

## METHOD 1310A

### EXTRACTION PROCEDURE (EP) TOXICITY TEST METHOD AND STRUCTURAL INTEGRITY TEST

#### 1.0 SCOPE AND APPLICATION

1.1 This method is an interim method to determine whether a waste exhibits the characteristic of Extraction Procedure Toxicity.

1.2 The procedure may also be used to simulate the leaching which a waste may undergo if disposed of in a sanitary landfill. Method 1310 is applicable to liquid, solid, and multiphase samples.

#### 2.0 SUMMARY OF METHOD

2.1 If a representative sample of the waste contains  $> 0.5\%$  solids, the solid phase of the sample is ground to pass a 9.5 mm sieve and extracted with deionized water which is maintained at a pH of  $5 \pm 0.2$ , with acetic acid. Wastes that contain  $< 0.5\%$  filterable solids are, after filtering, considered to be the EP extract for this method. Monolithic wastes which can be formed into a cylinder 3.3 cm (dia) x 7.1 cm, or from which such a cylinder can be formed which is representative of the waste, may be evaluated using the Structural Integrity Procedure instead of being ground to pass a 9.5-mm sieve.

#### 3.0 INTERFERENCES

3.1 Potential interferences that may be encountered during analysis are discussed in the individual analytical methods.

#### 4.0 APPARATUS AND MATERIALS

4.1 Extractor - For purposes of this test, an acceptable extractor is one that will impart sufficient agitation to the mixture to (1) prevent stratification of the sample and extraction fluid and (2) ensure that all sample surfaces are continuously brought into contact with well-mixed extraction fluid. Examples of suitable extractors are shown in Figures 1-3 of this method and are available from: Associated Designs & Manufacturing Co., Alexandria, Virginia; Glas-Col Apparatus Co., Terre Haute, Indiana; Millipore, Bedford, Massachusetts; and Rexnord, Milwaukee, Wisconsin.

4.2 pH meter or pH controller - Accurate to 0.05 pH units with temperature compensation.

4.3 Filter holder - Capable of supporting a 0.45- $\mu\text{m}$  filter membrane and of withstanding the pressure needed to accomplish separation. Suitable filter holders range from simple vacuum units to relatively complex systems that can exert up to 5.3 kg/cm<sup>3</sup> (75 psi) of pressure. The type of filter holder used depends upon the properties of the mixture to be filtered. Filter holders known to EPA and deemed suitable for use are listed in Table 1.

4.4 Filter membrane - Filter membrane suitable for conducting the required filtration shall be fabricated from a material that (1) is not physically changed by the waste material to be filtered and (2) does not absorb or leach the chemical species for which a waste's EP extract will be analyzed. Table 2 lists filter media known to the agency to be suitable for solid waste testing.

4.4.1 In cases of doubt about physical effects on the filter, contact the filter manufacturer to determine if the membrane or the prefilter is adversely affected by the particular waste. If no information is available, submerge the filter in the waste's liquid phase. A filter that undergoes visible physical change after 48 hours (i.e., curls, dissolves, shrinks, or swells) is unsuitable for use.

4.4.2 To test for absorption or leaching by the filter:

4.4.2.1 Prepare a standard solution of the chemical species of interest.

4.4.2.2 Analyze the standard for its concentration of the chemical species.

4.4.2.3 Filter the standard and reanalyze. If the concentration of the filtrate differs from that of the original standard, then the filter membrane leaches or absorbs one or more of the chemical species and is not usable in this test method.

4.5 Structural integrity tester - A device meeting the specifications shown in Figure 4 and having a 3.18-cm (1.25-in) diameter hammer weighing 0.33 kg (0.73 lb) with a free fall of 15.24 cm (6 in) shall be used. This device is available from Associated Design and Manufacturing Company, Alexandria, VA 22314, as Part No. 125, or it may be fabricated to meet these specifications.

## 5.0 REAGENTS

5.1 Reagent grade chemicals shall be used in all tests. Unless otherwise indicated, it is intended that all reagents shall conform to the specifications of the Committee on Analytical Reagents of the American Chemical Society, where such specifications are available. Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lessening the accuracy of the determination.

5.2 Reagent water. All references to water in this method refer to reagent water, as defined in Chapter One.

5.3 Acetic acid (0.5N),  $\text{CH}_3\text{COOH}$ . This can be made by diluting concentrated glacial acetic acid (17.5N) by adding 57 mL glacial acetic acid to 1,000 mL of water and diluting to 2 liters. The glacial acetic acid must be of high purity and monitored for impurities.

5.4 Analytical standards should be prepared according to the applicable analytical methods.

## 6.0 SAMPLE COLLECTION, PRESERVATION, AND HANDLING

6.1 All samples must be collected using a sampling plan that addresses the considerations discussed in Chapter Nine of this manual.

6.2 Preservatives must not be added to samples.

6.3 Samples can be refrigerated if it is determined that refrigeration will not affect the integrity of the sample.

## 7.0 PROCEDURE

7.1 If the waste does not contain any free liquid, go to Step 7.9. If the sample is liquid or multiphase, continue as follows. Weigh filter membrane and prefilter to  $\pm 0.01$  g. Handle membrane and prefilters with blunt curved-tip forceps or vacuum tweezers, or by applying suction with a pipet.

