
REMOVE WALL	3	14	14	14	14	0	59
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
FREE VOLUME	3	0	1	1	1	0	6
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
DTT POUR	0	0	1	2	1	0	4
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
WELD CLOSURE DEMO	2	1	1	1	1	0	6
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
ARCHIVE - THX	19	20	21	20	21	0	101

TABLE 7: TOTALS FOR TESTS

TEMPERATURE STUDY		
TEST #	RUN #	*LOC.
[illegible]	[illegible]	[illegible]
2	4	PTT
[illegible]	[illegible]	[illegible]

TABLE 8: TEMPERTURE STUDY TESTS

* DTT = DRAIN TURNTABLE
INS = INSULATED STORAGE IN MELT CELL
PTT = POUR TURNTABLE

DTT POUR			
TEST #	RUN #	TYPE	CAN. #
1	3	FILL	[illegible]
2	4	PART	2
3	6	PART	[illegible]
4	5	PART	2

TABLE 9: DTT POURS

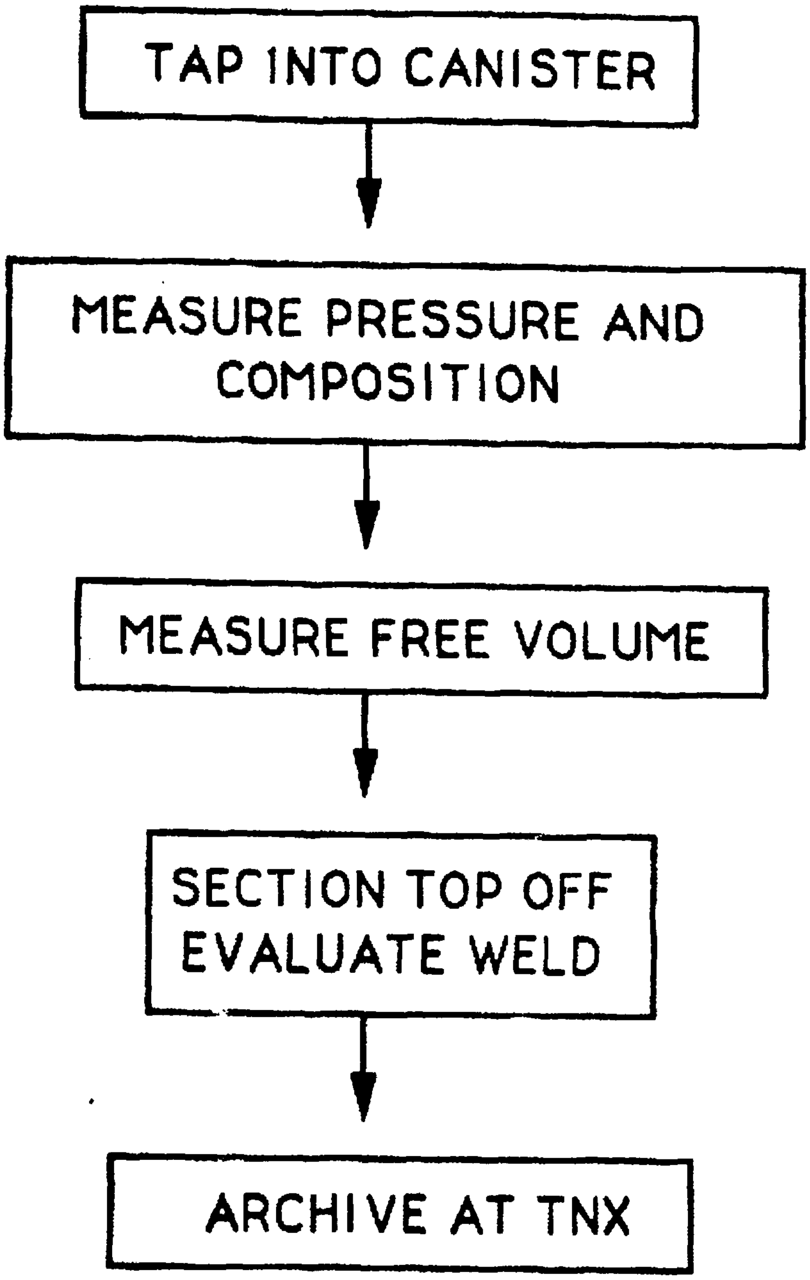

FIGURE 1. CANISTER #10

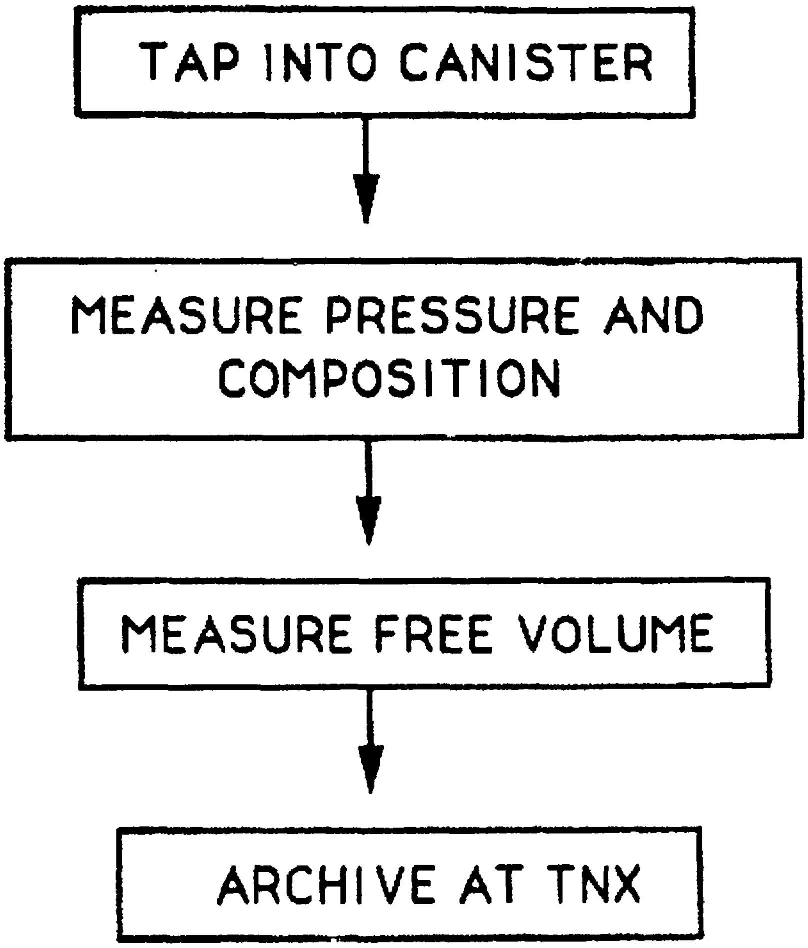

FIGURE 2. CANISTER #17

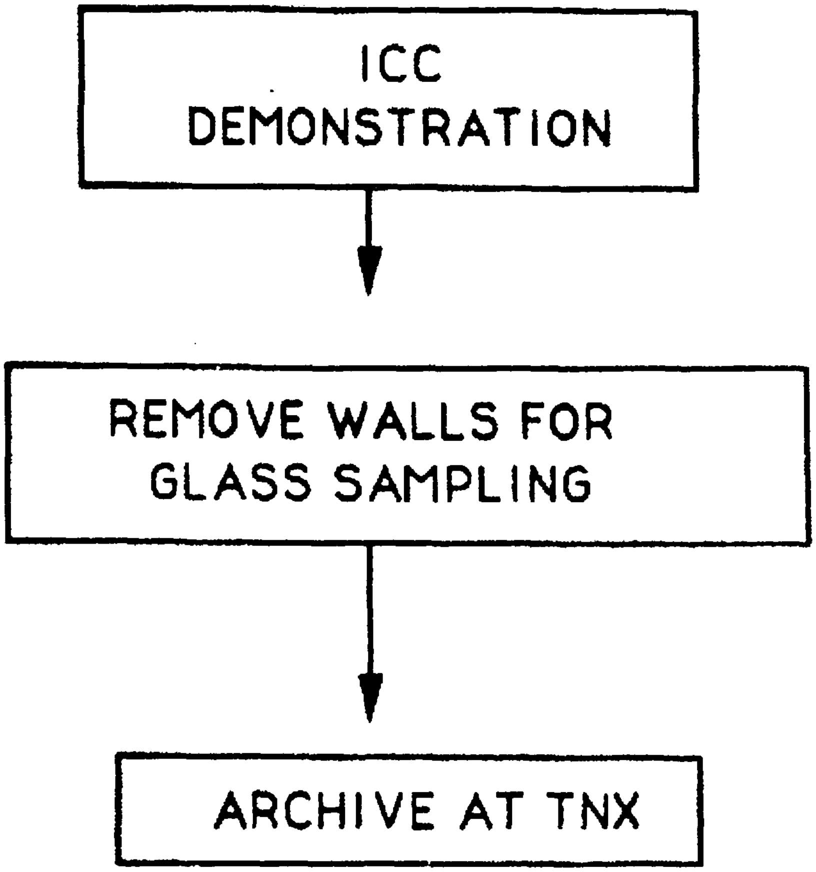

