SUMMARY REPORT ON THE DESIGN OF THE RETAINED GAS SAMPLER SYSTEM (RETAINED GAS SAMPLER, EXTRUDER AND EXTRACTOR)

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TABLE OF CONTENTS

LIST OF FIGURES

1.0 SUMMARY

This document summarizes work performed in Fiscal Year 1994 to develop the three main components of Retained Gas Sampler System (RGSS). These primary components are the Retained Gas Sampler, Extruder, and Extractor (RGSE&E).

1.1 Purpose

The Flammable Gas Watch List (FGWL) consists of six (6) double-shell tanks (DST) and nineteen (19) single-shell tanks (SST), which have the capability of generating, retaining, and suddenly releasing flammable gases, such as hydrogen and nitrous oxide. These flamable gas watchlist DSTs and SSTs are identified in Appendix 1. Sudden releases of flammable gas mixtures are a safety concern for normal waste storage operations and eventual waste retrieval. The RGSS is being developed by Westinghouse Hanford Company (WHC) to extract a representative waste sample from a FGWL DST and to measure both the amount and composition of free and "bound" gases.

1.2 Hardware Design

The RGSS consists of three main components: the Retained Gas Sampler (RGS or sampler), the Retained Gas Extruder (RGE or extruder), and the Retained Gas Extractor (RGEx or extractor). The RGS is based on the WHC Universal Sampler design, and includes modifications to reduce gas leakage. The modifications include incorporating an additional O-ring seal on the RGS piston, using a double O-ring cable piston seal, and welding the valve housing to the RGS housing. The RGE is a new device specially designed for the RGSS for extruding the waste material from the RGS into the RGEx. The RGEx is being developed to extract the gas (both free and bound) from the waste sample. Gas will be removed from the waste sample in the RGEx by the following methods: (1) mechanical stirring, (2) thermal treatment, and (3) dilution. The Extractor will be instrumented and the gas will be removed in stages to aid in characterizing the gas retention properties of the sample.

1.3 Testing

Flow visualization testing was used to identify important fluid dynamic issues related to the sampling process. A transparent fluid with a yield stress and viscosity in the range of actual tank waste was used. This allowed gas bubbles of up to 25 mm (1 in.) in diameter to be retained. These tests indicated that a 60 degree drill string tip provided the best gas collection efficiency.

Helium leak rate testing was used to identify those parts of the RGS that were susceptible to gas leaks. This information was used to modify the RGS piston and cable attachment to improve gas retention capabilities.

Preliminary gas extraction testing is being used to determine the system factors that affect quantitative mass transfer. Operation characteristics being investigated include condenser utilization; gas flow rates; pump cycle frequency; displacement pump operation; gas sample transfer and analysis technique; position and tolerance of pressure transducers; and carrier gas chemistry, pressure, and flow rate. Two "standardized" gas mixtures have been used for testing, one with thirty percent (30%) hydrogen and the other with thirty percent (30%) nitrous oxide.

1.4 Requirements

The primary data priorities for the RGSS are to measure the void fraction and the flammable gas concentration in the waste sample. Goals of twenty percent (20%) relative uncertainty for void fraction and nitrous oxide concentration measurements appear to be within reach. A goal of three percent (3%) relative uncertainty for hydrogen concentration may require that the RGS gas sample be tested within seven (7) hours of sampling. A full mockup of the RGS apparatus will be assessed using known gas standards to verify that errors from all sources remain within desired uncertainty limits. A set of functional requirements for the RGSS components (RGS, RGE, and RGEx) have been compiled and are used to guide the component development.

1.5 Safety Analysis

The safety analysis for the RGSS is being performed by Los Alamos National Laboratory (LANL) and is more than sixty percent (60%) complete. It will be provided as an addendum to the safety assessment for the 241-SY-101 tank mixer pump.

1.6 Work in Progress

Significant progress has been made in developing the RGSS. The design of the RGS is complete, components have been fabricated and tested, and units for final testing have been fabricated. The design of the RGE also has been completed, and it is ready for fabrication. Detailed design of the RGEx depends on the results of development testing, which is in progress. Project work remaining includes functional testing of the RGS, RGE, and RGEx components with waste simulants, including the recovery of known quantities of retained gas.

2.0 INTRODUCTION

2.1 Problem Description

The radioactive liquid waste contained in Hanford storage tanks produces hydrogen through radiolysis of water and other hydrogenous compounds. Other gases, such as nitrous oxide and ammonia, are believed to form primarily from organic complexant chemical degradation reactions and to some extent from radiolysis mechanisms. Waste stored in Hanford FGWL tanks also has the ability to store these gases and suddenly release them in periodic "gas release events". Gases released periodically from tank 241-SY-101 were primarily hydrogen (H_2), nitrogen (N_2), and nitrous oxide (N_2O). Hydrogen mixed with an oxidizer is flammable over concentrations ranging from 4 to 75 volume percent. This has lead to numerous safety and operational concerns, including the potential for accidental release of the tank contents to the environment (Estey, 1992).

Historically, Tank 241-SY-101 released thousands of cubic meters of gas to the dome space about every one hundred days, until the mixer pump was installed. Such gas release events have on occasion been very violent and resulted in gas mixtures above the 4 volume percent lower flammability limit. Currently, the amount of gas released during a gas release event is calculated based on the tank volume change (i.e., variations in liquid level), while the gas composition is determined by analysis of gas in the dome space. The amount of gas remaining in the waste after a gas release event, however, is still unknown. During the April 1990, unusually large gas volumes were liberated. As a result, tank pressure rose above atmosphere conditions, while the waste surface elevation dropped 23.62 centimeter (9.3 inch). This behavior in 241-SY-101 suggested the presence of two distinct fluid layers. An upper conductive layer where gas was formed and released on a continuous basis, and a lower non-convective layer where gas was retained in greater amounts and released periodically. Prior to pump operation, the average non-convective layer void fraction was estimated to be 19%, with localized values as high as 35%. In addition, the hydrostatic pressure could produce an axial void fraction gradient in the non-convective layer of 4 to 10%.

The current operation of the mixer pump in 241-SY-101 has altered the gas release/retention behavior. The waste level has remained fairly stable and gases are being released at approximately the same rate they are generated. It is speculated that mixer pump operation has homogenized tank contents, resulting in two convective layers and distinctive unmixed regions in the tank, where local gas concentrations may be higher than the average. Although the retained gas values are still unknown, the average void fraction is estimated at 3 volume percent, with variations depending on individual convective layer characteristics and hydrostatic head.

Other FGWL tanks exhibit similar, but less extreme cyclic variations of surface levels. Tank 104-AN shows surface level variations of 7.6 to 20.3 centimeters (3 to 8 inches) with a period of about one year. Tanks 105-AN, 103-SY, and 101-AW exhibit 2.5 to 5.0 centimeter (1 to 2 inch) surface variations with periods ranging from six to twelve months.

Tank 103-AN shows minimal cyclic behavior and only a slight increase in surface elevation of 1.25 centimeter (0.5 inch) per year since 1990.

Finally, other SSTs may be storing gas without evidence of release, such as those exhibiting slurry growth or level changes that correlate with atmospheric pressure changes.

Sampling of the waste in Hanford single and double shelled tanks is required to support characterization of the wastes under the Resource Conservation and Recovery Act (RCRA). Resolution of tank safety issues, and development of tank waste retrieval techniques are also requirements of the Hanford Federal Facility and Consent Order, an agreement between Washington State, the U.S. Department of Energy (DOE), and the U.S. Environmental Protection Agency (EPA).

2.2 Approach

The amount and constituents of gas stored in Hanford waste tanks are needed to address the flammable gas safety issue. Measurement of the stored gas in Hanford waste tanks will provide better hazards evaluations and may allow tanks to be removed from the FGWL. Current methods for determining the gas content of FGWL waste tanks rely on indirect measurements of the volume of stored gas. The RGSS is being developed to provide a direct measurement of the void gas content, total gas content including dissolved and adsorbed gases, and the gas constituents in a waste sample.

The RGSS contains two major subsystems: 1) a "sampler device" to be inserted into a FGWL_DST that is capable of capturing and isolating part of the stored waste; and 2) laboratory equipment ("extraction device or system") to remove, measure, and analyze the gaseous constituents of the waste.

The initial scope and work plans for the development of the RGSS were described in Birney 1993. The approach consisted of developing a prototype RGSS and then a full-scale RGSS. The prototype RGSS will be tested in a mock-up of a Hanford waste tank with a waste simulant, and sample analysis equipment will be tested in a hot-cell mock-up. Lessons learned from these tests will be factored into the full-scale RGSS design, which will be subjected to acceptance testing to prove that the system is deployable in a FGWL tank.

Major development tasks for the RGSS include: 1) development of design requirements and data quality objectives; 2) identification of gas sampling and analysis components; 2) modification of laboratory techniques and equipment; 3) modification of sampling equipment and field activities to obtain waste sample; 4) extraction of gas sample from waste obtained from a FGWL tank; and 5) sample analysis.

3.0 REQUIREMENTS

3.1 Functions

Functional design requirements for the RGSS components: the RGS, the RGE, and the RGEx, have been developed as the function and design of the system has matured. The early requirements by Wootan (1993a) were used to evaluate alternatives and develop a conceptual design. These were further developed in Bridges (1993) as the conceptual design was developed into a prototype design. The full scale requirements have now been documented by Bolden (1994).

3.1.1 The RGS has the following three primary functions:

- Capture a representative waste sample from a FGWL tank;
- Transport the captured waste sample with minimal loss of gas content from the tank to the analysis laboratory;
- Interface with other components to transfer waste sample from the RGS to the Extractor for processing.

3.1.2 The RGE has one primary function:

- Interface with other components to transfer waste sample from the RGS to the RGEx for processing.

3.1.3 The RGEx has six primary functions:

- Perform preliminary testing to determine gas void fraction of waste sample;
- Remove and analyze "free gas" volume and composition;
- Release existing "trapped gases";
- Measure temperature and pressure;
- Heat and cool sample;
- Mix sample.

The Sampler shall be compatible with the waste material in a FGWL tank: hydrostatic head of ~ 0.20 MPa (29.4 psia), temperatures of ~ 65 °C (150 °F), maximum viscosity of 1.0e+05 cP (roughly the consistency of peanut butter), radiation field of ~ 10 Gy/hr (1000 rad/hr), and pH = 14.

The RGSS will attempt to obtain representative samples of waste from a FGWL tank, but this should not be interpreted to mean that a representative sample is representative of the entire tank contents or of any entire layer contained in a tank. Multiple samples would be required to achieve "representative sample" status for even one layer of waste in a tank. Constraints of funding and riser availability preclude obtaining a truly representative sample.

3.2 Data Priorities and Uncertainties

Feedback from potential users of the data generated by the RGSS have been obtained regarding data priorities and desired uncertainties (Wootan 1994c, Pederson 1994, Allemann 1993, Alzheimer 1993). Major sources of uncertainty have been identified and quantified.

3.2.1 Computer Models and other Analyses

TEMPEST (Trent 1990) computer models and other analyses are used to predict the amount of trapped gas remaining in a tank after a gas release event. These computer models require numerous assumptions to be made about waste properties, so that they can predict the size and number of gas bubbles. Uncertainties are associated with the amount of gas which remains trapped in the waste after a gas release event. The analytic gas release models are refined based on measured tank data, such as the observed drop in the waste liquid level. To help calibrate the models further, data is needed on the amount of gas trapped in the waste. Calibration of these models with measured data will allow a reduction in current conservatism in safety assessments and in work control operational limits. Measurements of the stored gas in other tanks will provide better hazards evaluations and may allow tanks to be removed from the FGWL.

Waste sample data required of the RGS includes the void gas content, total gas content including dissolved gases, and the gas constituents. The amount of gas stored in the waste is the primary parameter for safety analyses. Measurement of the dissolved and tightly bound gas content is needed to determine the total potential release for safety analyses. Measurements of the free gas will identify the gases participating in normal gas releases. Measurements of gas in solution and tightly bound gas attached to particles will provide the total gas volume. Measurement of the primary gas constituents will also reduce conservatism in the safety assessments.

It is not clear why liquid waste storage tanks retain gases while others do not. The analysis of FGWL waste tank samples with the retained gas "intact" should allow a better understanding of this behavior.

3.2.2 Sources of Uncertainty

Uncertainties in the RGS measurement of gas content and composition will be contributed by the waste sampling process, the gas extraction process, and the gas analysis process.

The waste sampling process uncertainty contributions include sample representativeness, waste disturbance effects, partial filling of the sampler, gas loss during transportation from the tank to the laboratory, and temperature effects.

The gas extraction process uncertainty contributions include temperature effects, pressure effects, extraction efficiency, instrumentation error, sample dilution effects, undetected contamination, and leaks. The changes in temperature and pressure will alter the soluble gas concentration, so that measured gas concentrations must be corrected to reflect the tank

conditions. The efficiency of the gas extraction process for releasing all of the soluble gases such as ammonia must also be characterized.

3.2.3 Desired Uncertainties

The approximate primary gas composition of tank 241-SY-101 samples and desired uncertainties are shown in the following table:

Gas Type	Chemical Symbol	Estimated Percent of Total	Desired Uncertainty
Hydrogen	H_2	30	3
Nitrogen	N_2	30	20
Nitrous Oxide	N_2O	30	20
Water Vapor	H_2O	5	NA
Ammonia	NH_3	5	20

The highest priority parameters are the void fraction and the hydrogen content. For the general case of void fractions ranging from 0% to 35%, a 2% absolute uncertainty would be the minimum to calibrate models of tank behavior. For the specific case of the present status of 241-SY-101 with the mixer pump operating, the expected void fraction is about 3% with ~ 100% relative uncertainty. Under these conditions, a target of 20% relative uncertainty is desired. A single point measurement would be the minimum needed to calibrate models.

Hydrogen constitutes about 30% of the gas, and the current estimated absolute uncertainty is about 5%. To provide a significant improvement, this would need to be reduced to 1% absolute uncertainty. Nitrous oxide and nitrogen are the other major gas components, and a target relative uncertainty of 20% is desired. Ammonia will be found in solution as well as in the gas, and is expected to be about 5% of the gas. A reasonable target for total ammonia is 20% relative uncertainty. A relative uncertainty of 100% was suggested as probably sufficient for the other gas constituents.

The hydrogen accuracy requirement (goal 3%) is the most demanding. The Sampler volume is planned at ~ 310 cm^3 (18.9 in^3). With a 3 % void fraction at 0.25 MPa (36.8 psia), the gas sample volume would expand to ~ 25 cm^3 (1.53 in^3) at 0.10 MPa (14.7 psia).

Assuming that 25 cm^3 (1.53 in^3) of gas sample will be available, and using conservative assumptions, the RGS gas sample will need to be tested or stored within seven hours of sampling in order to meet a 3% accuracy for the hydrogen measurement.

To verify that errors from all sources remain within goals, a full mockup (including a gritty waste simulant artificially injected with a known gas mix) of the RGS apparatus will be completed and used to measure known gas standards.

4.0 EVALUATION OF ALTERNATIVES

4.1 LITERATURE AND VENDOR SEARCH

A literature search was conducted for commercial or experimental sampler devices that could be used as a Sampler with little or no modification. This literature search included published articles, new product announcements, and patents. No off-the-shelf device was found that would meet the sampling requirements of the RGSS (Wootan 1993b).

Additionally, contact (telephone or personal visit) was made with numerous companies, universities, institutes, and national laboratories involved in developing or using sampling devices in the fields of oceanography, petroleum and geothermal exploration, environmental monitoring and remediation, and sea floor mining. The sampling devices identified in this activity ranged from simple fluid samplers (water, oil) to complex geothermal well samplers. The simple fluid samplers were either unsealed or used springs to close caps at the ends of the collection bottle. They are not suitable for sampling materials with high viscosity. The more complex devices were similar in function to the WHC Universal Sampler (H-2-85097, Rev. 2). While these devices are designed for the higher pressures encountered in ocean floor, oil field, or geothermal environments, they would be difficult to adapt to the RGS sampling requirements and showed no significant advantage over the WHC Universal Sampler.

Oceanographic Samplers: A variety of sampling devices are used in the field of oceanography to collect water and sediment samples . The water samplers are generally similar to Niskin bottles (Figure 4.1-1), which rely on springs or elastic bands to close the ends of a collection tube. These devices can take fluid samples containing gases. They are inexpensive and widely available, but allow small amounts of fluid or gas to escape during retrieval, and are not well suited to sampling viscous material. Sediment samplers are generally open ended corers and do not seal the sample (see Figure 4.1-2). Both the Ocean Drilling Program and the Texas A&M University Oceanography Department are developing large and rugged sediment coring devices that can be used to take gas-tight samples from beneath the ocean floor. Both use ball valves to seal the sample. The operation of these devices is similar to the existing WHC Universal Sampler.

Figure 4.1-1 Niskin Bottles

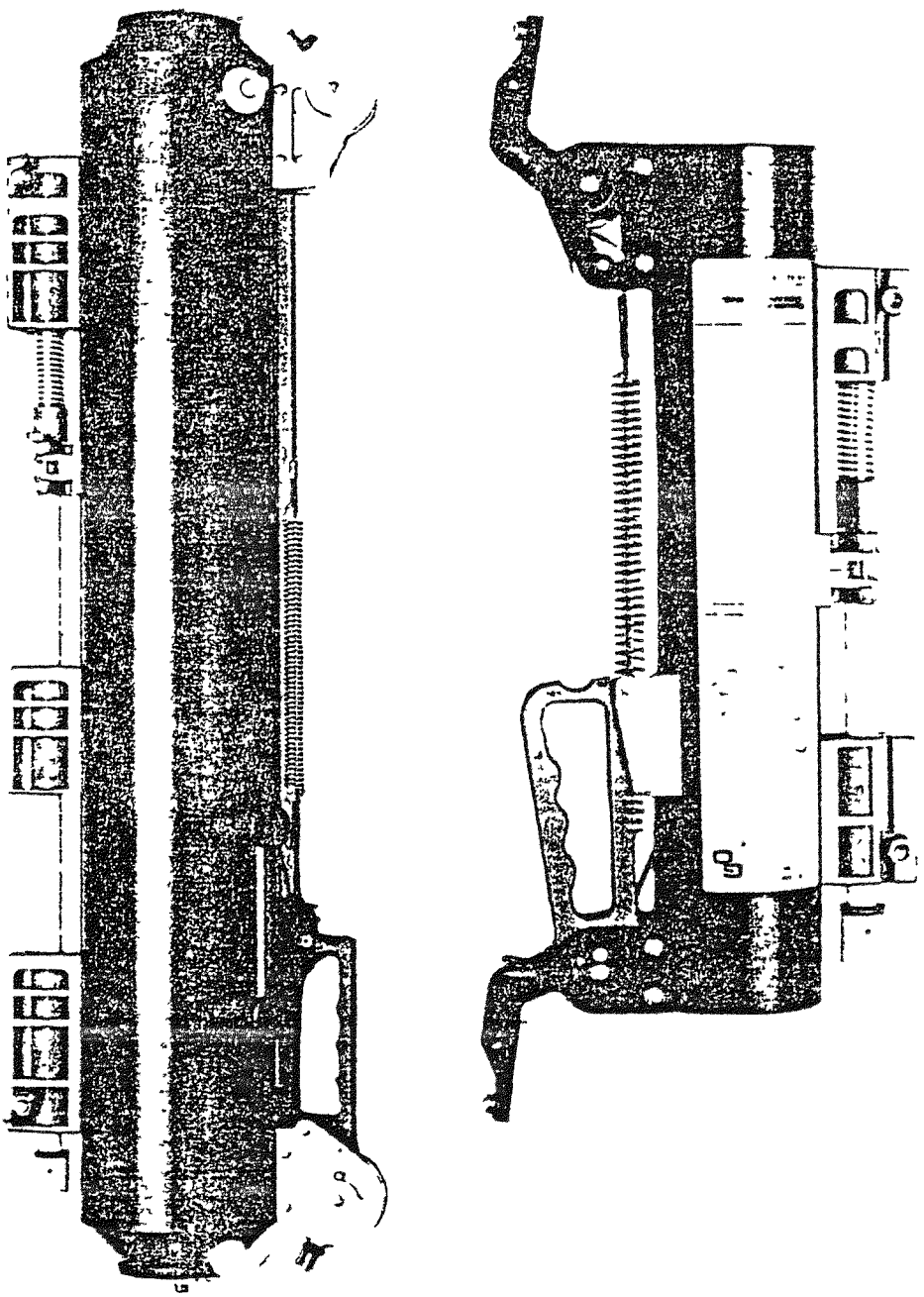
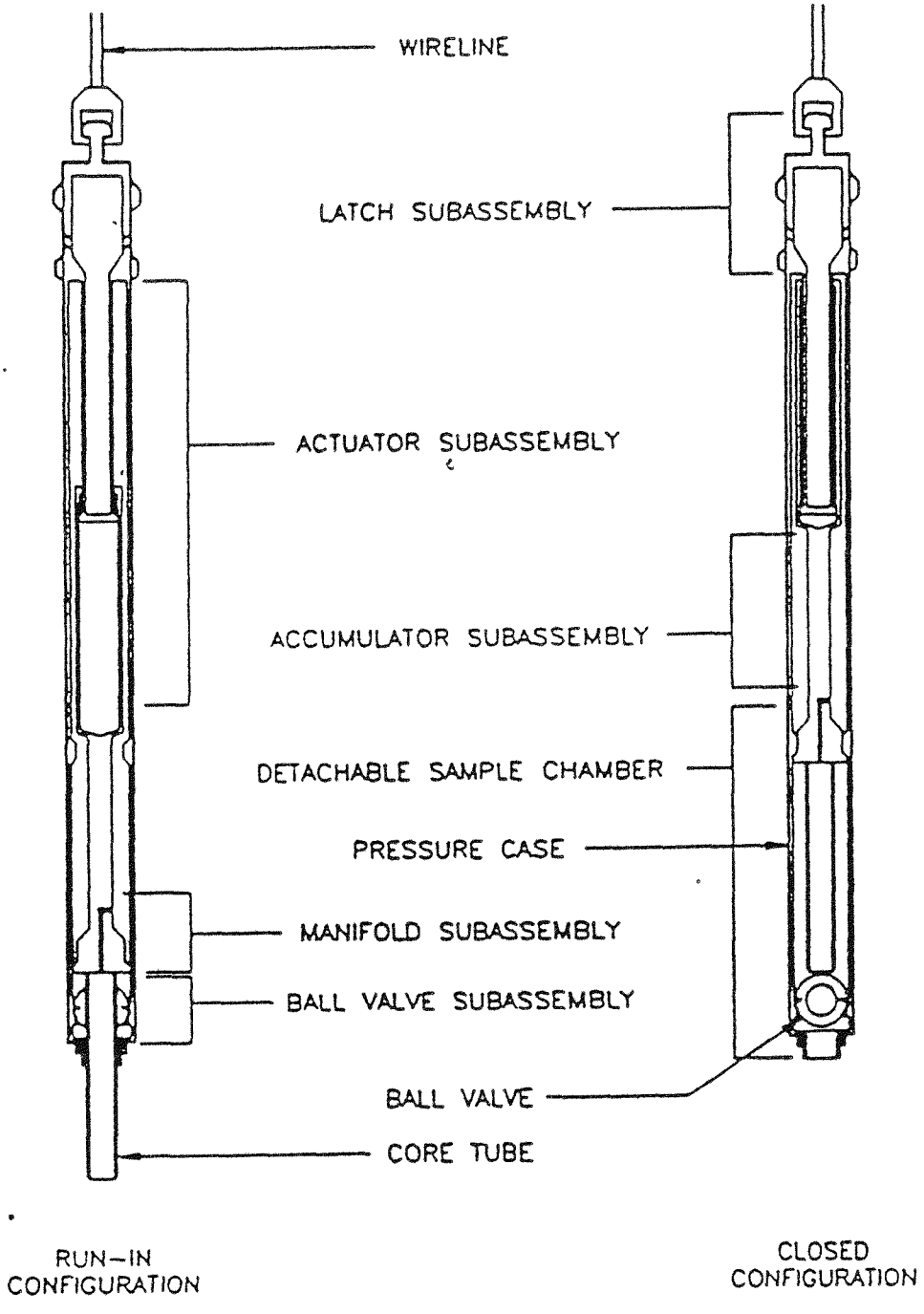


Figure 4.1-2 Sediment Sampler (Open ended corer)



Petroleum Samplers: The petroleum industry uses a variety of devices for taking samples in oil wells. Companies such as Slumberger, Kuster, and Leutert make fluid samplers that can take oil well fluid samples at high pressure and temperatures (see Figure 4.1-3). These devices generally rely on the in situ pressures to force fluids into the sample container through small openings. The relatively small openings and reliance on outside pressure to fill the sampler make it difficult to sample viscous materials, and would introduce significant disturbance to the sample. These devices generally use plunger valves to seal the sampler. In addition to petroleum wells, the Kuster and Leutert devices have also been used in sampling geothermal wells under corrosive conditions. Los Alamos National Laboratory has modified the Leutert sampler to improve corrosive resistance.

Environmental Samplers: Many companies are involved in environmental sampling and ground water monitoring and remediation, and use a number of different devices to collect soil, water, and gas samples. Gas and water samples are collected through pumping or collection bottles. Soil samples are taken through coring and generally are not sealed. None of the devices explored were capable of sampling viscous material while containing gases in a waste tank environment (see Figure 4.1-4).

Gas Extraction: In addition, efforts were also made to identify existing technologies that could be used for extracting gas from the waste sample once it has been collected. One device identified as having potential for this application was the modified Van Slyke apparatus used at Argonne National Laboratory. Figure 4.1-5 is a schematic of the Van Slyke apparatus. The Van Slyke apparatus has been used for many years to extract gases from solutions and delivering them to analytical instruments for analysis. It has been used at Argonne National Laboratory to successfully separate gases such as hydrogen (H_2), nitrogen (N_2), nitrous oxide (N_2O), and oxygen (O_2) from waste simulants to study the gas generation mechanisms in waste tank material. The device performed well for the separation of the gas phase components from solutions of waste tank simulant (Meisel 1993).

A trip was made to Argonne National Laboratory and observations were made of the Van Slyke apparatus in operation (Hey 1994a). A sample solution is introduced into a chamber closed to the atmosphere with no head space volume. A head space volume is then created by using mercury to displace the volume of the chamber, and then draining the mercury from the chamber, effectively increasing the chamber volume. Solvents are added to the solution to release the dissolved gasses into the head space volume. The volume of the chamber is then decreased by returning the mercury to the chamber and the accumulated head space gases are transferred to the analytical instrumentation for analysis. One apparent limitation was that only solutions or very dilute slurries could be introduced into the Van Slyke apparatus. Thus, Hanford waste tank samples would require pre-treatment such as dilution or filtration. Since free gases would be released from the sample during dilution or filtration, steps would be needed to ensure the collection of these gases, and ensure atmospheric integrity.