7.2 Assemble filter holder, membranes, and prefilters following the manufacturer's instructions. Place the  $0.45\text{-}\mu\text{m}$  membrane on the support screen and add prefilters in ascending order of pore size. Do not prewet filter membrane.

7.3 Weigh out a representative subsample of the waste (100 g minimum).

7.4 Allow slurries to stand, to permit the solid phase to settle. Wastes that settle slowly may be centrifuged prior to filtration.

7.5 Wet the filter with a small portion of the liquid phase from the waste or from the extraction mixture. Transfer the remaining material to the filter holder and apply vacuum or gentle pressure (10-15 psi) until all liquid passes through the filter. Stop filtration when air or pressurizing gas moves through the membrane. If this point is not reached under vacuum or gentle pressure, slowly increase the pressure in 10-psi increments to 75 psi. Halt filtration when liquid flow stops. This liquid will constitute part or all of the extract (refer to Step 7.16). The liquid should be refrigerated until time of analysis.

NOTE: Oil samples or samples containing oil are treated in exactly the same way as any other sample. The liquid portion of the sample is filtered and treated as part of the EP extract. If the liquid portion of the sample will not pass through the filter (usually the case with heavy oils or greases), it should be carried through the EP extraction as a solid.

7.6 Remove the solid phase and filter media and, while not allowing them to dry, weigh to  $\pm 0.01$  g. The wet weight of the residue is determined by calculating the weight difference between the weight of the filters (Step 7.1) and the weight of the solid phase and the filter media.

7.7 The waste will be handled differently from this point on, depending on whether it contains more or less than 0.5% solids. If the sample appears to have  $< 0.5\%$  solids, determine the percent solids exactly (see Note below) by the following procedure:

7.7.1 Dry the filter and residue at 80°C until two successive weighings yield the same value.

7.7.2 Calculate the percent solids, using the following equation:

$$\frac{\text{weight of filtered solid and filters} - \text{tared weight of filters}}{\text{initial weight of waste material}} \times 100 = \% \text{ solids}$$

NOTE: This procedure is used only to determine whether the solid must be extracted or whether it can be discarded unextracted. It is not used in calculating the amount of water or acid to use in the extraction step. Do not extract solid material that has been dried at 80°C. A new sample will have to be used for extraction if a percent solids determination is performed.

7.8 If the solid constitutes < 0.5% of the waste, discard the solid and proceed immediately to Step 7.17, treating the liquid phase as the extract.

7.9 The solid material obtained from Step 7.5 and all materials that do not contain free liquids shall be evaluated for particle size. If the solid material has a surface area per g of material  $\geq 3.1 \text{ cm}^2$  or passes through a 9.5-mm (0.375-in.) standard sieve, the operator shall proceed to Step 7.11. If the surface area is smaller or the particle size larger than specified above, the solid material shall be prepared for extraction by crushing, cutting, or grinding the material so that it passes through a 9.5-mm (0.375-in.) sieve or, if the material is in a single piece, by subjecting the material to the "Structural Integrity Procedure" described in Step 7.10.

#### 7.10 Structural Integrity Procedure (SIP)

7.10.1 Cut a 3.3-cm diameter by 7.1-cm long cylinder from the waste material. If the waste has been treated using a fixation process, the waste may be cast in the form of a cylinder and allowed to cure for 30 days prior to testing.

7.10.2 Place waste into sample holder and assemble the tester. Raise the hammer to its maximum height and drop. Repeat 14 additional times.

7.10.3 Remove solid material from tester and scrape off any particles adhering to sample holder. Weigh the waste to the nearest 0.01 g and transfer it to the extractor.

7.11 If the sample contains > 0.5% solids, use the wet weight of the solid phase (obtained in Step 7.6) to calculate the amount of liquid and acid to employ for extraction by using the following equation:

$$W = W_f - W_t$$

where :

W = Wet weight in g of solid to be charged to extractor.

$W_f$  = Wet weight in g of filtered solids and filter media.

$W_t$  = Weight in g of tared filters.

If the waste does not contain any free liquids, 100 g of the material will be subjected to the extraction procedure.

7.12 Place the appropriate amount of material (refer to Step 7.11) into the extractor and add 16 times its weight with water.

7.13 After the solid material and water are placed in the extractor, the operator shall begin agitation and measure the pH of the solution in the extractor. If the pH is  $> 5.0$ , the pH of the solution should be decreased to  $5.0 \pm 0.2$  by slowly adding 0.5N acetic acid. If the pH is  $\leq 5.0$ , no acetic acid should be added. The pH of the solution should be monitored, as described below, during the course of the extraction, and, if the pH rises above 5.2, 0.5N acetic acid should be added to bring the pH down to  $5.0 \pm 0.2$ . However, in no event shall the aggregate amount of acid added to the solution exceed 4 mL of acid per g of solid. The mixture should be agitated for 24 hours and maintained at 20-40°C (68-104°F) during this time. It is recommended that the operator monitor and adjust the pH during the course of the extraction with a device such as the Type 45-A pH Controller, manufactured by Chemtrix, Inc., Hillsboro, Oregon 97123, or its equivalent, in conjunction with a metering pump and reservoir of 0.5N acetic acid. If such a system is not available, the following manual procedure shall be employed.

NOTE: Do not add acetic acid too quickly. Lowering the pH to below the target concentration of 5.0 could affect the metal concentrations in the leachate.