FIGURE 3. CANISTERS *32, 40, 56, 70, AND 101

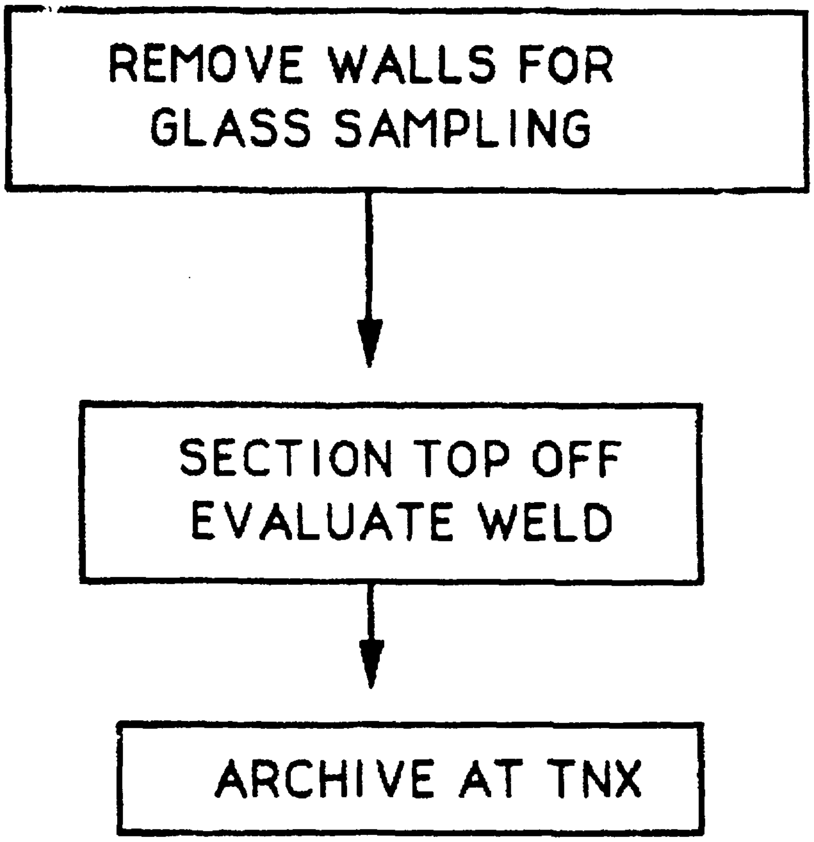

FIGURE 4. CANISTERS #33, 60, 73, AND 89

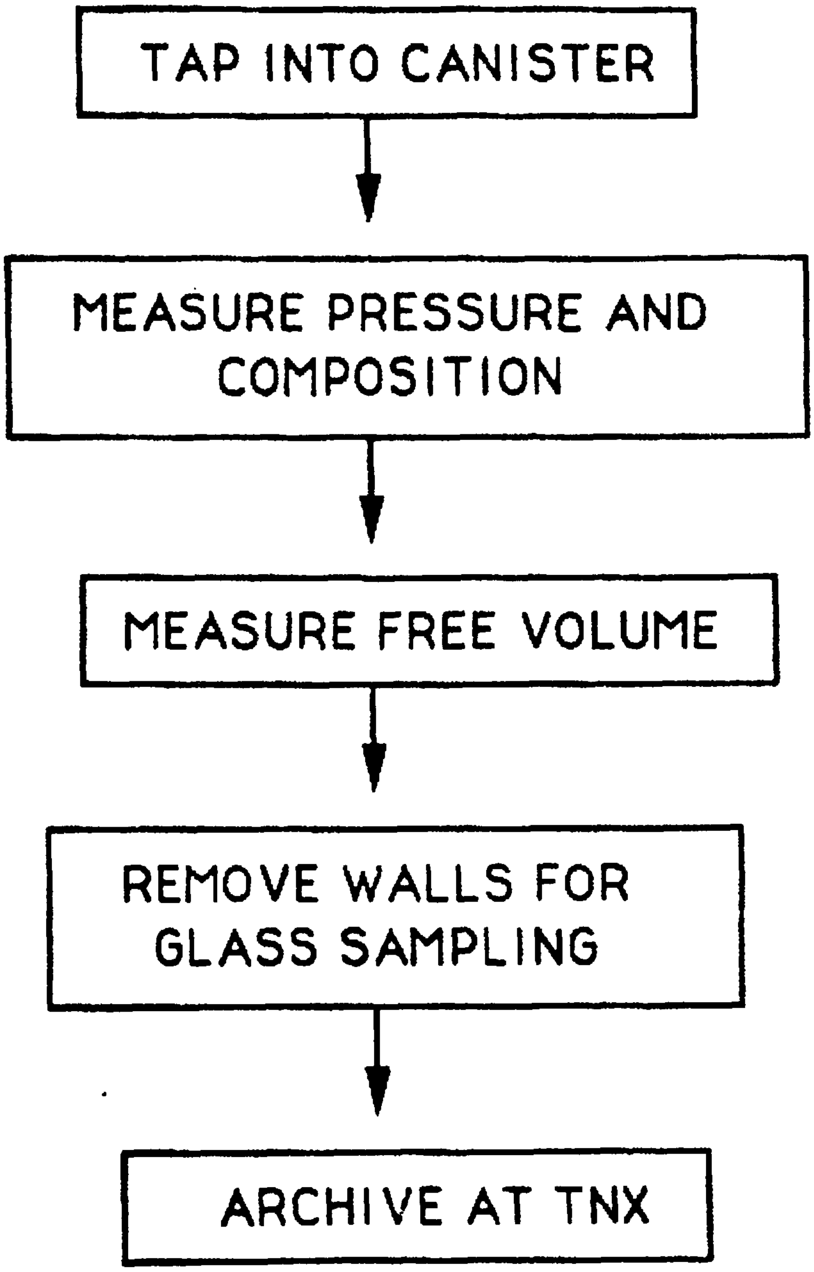

FIGURE 5. CANISTERS 49, 74, AND 92