Figure 4.1-3 Subsurface Sampler

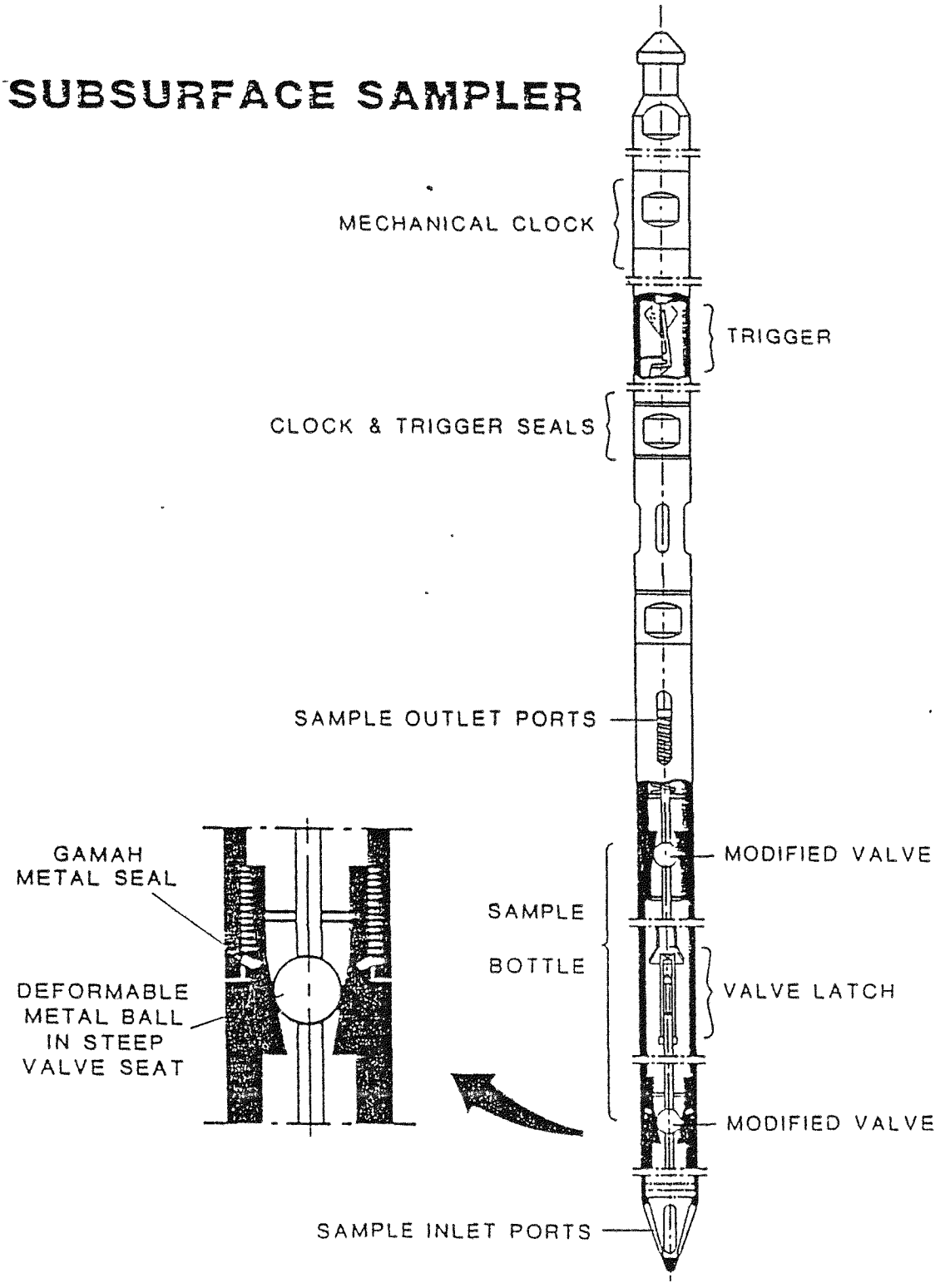


Figure 4.1-4 Typical Soil Sampling Probe

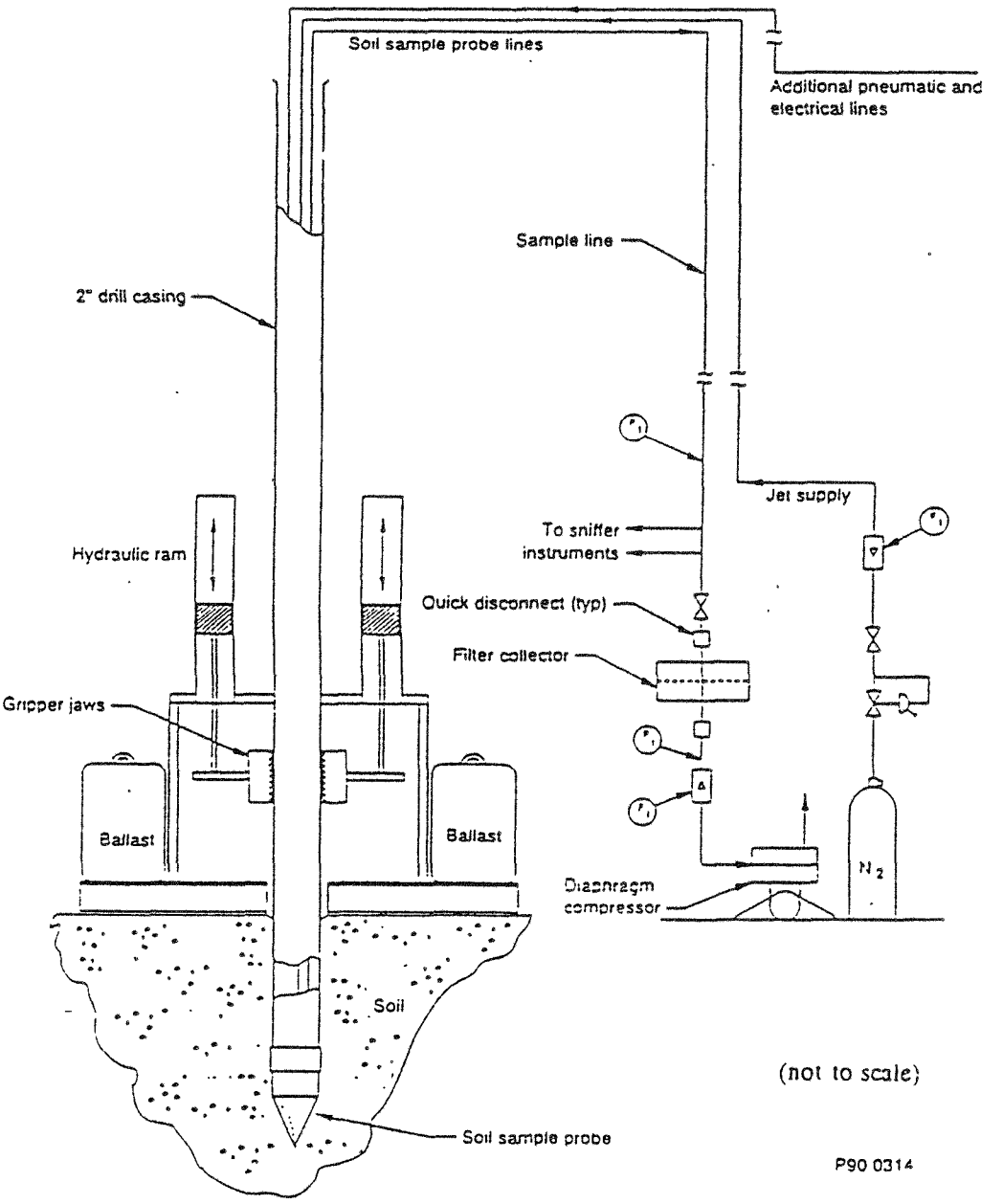
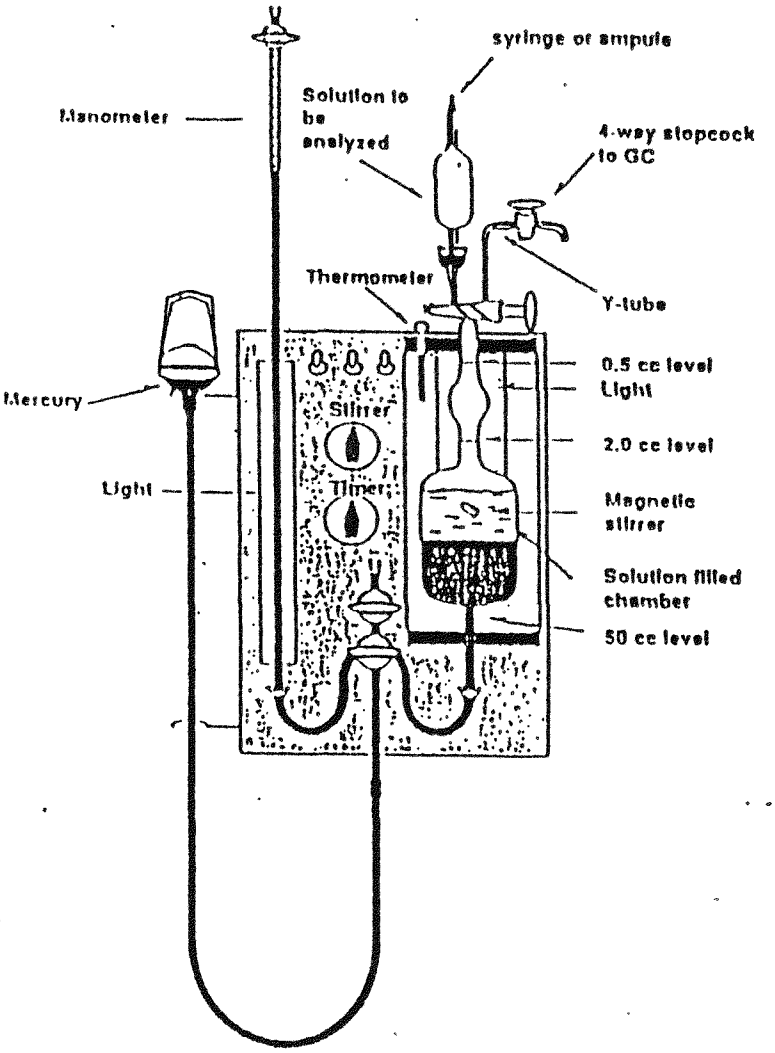


Figure 4.1-5 Schematic of the Van Slyke Apparatus



After evaluating the advantages and disadvantages of the Van Slyke apparatus, it was decided that this device was not appropriate for separating gas phase components from waste tank core samples. However, the basic operating principles of Van Slyke apparatus could be incorporated into a more robust gas separation device, capable of meeting the RGS project needs.

4.2 PREVIOUS EVALUATIONS OF SAMPLING DEVICES

Several studies have been performed to evaluate alternative approaches for measuring waste tank void fractions and obtaining waste samples. Among these were:

Minette (1992) evaluated both solid and liquid sampling devices and rated various systems against performance criteria. This study did not consider the ability of the sampling systems to contain gases. The recommended system was the Universal Sampler coupled with the rotary mode core sampling system for taking samples of solids, liquids, and slurries.

Estey (1992) evaluated in-situ methods for measuring the total gas content and detecting local changes in gas accumulation in tank 241-SY-101. The study was limited to in situ methods that could be used to analyze the entire tank. The recommended system for determining the total gas content in the tank was ultrasonic detection of the convective/non-convective interface combined with measured vertical pressure profiles.

Esvelt (1993) evaluated methods for measuring the void fraction in the FGWL waste tanks. The study was not concerned with the constituents of the gases. The two recommended options were the Universal Sampler modified with a less blunt end profile and an in situ compressibility device.

Webb (1993) provided a preliminary draft of a report summarizing the sampling alternatives for solids, liquids, and interstitial gases. For interstitial gas measurements, the results were essentially the same as Esvelt (1993).

A recent related study, Greenslade (1994), performed a technical survey of alternatives to the present waste tank liquid grab sampling technique (supernatent sampler). No off-the-shelf device was found that met the unique needs of the supernatent sampler.

4.3 RECOMMENDATIONS

No off-the-shelf device for sampling interstitial gases in a FGWL tank was found in the fields of oceanography, petroleum exploration, or environmental monitoring, which had any advantage over the Universal Sampler under development at WHC.

In January 1994, the RGSS status was reviewed and prototype design recommendations were set (Wootan 1994a). The prototype sampler device was chosen to be the Universal Sampler, WHC drawing H-2-85097, Rev. 2. The Sampler shall be deployed with the new Rotary

Mode Core Sampling Systems, although sampling will be performed using only the Push Mode process. Similarly, the prototype gas extraction device was selected as: 1) the modified hydraulic extrusion device, WHC drawing H-2-35272, Rev. 0, being developed for the Universal Sampler and 2) a new gas extraction device (Extractor). The Extruder couples the Sampler to the Extractor. It extrudes the waste sample into the Extractor by hydraulic movement of the Sampler piston. The following techniques were suggested as potential methods to be investigated for removing the gas from the waste sample in the Extractor: 1) mechanical stirring, 2) heating, 3) ultrasonics, and 4) dilutions. The gas should be removed in stages to allow determination of the gas sources.

5.0 DESIGN DESCRIPTION

5.1 RETAINED GAS SAMPLER SYSTEM

The RGSS consists of three main components: the Retained Gas Sampler, the Retained Gas Extruder, and the Retained Gas Extractor. Figure 5.1-1 is a schematic diagram of how the three components interface. The Retained Gas Sampler will be used to capture a sample of waste from a Hanford waste tank, including any gases which may be present in the waste, and transport it to the laboratory for analysis. It is based on the Universal Sampler design, and is deployed using the same equipment as the Universal Sampler. The Retained Gas Extruder is a new device specially designed for the RGSS for extruding the waste material from the Retained Gas Sampler into the Retained Gas Extractor. The Retained Gas Extractor is being developed to extract the gas (both free and bound) from the waste sample. The Extruder and Extractor will be deployed in the 1E2 hot cell in the 222S Laboratory (Figure 5.1-2).

Figure 5.1-1 The Interface of the Three Components of the RGSS
(the RGS, the RGE, and the RGEx)

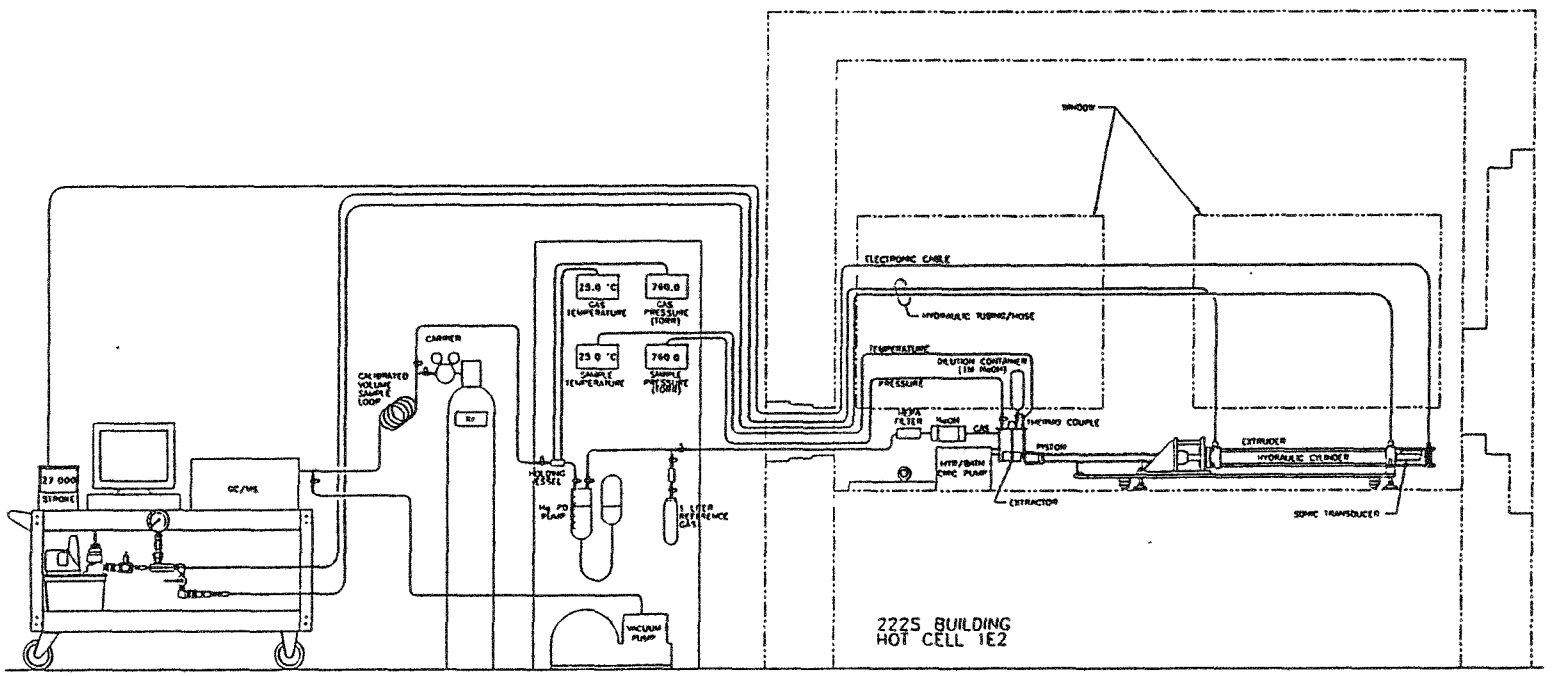
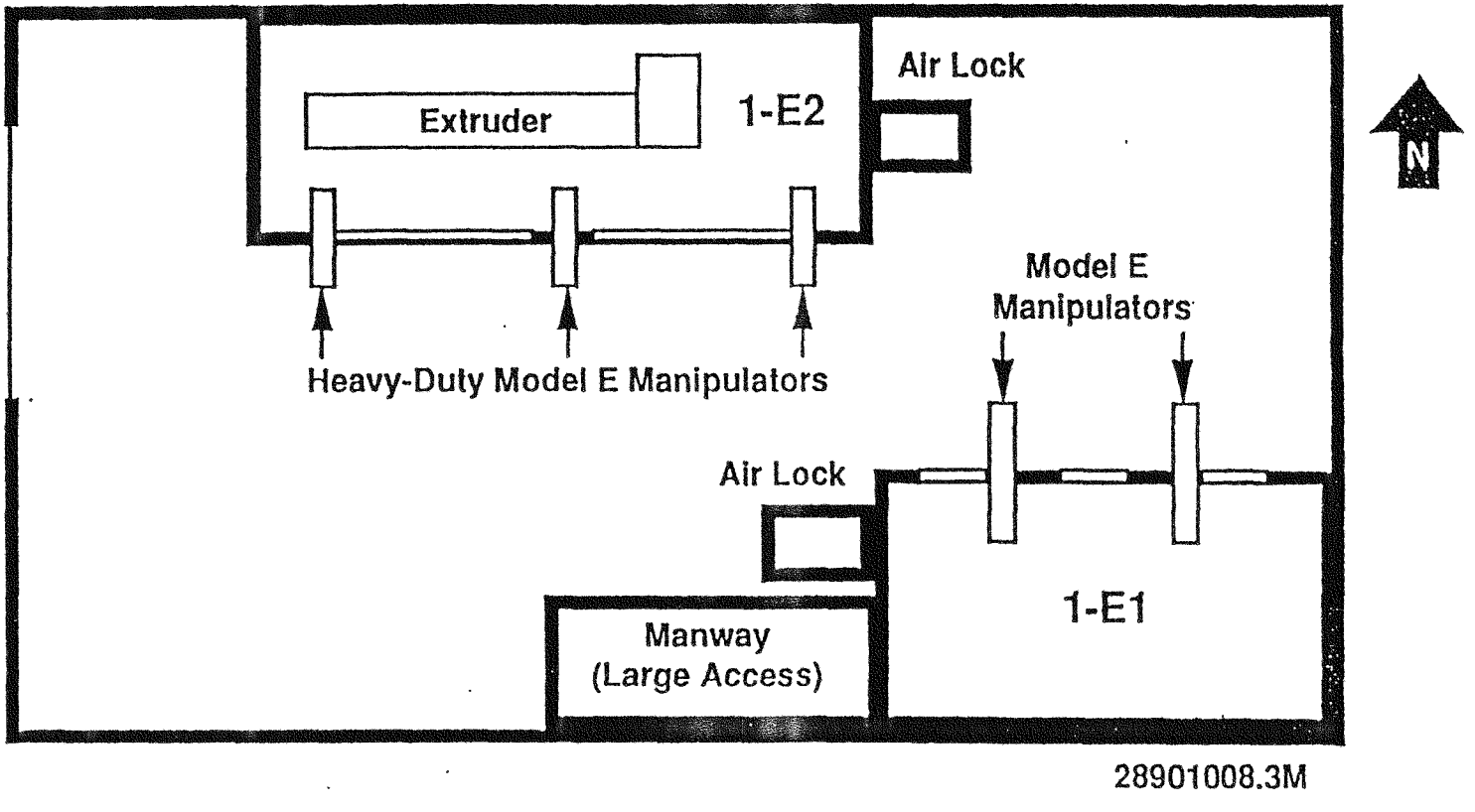


Figure 5.1-2 Deployment of the Extruder
and Extractor in the 222-S Laboratory 1E2 hot cell



5.2 RETAINED GAS SAMPLER

The Sampler is based on the Universal Sampler design (WHC drawing H-2-85097, Rev. 2). The Universal Sampler was developed primarily for sampling liquids and solids. The development criteria for the Universal Sampler are described by Farris (1993). Figure 5.2-1 shows the Universal Sampler design used as a prototype for the Sampler.

Figure 5.2-2 shows the Sampler design that has evolved from testing the Universal Sampler. The Sampler consists primarily of: 1) a sampler housing; 2) a rotary valve at the lower end; 3) a piston with O-ring(s) that seals the upper end; 4) a spring-loaded trigger mechanism that closes the rotary valve; 5) a pintle rod attached to the piston, that trips the trigger mechanism; and 6) a Quadralatch assembly for ingress and egress of the sampler. Figure 5.2-3 shows the modification to the design of the cable-valve housing interface that was made, based on the detection of leakage paths. A piston is used to provide the sealing gland for the O-ring in the valve housing. The piston is connected to the cable by swaging. This design modification also simplifies the fabrication process. Since the Sampler will be used primarily with the liquids and sludges of DSTs on the FGWL, the rotary mode parts (which are used to drill through solid materials) of the Universal Sampler are not needed. Additionally, the sampling system will utilize a hydrostatic head balancing fluid that does not interfere with the sample. This fluid basically pressurizes the drill string to prevent waste from entering it. Argon gas is currently planned as the hydrostatic fluid, rather than the nitrogen gas that is currently used with the universal sampler.

Operation of the Retained Gas Sampler consists of simply pushing the sampler through approximately 48 cm (19 inches) of waste material. At the start of the sampling operation, the rotary valve is open with the piston in its lower position (see Figure 5.2-4). The sampler is pushed through the material by the drill string while the piston is held at a constant elevation position by the pintle rod (see Figure 5.2-5). After traversing approximately 48 cm, the piston nears the top of the sampler housing and a pin on the pintle rod trips the trigger mechanism. This mechanism activates the spring which closes the rotary valve, sealing the sample in the sampler housing (see Figure 5.2-6). The pintle rod is removed by applying enough force to shear the wire connecting the rod to the piston (see Figure 5.2-7). The drilling truck is prepared for retrieval of the sampler by pressurizing the drill string with argon gas (see Figure 5.2-8). The remote latch unit is lowered down the drill string until it locks onto the quadralatch assembly of the sampler (see Figure 5.2-9). The sampler is removed from the drill string (see Figure 5.2-10 while the pneumatic head is maintained, preventing waste from entering the drill string (see Figure 5.2-11). The shielded receiver, containing the sampler, is depressurized by closing the lower ball valve, venting the argon to the tank airspace (see Figure 5.2-12). Sampler exchange occurs by closing the ball valve to the shielded receiver (see Figure 5.2-13), rotating the receiver to a cask, connecting the receiver to the cask, opening the ball valve, and lowering the sampler into the cask. A new sampler is inserted into the shielded receiver, the receiver is rotated to a position over the drill string, connected to the drill string, and repressurized before opening the ball valve (see Figure 5.2-14). The second sampler is lowered into the drill string (see Figure 5.2-15). When the new sampler reaches the bottom of the drill string, it locks in place (see Figure

5.2-16). The drill string is depressurized by opening both ball valves, venting the argon to the tank airspace (see Figure 5.2-17).

Figure 5.2-1. Universal Sampler Design Used as a Prototype for Sampler.

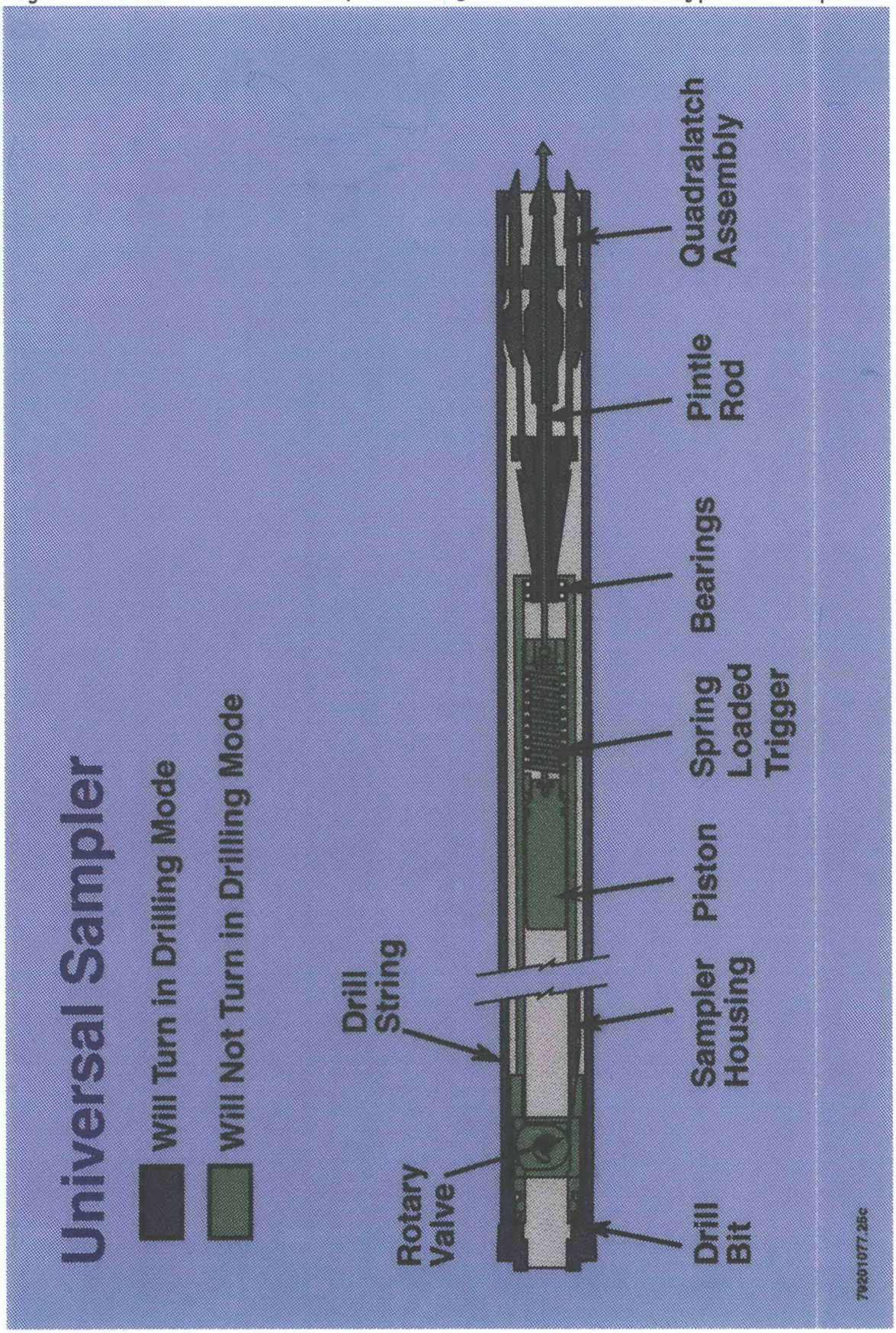


Figure 5.2-2. Sampler Design Evolved from Testing the Universal Sampler.

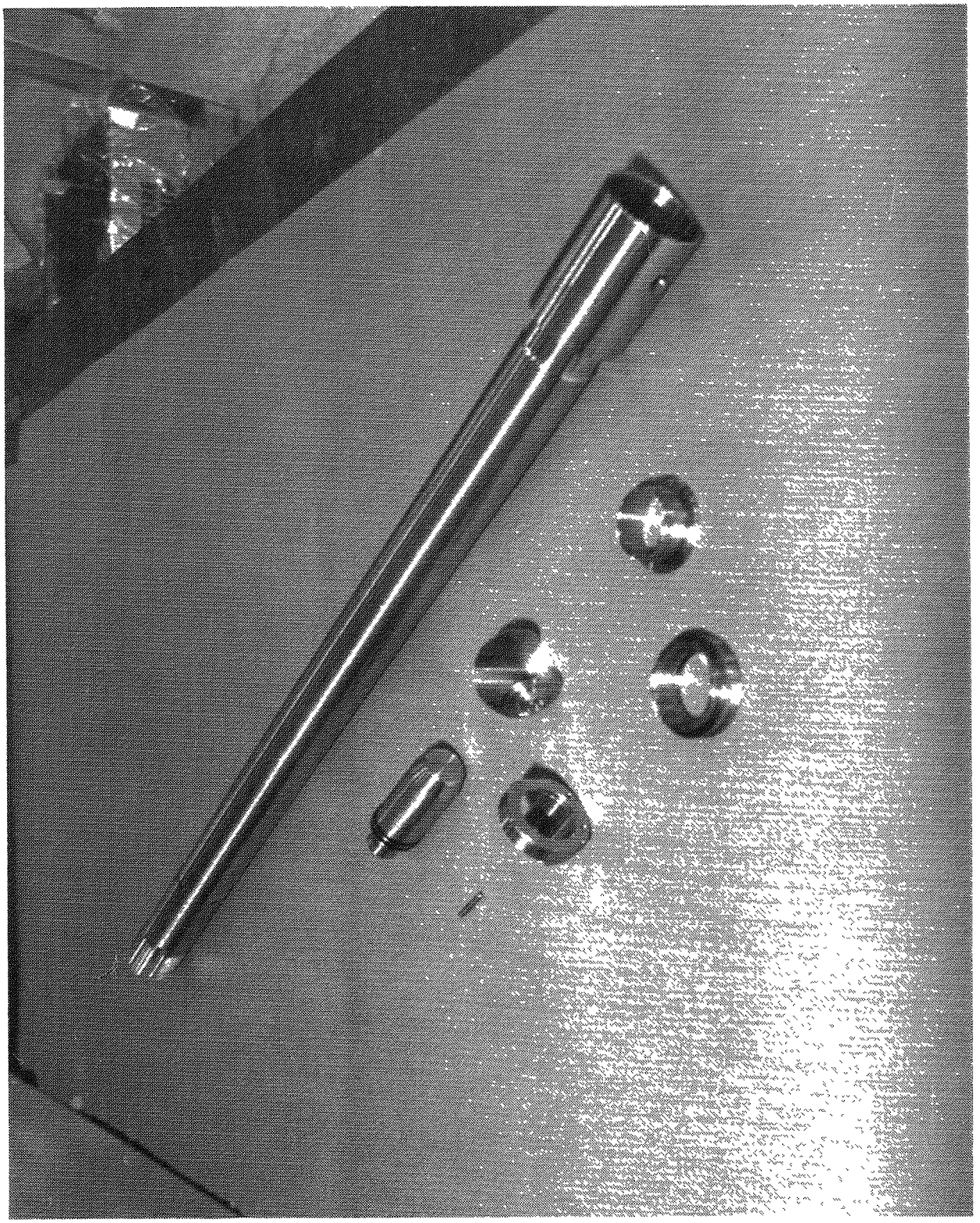


Figure 5.2-3 Modification to the Design of the Cable-Valve Housing Interface

Figure 5.1-2. New Piston/O-ring Design.