7.13.1 A pH meter should be calibrated in accordance with the manufacturer's specifications.

7.13.2 The pH of the solution should be checked, and, if necessary, 0.5 N acetic acid should be manually added to the extractor until the pH reaches  $5.0 \pm 0.2$ . The pH of the solution should be adjusted at 15-, 30-, and 60-minute intervals, moving to the next longer interval if the pH does not have to be adjusted  $> 0.5$  pH units.

7.13.3 The adjustment procedure should be continued for at least 6 hours.

7.13.4 If, at the end of the 24-hour extraction period, the pH of the solution is not below 5.2 and the maximum amount of acid (4 mL per g of solids) has not been added, the pH should be adjusted to  $5.0 \pm 0.2$  and the extraction continued for an additional 4 hours, during which the pH should be adjusted at 1-hour intervals.

7.14 At the end of the extraction period, water should be added to the extractor in an amount determined by the following equation:

$$V = (20)(W) - 16(W) - A$$

where:

V = mL water to be added.

W = Weight in g of solid charged to extractor.

A = mL of 0.5N acetic acid added during extraction.

7.15 The material in the extractor should be separated into its component liquid and solid phases in the following manner:

7.15.1 Allow slurries to stand to permit the solid phase to settle (wastes that are slow to settle may be centrifuged prior to filtration) and set up the filter apparatus (refer to Steps 4.3 and 4.4).

7.15.2 Wet the filter with a small portion of the liquid phase from the waste or from the extraction mixture. Transfer the remaining material to the filter holder and apply vacuum or gentle pressure (10-15 psi) until all liquid passes through the filter. Stop filtration when air or pressurizing gas moves through the membrane. If this point is not reached under vacuum or gentle pressure, slowly increase the pressure in 10-psi increments to 75 psi. Halt filtration when liquid flow stops.

7.16 The liquids resulting from Steps 7.5 and 7.15 should be combined. This combined liquid (or waste itself, if it has < 0.5% solids, as noted in Step 7.8) is the extract.

7.17 The extract is then prepared and analyzed using the appropriate analytical methods described in Chapters Three and Four of this manual.

NOTE: If the EP extract includes two phases, concentration of contaminants is determined by using a simple weighted average. For example: An EP extract contains 50 mL of oil and 1,000 mL of an aqueous phase. Contaminant concentrations are determined for each phase. The final contamination concentration is taken to be:

$$\frac{(50 \times \text{contaminant conc. in oil}) + (1,000 \times \text{contaminant conc. of aqueous phase})}{1050}$$

NOTE: In cases where a contaminant was not detected, use the MDL in the calculation. For example, if the MDL in the oily phase is 100 mg/L and 1 mg/L in the aqueous phase, the reporting limit would be 6 mg/L (rounded to the nearest mg). If the regulatory threshold is 5 mg/L, the waste may be EP toxic and results of the analysis are inconclusive.

## 8.0 QUALITY CONTROL

8.1 All quality control data should be maintained and available for easy reference or inspection.

8.2 Employ a minimum of one blank per sample batch to determine if contamination or any memory effects are occurring.

8.3 All quality control measures described in Chapter One and in the referenced analytical methods should be followed.

## 9.0 METHOD PERFORMANCE

9.1 The data tabulated in Table 3 were obtained from records of state and contractor laboratories and are intended to show the precision of the entire method (1310 plus analysis method).

## 10.0 REFERENCES

1. Rohrbough, W.G.; et al. Reagent Chemicals, American Chemical Society Specifications, 7th ed.; American Chemical Society: Washington, DC, 1986.
2. 1985 Annual Book of ASTM Standards, Vol. 11.01; "Standard Specification for Reagent Water"; ASTM: Philadelphia, PA, 1985; D1193-77.
3. Gaskill, A., Compilation and Evaluation of RCRA Method Performance Data, Work Assignment No. 2, EPA Contract No. 68-01-7075, September 1986.

TABLE 1. EPA-APPROVED FILTER HOLDERS

| Manufacturer             | Size   | Model No.   | Comments  |
|--------------------------|--------|-------------|---|
| <u>Vacuum Filters</u>    |        |             |   |
| Gelman                   | 47 mm  | 4011        |   |
| Nalgene                  | 500 mL | 44-0045     | Disposable plastic unit, including prefilter, filter pads, and reservoir; can be used when solution is to be analyzed for inorganic constituents. |
| Nuclepore                | 47 mm  | 410400      |   |
| Millipore                | 47 mm  | XX10 047 00 |   |
| <u>Pressure Filters</u>  |        |             |   |
| Nuclepore                | 142 mm | 425900      |   |
| Micro Filtration Systems | 142 mm | 302300      |   |
| Millipore                | 142 mm | YT30 142 HW |   |