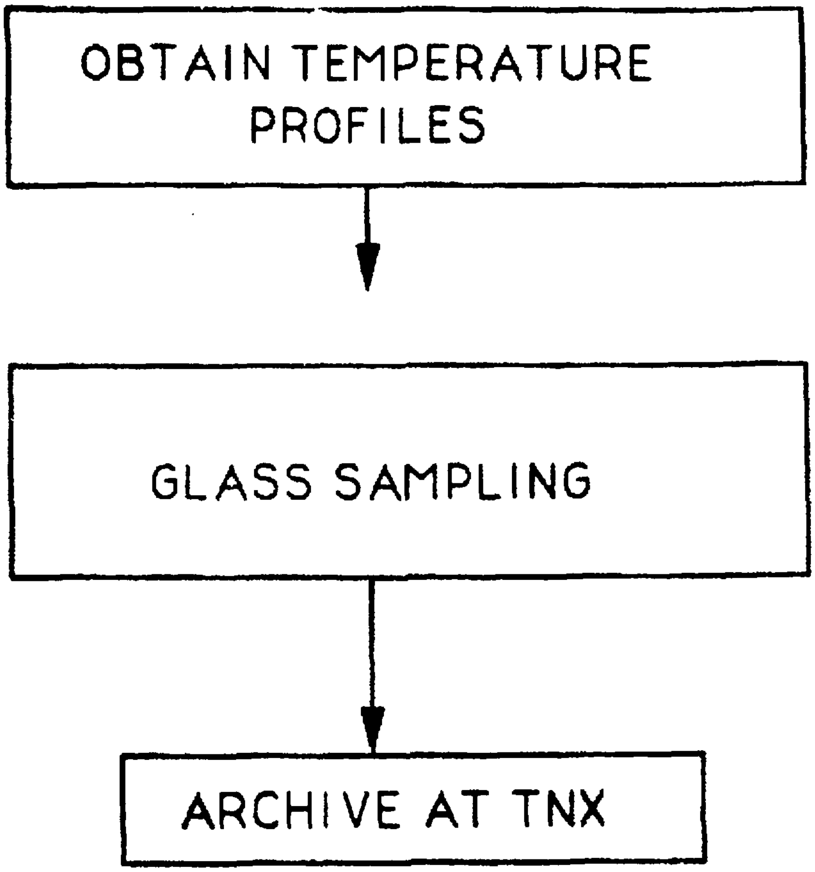

FIGURE 6. CANISTERS 77, DTT-1, AND 97

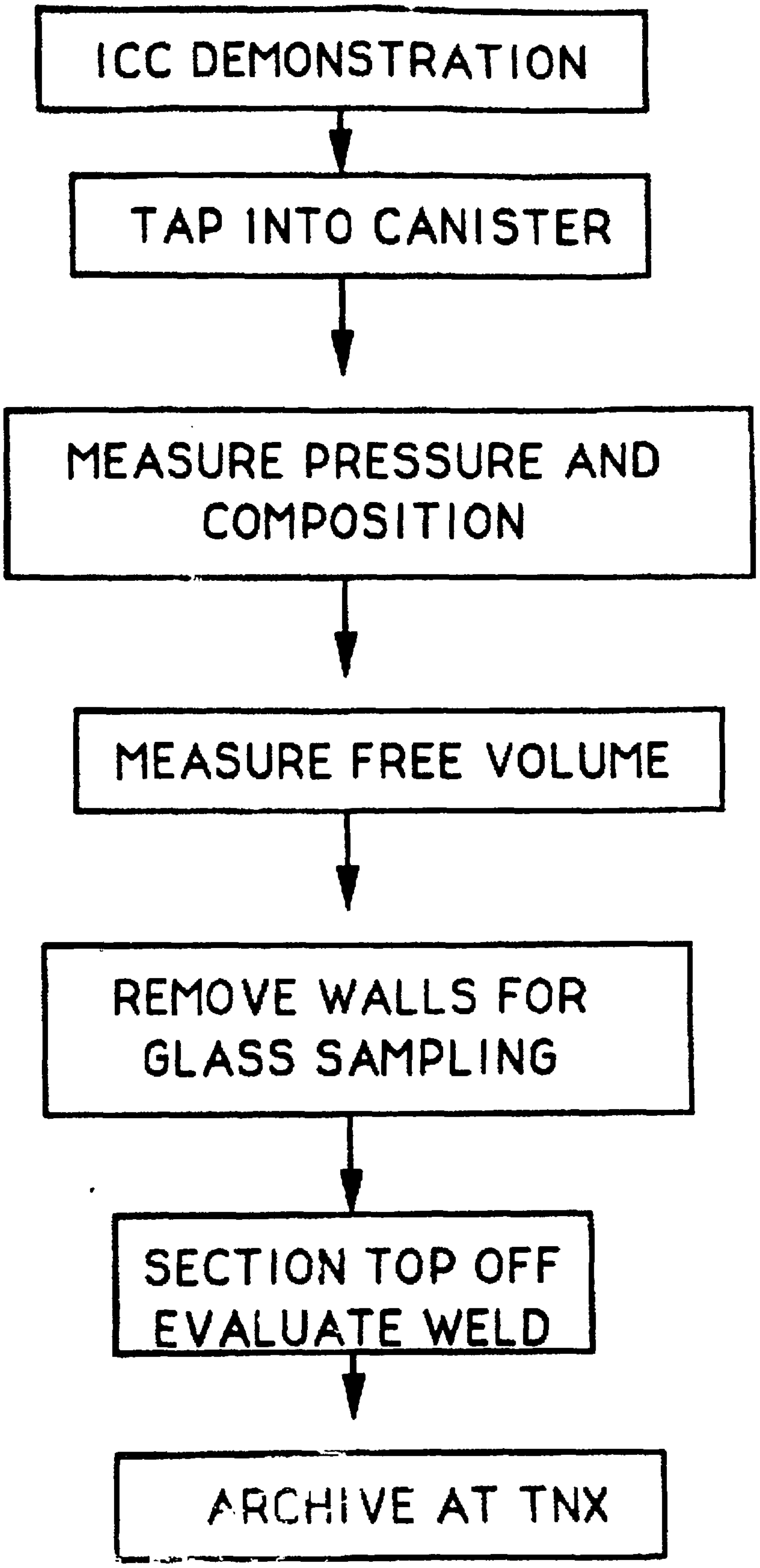

FIGURE 7. CANISTER WITH REPAIR PLUG

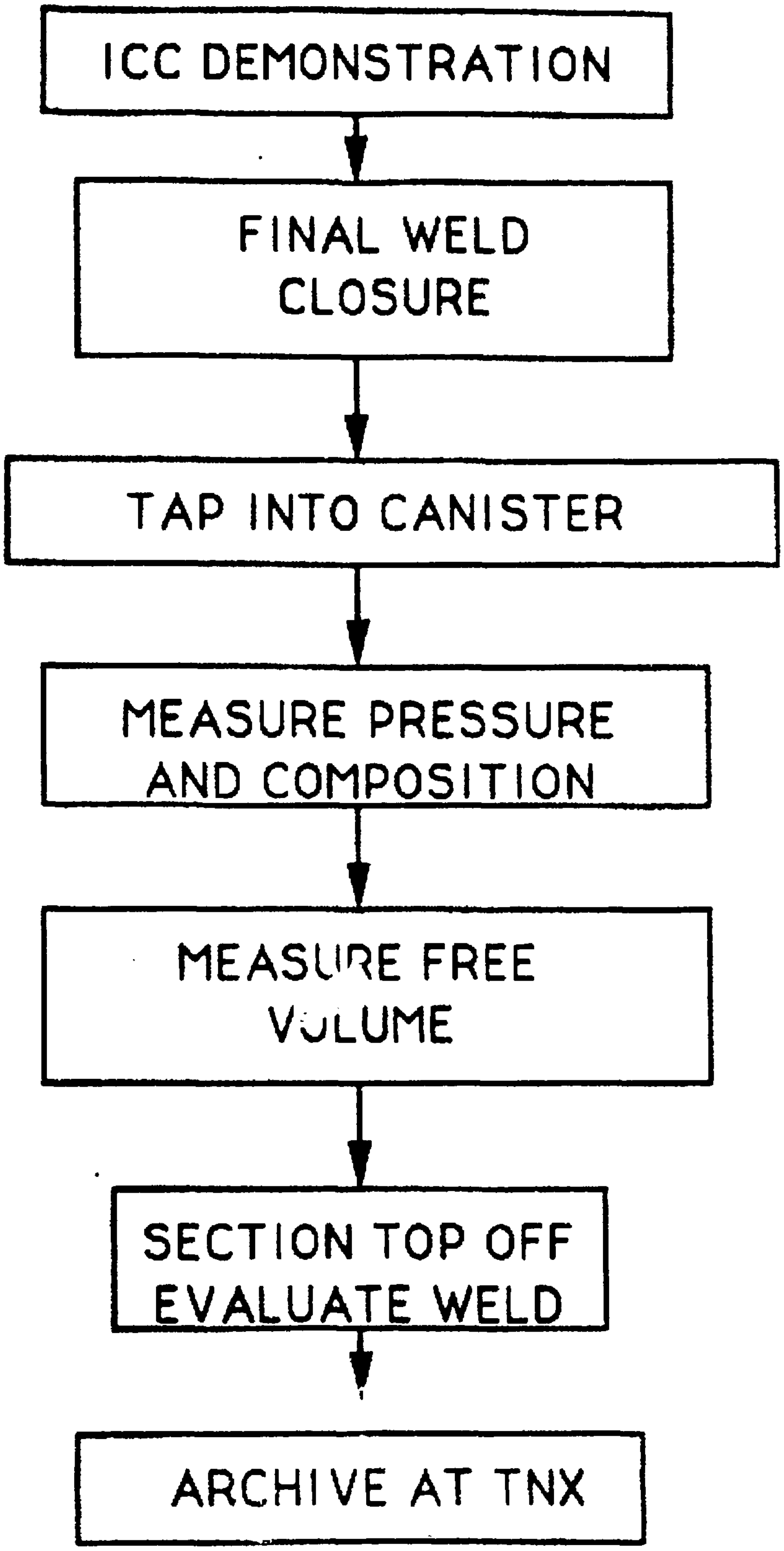

FIGURE 8. CANISTER # 12