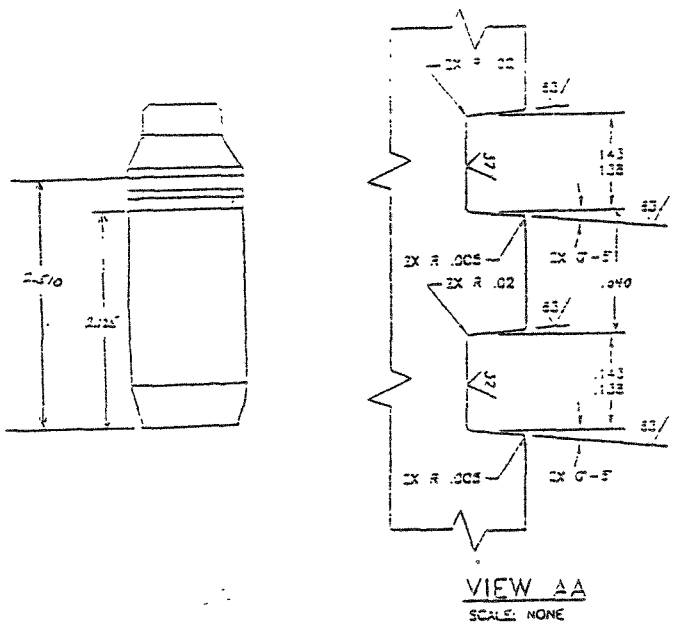


Figure 5.2-3 Cable-Piston Design

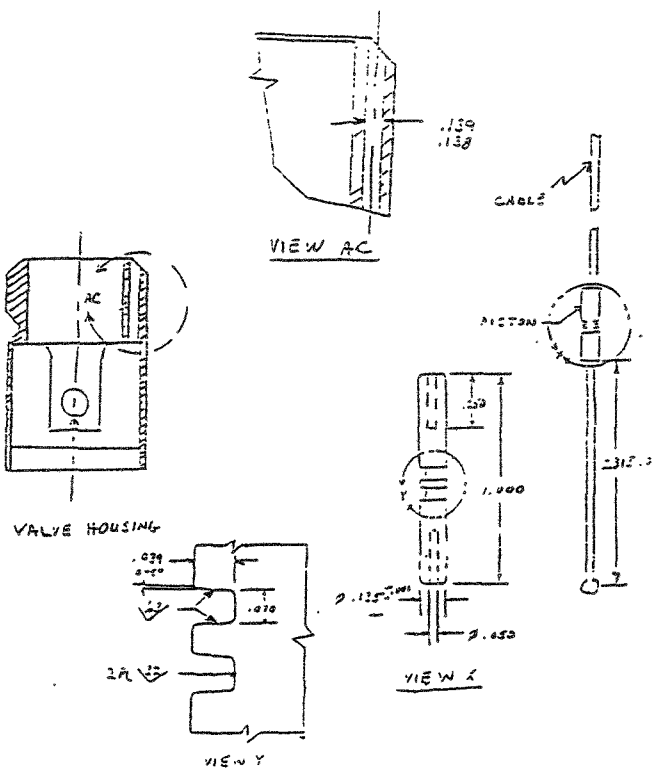


Figure 5.2-4. Start of the Sampling Operation.

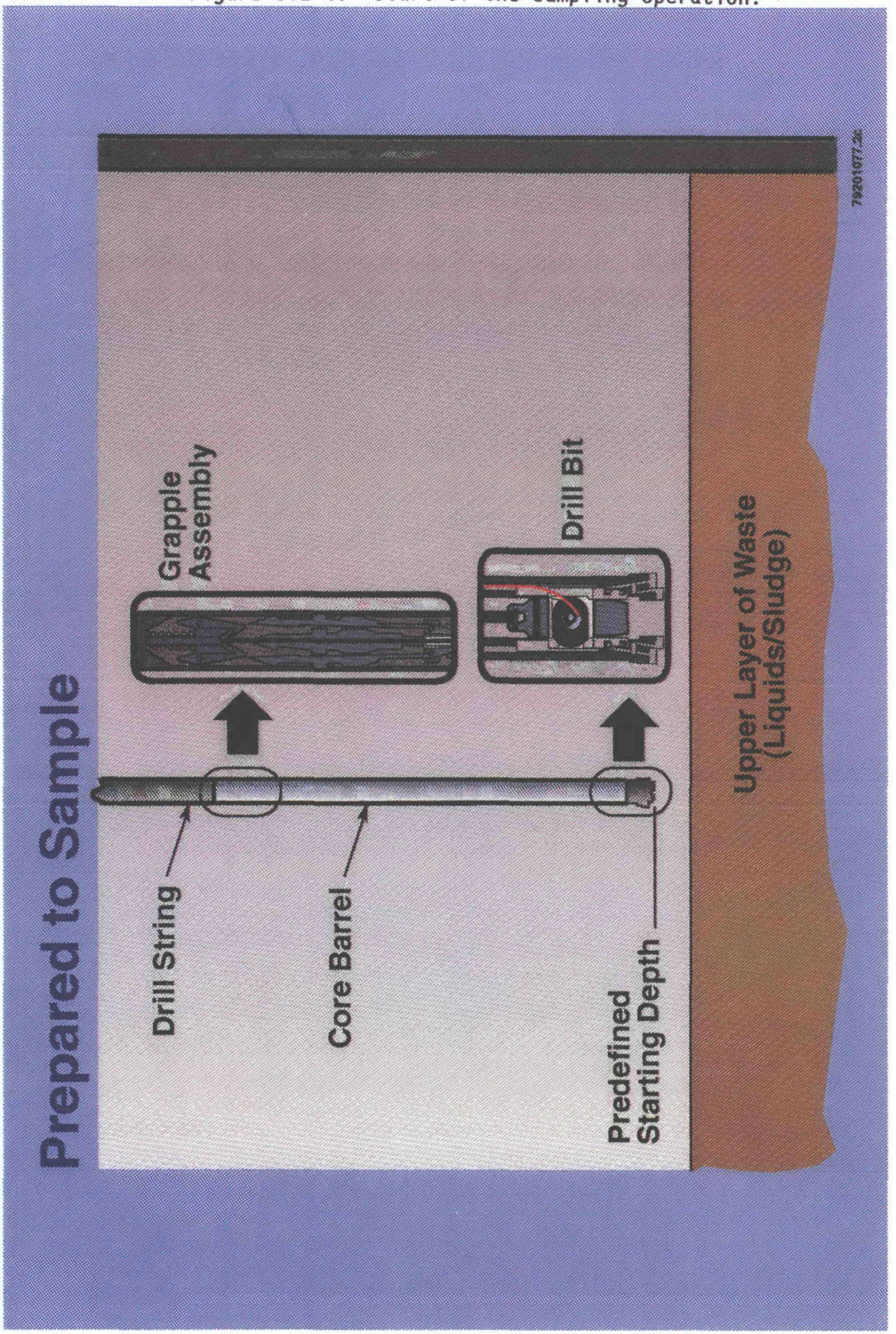


Figure 5.2-5. Sampling Demonstration.

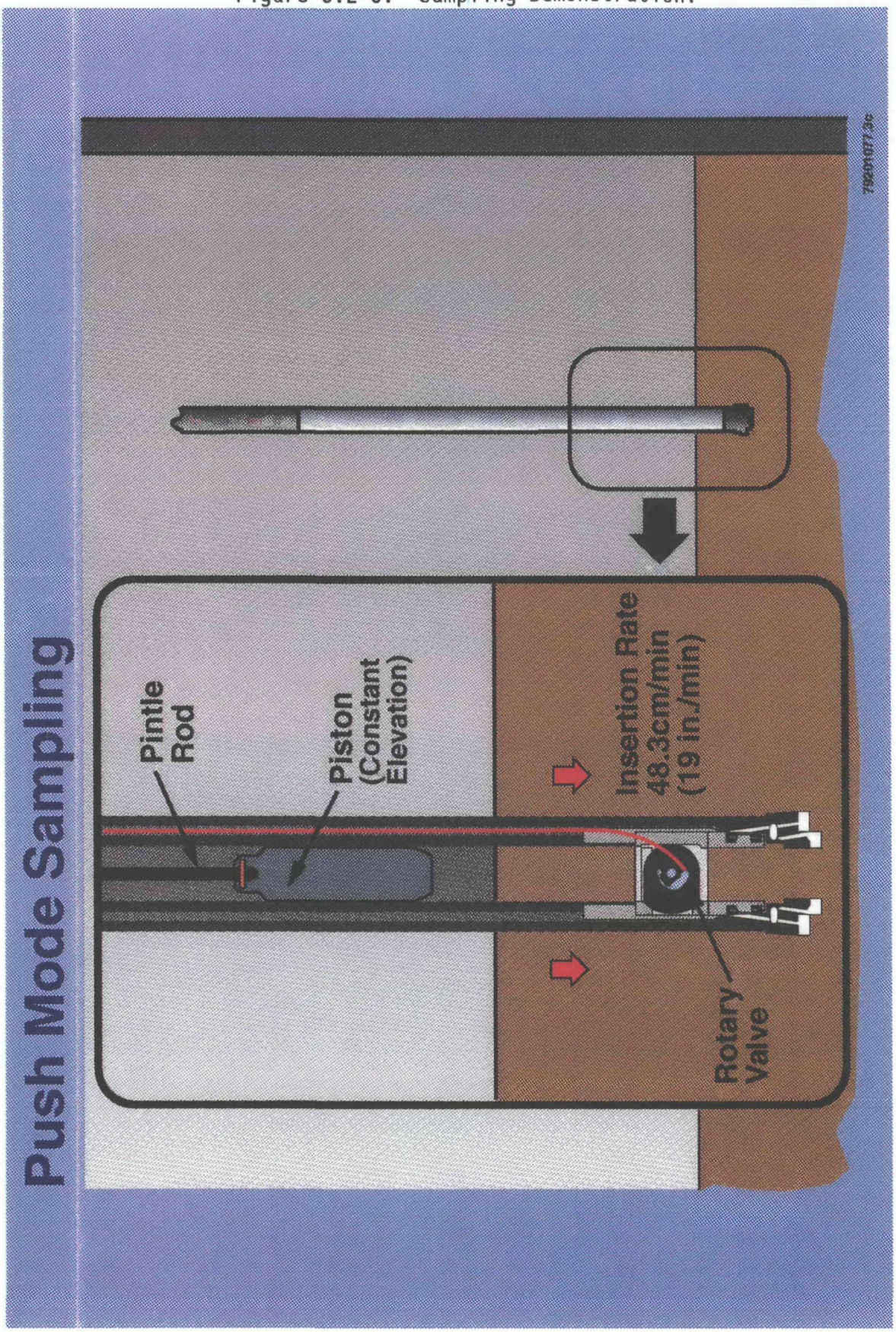


Figure 5.2-6. Sample Capturing (sealing the sample in the sampler housing).

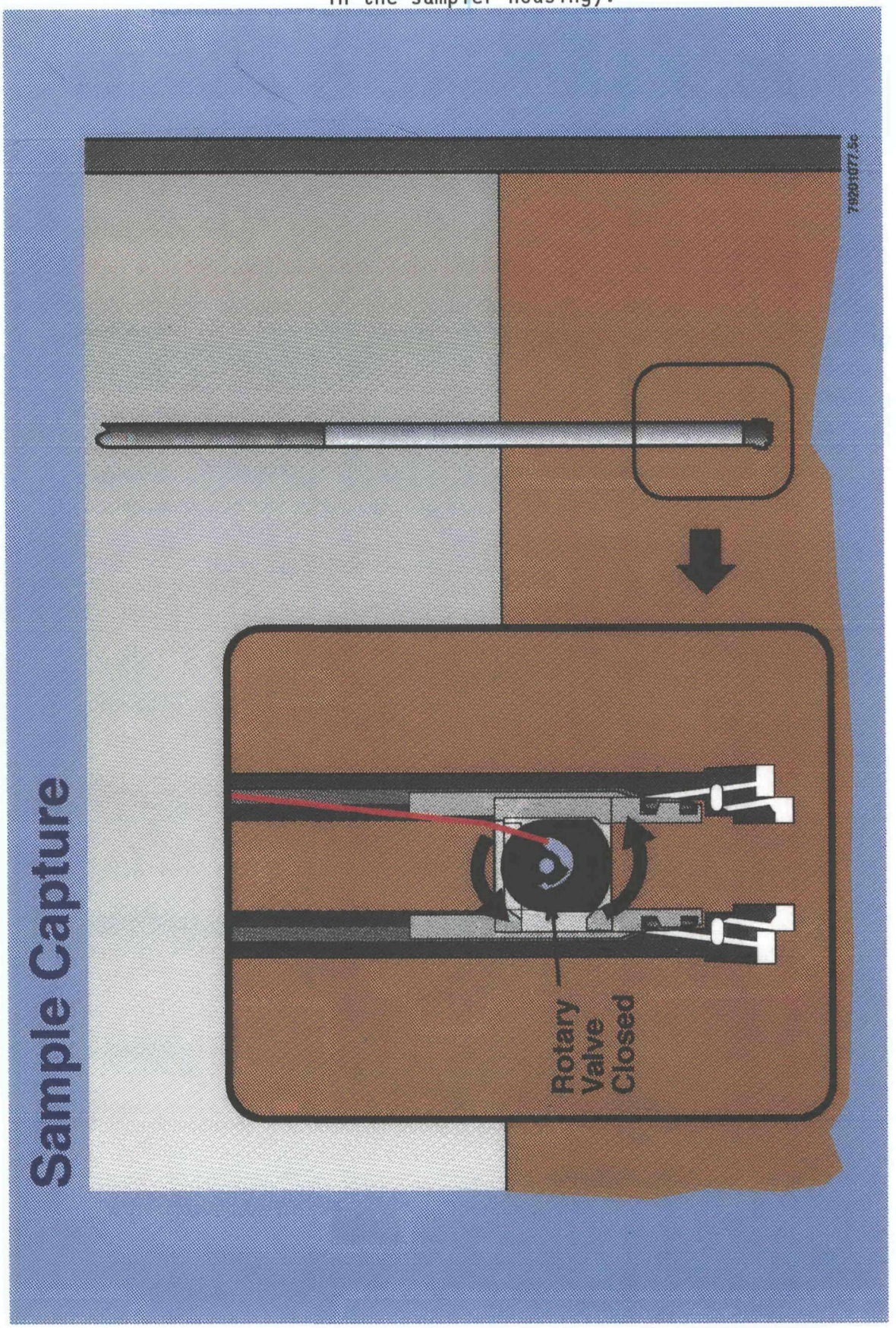


Figure 5.2-7. Pintle Rod Removal.

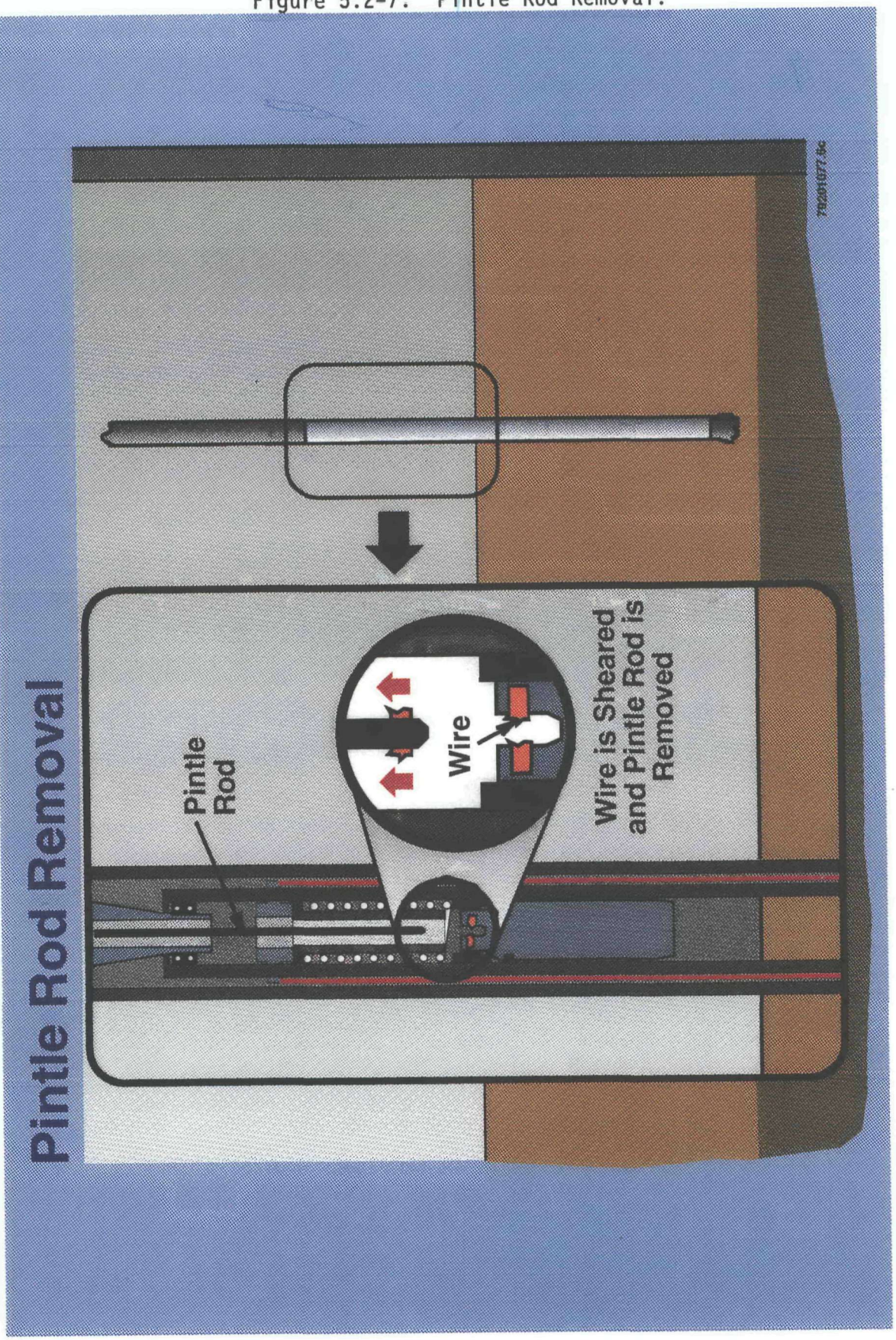


Figure 5.2-8. Drilling Truck Preparation for Retrieval of the Sampler by Pressurizing the Drill String with Argon Gas.

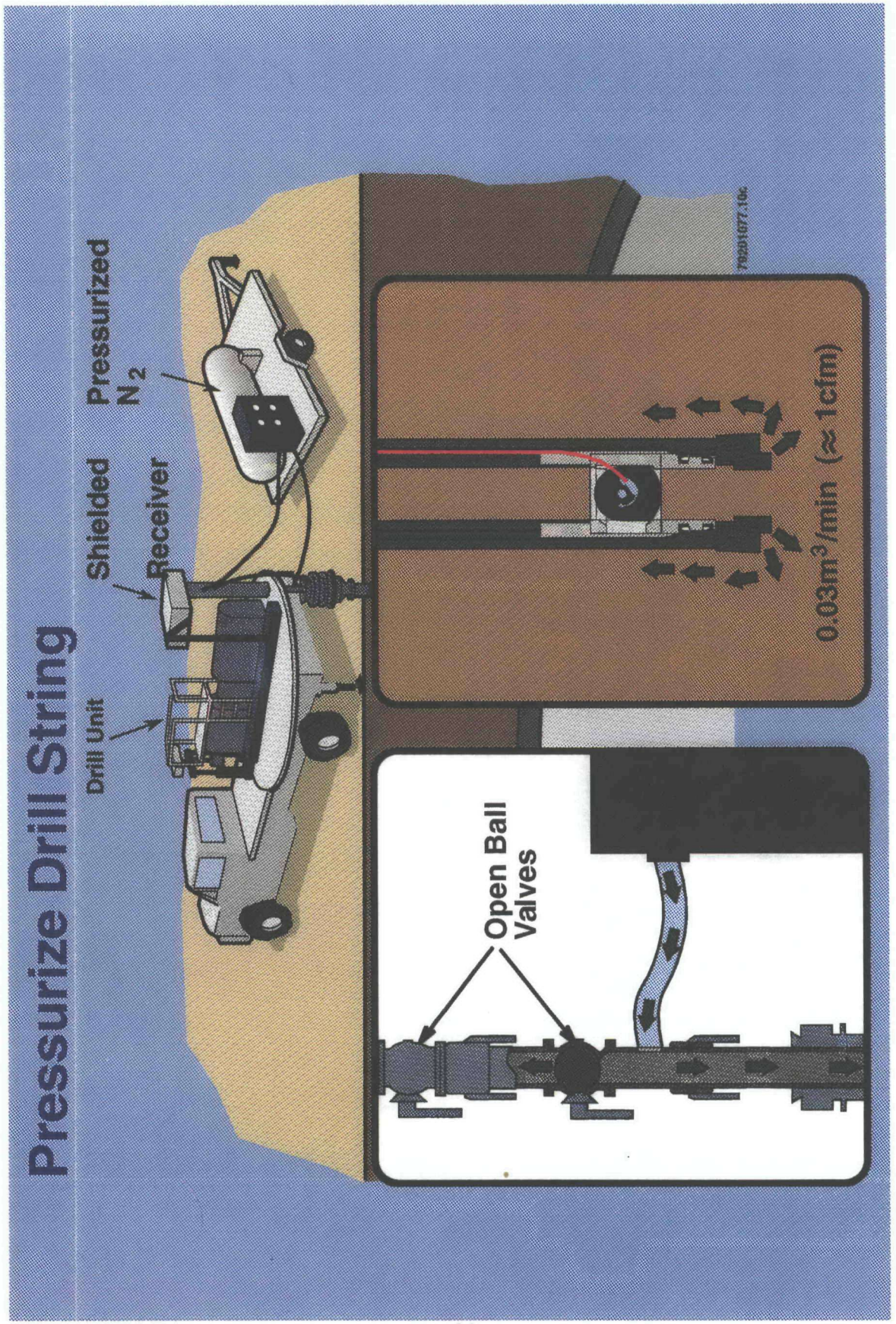


Figure 5.2-9. Prepared (all set) to Remove Sampler.

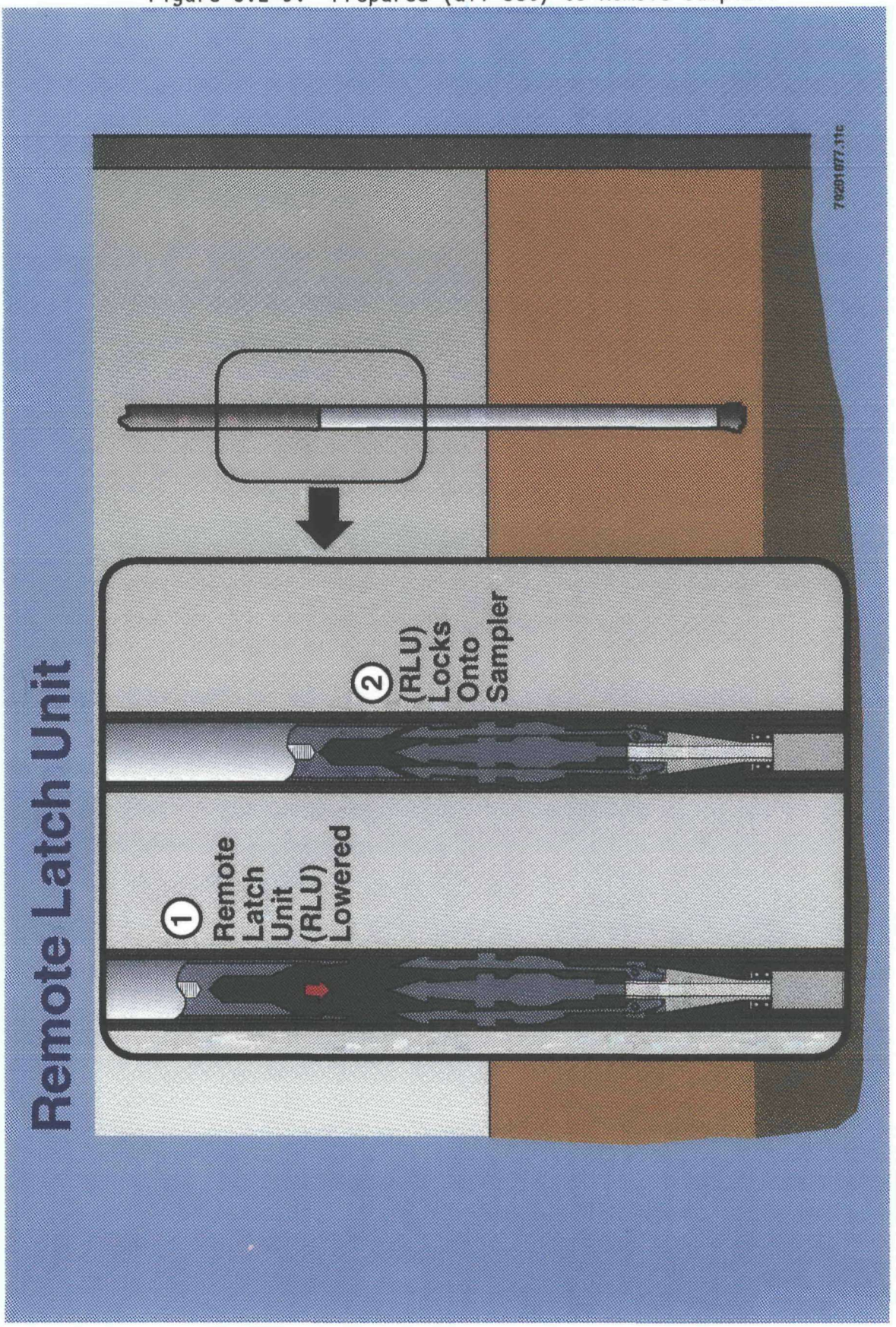


Figure 5.2-10. Removal of the Sampler from the Drill String.

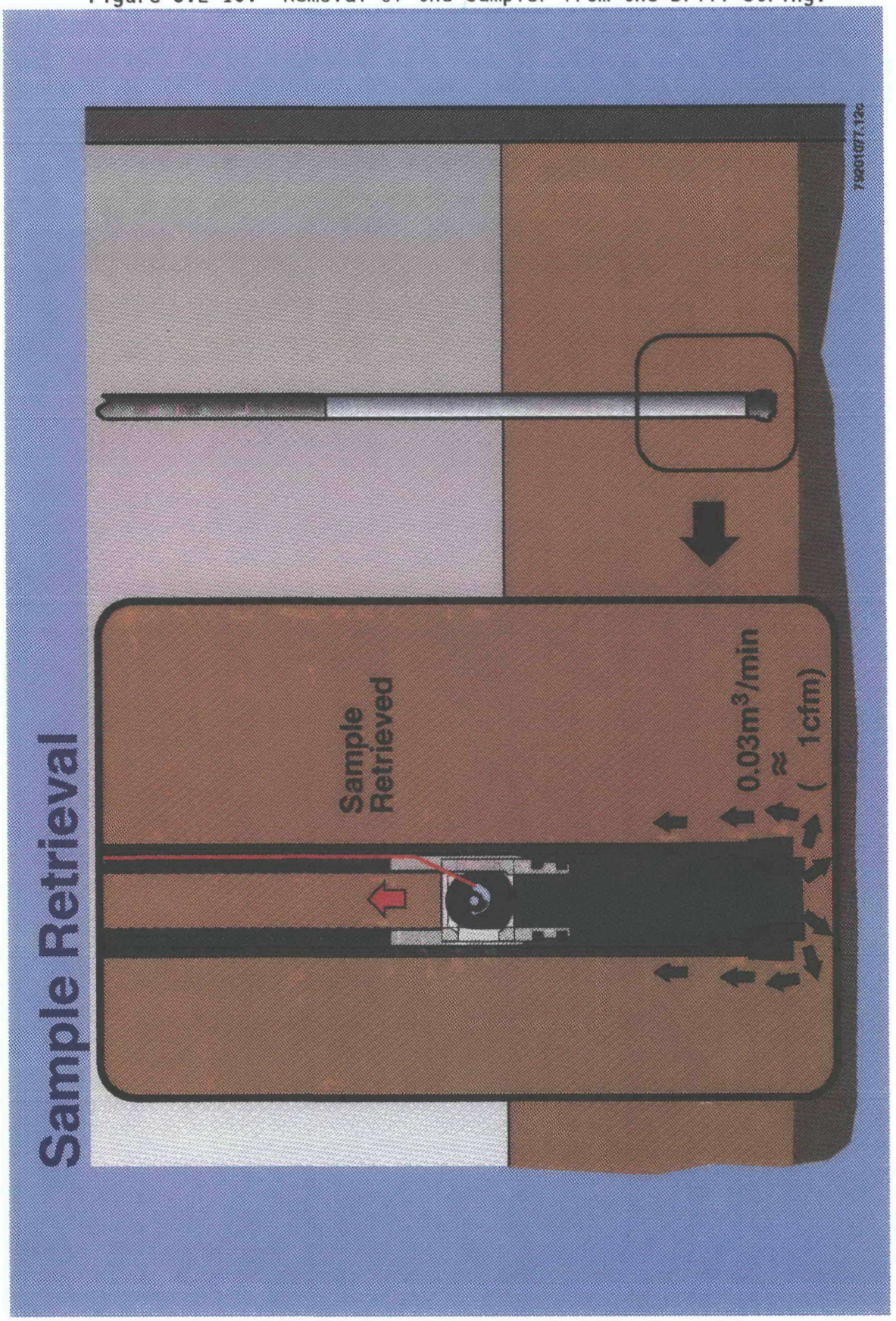


Figure 5.2-11. Pneumatic Head is Maintained (to prevent waste from entering the drill string.