TABLE 2. EPA-APPROVED FILTRATION MEDIA

| Supplier  | Filter to be used<br>for aqueous systems | Filter to be used<br>for organic systems |
|---|--|--|
| <u>Coarse prefilter</u>                             |  |  |
| Gelman  | 61631, 61635                             | 61631, 61635                             |
| Nuclepore   | 210907, 211707                           | 210907, 211707                           |
| Millipore   | AP25 035 00,<br>AP25 127 50              | AP25 035 00,<br>AP25 127 50              |
| <u>Medium prefilters</u>                            |  |  |
| Gelman  | 61654, 61655                             |  |
| Nuclepore   | 210905, 211705                           | 210905, 211705                           |
| Millipore   | AP20 035 00,<br>AP20 124 50              | AP20 035 00,<br>AP20 124 50              |
| <u>Fine prefilters</u>                              |  |  |
| Gelman  | 64798, 64803                             | 64798, 64803                             |
| Nuclepore   | 210903, 211703                           | 210903, 211703                           |
| Millipore   | AP15 035 00,<br>AP15 124 50              | AP15 035 00,<br>AP15 124 50              |
| <u>Fine filters (0.45 <math>\mu\text{m}</math>)</u> |  |  |
| Gelman  | 63069, 66536                             | 60540 or 66149,<br>66151                 |
| Pall  | NX04750, NX14225                         |  |
| Nuclepore   | 142218                                   | 142218 <sup>a</sup>                      |
| Millipore   | HAWP 047 00,<br>HAWP 142 50              | FHUP 047 00,<br>FHLP 142 50              |
| Selas   | 83485-02,<br>83486-02                    | 83485-02,<br>83486-02                    |

<sup>a</sup>Susceptible to decomposition by certain polar organic solvents.

TABLE 3. PRECISIONS OF EXTRACTION-ANALYSIS  
PROCEDURES FOR SEVERAL ELEMENTS

| Element  | Sample Matrix                                      | Analysis Method | Laboratory Replicates      |
|----------|--|-----------------|----------------------------|
| Arsenic  | 1. Auto fluff                                      | 7060            | 1.8, 1.5 $\mu\text{g/L}$   |
|          | 2. Barrel sludge                                   | 7060            | 0.9, 2.6 $\mu\text{g/L}$   |
|          | 3. Lumber treatment company sediment               | 7060            | 28, 42 $\text{mg/L}$       |
| Barium   | 1. Lead smelting emission control dust             | 6010            | 0.12, 0.12 $\text{mg/L}$   |
|          | 2. Auto fluff                                      | 7081            | 791, 780 $\mu\text{g/L}$   |
|          | 3. Barrel sludge                                   | 7081            | 422, 380 $\mu\text{g/L}$   |
| Cadmium  | 1. Lead smelting emission control dust             | 3010/7130       | 120, 120 $\text{mg/L}$     |
|          | 2. Wastewater treatment sludge from electroplating | 3010/7130       | 360, 290 $\text{mg/L}$     |
|          | 3. Auto fluff                                      | 7131            | 470, 610 $\mu\text{g/L}$   |
|          | 4. Barrel sludge                                   | 7131            | 1100, 890 $\mu\text{g/L}$  |
|          | 5. Oil refinery tertiary pond sludge               | 7131            | 3.2, 1.9 $\mu\text{g/L}$   |
| Chromium | 1. Wastewater treatment sludge from electroplating | 3010/7190       | 1.1, 1.2 $\text{mg/L}$     |
|          | 2. Paint primer                                    | 7191            | 61, 43 $\mu\text{g/L}$     |
|          | 3. Paint primer filter                             | 7191            | --                         |
|          | 4. Lumber treatment company sediment               | 7191            | 0.81, 0.89 $\text{mg/L}$   |
|          | 5. Oil refinery tertiary pond sludge               | 7191            | --                         |
| Mercury  | 1. Barrel sludge                                   | 7470            | 0.15, 0.09 $\mu\text{g/L}$ |
|          | 2. Wastewater treatment sludge from electroplating | 7470            | 1.4, 0.4 $\mu\text{g/L}$   |
|          | 3. Lead smelting emission control dust             | 7470            | 0.4, 0.4 $\mu\text{g/L}$   |

TABLE 3 (Continued)

| Element      | Sample Matrix                                      | Analysis Method | Laboratory Replicates      |
|--------------|--|-----------------|----------------------------|
| Lead         | 1. Lead smelting emission control dust             | 3010/7420       | 940, 920 mg/L              |
|              | 2. Auto fluff                                      | 7421            | 1540, 1490 $\mu\text{g/L}$ |
|              | 3. Incinerator ash                                 | 7421            | 1000, 974 $\mu\text{g/L}$  |
|              | 4. Barrel sludge                                   | 7421            | 2550, 2800 $\mu\text{g/L}$ |
|              | 5. Oil refinery tertiary pond sludge               | 7421            | 31, 29 $\mu\text{g/L}$     |
| Nickel       | 1. Sludge  | 7521            | 2260, 1720 $\mu\text{g/L}$ |
|              | 2. Wastewater treatment sludge from electroplating | 3010/7520       | 130, 140 mg/L              |
| Chromium(VI) | 1. Wastewater treatment sludge from electroplating | 7196            | 18, 19 $\mu\text{g/L}$     |