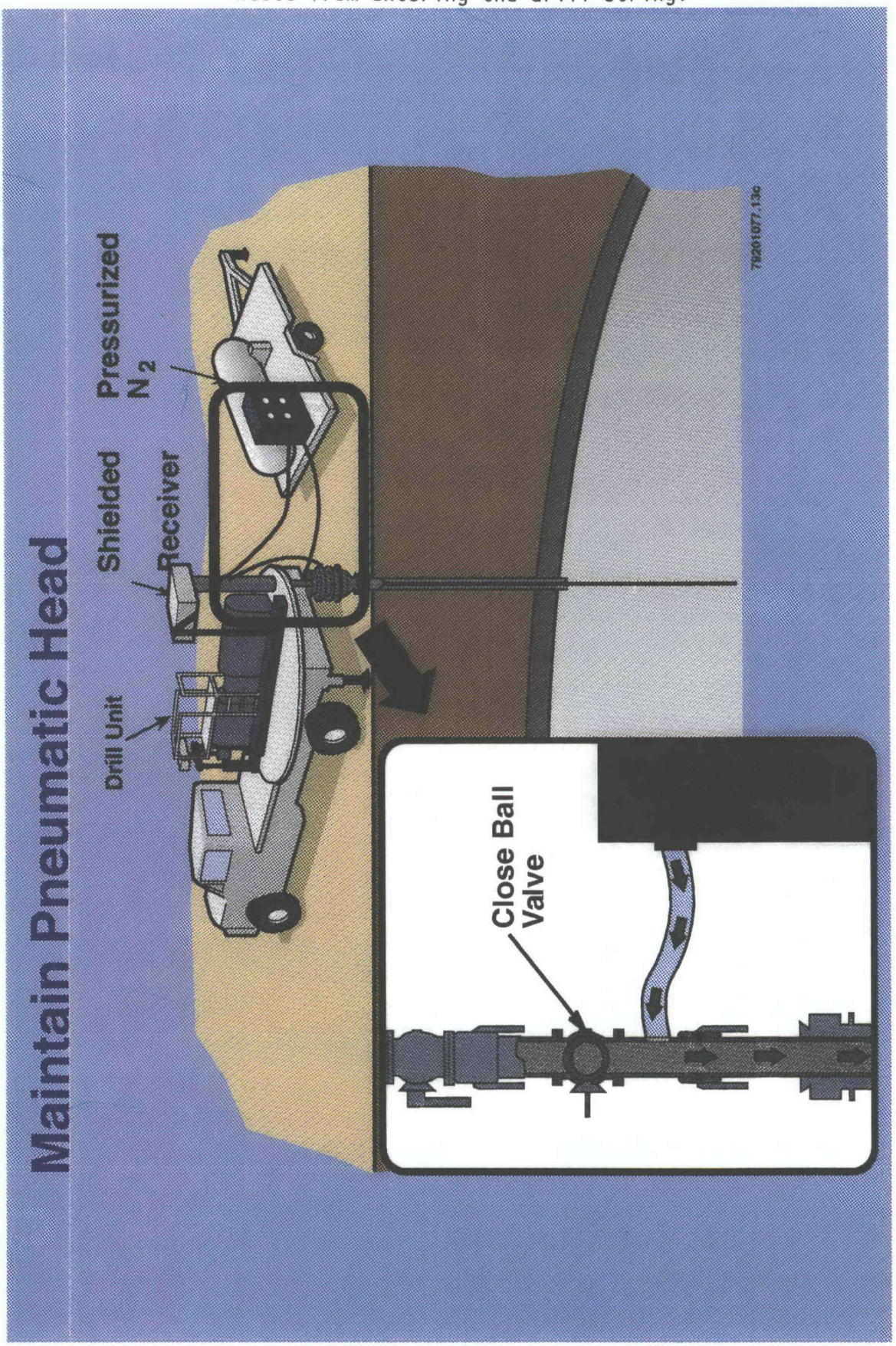


Figure 5.2-12. Depressurization of the Shielded Receiver, Containing the Sampler (by closing the lower ball valve and venting the argon to the tank airspace).

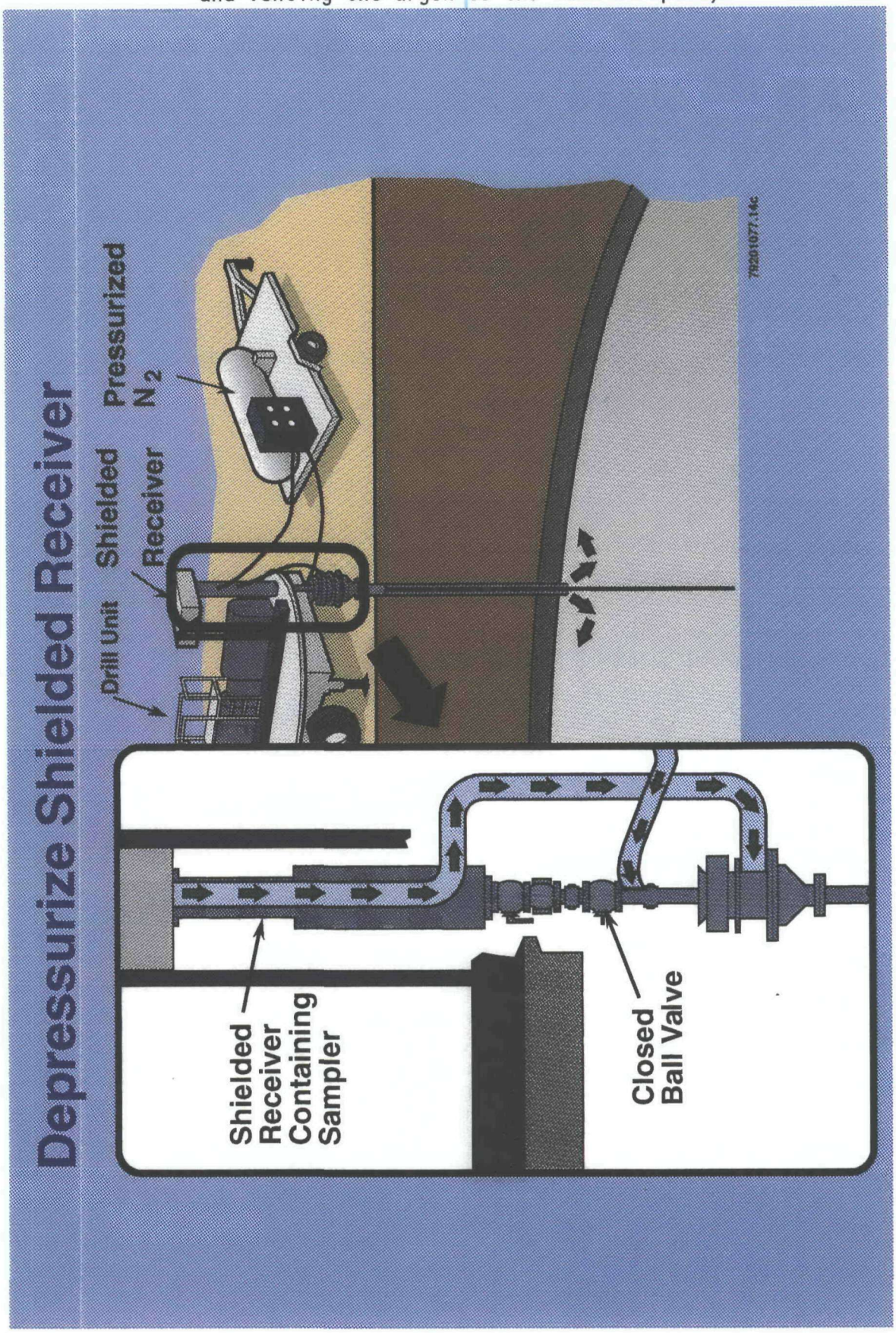


Figure 5.2-13. Used Sampler is Exchanged for New One (by closing the ball valve to the shielded receiver).

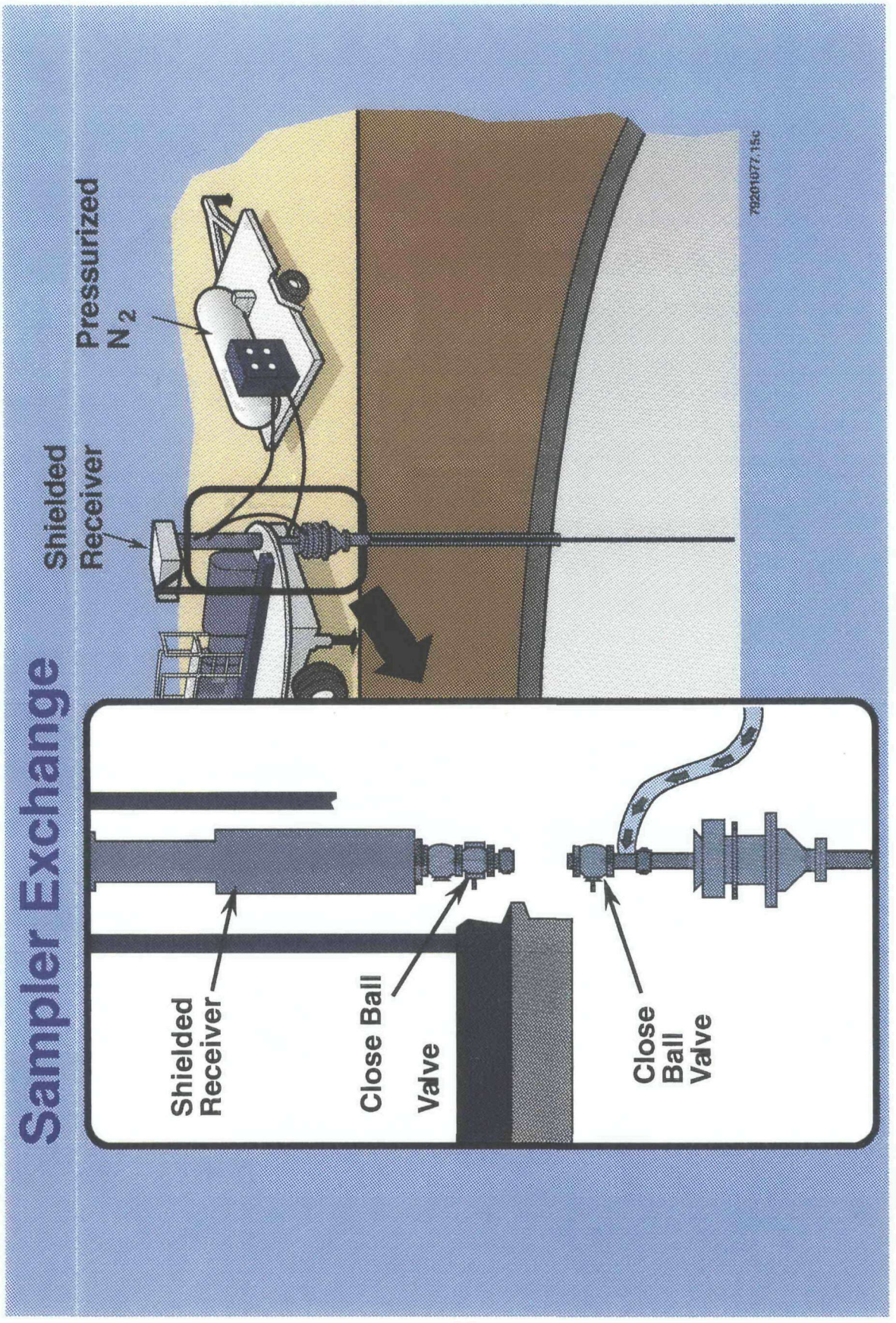


Figure 5.2-14. Shielded Receiver is Repressurized (before opening the ball valve).

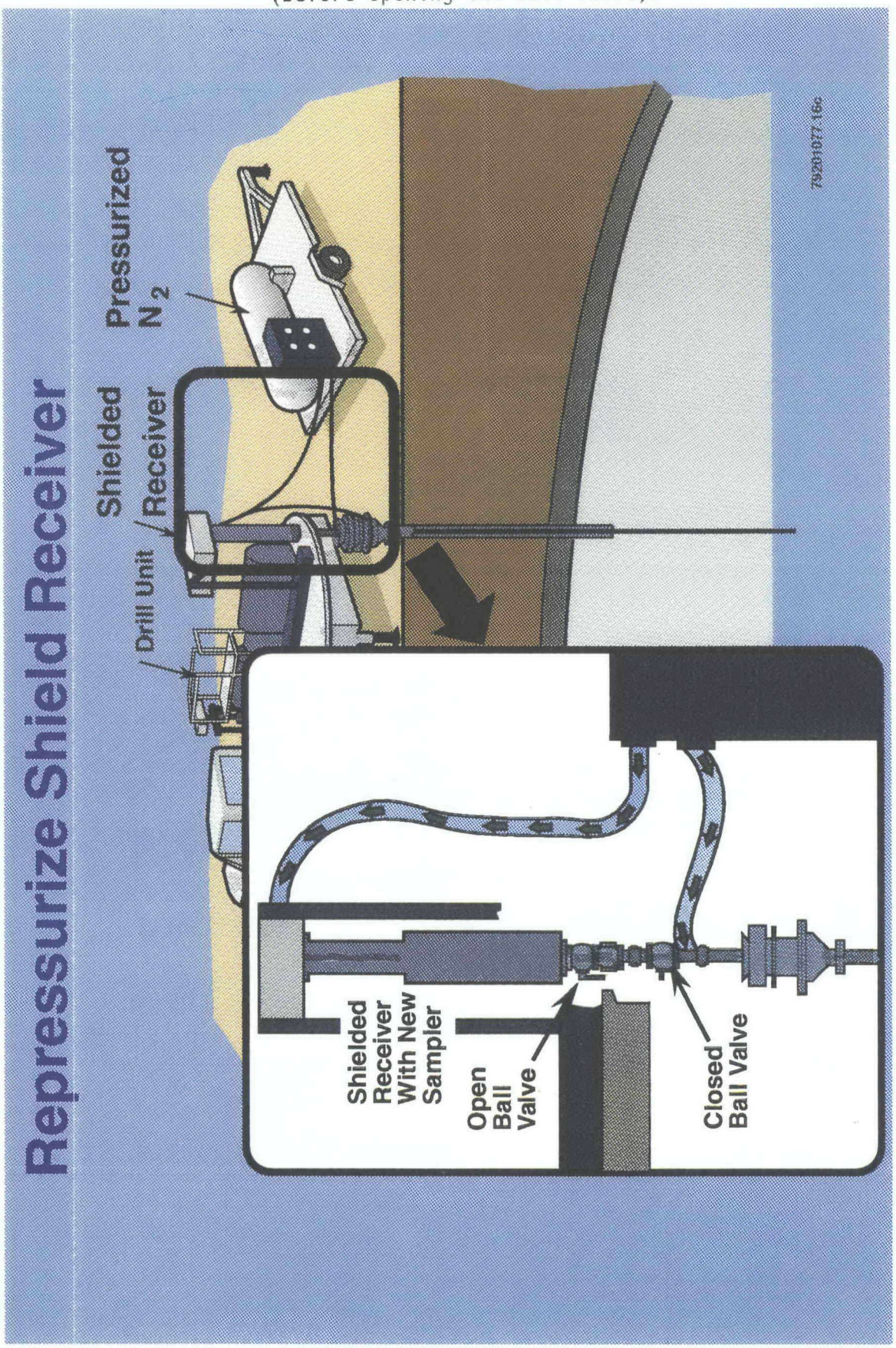


Figure 5.2-15. Lowering of the New Sampler into the Drill String.

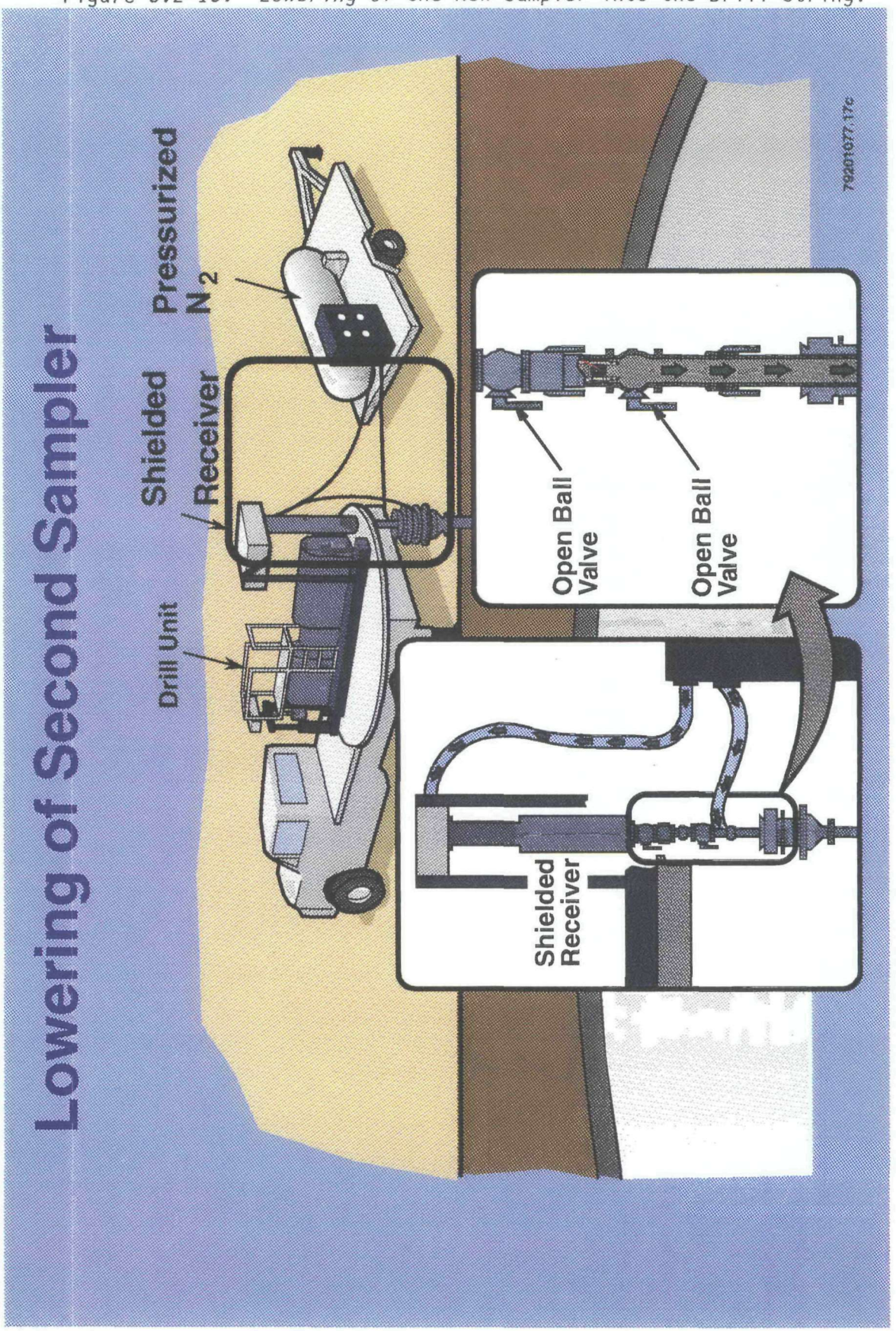


Figure 5.2-16. Locking of the New Sampler into Place.

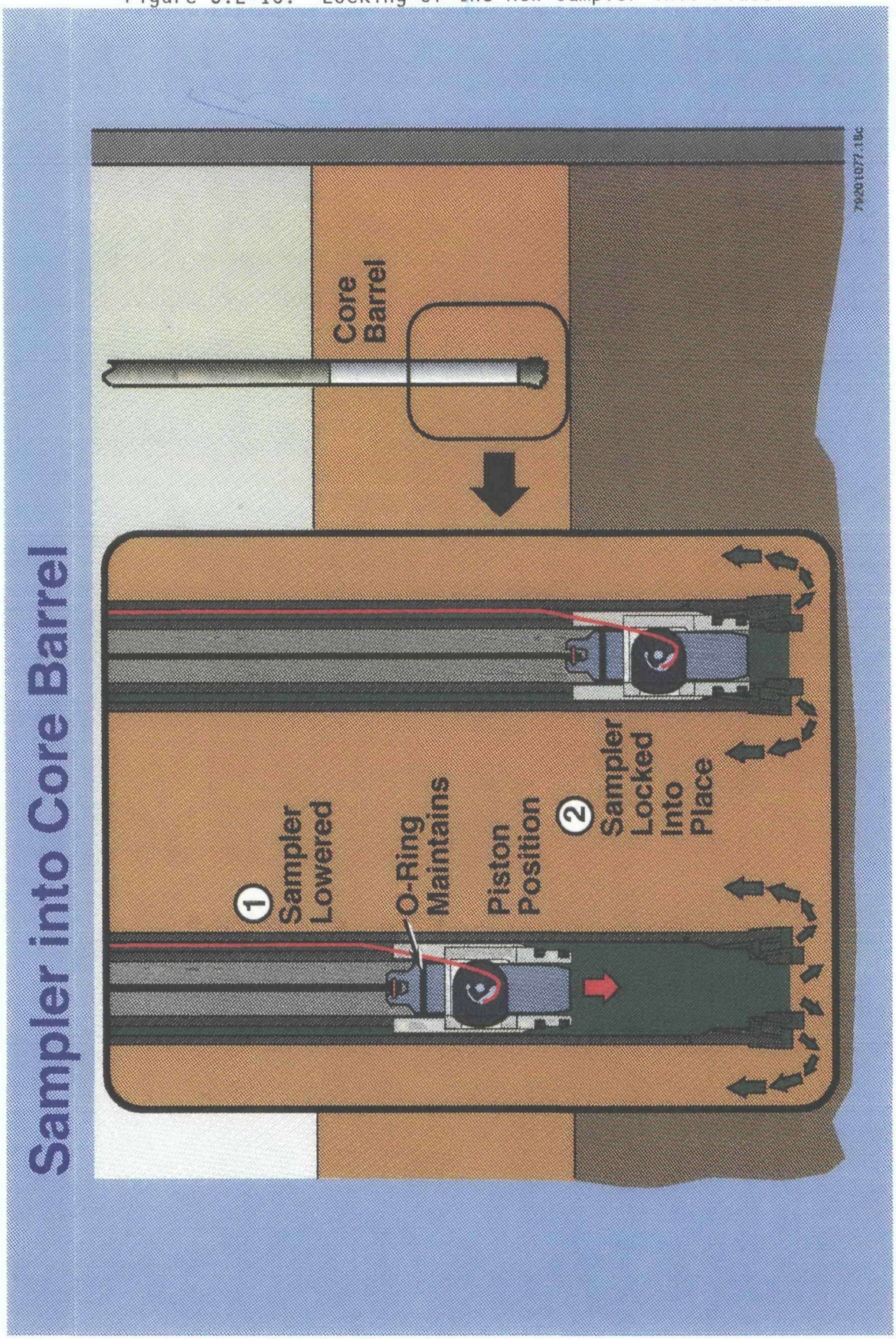
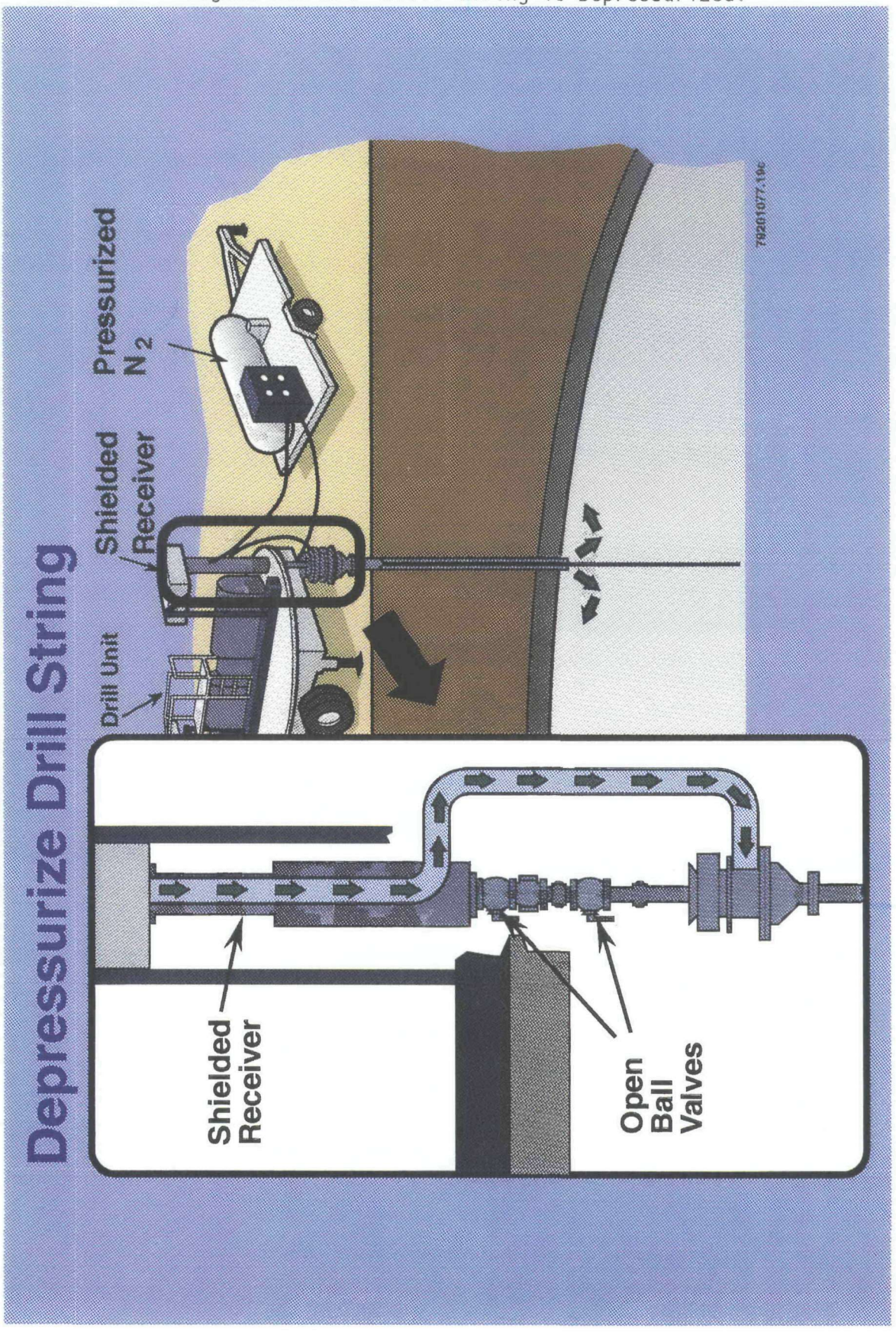


Figure 5.2-17. Drill String is Depressurized.



5.3 RETAINED GAS EXTRUDER

The Extruder is the primary device for extrusion of the waste material from the Sampler into the Extractor. Figure 5.3-1 is a sketch of the extrusion device. It is a new device specially designed for the RGSS, but is similar to the existing extrusion device for the Universal Sampler. The existing Universal Sampler Extruder design would not work for the RGSS because it deposits the sample onto a tray which would release any free gas to the hot cell atmosphere. The Extruder basically pushes the waste out by driving the sampler piston to the bottom of the Sampler. Additionally, the Extruder provides the means for the Sampler to be connected to the Extractor, preventing gas leakage during transfer.

Prior to insertion into the Extruder, the Sampler has the quadralatch assembly, the pull block, the spring assembly, and the cap removed, allowing the Extruder rod direct access to the sampler piston. Removal of the pull block requires disconnecting the cables, accomplished by extracting the pins from the pull block. The Sampler is placed into the Extruder in the hot cell. It is connected to the Extractor Device by removing the inner insert at the bottom and screwing the Sampler onto the Extractor. The extruder rod is positioned against the sampler piston. After the Extractor has been readied for receipt of the waste sample, the sampler valve is opened by turning the valve shaft one-quarter turn. The Extruder's hydraulic ram is used to push the sampler piston to the valve end, extruding the waste into the Extractor. The Extruder with the Sampler remains connected to the Extractor during all further operations because the Sampler piston O-rings provide the remaining seal for the Extractor.

5.4 RETAINED GAS EXTRACTOR

The Extractor is being developed to extract the gas (both "free" and "bound") from the waste sample. General requirements for the Extractor are described in Bridges (1993) and Bolden (1994). The Extruder will push the waste sample into the Extractor by moving the Sampler piston. Gas will be removed from the waste sample in the Extractor by the following methods: 1) mechanical stirring, 2) thermal treatment (heating and/or cooling), and 3) dilution. The gas will be removed in stages to allow determination of the gas sources. Additionally, the Extractor will be instrumented to characterize the sample. The concept currently being developed for use as the Extractor includes 1) a vacuum vessel with rotary motion, instrument, and material feed through capabilities; 2) a mixer with a rotary motion feed through device; and 3) an external heating/cooling device. Figure 5.4-1 is a sketch of the Extractor.

The Sampler is attached to the Extractor by removing the inner insert and screwing the Sampler into the Extractor. The Extractor is evacuated to a pressure of 0.01 Torr or less. The sampler valve is opened and the waste sample is extruded into the Extractor. The following paragraphs describe the processes for removal of the "free" and "bound" gases from the waste sample.

Figure 5.3-1 Sketch of the Retained Gas Extruder

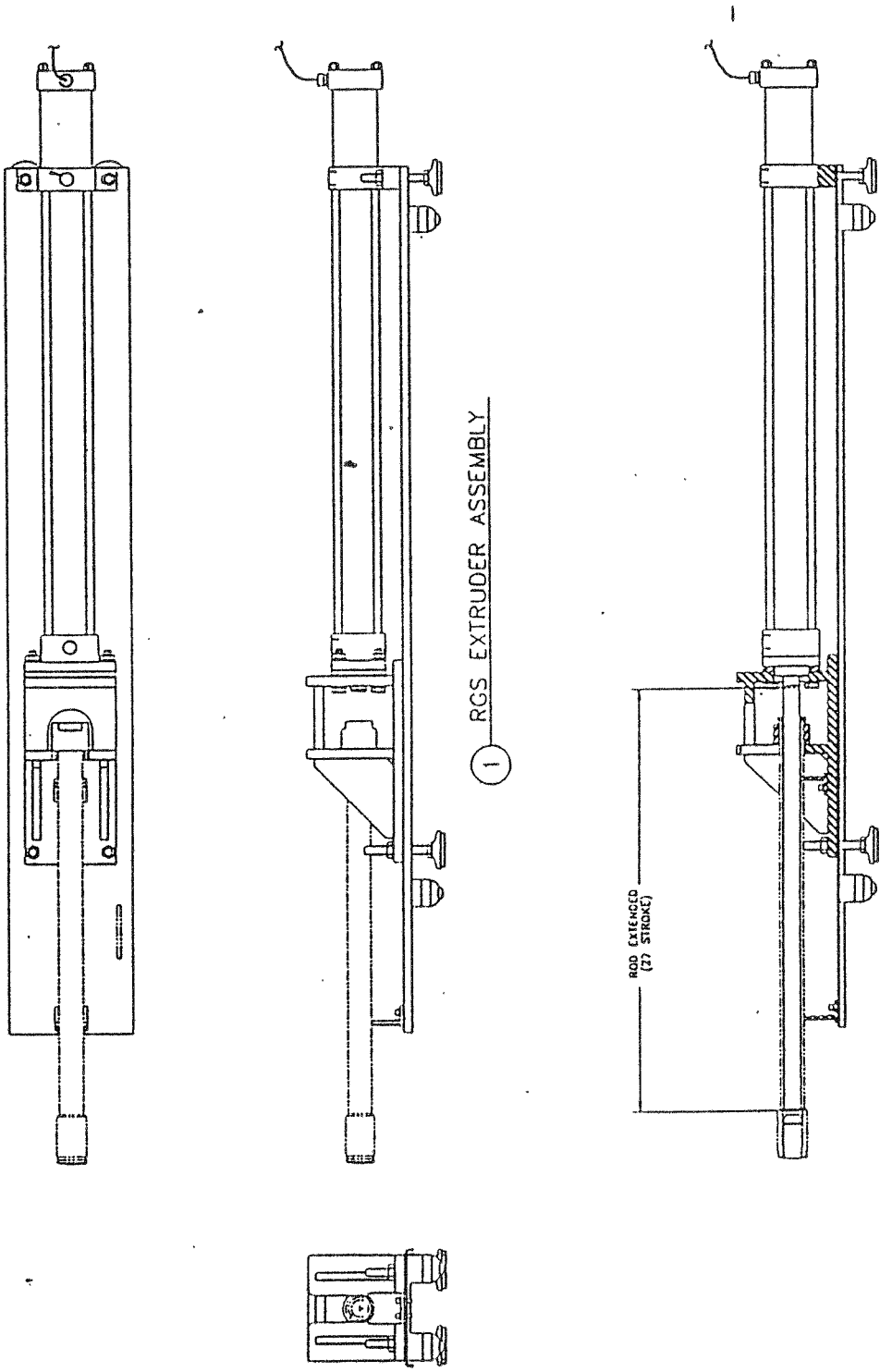
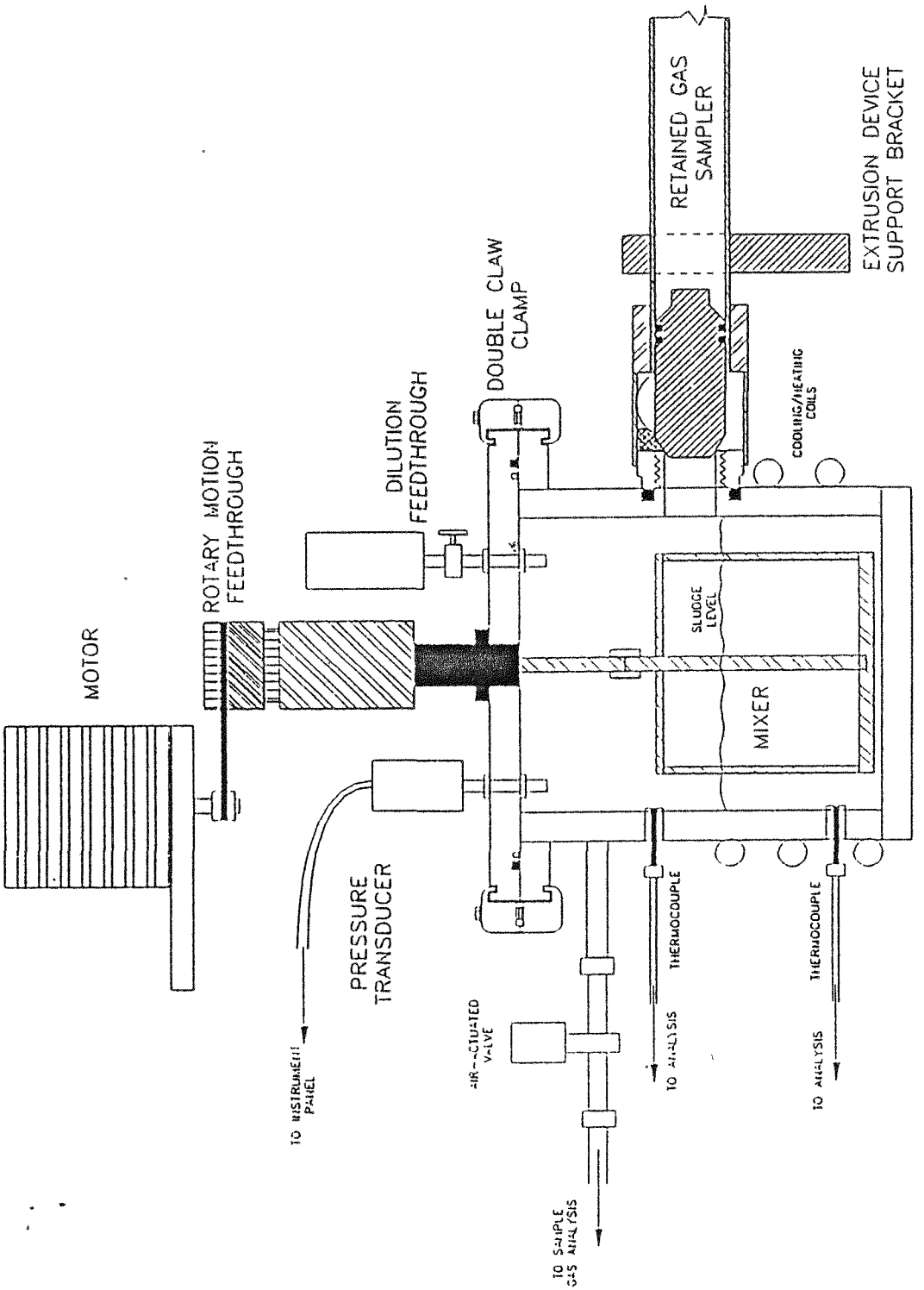


Figure 5.4-1 Sketch of the Retained Gas Extractor



"Free" gases are extracted from the waste sample by the following processes: 1) the waste material is stirred and heated to 50 °C (122 °F); 2) after 10 minutes, the accumulated gases are transferred to a collection vessel using a mercury positive displacement pump; and 3) the gases are analyzed for total volume and composition.

There are two categories of "bound" gases anticipated for extraction. These categories are defined by the procedures required to remove them from the waste sample. The basic extraction processes are as follows: 1) 300 cm^3 of 1Molar Sodium Hydroxide is added to the waste material in the Extractor; 2) after 1 hour, the accumulated gases are transferred to a collection vessel using the mercury positive displacement pump; 3) the "loosely bound" gases are analyzed for total volume and composition; 4) steps 1 through 3 are repeated to recover the "tightly bound" gases. All of these steps occur while the waste sample is being stirred and kept at a temperature of 50 °C (122 °F).

Once the above processes are completed, the Extractor is relieved of its vacuum and disassembled. The remaining waste materials are visually examined for extent of gas removal and dissolution. Materials are retrieved for additional analyses, i.e., total organic carbon, ammonia, etc. The remaining materials are disposed of per procedure.

6.0 TESTING

6.1 FLOW VISUALIZATION

The flow visualization testing focused on assessing the performance of the Sampler and identifying some of the critical issues, such as how the waste forms are affected during the sampling process and what the state of the waste, especially gas retaining waste, is after sampling compared to its original state (Shekarriz 1994a). Later tests investigated whether the sampler performance is improved as the geometry of the insertion end of the sampler changes from a blunt shape to a sharper leading edge. Secondary objectives were to investigate how the fluid viscosity and insertion rate affect the characteristics of sampling (Shekarriz 1994b).

Approach

The simulant for these tests had to be optically transparent and have a yield stress and a viscosity similar to that of the waste. The fluid used in these studies was a gel composed of 0.25% to 1.0% by weight of Carbopol-980[1] resin and water. The simulant has a shear thinning behavior and a yield value greater than 2 Pa. The viscosity of the simulant at a shear rate of 0.1 s^{-1} ranged between 150,000 to 900,000 cP for 0.25% and 1.0% by weight mixtures, respectively. The yield strength of the material allowed the simulant to retain gas bubbles of up to $\sim$ 2.5 cm (1 in) in diameter.

[1](Carbopol is the trademark of the B. F. Goodrich Company)

Figure 6.1-1 shows a schematic diagram of the setup used for the visualization studies. A 152 cm (60 in) high, 25 cm (9.8 in) x 25 cm (9.8 in) cross section clear walled acrylic tank was filled with the transparent non-Newtonian simulant. A simple cable/pulley apparatus was used as an insertion mechanism for lowering the Sampler into the simulant while keeping the inner piston stationary. The insertion rate was controlled manually. In order to overcome the buoyancy force acting on the sampler, additional weights were added to the top of the sampler. Bubbles with a size distribution between 0.1 to 2 cm (0.04 to 0.79 in) were distributed throughout the simulant. Insertion rates varied from 50 to 250 cm/min (20 to 100 in/min). The fluid viscosity ranged between 1.0e+05 to 1.0e+06 cP.

The sampler bit is a hollow cylinder with an inner diameter of 2.54 cm (1 in) and an outer diameter of approximately 5 cm (1.97 in). Figure 6.1-2 is a photograph of the sampler bit shapes used in this study. Five different sampler bit geometries were tested: 1) the original flat tip, 2) modified flat tip, 3) truncated cone with 30 degree tip angle, 4) 45 degree tip angle, and 5) 60 degree tip angle. The main difference in the geometry of the tips is a progressively sharper leading edge.

Results and Observations

For a fluid with a yield stress, the flow will be split into three regions because of flow blockage and friction: an inner region that will enter the sampler, an outer region that is diverted around the sampler, and a third region within which the fluid doesn't yield and is attached to the Sampler. This is exactly the situation that is recorded in the videos of the sampler insertion. The displacement of the bubbles upstream of the sampler were measured as a function of the displacement of the sampler. Changes in the viscosity and insertion rate did not affect the relative bubble to sampler displacement. Increasing the insertion rate only increased the rate at which this displacement took place and increasing the velocity increased the resistance on the sampler due to friction. The number of captured bubbles and the bubble size distribution appear to be independent of the insertion rate.

Most of the bubbles trapped in the simulant in the Sampler were smaller than those in the simulant prior to sampling due to the extension and compression that the bubbles experienced at the tip of the sampler. Near the stagnation streamline there is a substantial amount of lateral extensional stresses.

As shown in Figure 6.1-3, the stagnation point moves inward toward the entrance of the sampler as the leading edge angle increases from 0 degrees to 60 degrees from the horizontal. As the cross sectional area of the fluid entering the sampler approaches the cross sectional area of the sampler, the amount of compressive and elongational stresses acting on the fluid upstream of the sampler is minimized.

Figure 6.1-1 Schematic Diagram of the Experimental setup

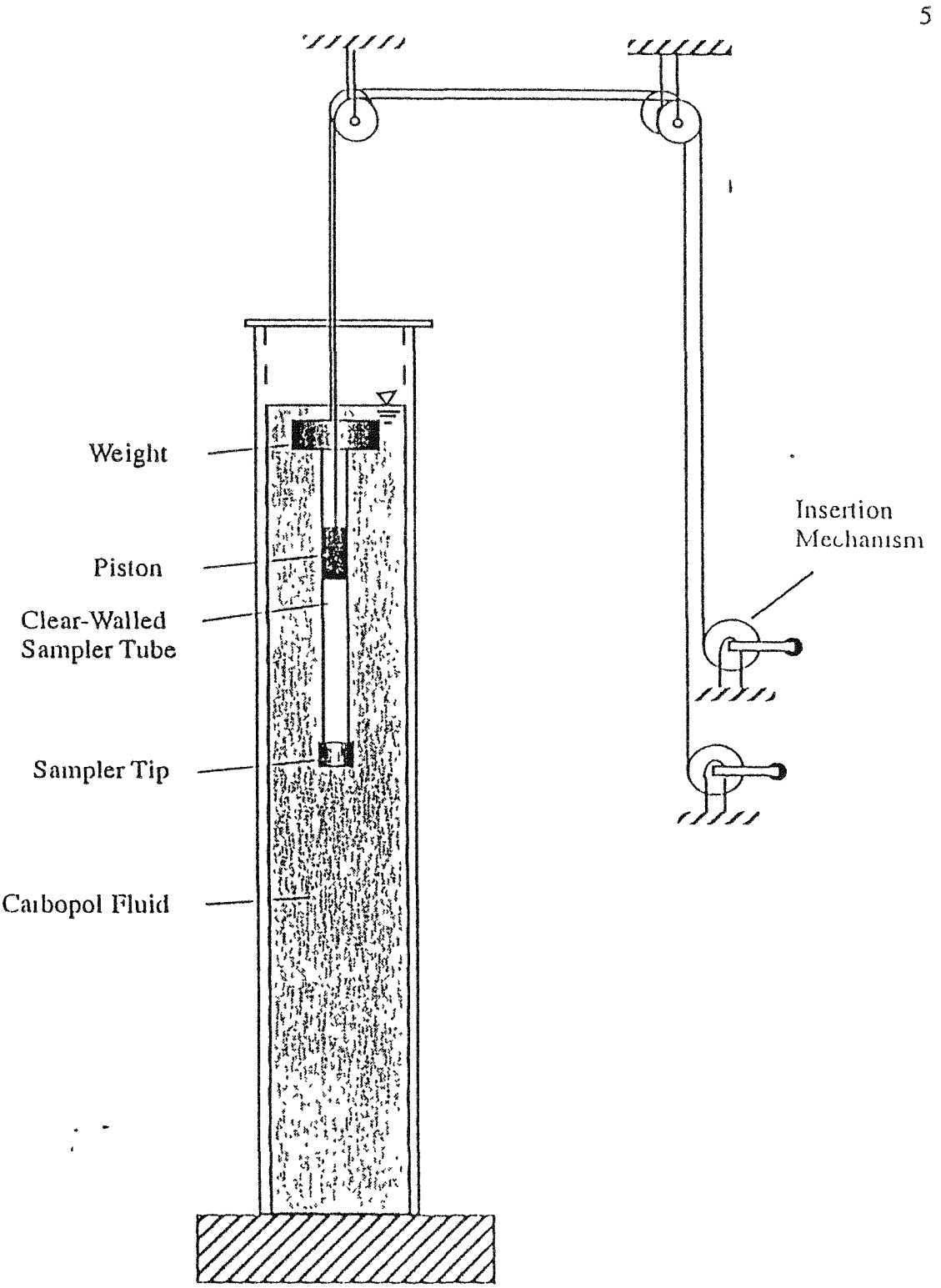


Figure 6.1-2 Photograph of the Different Sampler Tip Geometries Tested

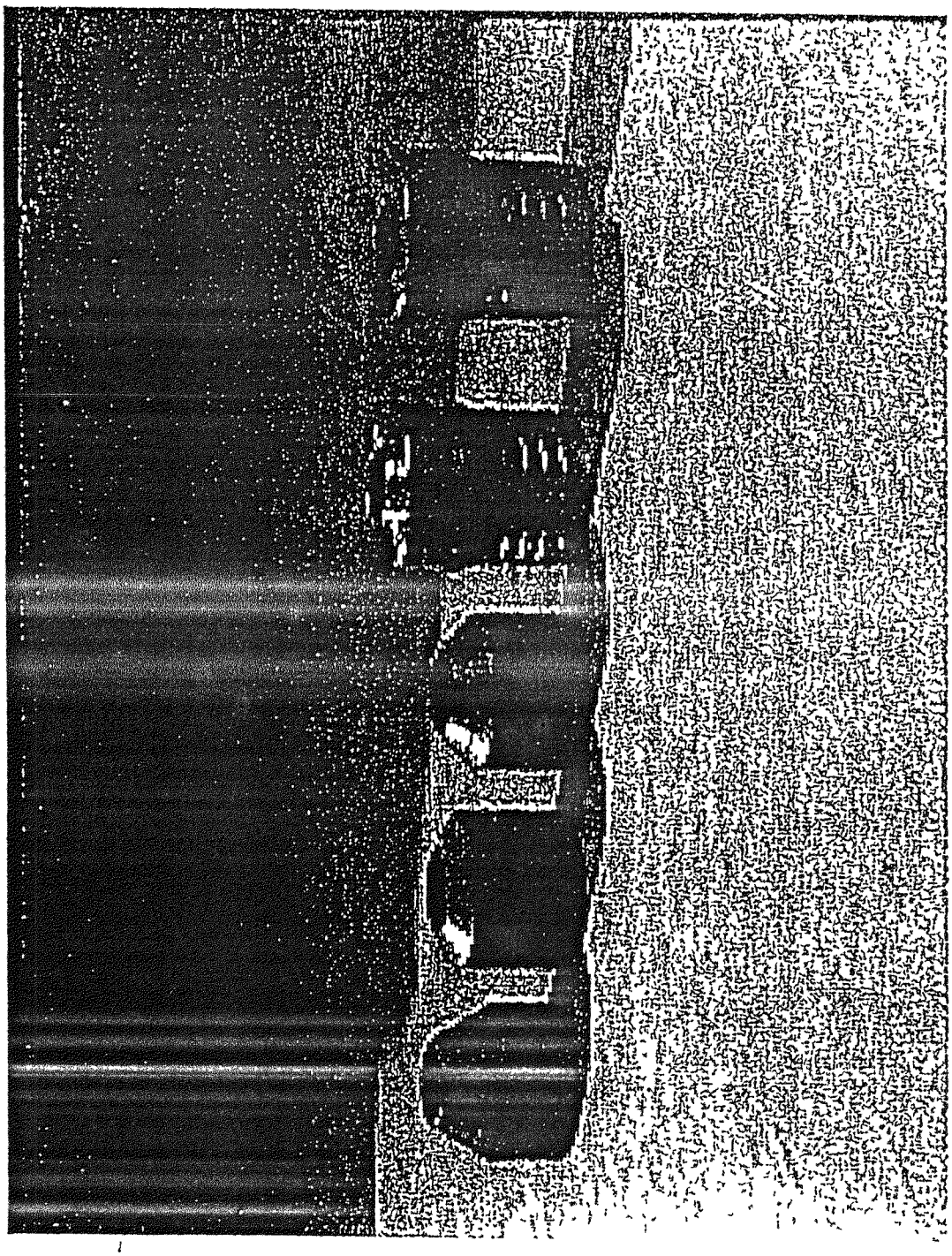
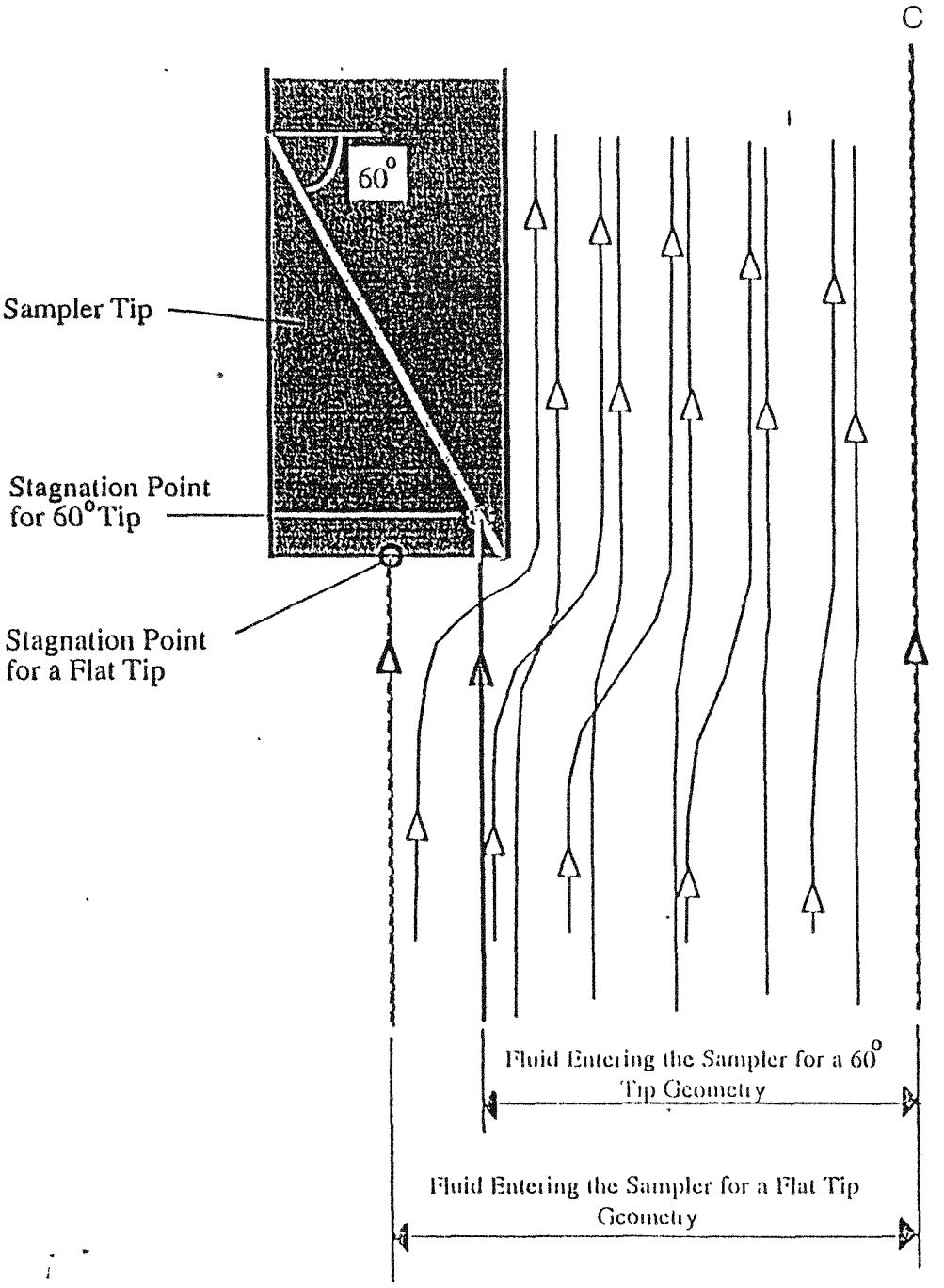


Figure 6.1-3 Approximated Streamlines and Location of the Leading Edge Stagnation Points



shown for the flat tip and 60° tip geometries, based on the video images. Note that the sampling cross-sectional area has reduced for the sharper leading edge.

Conclusions

Visualization tests clearly outlined the main fluid dynamics issues. That is, the sampler bit geometry can impact the sampling performance in two different ways: 1) the column of fluid extracted from the waste tank may not correctly represent the range of insertion depth from which the fluid is sampled due to flow blockage and stretching of the fluid; and 2) excessive disturbance of the waste immediately before sampling could result in poor sampling performance.

The sampler cross sectional area and the influence of the sampler on the fluid upstream should be minimized in order to minimize the waste disturbance before and during the sampling. However, as the leading edge of the sampler becomes sharper, the volume of fluid that enters the sampler tip but does not enter the sampler tube increases. This causes additional disturbance for subsequent sampling. Based on the current testing results the 60 degree sampler tip geometry is recommended.

6.2 HELIUM LEAK RATE

Helium leak testing of two Universal Samplers has been performed (Chastain 1994). No leaks were detected for the rotary valve seal, the axle seals, and the piston O-ring seal. However, gross leaks were detected at the cable entrance to the valve housing, indicating the O-ring seal there was not adequate. Additionally, the cable sheathing provided a leak path. This testing was performed at room temperature with a differential pressure of 1 atm. These results necessitated a modification to the design of the cable-valve housing interface.

A review of the effect of gamma irradiation on the materials of the Sampler was performed to determine if the leak tightness of the sampler would be degraded in the tank environment (Bridges 1994a). The only critical parts used in the RGS that are susceptible to gamma radiation damage are the O-rings and lower seal. These parts are constructed from Viton. The gamma radiation exposure for the sampler is expected to be less than 100 Gray (10,000 rad). This value is based on a maximum gamma radiation dose rate of 10 Gray/hr (1000 rad/hr) for Tank 241-SY-101 and a maximum time in tank of 8 hours. No sampler should be in the high radiation portion of the tank for more than a few hours. Vitons start exhibiting compression set at gamma radiation exposures of 1000 to 10,000 Gray (1.0e+05 to 1.0e+06 rad). Therefore, the Viton seals should not experience any significant compression set that would lead to a higher gas leak rate.

6.3 GAS EXTRACTION

The development of the RGS extraction device is being done in three steps, with testing as an integral part of each step.

Phase 1

Cold laboratories for gas transport, void fraction, and analytical testing have been set up in the WHC 222-SA and 306E facilities. Figure 6.3-1 shows the equipment setup in 306E. This setup includes a sampler, a vacuum chamber simulating the Extractor, a high efficiency vacuum pump, and several pressure transducers. Figure 6.3-2 shows a schematic of the 222-SA setup, which includes the mercury positive displacement pump.

A Phase One Test Plan is described in Hey (1994b). The first phase deals with the proof of principle of quantitative gas transfer. Gas transfer behavior will be analyzed by quantitatively measuring and transferring gases which have been introduced to the system from external sources. The objective of the first phase is to determine what system factors affect quantitative mass transfer and establish the best method for the determination of "void fraction". Tests will investigate characteristics of samples, equipment, and operations that affect quantitative mass transfer. Sample characteristics being investigated include the effects of water vapor pressure, relative proportions of oxidizing and reducing gases, and sample temperature. Equipment characteristics being investigated include the effects of in-line moisture scrubbers and HEPA filters, tubing diameter and length, sample loop dimensions, and gas analyzer sensitivity and selectivity. Operation characteristics being investigated include condenser utilization, gas flow rates, pump cycle frequency, displacement pump operation, gas sample transfer and analysis technique, position and tolerance of pressure transducers, and carrier gas chemistry, pressure, and flow rate.

A mercury positive displacement pump (similar to the type used on the Van Slyke apparatus) will be used to transfer the gas sample. A condenser, moisture scrubber, and HEPA filter will be tested. The condenser allows most of the water vapor to condense out of the gas sample prior to the moisture scrubber. The moisture scrubber contains a desiccant and will absorb much of the water vapor. It is uncertain at this time whether the scavenging of water vapor will compromise quantitative gas transfer (by simultaneously trapping other gases or possibly even disrupting the flow of gas through the scrubber). The effectiveness and need for the condenser and moisture scrubber will be tested. Filters with large surface areas and restricted gas flow passageways will likely outgas contaminants indefinitely. If possible, the HEPA filter and water removing filter will be eliminated in favor of some sort of monitoring system.

Since sample temperature has a considerable effect on water vapor pressure it will be important to determine the effects of water vapor pressure on quantitative gas transfer. Extracting and pumping the gas from the waste sample at room temperature or higher, for instance, could involve adiabatic expansion of the gas and cause the water vapor component to condense. The extent at which water vapor condensation will affect quantitative gas transfer will have to be determined.

Figure 6.3-1. Extractor Mockup in 306E.