FIGURE 1.  
EXTRACTOR

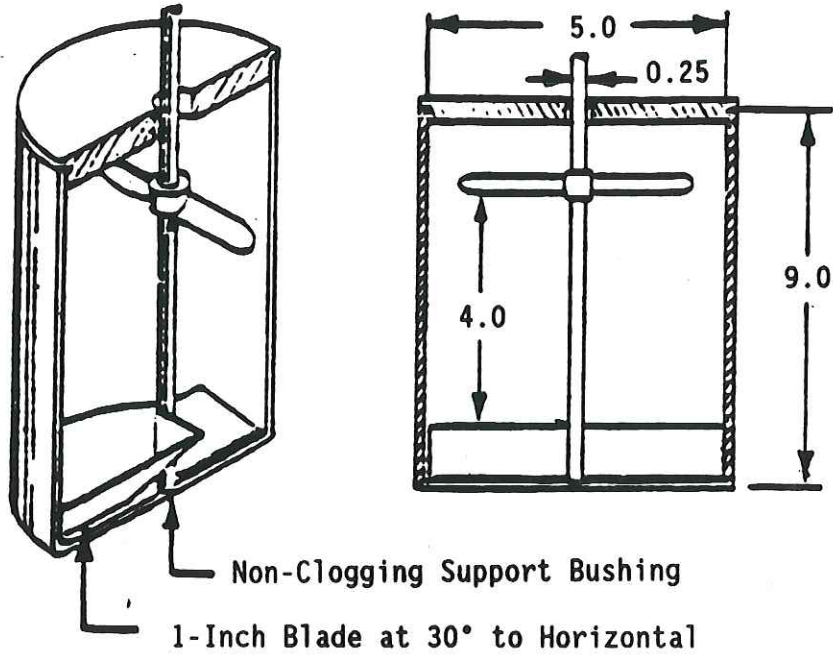


FIGURE 2.  
ROTARY EXTRACTOR