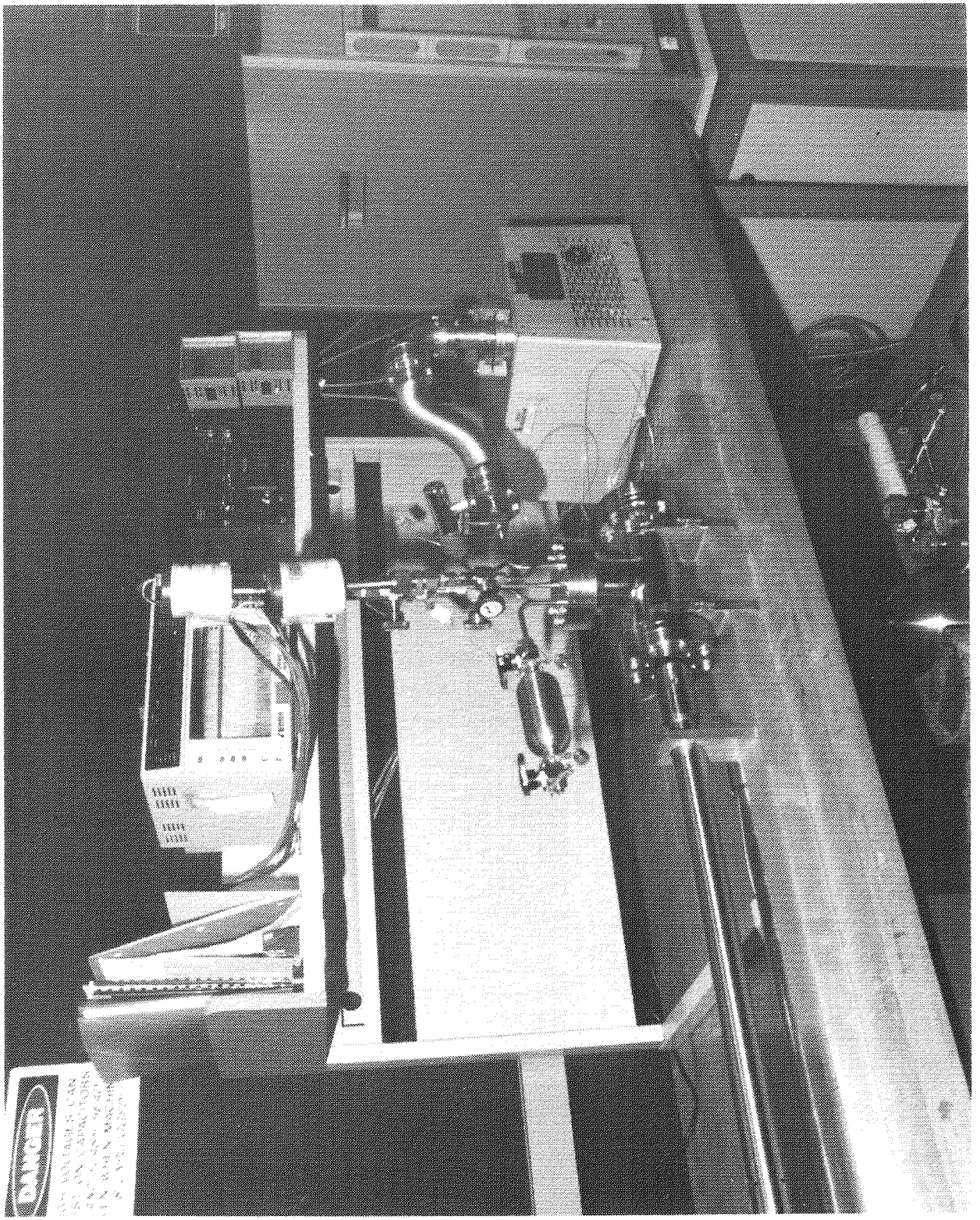
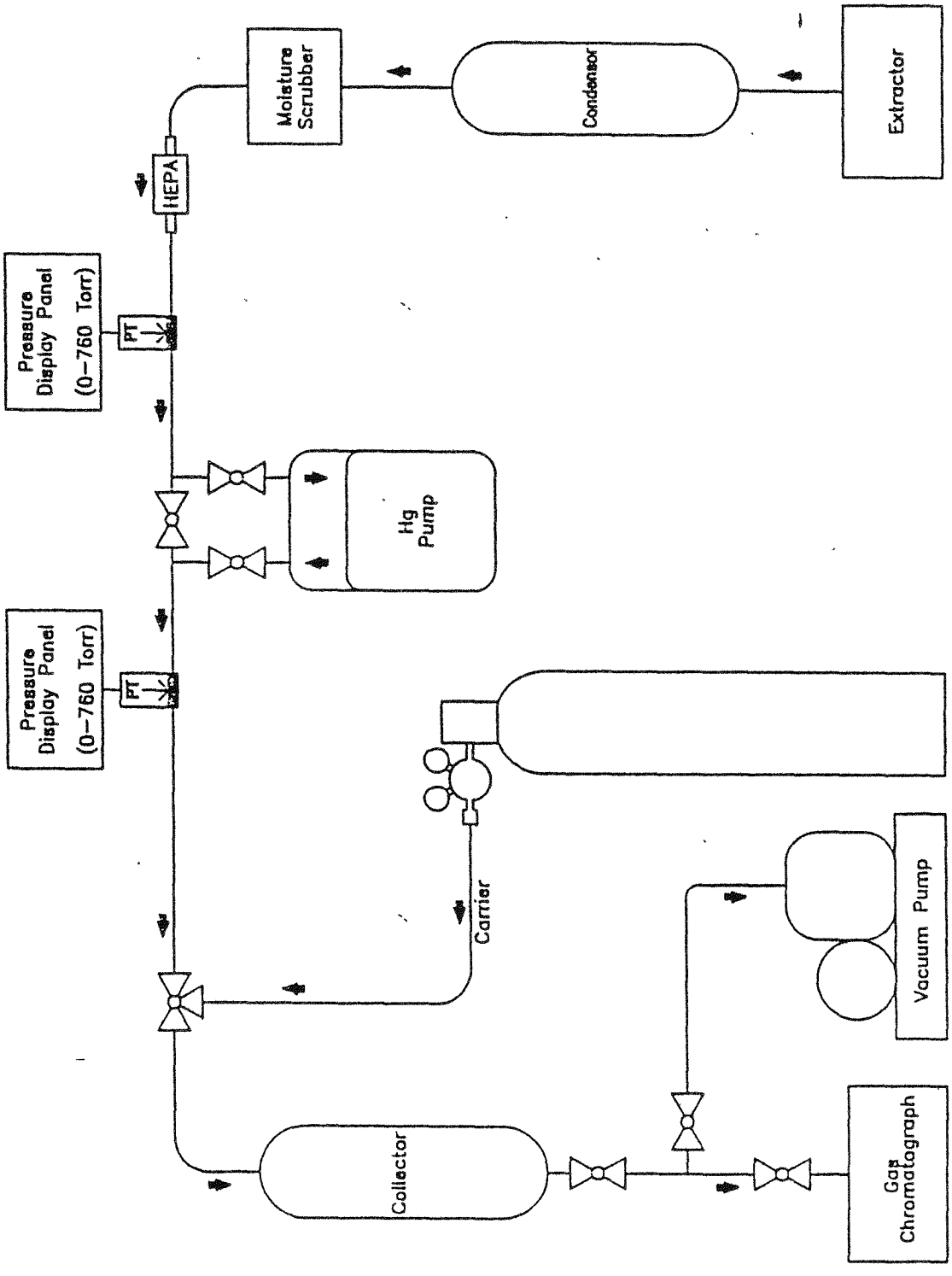


Figure 6.3-2 Phase 1 Laboratory (222-SA) System Setup



Condensed water vapor will, most certainly, affect the determination for ammonia. It will be impossible to distinguish the water vapor in the sample gas from water existing in the waste which vaporizes during the extraction process. Therefore a direct measure of the water vapor fraction of the retained gas cannot be made. However, water vapor pressure dependence on temperature is well known and its contribution to the gas sample volume can be calculated.

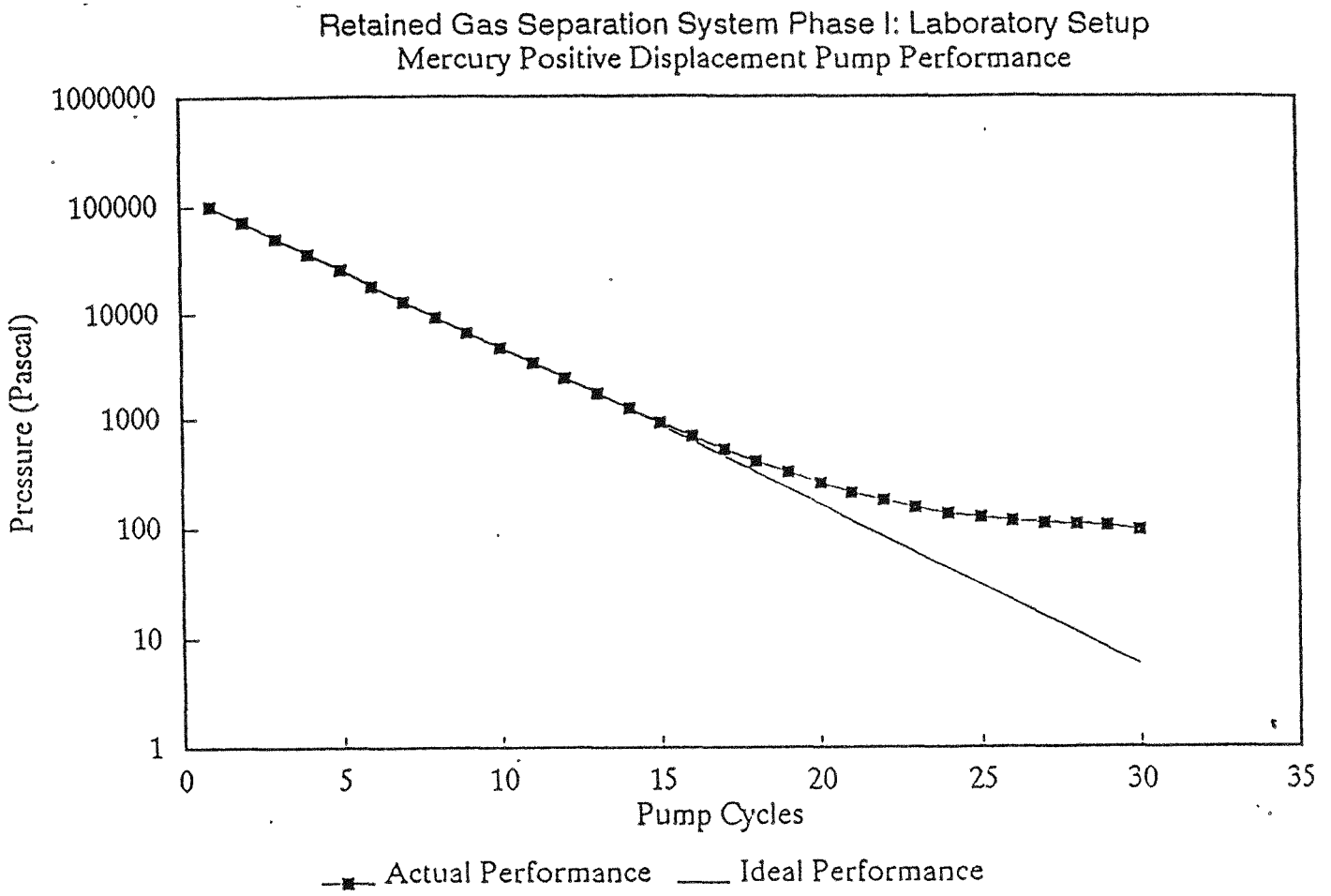
Two "standardized" gas mixtures have been obtained for testing. The first mixture contains 30% hydrogen, 25% argon, 40% nitrogen, and 5% ammonia. The second mixture contains 30% nitrous oxide, 40% helium, and 30% nitrogen. Mass spectrometry analysis with the Pacific National Laboratory (PNL) mass spectrometer of both gas mixtures produced excellent agreement with vendor specification except for ammonia. The removal and absorption of ammonia with a water bath has been demonstrated. Testing has indicated that the preferred method for analysis of ammonia is using water absorption followed by wet chemistry analysis. Additional measurements on these gas mixtures using gas chromatography (GC) and residual gas analytical (RGA) equipment is in progress.

A two volume mockup of the Extractor has been completed and tested using both gas mixtures. Measurement of sample volume using dry gases has been demonstrated with uncertainties ranging from 1 to 5%. Additional tests with wet gases in progress.

The mercury positive displacement pump performance has been tested and characterized with dry gases and multi-cycle gas transfer has been demonstrated. Figure 6.3-3 shows the performance of the mercury positive displacement pump. High accuracy pressure transducers for the extractor have also been tested. It is critical that the pressure in the extraction vessel be determined accurately. The use of two or three transducers with overlapping ranges located right at the vessel is recommended.

An extrusion leakage test is underway to demonstrate that a pre-loaded mixture of simulated waste and gas (known quantities of each) can be extruded from a Sampler into an extractor vessel mock-up with essentially no loss of materials. For the extrusion leak test, a Sampler will be filled with a known amount of simulated waste and helium gas. The simulated waste will have representative physical properties, such as grit and viscosity, but no injected gas. The sample will be compressed with the sampler piston and extruded into an extractor mock-up where the amount of gas recovered will be measured.

Figure 6.3-3 Retained Gas Separation System Phase 1:
Laboratory Setup Mercury Positive Displacement Pump Performance



Extractor Volume: 1000 cm^3
Collector Volume 40 cm^3

Phase 2

The second phase of development testing deals with the transfer and characterization of extracted gases from waste tank material simulant in a "full-scale" RGS setup configured in a hot cell. The objectives of this phase are to determine how gas may be separated from the bulk of the material and to evaluate the performance of the prototype system setup.

Phase 3

The third phase of development testing deals with the performance evaluation of the full scale RGS setup with authentic waste tank samples. Tank 241-SY-101 has been proposed for sampling in this first application of the RGS extraction system.

6.4 SAMPLE COLLECTION

A series of sample collection efficiency tests are underway to demonstrate that a prototypic Sampler can capture and retain a representative sample of simulated 241-SY-101 waste under anticipated conditions of pressure and temperature. For this test a 15 meter (49.2 ft) tall chamber is being fabricated in a test stand. The bottom 1 m (3.28 ft) will contain simulated waste, with about 14 meter (45.9 ft) of water on top to provide hydraulic head. The simulant will have physical properties representative of typical double shell tank waste. A sample will be taken with a prototypic Sampler and extruded into the extractor mock-up. The void fraction in the sample will be determined through pressure measurements.

7.0 SAFETY ANALYSIS

Los Alamos National Laboratory has been contracted to perform the safety analysis for the RGSS. A safety assessment of push mode core sampling was completed and later updated in 1991 (Marusich 1991). Since that time there have been changes to tank related equipment and operations that require evaluation prior to the conduct of operations. The major change was the introduction of the Mixer Pump in tank 241-SY-101 for mitigation of episodic hydrogen gas release. Other changes introduced by the RGSS include new sampling equipment and the use of argon to maintain hydrostatic pressure. A safety analysis for the 241-SY-101 Mixer Pump has been completed and is undergoing revision (LANL 1994). Use of the Sampler involves tank intrusion, like the Mixer Pump introduction. Unlike the Mixer Pump, however, the operations of the Sampler are simpler with minimal relative disruption of the tank contents during the operational stage. The Sampler safety analysis is being provided as Addendum 3 to the Mixer Pump safety assessment.

The first step in performing the safety assessment included gathering data and identifying hazards. The identified hazards were then reviewed to develop logical accident scenarios. A matrix of the accident scenario to the hazards was developed. Then using quantitative methods the accident analysis was performed to identify a probability of accident occurrence. Then a consequence analysis was performed to identify the severity of the accidents. Finally, an overall qualitative risk identification was developed for each hazard. The assessment of the controls proposed was also made with any additional controls needed for retained gas sampling recommended.

A review of the safety assessment work was conducted in April 1994. Shortly after this the safety assessment work was temporarily halted due to other higher priority work. Work is expected to resume in September 1994. The safety assessment is currently over 60% complete.

8.0 WORK REMAINING

Significant progress has been made in developing the RGSS. The design of the gas-tight sampler is complete, components have been fabricated and tested, and units for final testing have been fabricated. The design of the sample extruder has also been completed, and it is ready for fabrication. Detailed design of the gas extractor depends on the results of development testing, which is in progress. Project work remaining includes functional testing of the sampler, extruder, and extractor components with waste simulants, including the recovery of known quantities of retained gas.

The following specific issues need to be addressed to confirm the functionality of the retained gas sampler and extraction system:

* Leak tightness of the sampler assembly as a whole - The individual features of the sampler have been tested to verify the design. However, an entire sampler needs to be assembled and tested under anticipated operating extremes to assure that it will

remain leak-proof. Performance of the sampler tests previously described (extrusion leak test and collection efficiency test) should answer the remaining questions regarding this issue.

* Performance of the extraction system gas transfer apparatus - Plans call for the use of a mercury pump to move the sample gas from the low-pressure extractor vessel to the analytical or sampling station. Since very small gas volumes are anticipated, the efficiency of this pump needs to be very high. Tests underway in the 222-SA cold laboratory are designed to resolve these issues.

* On-line analytical capabilities - Since system leakage is such a key issue in the entire process, immediate on-line analysis of retained gas samples is a very desirable feature. Testing of a gas chromatograph with gas samples of known composition to determine analytical precision is planned.

* Ability to accurately measure ammonia gas constituent - Because ammonia is known to be very soluble in water, and water will certainly be present in the all of the samples, methods to accurately quantify ammonia need to be determined. Plans call for investigating methods to trap all of the ammonia in water and then perform the analysis using "wet chemistry" techniques. Both offsite and PNL resources have been identified for this work.

* Adaptability of RGSS to hot cell operations - Numerous problems are anticipated in converting bench-test results into a system that can be disassembled, cleaned, reassembled, repaired, etc., in a hot cell environment. A series of integrated tests, designed to resolve these issues, are currently included in the schedule.

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APPENDIX A

GENERAL NOTES (UNLESS OTHERWISE SPECIFIED)

1. BREAK ALL SHARP EDGES & REMOVE ALL BURRS.
2. UNLESS OTHERWISE SPECIFIED, MACHINED SURFACES TO BE 125√.
3. ALL MACHINED RADII SHALL BE .030 RAD MAXIMUM UNLESS OTHERWISE INDICATED.
4. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M (82). DIMENSIONS ARE IN INCHES. TOLERANCE: .X = ±.1, .XX = ±.01, .XXX = ±.005. ANGLES ±1°.
5. BRAZE AND INSPECT PER ASME SECTION VIII, DIV 1. VT BRAZED JOINTS AT FINAL PASS.
6. ELECTRON-BEAM WELDS TO BE PERFORMED IN ACCORDANCE TO HS-V-6-0013
7. IDENTIFY ASSEMBLY PER HS-85-0015 TYPE 5 WITH DRAWING NUMBER, REVISION NUMBER, AND SERIAL NUMBER APPROX WHERE SHOWN. SERIAL NUMBERS WILL BE GIVEN TO ALL SAMPLERS ASSEMBLED, RANGING FROM -001 TO -999. THE FIRST TWO NUMBERS WILL IDENTIFY THE YEAR IN WHICH THE UNITS ARE BUILT. THE NEXT THREE NUMBERS WILL IDENTIFY THE SEQUENCE. USE .25 HIGH CHARACTERS ON THE SERIAL NUMBERS AND .09 HIGH CHARACTERS ON DRAWING AND REVISION NUMBERS. EXAMPLE: A UNIT BUILT IN 1992 WILL READ 92-001.
8. .25 x 1.77 SLOT IN ITEM NO 12 TO BE MACHINED AFTER ASSEMBLY WITH ITEM NO 18 SLOTS TO BE IN-LINE WITH ROTARY VALVE (ITEM NO17) WITHIN ±5°.
9. ITEM NO 14, 12, 16, 17, 18, 19, 20, 30, 31 AND 33 REQUIRE CHEMICAL MATERIAL CERTIFICATE.
10. ASSEMBLE SAMPLER WITH ROTARY VALVE (ITEM NO 17) IN OPEN POSITION.
11. THE SAMPLER SHALL BE LEAK TESTED IN ACCORDANCE WITH WHC-SD-WM-SCD-042
12. INSTRUCTIONS ON HOW TO SET CABLE TENSION:

    ITEM NO 17 (VALVE) SHALL BE IN THE OPEN POSITION WITH ITEM NO 14 (PISTON) IN THE DOWN POSITION, AS SHOWN IN ASSY 1 ON SHEET 2. REMOVE 2 TO 3 INCHES OF PLASTIC COATING FROM FREE END OF ITEM NO 42 (CABLE). SLIDE ITEM NO 40 (SWIVEL SLEEVE) ONTO ITEM NO 42. INSERT ITEM NO 42 THROUGH HOLE IN ITEM NO 11 (PIN). INSERT ITEM NO 42 BACK THROUGH ITEM NO 36. REMOVE SLACK ONLY FROM CABLE. DO NOT PRETENSION. CRIMP ITEM NO 36. REPEAT SAME PROCEDURE FOR OTHER SIDE.
13. APPLY ITEM NO 46 (ADHESIVE) PER MANUFACTURER'S SPECIFICATIONS.
14. SUBSTITUTION FOR TYPE 304 SST.
    ALL TYPE 304 SST MAY BE SUBSTITUTED BY ANY 300 SERIES SST, TYPE 304 AND ABOVE, INCLUDING THE LOW CARBON SERIES TYPE 304 AND ABOVE.
15. PN 19 MATERIAL CAN BE ANY TYPE 400 SERIES HEAT TREATABLE SST WITH A MIN. HARDNESS OF 24 RC.
16. ITEM NO 24 MATERIAL CAN BE ANY GRADE CS OR ANY GRADE SST.
17. ITEM NO 31 (OUTER INSERT) SHALL BE MODIFIED BY BONDING A PN 70 TO PRODUCE PN 68 (OUTER INSERT , MODIFIED).

PARTS/MATERIAL LIST

QTY -08	QTY -16	QTY -30	QTY -60	QTY -85	PART/DWG NUMBER	NOMENCLATURE/DESCRIPTION	MATERIAL/REFERENCE	SHEET	ITEM NO
				2	ØDC31-0408	PIN,DOWEL, ø1/8 X 1/4 L	STOCK DRIVE PROD	3	51
		2			9135-0408	ROLL PIN	STOCK DRIVE PROD	8	52
				1	9135-0208	ROLL PIN	STOCK DRIVE PROD		53
									54
									55
	16					LOCK WASHER, HI-COLLAR 1/4	ANSI B18.21.1/SST 18-8	7	56
	1					JAM NUT, HEX, 3/4-16UNF-2B	CS / ANSI B18.2.2	7	57
				AR		DUCT TAPE	ANY GRADE	2	58
				1		WIRE, SHEAR AWG18(ø.0403) X 1.0L	18-8-316 WIRE ANNEALED	2	59
				2		SKT SSCR, CUP PT,ø8-32UNC-3A 3/16 L	SST 18-8/ANSI B18.3	1	60

PARTS/MATERIAL LIST

QTY -08	QTY -16	QTY -30	QTY -60	QTY -85	PART/DWG NUMBER	NOMENCLATURE/DESCRIPTION	MATERIAL/REFERENCE	SHEET	ITEM NO
					-010	ASSEMBLY, RETAINED GAS SAMPLER		2	1
				1	-020	ASSEMBLY, VALVE STOP		6	2
				1	-030	ASSEMBLY, SPRING		6	3
				1	-040	ASSEMBLY, QUADRA LATCH		7	4
				1	-050	ASSEMBLY, CABLE PISTON		3	5
									6
									7
									8
				1	-001	PINTLE ROD, .187 STOCK	SST 304 ASTM A 276	4	9
				1	-002	PULL BLOCK	CS ASTM A36	4	10
				2	-003	PIN, 7/32" DIA STOCK	SST 300 ASTM A276	4	11
				1	-004	SAMPLE HOUSING	SST 304 ASTM A 269	4	12
				1	-005	CONE	CS ASTM A 36	4	13
				1	-006	PISTON	SST 304 ASTM A276	4	14
				1	-007	GUIDE	SST 304 ASTM A276	4	15
				1	-008	VALVE HOUSING (ANNEALED)	SST 304 ASTM A276 A911	5	16
				1	-009	ROTARY VALVE	SST 410 ASTM A 276	5	17
				2	-011	VALVE AXLE	SST 304 ASTM A 276	5	18
			1		-012	VALVE GUIDE	SST 304 ASTM A 276	6	19
			1		-013	FILLER VALVE STOP	SST 304 ASTM A 276	6	20
		1			-014	STOP	SST 410 ASTM A 276	6	21
		1			-015	TRIGGER	SST 410 ASTM A 276	6	22
		1			-016	PLUNGER	SST 304 ASTM A 276	6	23
	1				-017	HEAD BASE, QUADRA LATCH	CS ASTM A 36	7	24
	1				-018	NECK, TUBE 3/4 O.D.X.109 W	CS ASTM A513	7	25
	4				-019	LATCH, ALTERED		7	26
	4				-021	SPRING, ALTERED		7	27
				1	-022	CAP	ALUMINUM ANY GRADE	5	28
				2	-023	SPRING STOP	CS ASTM A 36	5	29
				1	-024	INNER INSERT	SST 410 ASTM A 276	8	30
				1	-025	OUTER INSERT	SST 410 ASTM A 276	8	31
				1	-026	LOWER SEAL, ALTERED WHITE VITON 80±5 DURO	ACME RICH RUBBER MFG CO #R2280		32
1					-027	CABLE PISTON	SST 304 ASTM A 276	3	33
									34
									35
	16				PN 006-005-615	SCREW	BOYLE BROS DRILLING CO	7	36
	2				#NSK 6903	BEARING	HOOVER	7	37
				2	2-010-V747-75	O-RING, AXLE SEAL	PARKER SEALS	3	38
				1	2-212-V747-75	O-RING, PISTON SEAL	PARKER SEALS	3	39
				2	2-002-V747-75	O-RING, CABLE SEAL	PARKER SEALS	3	40
	1				ø5100-66	RETAINING RING	TRUARC	7	41
2				2	#CMA 11663	CABLE, ø.060 X 30.00 L	CABLE MFG & ASSY	1	42
				AR	#111	GREASE, HIGH VACUUM	DOW CORNING	3	43
		1			LHC-142J-6	SPRING,COMPRESSION	LEE SPRING	3	44
				AR	LOCTITE QUICK-SET 404	ADHESIVE	McMASTER-CARR	1	45
	3				CAT #84 #98239K44	BALL, #7/32	McMASTER-CARR	7	46
				2	#3672T2	SLEEVE,OVAL ø3/64 CABLE	McMASTER-CARR	2	47
2					#CMA 11663	CABLE, ø.060 X 3.00 L	CABLE MFG & ASSY	3	48
1					#CMA 11663	BALL, #1/8 PLASTIC COATED	CABLE MFG & ASSY	3	49
					STOCK CAP	PLUG,TAPERED ø.38 X ø.25 X .75L	SEQUIM & BAR CO / EMERSE	3	50

H-2-95075		
H-2-91864	MODIFIED QUADRA LATCH ASSY	
H-2-95316	SLUDGE SAMPLER	
DWG NO	TITLE	
HANFORD TRANSMITTAL LIST	NEXT HIGHER ASY	H-2-140300
CABLE PISTON		

RETAINED GAS SAMPLER ASSEMBLY

H-2-821606 0

WHC-SD-WM-ER-387 Rev. 0 Page A2

A-1.1

NOTE:
INSTALL ITEM NO 15 (GUIDE) ON ITEM NO 9 (PINTLE ROD) BEFORE INSTALLING ITEM NO 53 (SPRING PIN) TO ITEM NO 9. FINAL LOCATION TO BE DETERMINED WITH ITEM NO 14 (PISTON) FLUSH WITH END OF ITEM NO 51 (INSERT) SLIDE ITEM NO 15 DOWN ITEM NO 9 UNTIL ITEM NO 15 IS IN CONTACT WITH ITEM NO 24 (HEAD BASE) OF ASSEMBLY 6. TORQUE ITEM NO 60 (SET SCREW) TO 10–12 IN–LBS.

APPLY A LIGHT COAT OF ITEM NO 44 (GREASE, HIGH VACUUM) TO ITEM NO 40 (O–RING), PIN 20 (LOWER SEAL) AND ITEM NO 17 (ROTARY VALVE).

VIEW X

SECTION A–A
VALVE OPEN/PISTON DOWN

NOTE:
PRESSFIT ITEM NO 11 (PINS) INTO ITEM NO 10 (PULL BLOCK) PINS SHALL NOT PROTRUDE THRU THE ID OF PN 10 HOLE IN PINS (FOR CABLE) MUST BE PERPENDICULAR TO THE CABLE PATH.

APPLY ITEM NO 46 TO THREADS OF ITEM NO 31 AND TORQUE ITEM NO 31 TO 14–16 IN–LBS

MOLDED SEAL

NOTE:
BOTTOM OUT ITEM NO8 (PINTLE ROD) IN ITEM NO 14(PISTON) BEFORE DRILLING HOLE FOR ITEM NO 58 (WIRE)(TEMPLATE FROM ITEM NO14)ALSO SEE NOTE AT ZONE C8

INSERT PIN TO BE FLUSH ON ONE SIDE ITEM NO 9

VIEW X
SCALE: NONE

SEE NOTE 1 AND 12
CLIP OFF FREE END OF ITEM NO 42 (CABLE) AS CLOSE AS POSSIBLE TO ITEM NO 36 (SLEEVE) AFTER INSTALLATION.

1.80 MAX

VIEW Y
SCALE: NONE

VIEW W
SCALE: NONE

DO NOT COVER Ø.25 WEEP HOLES WITH ITEM NO 58 (TAPE)

SEE NOTE 7

NOTE:
MEASURED WITH ITEM NO 14 (PISTON) FLUSH WITH END OF ITEM NO 31 (INSERT) AND THE QUADRA LATCH ASSEMBLY IN THE TOTALLY COLLAPSED POSITION. LATCHES MAY BE GROUND TO SUIT TO ATTAIN THE .250/.256 DIMENSION.

ALL LATCH TIPS (4) MUST FALL WITHIN A .080 TOLERANCE ZONE.

ALSO SEE NOTE AT ZONE E1

SEE NOTE 8

TORQUE TO 20–30 FT–LBS AT ASSEMBLY

ADJUST TO 35.80

36.6 MAX

FOR GENERAL NOTES AND PARTS LIST SEE SHEET 1

SECTION B–B

1 ASSEMBLY RETAINED GAS SAMPLER (VALVE OPEN/PISTON DOWN)
SCALE: 1/1

WHC-SD-WM-ER-387 Rev.0 Page A.3

A-1.2

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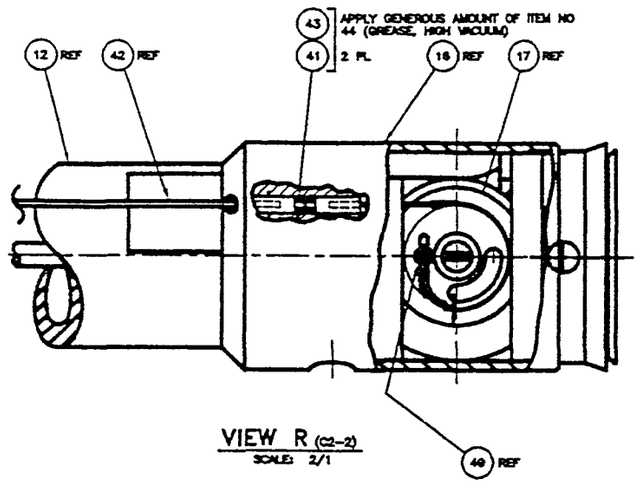
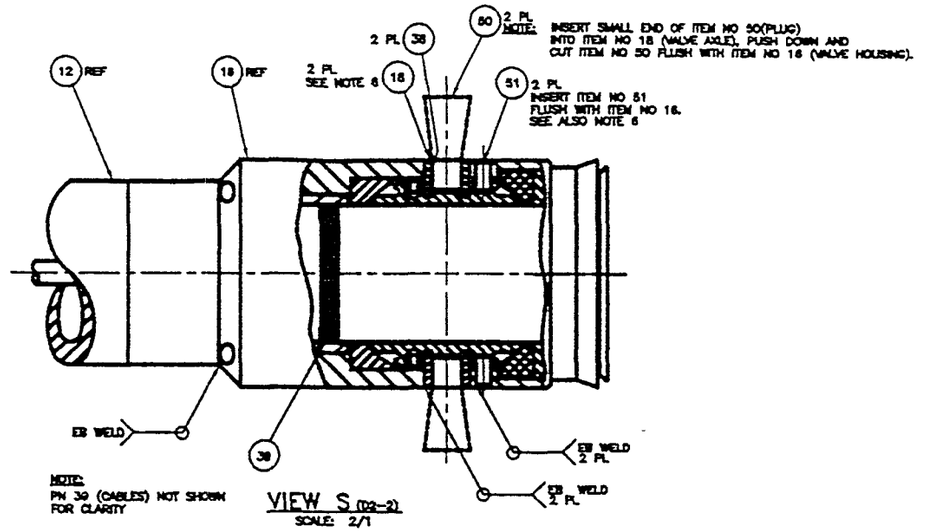
RETAINED GAS SAMPLER ASSEMBLY
H-2-821606 REV 0

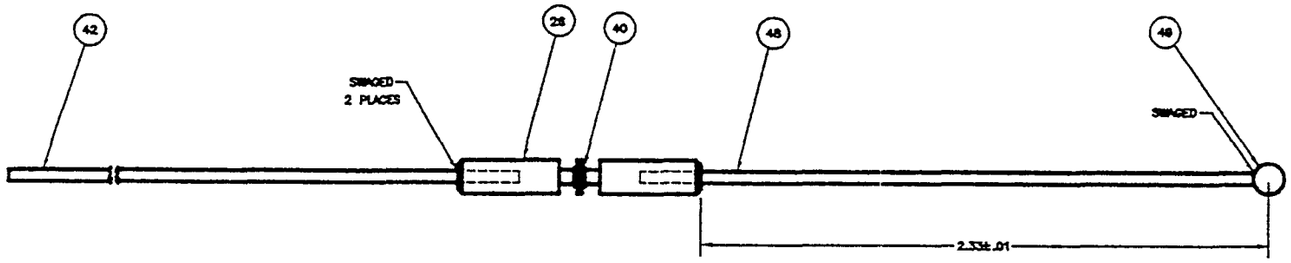


VIEW R (12-2)
SCALE: 2/1

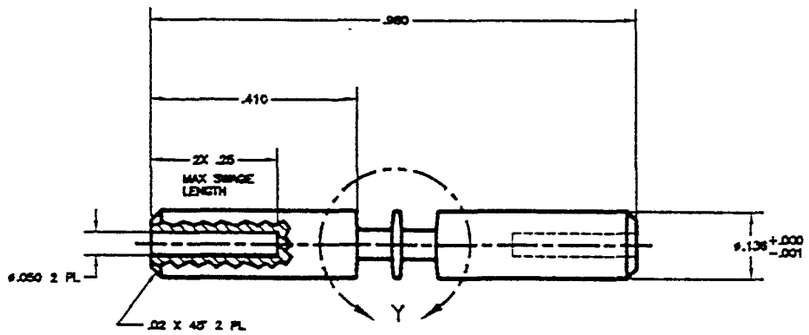


NOTE:
PN 39 (CABLES) NOT SHOWN FOR CLARITY

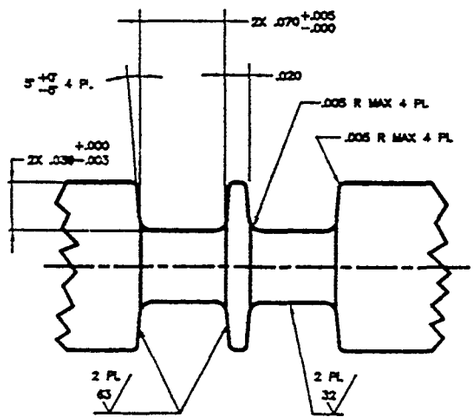
VIEW S (12-2)
SCALE: 2/1



5 ASSEMBLY CABLE PISTON
SCALE: 4/1



33 CABLE PISTON
SCALE: 8/1



VIEW Y
SCALE: 20/1

FOR GENERAL NOTES AND PARTS LIST SEE SHEET 1.

WHC-SD-WM-ER-387 Rev.0 Page A4

A-1.3

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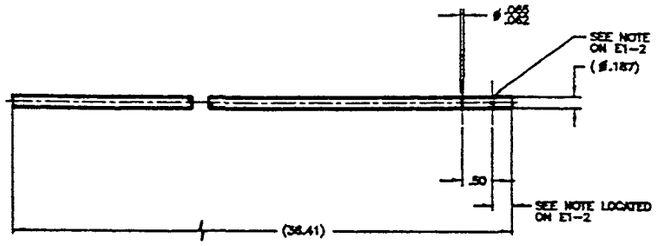
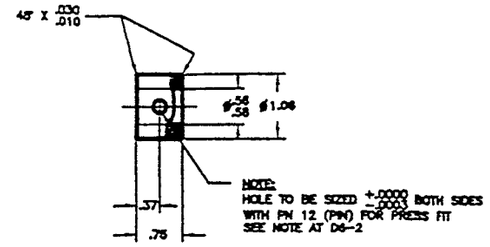
RETAINED GAS SAMPLER ASSEMBLY

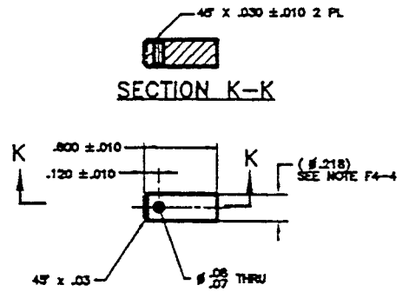
H-2-821606 0



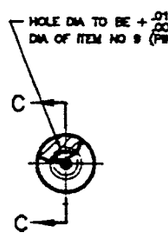
9 PINTLE ROD
SCALE: 1/1



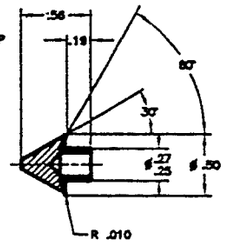
10 PULL BLOCK
SCALE: 1/1



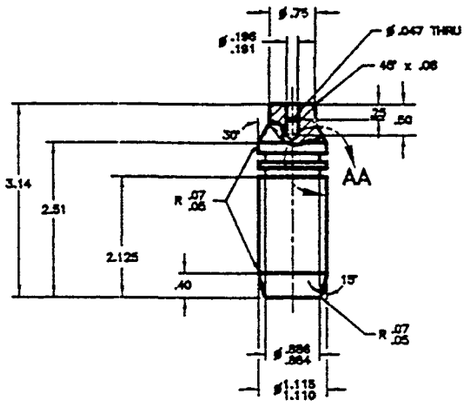
11 PIN
SCALE: 2/1



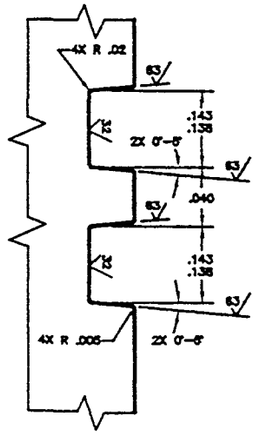
13 CONE
SCALE: 2/1



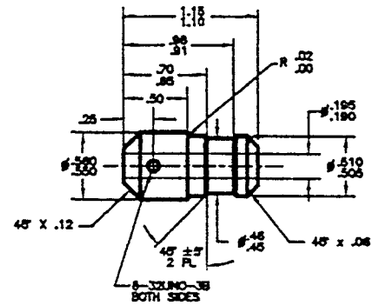
SECTION C-C



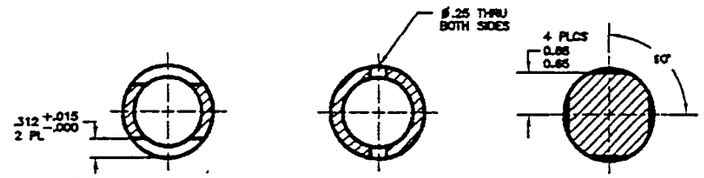
14 PISTON
SCALE: 1/1



VIEW AA
SCALE: NONE



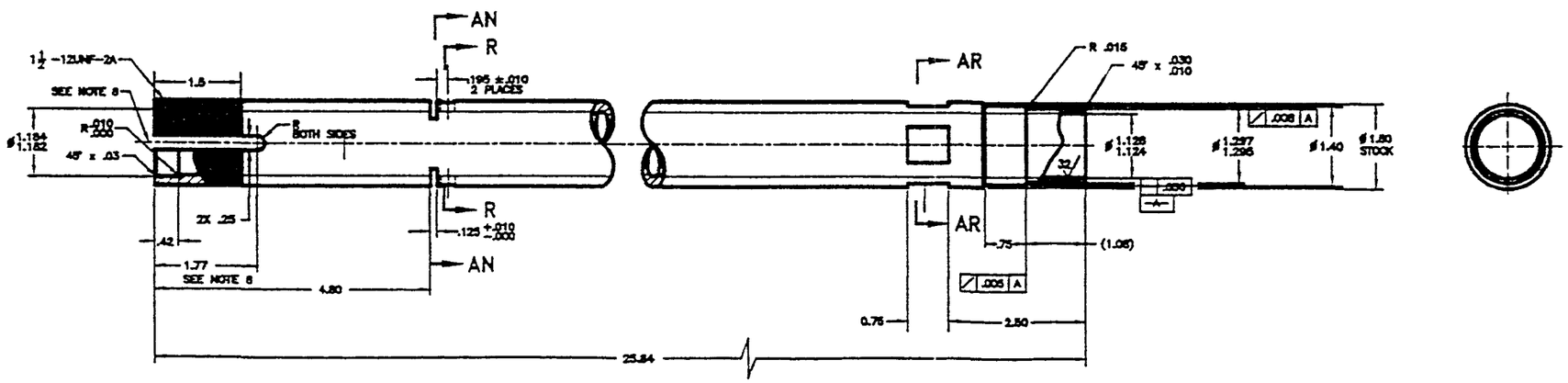
15 GUIDE
SCALE: 2/1



SECTION AN-AN

SECTION R-R

SECTION AR-AR



12 SAMPLE HOUSING
SCALE: 1/1

FOR GENERAL NOTES AND PARTS LIST SEE SHEET 1

WHC-SD-WM-ER-387 Rev.0 Page A5

A-1.4

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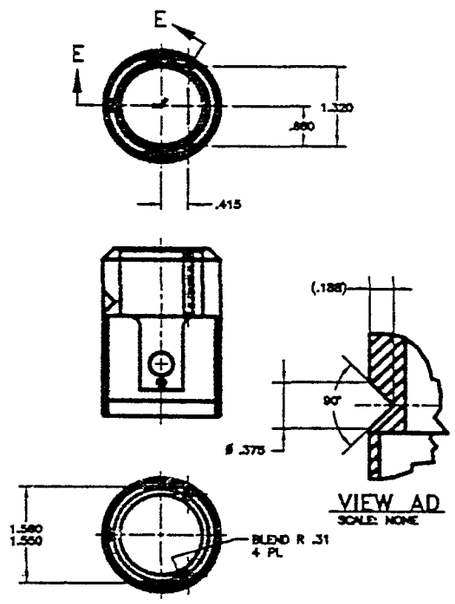
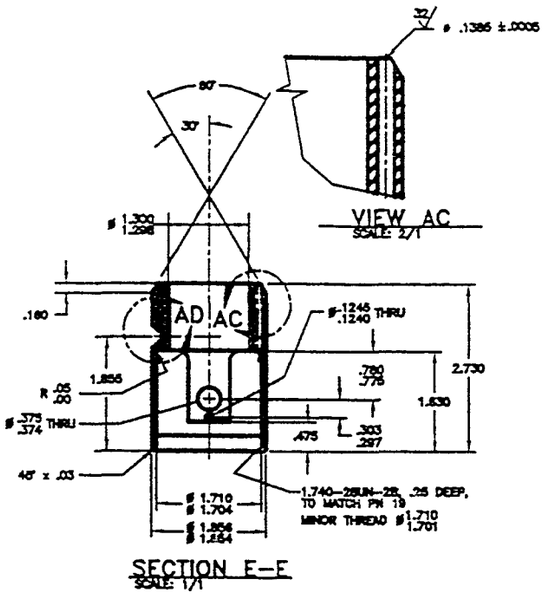
U.S. DEPARTMENT OF ENERGY

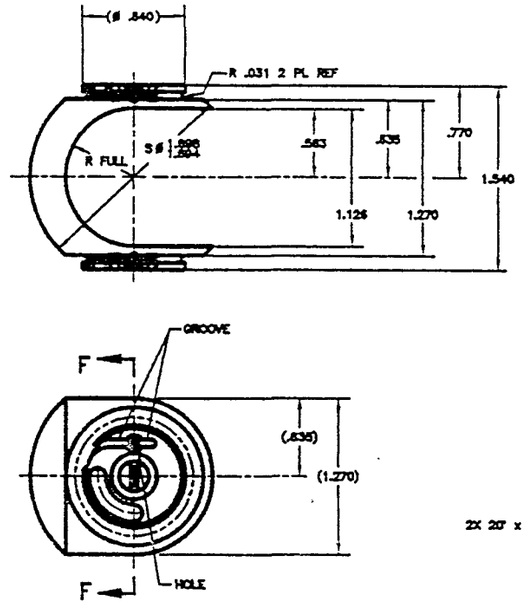
RETAINED GAS SAMPLER ASSEMBLY

H-2-821606 0

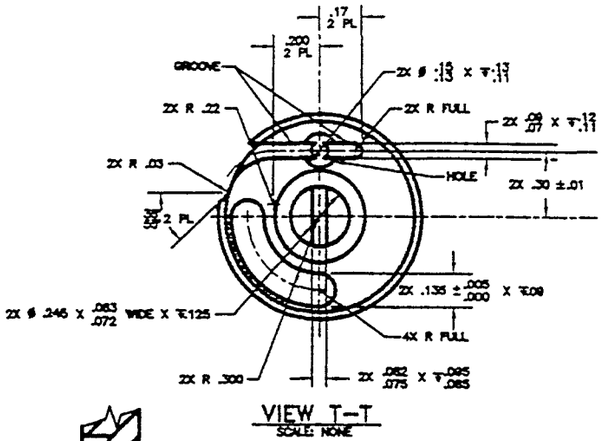


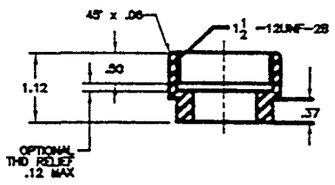
16 VALVE HOUSING
SCALE: 1/1

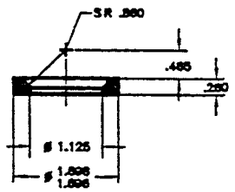


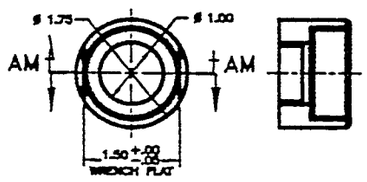


17 ROTARY VALVE
SCALE: NONE

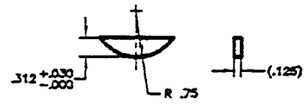




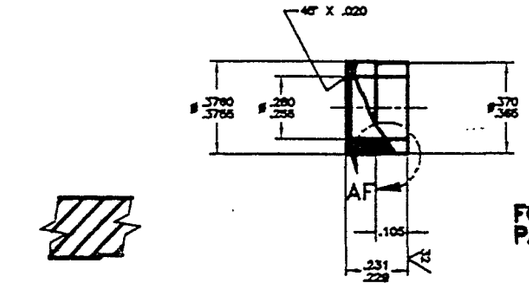




28 CAP
SCALE: 1/1



29 SPRING STOP
SCALE: 1/1



VIEW AF
SCALE: NONE

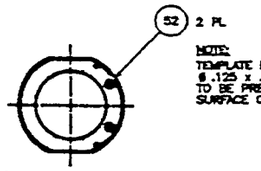
18 VALVE AXLE
SCALE: 4/1

FOR GENERAL NOTES AND PARTS LIST SEE SHEET 1

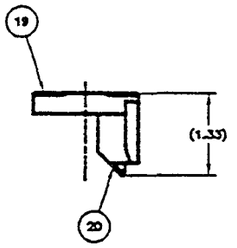
WHC-SD-WM-ER-387
Rev.0 Page A6

A-1.5

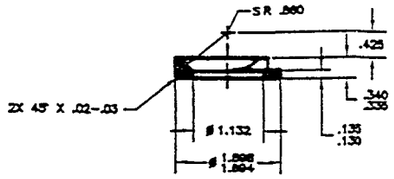
U.S. DEPARTMENT OF ENERGY	
RETAINED GAS SAMPLER ASSEMBLY	
SIZE F	DWG NO H-2-821606
REV 0	



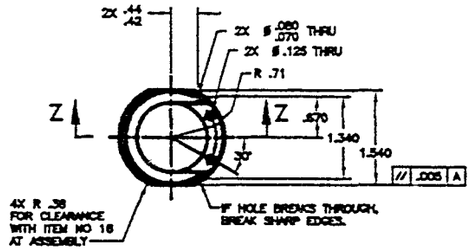
NOTE:
TEMPLATE ITEM NO 20 TO ITEM NO 19
Ø.125 x .30 DEEP FOR ITEM NO 52 (SPRING PIN)
TO BE PRESSED IN FLUSH OR BELOW
SURFACE OF PN 19

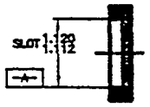


(2) ASSEMBLY – VALVE STOP
SCALE: 1/1

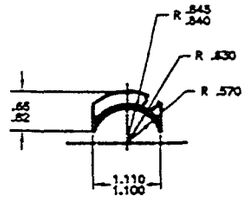


SECTION Z–Z
SCALE: 1/1

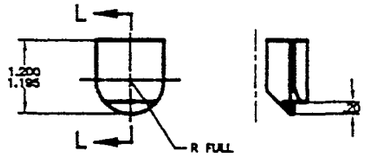




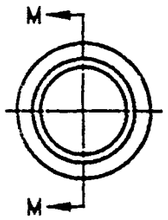
(19) VALVE GUIDE
SCALE: 1/1



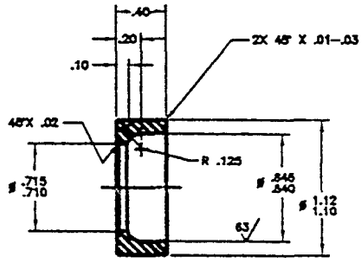
SECTION I–I
SCALE: 1/1



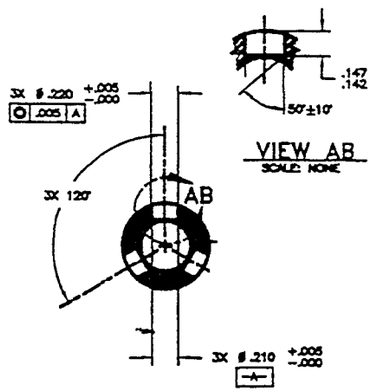
(20) FILLER VALVE STOP
SCALE: 1/1



(25) STOP
SCALE: 2/1

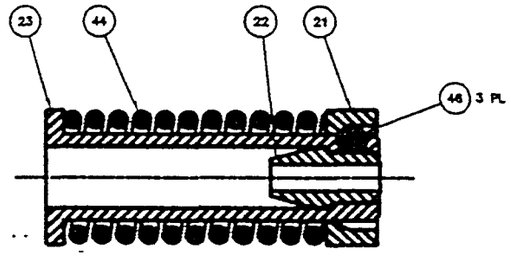


SECTION M–M
SCALE: 2/1

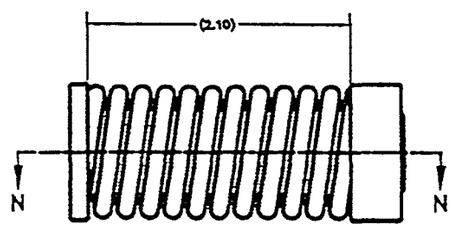


VIEW AB
SCALE: NONE

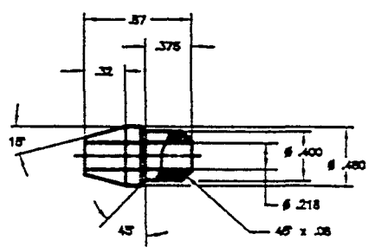
SECTION U–U
SCALE: NONE



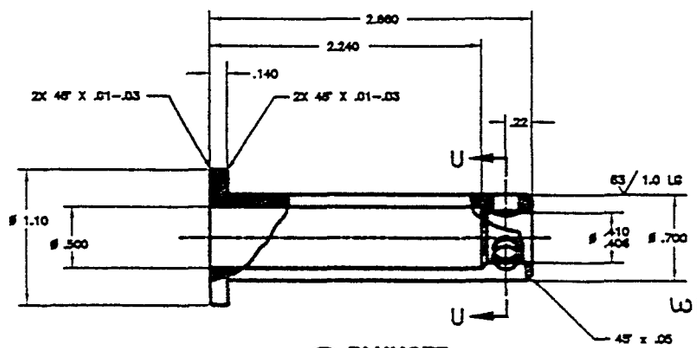
SECTION N–N
SCALE: 2/1



(3) ASSEMBLY – SPRING
SCALE: 2/1



(22) TRIGGER
SCALE: 2/1



(23) PLUNGER
SCALE: NONE

WHC-SD-WM-ER-387
Rev.0 Page A7

FOR GENERAL NOTES AND
PARTS LIST SEE SHEET 1

A-1.6

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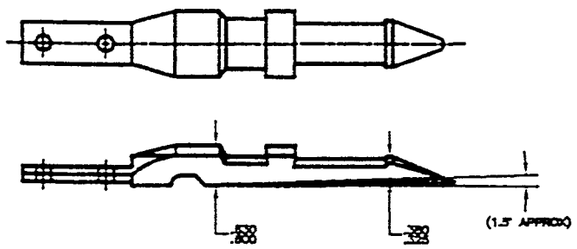
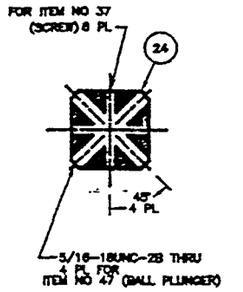
U.S. DEPARTMENT OF ENERGY

RETAINED GAS SAMPLER ASSEMBLY

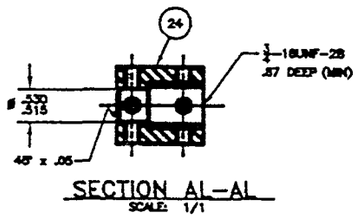
H-2-821608 0



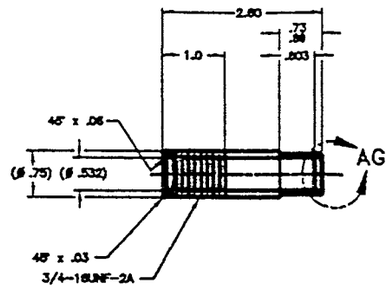
26 LATCH (ALTERED)
SCALE: 1/1



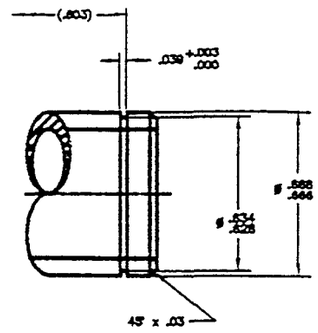
SECTION AK-AK
SCALE: 1/1



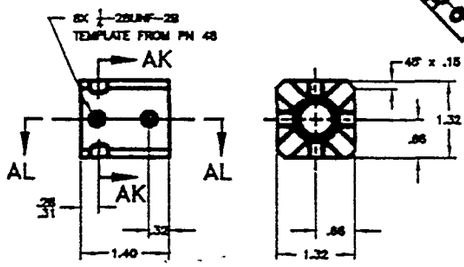
SECTION AL-AL
SCALE: 1/1



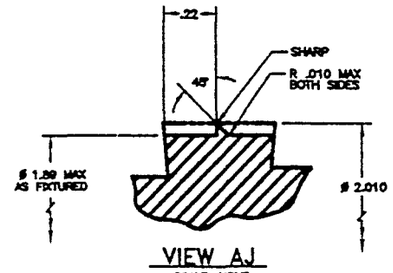
25 NECK
SCALE: 1/1



VIEW AG
SCALE: NONE



24 HEAD BASE, QUADRD LATCH
SCALE: 1/1

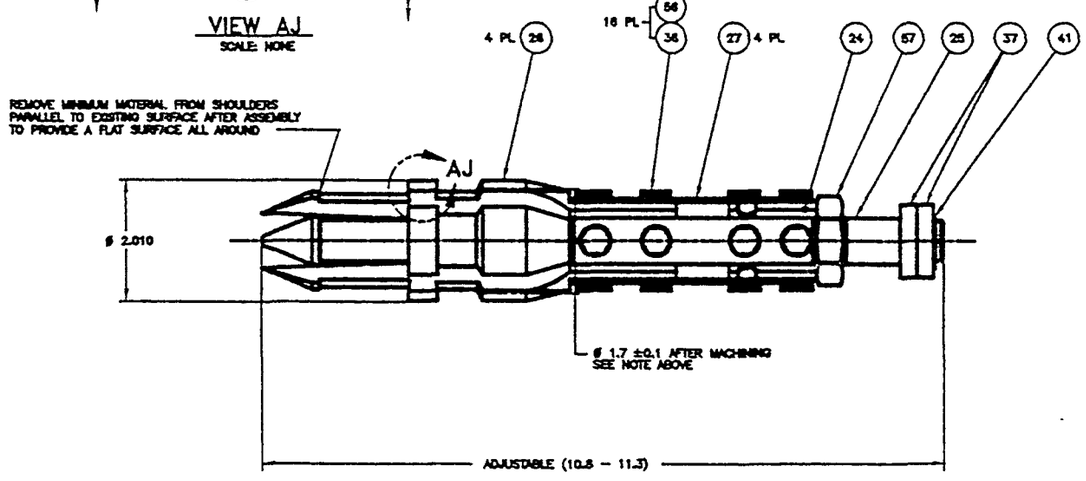


VIEW AJ
SCALE: NONE

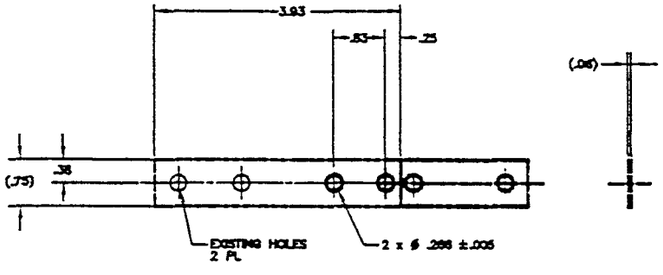
NOTE:

MACHINE AFTER ASSEMBLY, USE AS A TOOLING AID RING FIXTURE TO CLEAN UP AT 2.010 DIA, THEN MACHINE SERRATION AND TURN THE 1.7 ±.1 DIA

AFTER MACHINING, ALL FOUR (4) JAWS SHOULD HAVE FULL CONTACT WITH A RING GAUGE OF 2.010 ID



4 ASSEMBLY - QUADRA LATCH
SCALE: 1/1



27 SPRING (ALTERED)
SCALE: 1/1

FOR GENERAL NOTES AND PARTS LIST SEE SHEET 1

WHC-SD-WM-ER-387 Rev.0 Page A8

A-1.7

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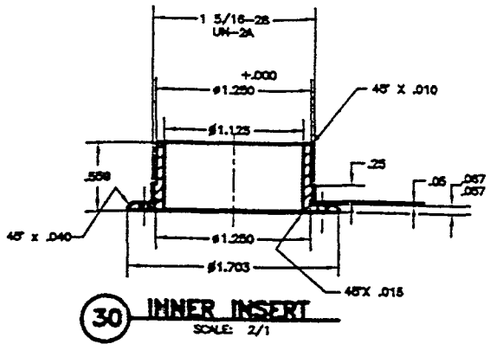
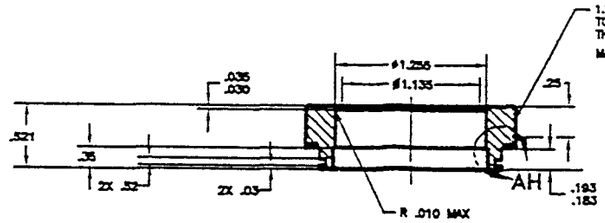
U.S. DEPARTMENT OF ENERGY