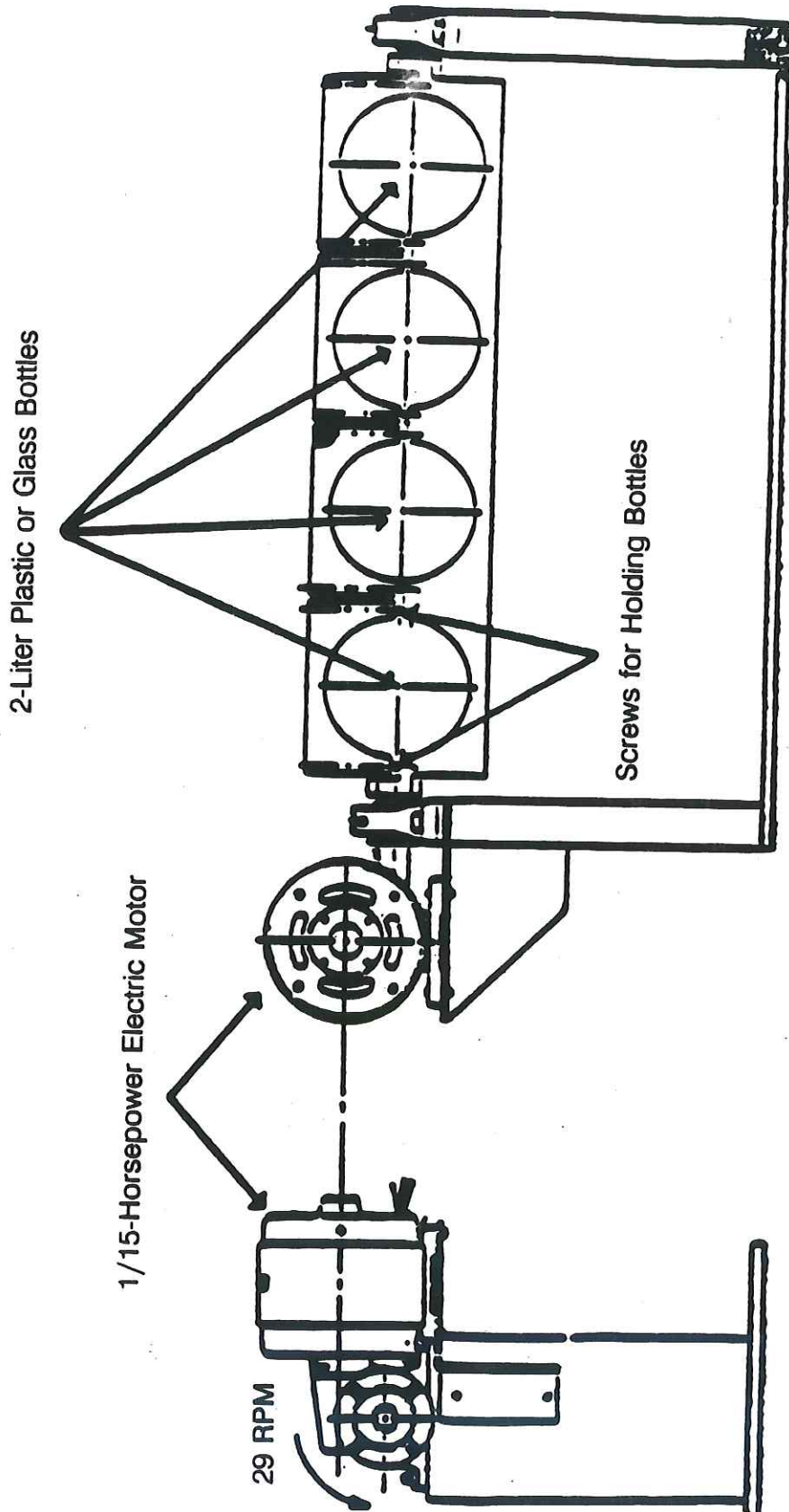


FIGURE 3.  
EPRI EXTRACTOR

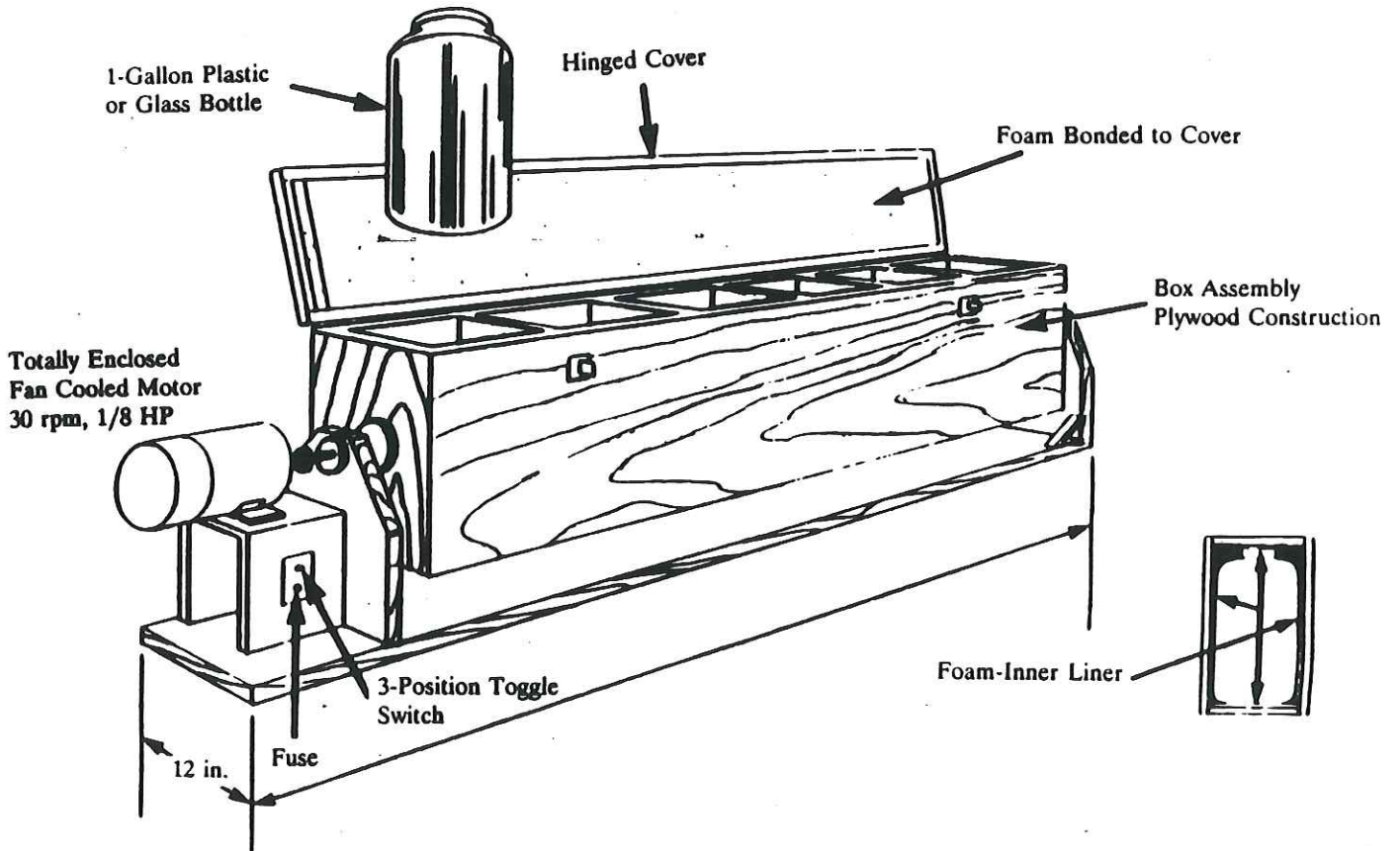
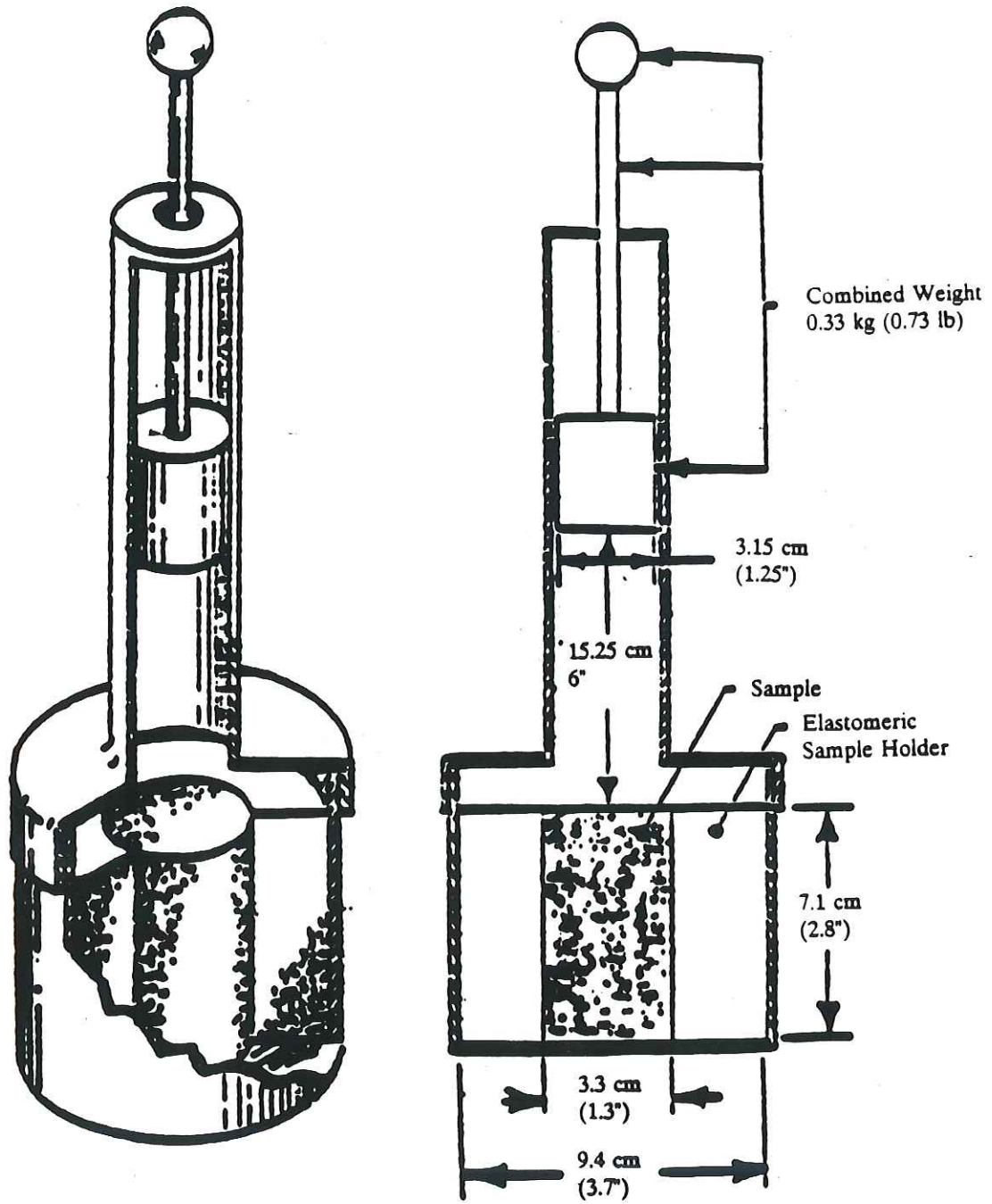
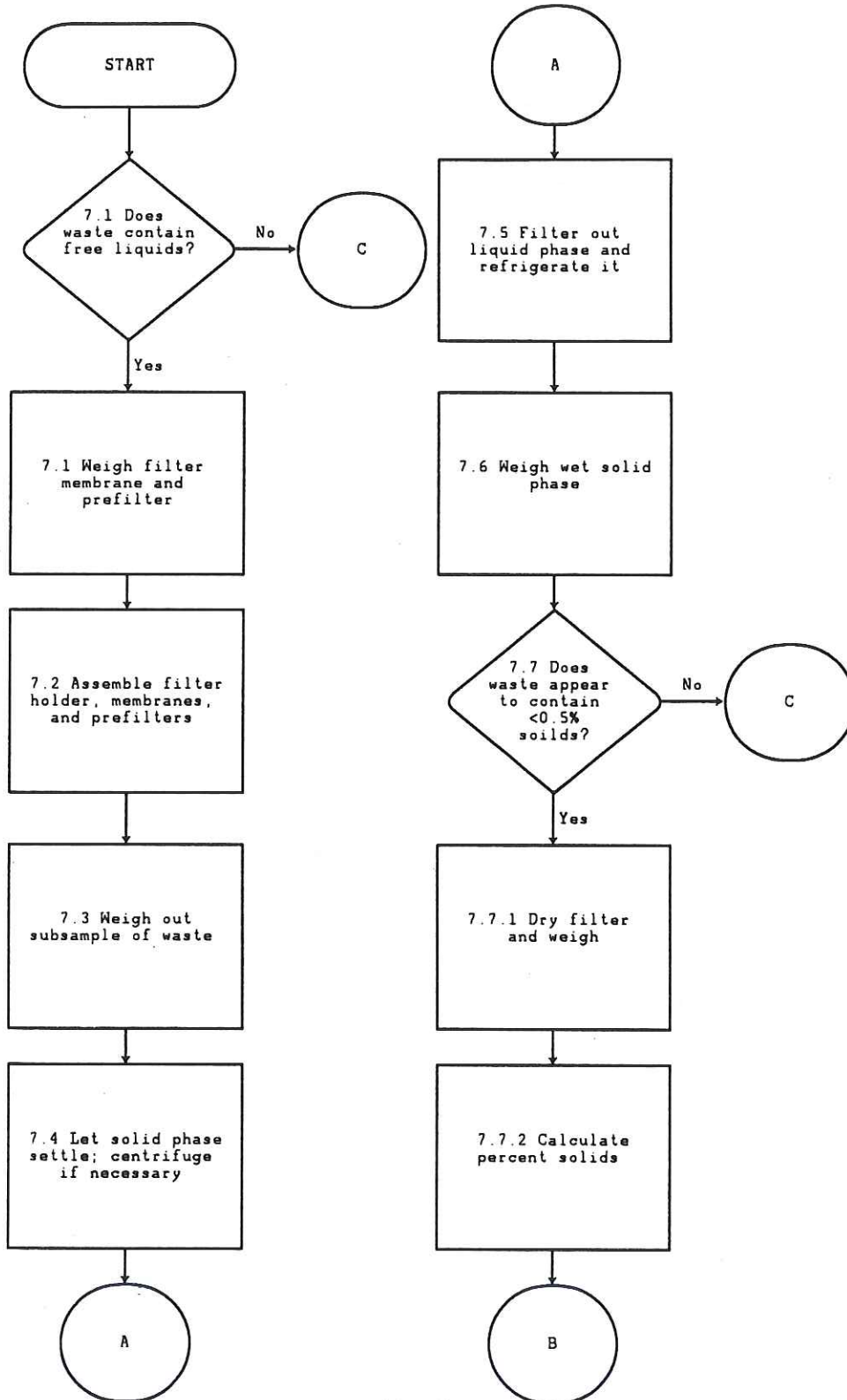