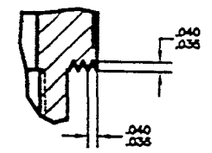
RETAINED GAS SAMPLER ASSEMBLY

H-2-821606 0

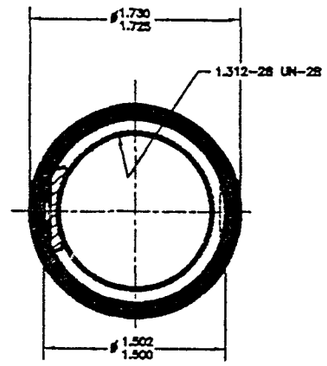


30 INNER INSERT
SCALE: 2/1

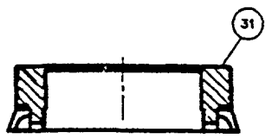




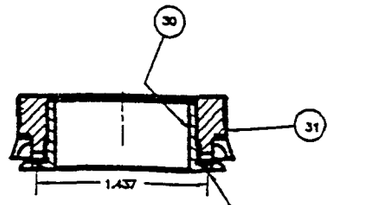
VIEW AH
SCALE: 4/1



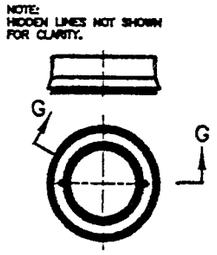
31 OUTER INSERT
SCALE: 2/1



OUTER INSERT, MODIFIED
SCALE: 2/1



SECTION G-G
SCALE: 2/1



INSERT
SCALE: 1/1

FOR GENERAL NOTES AND
PARTS LIST SEE SHEET 1

WHC-SD-WM-ER-387 Rev.0 Page A9

A-1.8

COPIED FROM H-2-65087

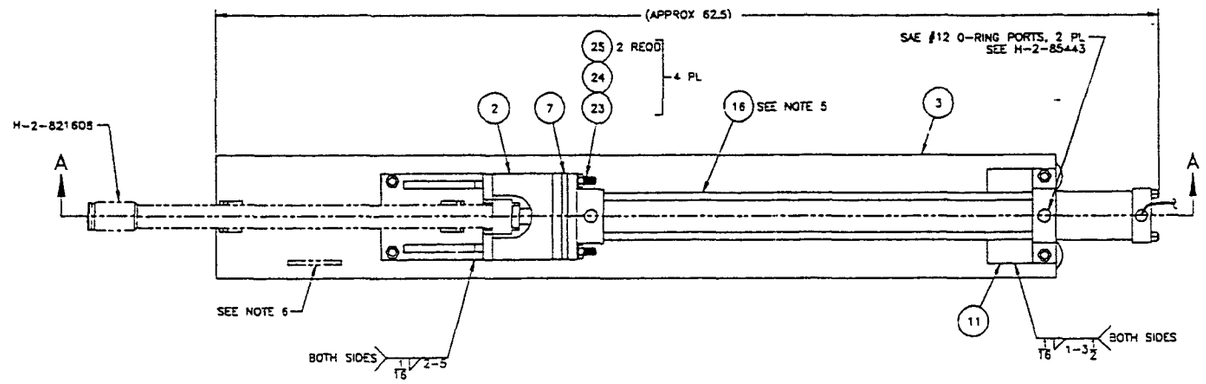
U.S. DEPARTMENT OF ENERGY

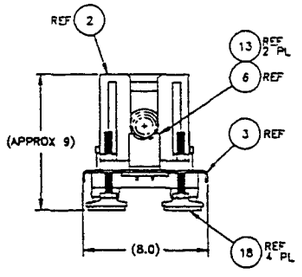
RETAINED GAS SAMPLER ASSEMBLY

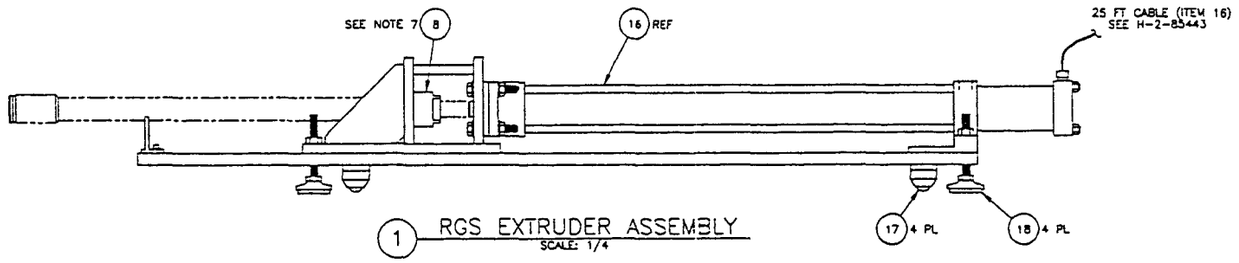
H-2-821606 0

GENERAL NOTES (UNLESS OTHERWISE SPECIFIED)

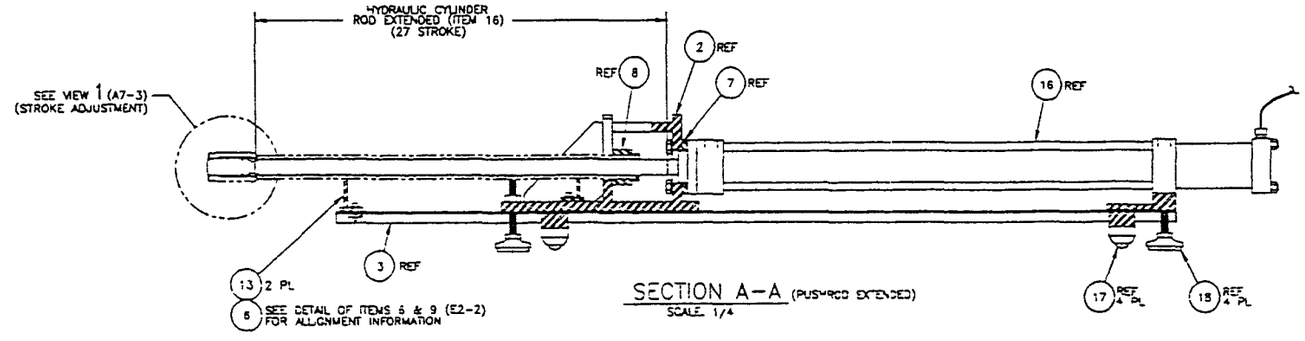
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M (82). DIMENSIONS ARE IN INCHES. TOLERANCE ON DECIMALS: X = ±.1, .XX = ±.03, .XXX = ±.005, ANGLES = 1°. DIMENSIONING AND TOLERANCING IN FRACTIONS ARE GENERAL DIMENSIONS.
2. BREAK ALL SHARP EDGES & REMOVE ALL BURRS.
3. MACHINED SURFACES TO BE 125 √.
4. WELD AND INSPECT STAINLESS STEEL STRUCTURAL MEMBERS PER HS-V-S-0013. VT ALL WELDS AT FINAL PASS. PT WELDS AS DESIGNATED.
5. PREPARE AND PAINT HYDRAULIC CYLINDER (ITEM 16) CARBON STEEL MOUNTING SURFACES WITH AN EPOXY OR VINYL PAINT. IF EPOXY PAINT IS USED, ONE COAT OF VALSPAR VAL-CHEM MASTIC 75 PAINT SHALL BE APPLIED. IF A VINYL PAINT IS USED, ONE COAT OF AMERCOAT 187 PRIMER FOLLOWED BY TWO TOP COATS OF AMERCOAT 33 SHALL BE APPLIED IN ACCORDANCE WITH THE MANUFACTURER'S SPECIFICATIONS. FINAL COLOR SHALL BE GRAY.
6. MARK PER (HS-BS-0015 TYPE 2), WITH DRAWING, REVISION, & PART NUMBER, IN LOCATION INDICATED USING (1/4 IN.) HIGH CHARACTERS.
7. PRESS NUT (ITEM 8) ATTACHES TO SAMPLE HOUSING (H-2-821608).







1 RGS EXTRUDER ASSEMBLY
SCALE: 1/4



SECTION A-A (PUSHROD EXTENDED)
SCALE: 1/4

PARTS/MATERIAL LIST

QTY REQD -030	-020	-010	PART/DASH NUMBER	NOMENCLATURE/DESCRIPTION	MATERIAL/REFERENCE	SHEET	ITEM NO
		X	-010	ASSEMBLY, RGS EXTRUDER			
	X	1	-020	SUBASSY, FIXTURE		2	2
X		1	-030	SUBASSY, BASE		3	3
							4
							5
		1	-001	BRACKET (2.38 L)		2	6
		1	-002	STROKE ADJUSTING FLANGE		2	7
		1	-003	PRESS NUT		3	8
	1		-004	BRACKET (1.75 L)		2	9
2			-005	CASTER MOUNT		3	10
		1	-006	SPACER BLOCK		3	11
1			-007	BRACKET MOUNT		3	12
	2	2	-008	BRACKET SCREW		3	13
							14
							15
		1	ESP-2	HYDRAULIC CYLINDER, Ø 2 1/2 BORE, Ø 1 ROD, 27 IN STROKE, FLANGE MOUNTED (ROD END), SAE O-RING PORTS, PROBE COVER	ATLAS, ANALOG POSITION INDICATING WAND WITH 0 TO 10 VDC OUTPUT		16
		4	(2415T28)	BALL CASTER, STUD MOUNT, Ø1 BALL, 75 LB CAP., 5/16-18 X 11/16 L STUD	SST, MCMASTER-CARR CATALOG NO. 97		17
		4	2254	LEVELING MOUNT, Ø2 3/8 MOUNT, 1/2-13 X 2 IN L BOLT W/NUT	SST, SUNNEX		18
							19
							20
	2	2		CAP SCREW, HEX SOCKET HEAD, 1/4-20UNC-3A X 1 L	SST, TYPE 18-8		21
	2	2		WASHER, PLAIN, 1/4 NOM	SST, TYPE 18-8		22
		4		BOLT, HEX, 1/2-13UNC-2A X 3 L	SST, TYPE 18-8		23
		4		NUT, HEX, 1/2-13UNC-2B	SST, TYPE 18-8		24
		8		WASHER, LOCK, 1/2 NOM	SST, TYPE 18-8		25
AR				SHEET 120 (11 GA)	ASTM A240 SST, TYPE 304L		26
AR		AR		PLATE 1/4	ASTM A240 SST, TYPE 304L		27
	AR	AR		PLATE 1/2	ASTM A240 SST, TYPE 304L		28
	AR			PLATE 5/8	ASTM A240 SST, TYPE 304L		29
AR				PLATE 1	ASTM A240 SST, TYPE 304L		30
		AR		PLATE 1 1/2	ASTM A240 SST, TYPE 304L		31
		AR		ROUND BAR Ø 2 1/4	ASTM A276 SST, TYPE 410 ROCKWELL "C" 32 OR HIGHER		32

PURPOSE OF THE TOOL: THE RETAINED GAS SAMPLING (RGS) EXTRUDER ASSEMBLY (-010) IS DESIGNED TO REMOVE CORE SAMPLES FROM A RGS SAMPLER (H-2-821608) INTO THE RGS EXTRACTOR ASSEMBLY (H-2-821610).

MAXIMUM OPERATING FORCE: 10,000 LBS

APPROXIMATE WEIGHT: 110 LBS

A-1.9

DRAWING TRACEABILITY LIST

DWG NO	TITLE
WHC-SD-WM-ETP-288	ENGINEERING TASK PLAN
WHC-SD-WM-X-X-171	STRUCTURAL SUPPORTING DOC
H-2-85443	RGS EXTRUDER INSTALLATION
H-2-821608	RGS SAMPLER ASSY

REF NUMBER / TITLE

REFERENCES

NEXT USED ON: H-2-85443

REVISIONS

CAGE FILE: B0854414 CAGECODE: DOE & CAGE 17 0 55

SD SEELEY 8/7/94

U.S. DEPARTMENT OF ENERGY
DOE Field Office, Richland
Westinghouse Hanford Company

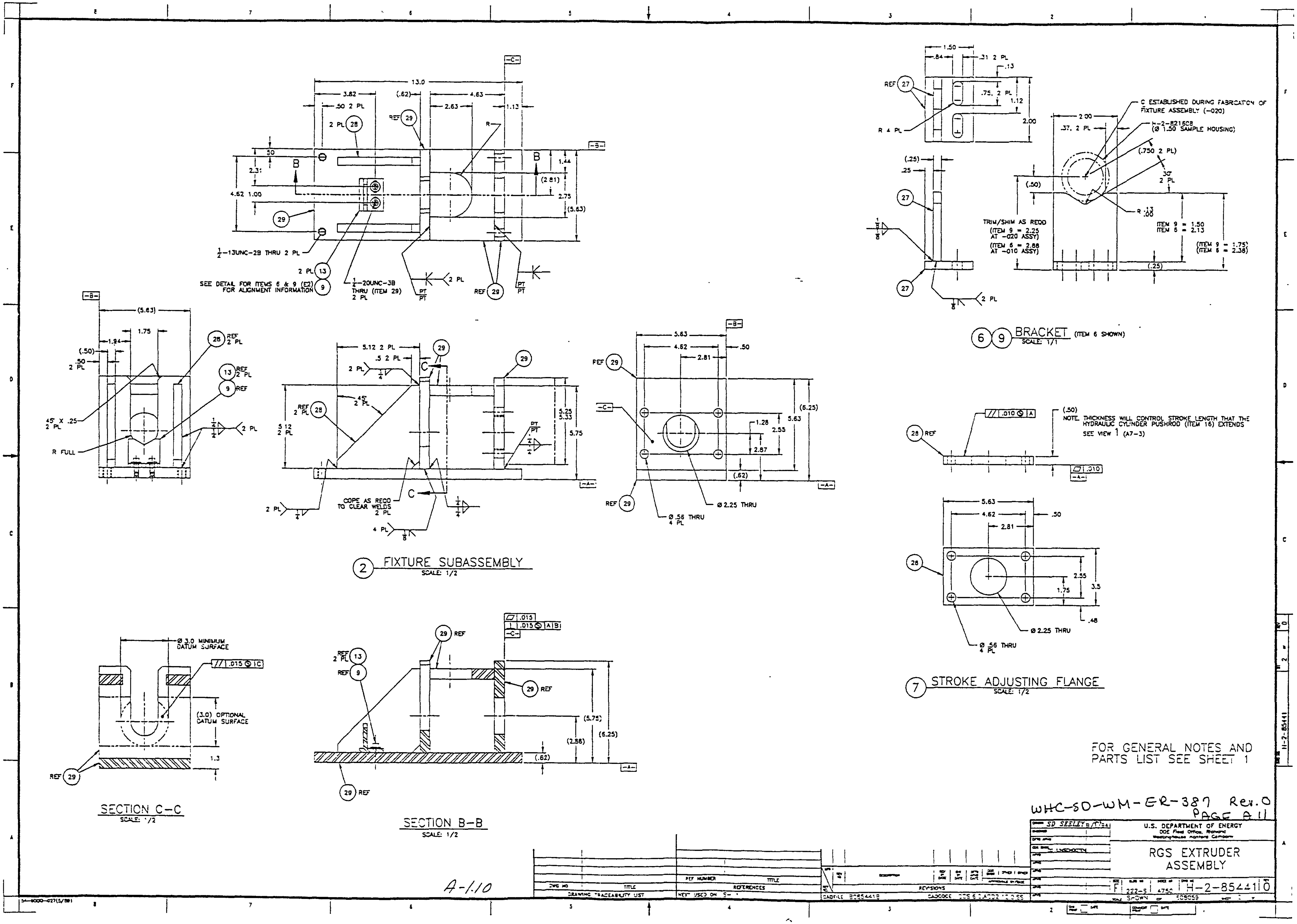
RGS EXTRUDER ASSEMBLY

SIZE F | FSCM NO 22Z-S | SHEET NO 4750 | DWG NO H-2-85441 | REV 0

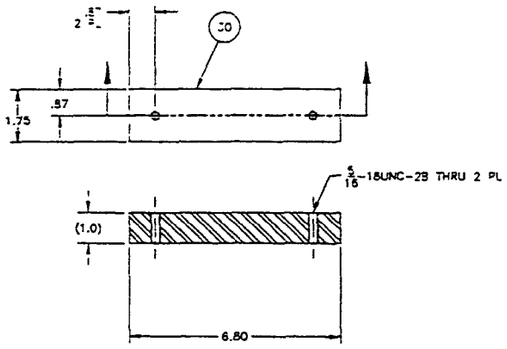
SCALE SHOWN | WEIGHT 508059 | SHEET 1 OF 3

WHC-SD-WM-ER-387 Rev. 0 Page A10

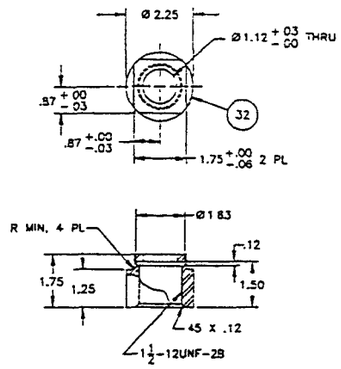
H-2-85441 REV 0



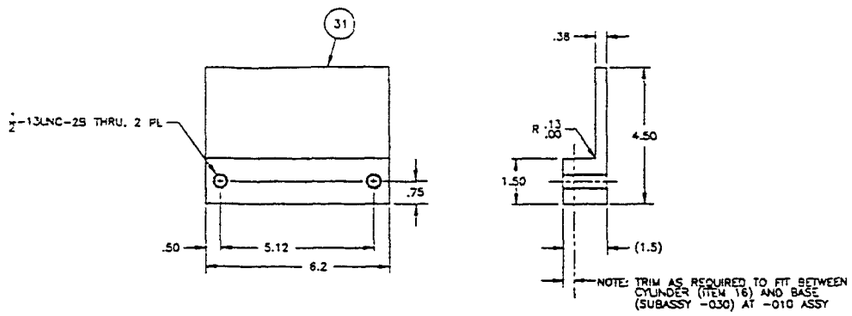
2 FIXTURE SUBASSEMBLY
SCALE: 1/2
6 9 BRACKET (ITEM 6 SHOWN)
SCALE: 1/1
7 STROKE ADJUSTING FLANGE
SCALE: 1/2
SECTION C-C
SCALE: 1/2
SECTION B-B
SCALE: 1/2
SEE DETAIL FOR ITEMS 6 & 9 (E2) FOR ALIGNMENT INFORMATION
C ESTABLISHED DURING FABRICATION OF FIXTURE ASSEMBLY (-020)
TRIM/SHIM AS REQD
NOTE. THICKNESS WILL CONTROL STROKE LENGTH THAT THE HYDRAULIC CYLINDER PUSHROD (ITEM 16) EXTENDS
SEE VIEW 1 (A7-3)
FOR GENERAL NOTES AND PARTS LIST SEE SHEET 1
WHC-SD-WM-ER-387 Rev.0
PAGE A11
U.S. DEPARTMENT OF ENERGY
RGS EXTRUDER ASSEMBLY
H-2-85441 0
A-1.10



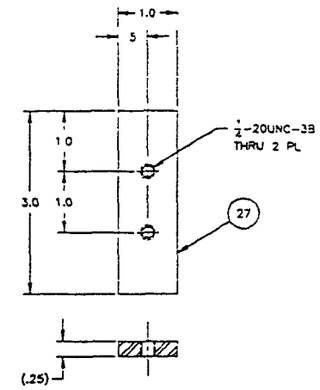
10 CASTER MOUNT
SCALE: 1/2



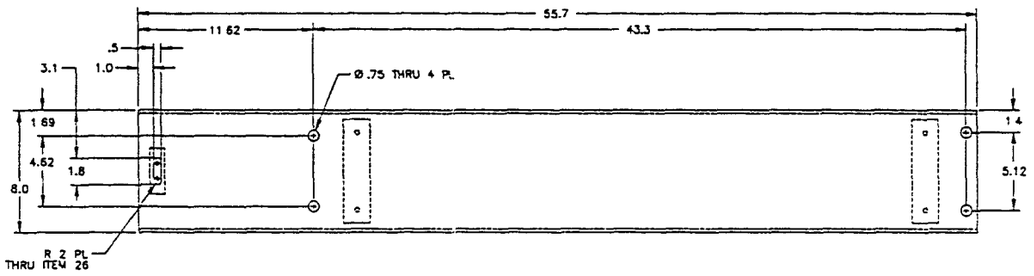
8 PRESS NUT
SCALE: 1/2

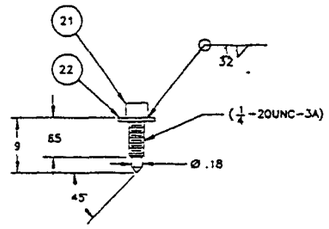


11 SPACER BLOCK
SCALE: 1/2

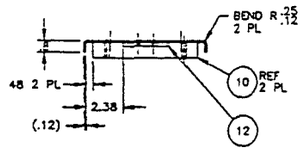


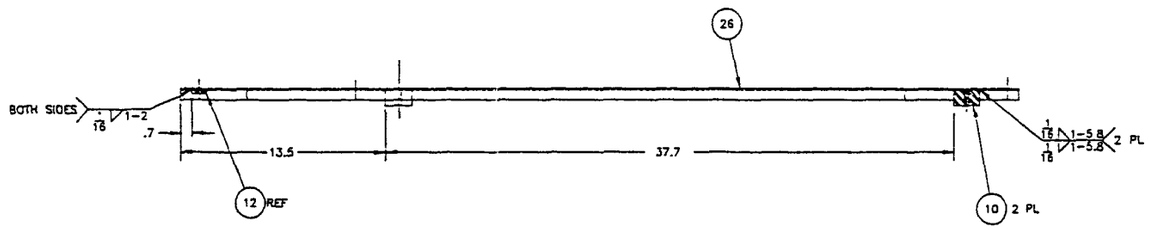
12 BRACKET MOUNT
SCALE: 1/1



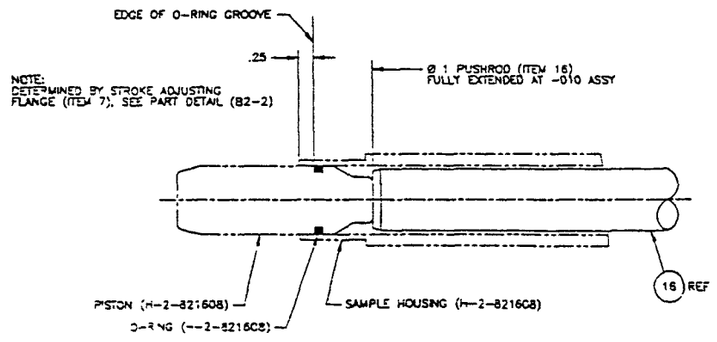


13 BRACKET SCREW
SCALE: 1/1





3 BASE SUBASSEMBLY
SCALE: 1/4



VIEW 1
SCALE: 1/1

FOR GENERAL NOTES AND PARTS LIST SEE SHEET 1

WHC-SD-WM-ER-387
Rev. 0 Page A12

A-1.11

DWG NO	TITLE	REF NUMBER	TITLE
DRAWING TRACEABILITY LIST		REFERENCES	
		NEXT USED ON SH 1	

NO	DESCRIPTION	REVISIONS
CADFILE B0854410	CADCODE	

U.S. DEPARTMENT OF ENERGY
DOE Field Office, Richland
Westinghouse Hanford Company

RGS EXTRUDER ASSEMBLY

F 222-S 4750 H-2-854410 0
SCALE: S-SHOWN SOB059

11-2-85441 REV 0

APPENDIX A.1

THE FLAMABLE GAS WATCHLIST TANKS

TABLE A-1. WATCH LIST TANKS (Sheet 1 of 2)

These tanks have been identified as Watch List Tanks in accordance with Public Law 101-510, Section 3137, " Safety Measures for Waste Tanks at Hanford Nuclear Reservation," (1990). These tanks have been identified as the Priority 1 Hanford Site Tank Farm Safety Issues: "Issues/situations that contain most necessary conditions that could lead to worker (onsite) or offsite radiation exposure through an uncontrolled release of fission products, e.g., Tank SY-101."

June 30, 1994

Single-Shell Tanks			Officially Added to Watch List
Tank No.		Category	
A-101	(2)	Hydrogen	1/91
	(9)	Organics	5/94
AX-101	(2)	Hydrogen	1/91
AX-102	(9)	Organics	5/94
AX-103	(2)	Hydrogen	1/91
B-103	(2)	Organics	1/91
BX-102	(2)	Ferrocyanide	1/91
BX-106	(2)	Ferrocyanide	1/91
BY-103	(2)	Ferrocyanide	1/91
BY-104	(2)	Ferrocyanide	1/91
BY-105	(2)	Ferrocyanide	1/91
BY-106	(2)	Ferrocyanide	1/91
BY-107	(2)	Ferrocyanide	1/91
BY-108	(2)	Ferrocyanide	1/91
BY-110	(2)	Ferrocyanide	1/91
BY-111	(2)	Ferrocyanide	1/91
BY-112	(2)	Ferrocyanide	1/91
C-102	(9)	Organics	5/94
C-103	(2)(4)	Organics	1/91
C-106	(2)	High Heat Load	1/91
C-108	(2)	Ferrocyanide	1/91
C-109	(2)	Ferrocyanide	1/91
C-111	(2)	Ferrocyanide	1/91
C-112	(2)	Ferrocyanide	1/91

Single-Shell Tanks			Officially Added to Watch List
Tank No.		Category	
S-102	(2)	Hydrogen,	1/91
	(2)	Organics	1/91
S-111	(2)	Hydrogen	1/91
	(9)	Organics	5/94
S-112	(2)	Hydrogen	1/91
SX-101	(1)(2)	Hydrogen	1/91
SX-102	(1)(2)	Hydrogen	1/91
SX-103	(1)(2)	Hydrogen	1/91
	(9)	Organics	5/94
SX-104	(1)(2)	Hydrogen	1/91
SX-105	(1)(2)	Hydrogen	1/91
SX-106	(1)(2)	Hydrogen,	1/91
	(1)(2)	Organics	1/91
SX-109	(1)(2)	Hydrogen because other tanks vent thru it	1/91
T-107	(3)	Ferrocyanide	2/91
T-110	(2)	Hydrogen	1/91
T-111	(8)	Organics	2/94
TX-105	(2)	Organics	1/91
TX-118	(2)	Ferrocyanide,	1/91
	(2)	Organics	1/91
TY-101	(2)	Ferrocyanide	1/91
TY-103	(2)	Ferrocyanide	1/91
TY-104	(2)	Ferrocyanide	1/91
	(9)	Organics	5/94

Single-Shell Tanks			Officially Added to Watch List
Tank No.		Category	
U-103	(2)	Hydrogen	1/91
	(9)	Organics	5/94
U-105	(2)	Hydrogen	1/91
	(9)	Organics	5/94
U-106	(2)	Organics	1/91
U-107	(2)	Organics	1/91
	(6)	Hydrogen	12/93
U-108	(2)	Hydrogen	1/91
U-109	(2)	Hydrogen	1/91
U-111	(7)	Organics	8/93
U-203	(9)	Organics	5/94
U-204	(9)	Organics	5/94
50 Tanks			

Double-Shell Tanks			
Tank No.		Category	
AN-103	(1)(2)	Hydrogen	1/91
AN-104	(1)(2)	Hydrogen	1/91
AN-105	(1)(2)	Hydrogen	1/91
AW-101	(1)(5)	Hydrogen	6/93
SY-101	(1)(2)	Hydrogen	1/91
SY-103	(1)(2)	Hydrogen	1/91
6 Tanks			

Ten tanks (A-101, S-102, S-111, SX-103, SX-106, TX-118, TY-104, U-103, U-105, and U-107,) are on more than one Watch List

3.0 PACKAGE CONTENTS

3.1 GENERAL DESCRIPTION

Contents of the WSSP-1 and WSSP-2 packages are considered to be three pumps placed in three flexible receiver assemblies. Specific details of the flexible receiver assembly system is shown on design drawing H-2-79341. The following data relates to the three pumps scheduled for removal from the tanks and placed in specific packages for transfer:

WSSP-1 Packages:

1. One heel pump located in tank 241-C-106. The physical description and reference drawings are as follows:

Maximum length:	37 ft - 7⅞ in.
Maximum diameter:	36 in.
Estimated weight:	3152 lb
Reference drawings:	H-2-41297

2. One transfer pump located in tank 241-C-106. The physical description and reference drawings are as follows:

Maximum length:	35 ft - 8 in.
Maximum diameter:	32½ in.
Estimated weight:	1528 lb
Reference drawings:	H-2-93179 H-9-1105 H-2-70001 H-2-69897

WSSP-2 Package:

3. One agitator pump located in tank 241-AY-101. The physical description and reference drawings are as follows:

Maximum length:	49 ft - 2½ in.
Maximum diameter:	42.43 in.
Estimated weight:	2779 lb
Reference drawings:	H-2-95343