FIGURE 4.  
COMPACTION TESTER

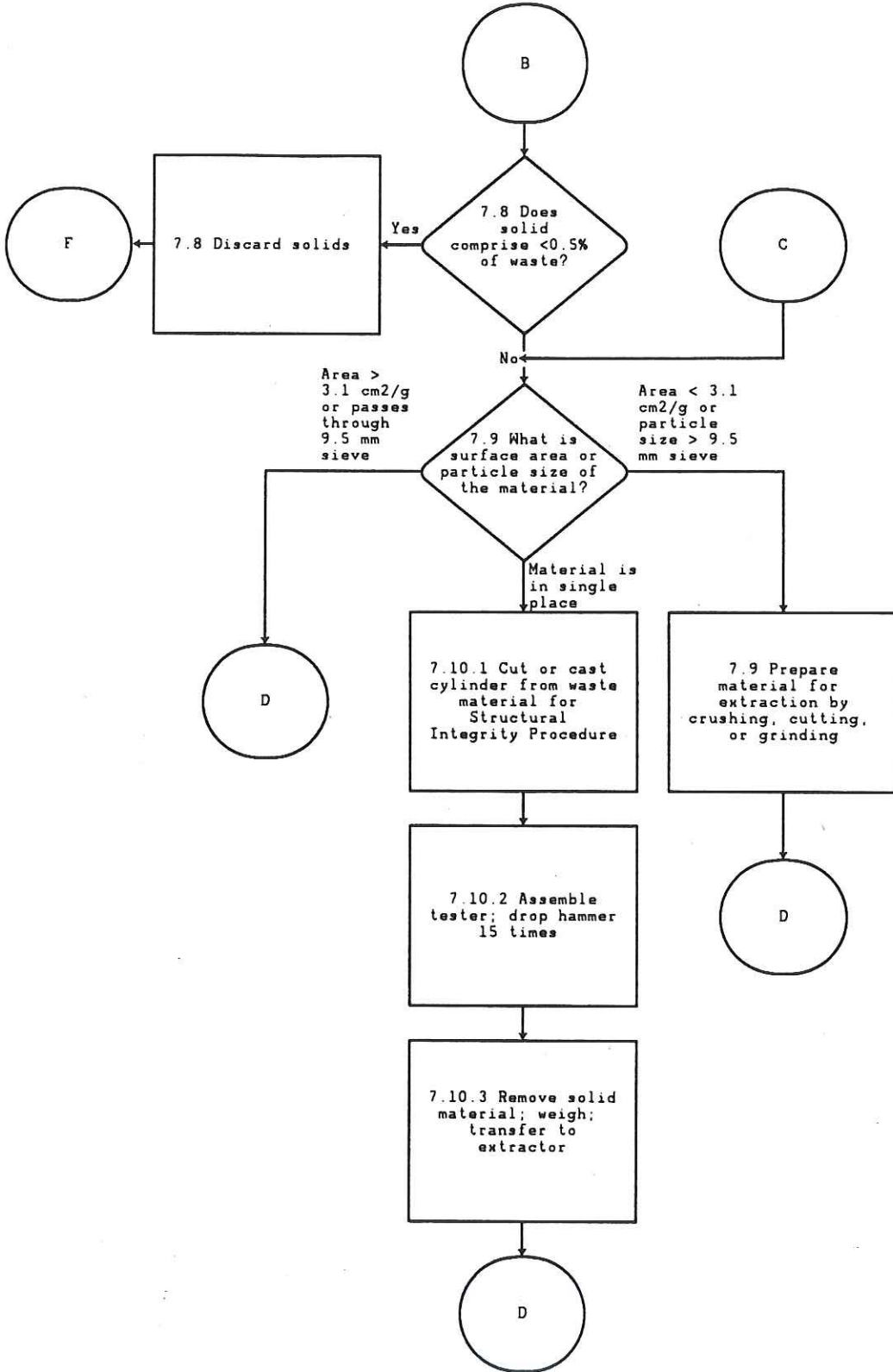


METHOD 1310A  
EXTRACTION PROCEDURE (EP) TOXICITY TEST METHOD  
AND STRUCTURAL INTEGRITY TEST





METHOD 1310A  
(Continued)



METHOD 1310A  
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