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University of California

Ernest O. Lawrence Radiation Laboratory

SAFETY SERVICES DEPARTMENT

(Formerly Health Chemistry Department)

SERVICES and EQUIPMENT

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SAFETY SERVICES DEPARTMENT

(Formerly Health Chemistry Department)

SERVICES and EQUIPMENT

Lawrence Radiation Laboratory
University of California
Berkeley, California

January 15, 1968

Operated under contract with the
U. S. Atomic Energy Commission

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SERVICES AND EQUIPMENT

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SAFETY SERVICES

LRL

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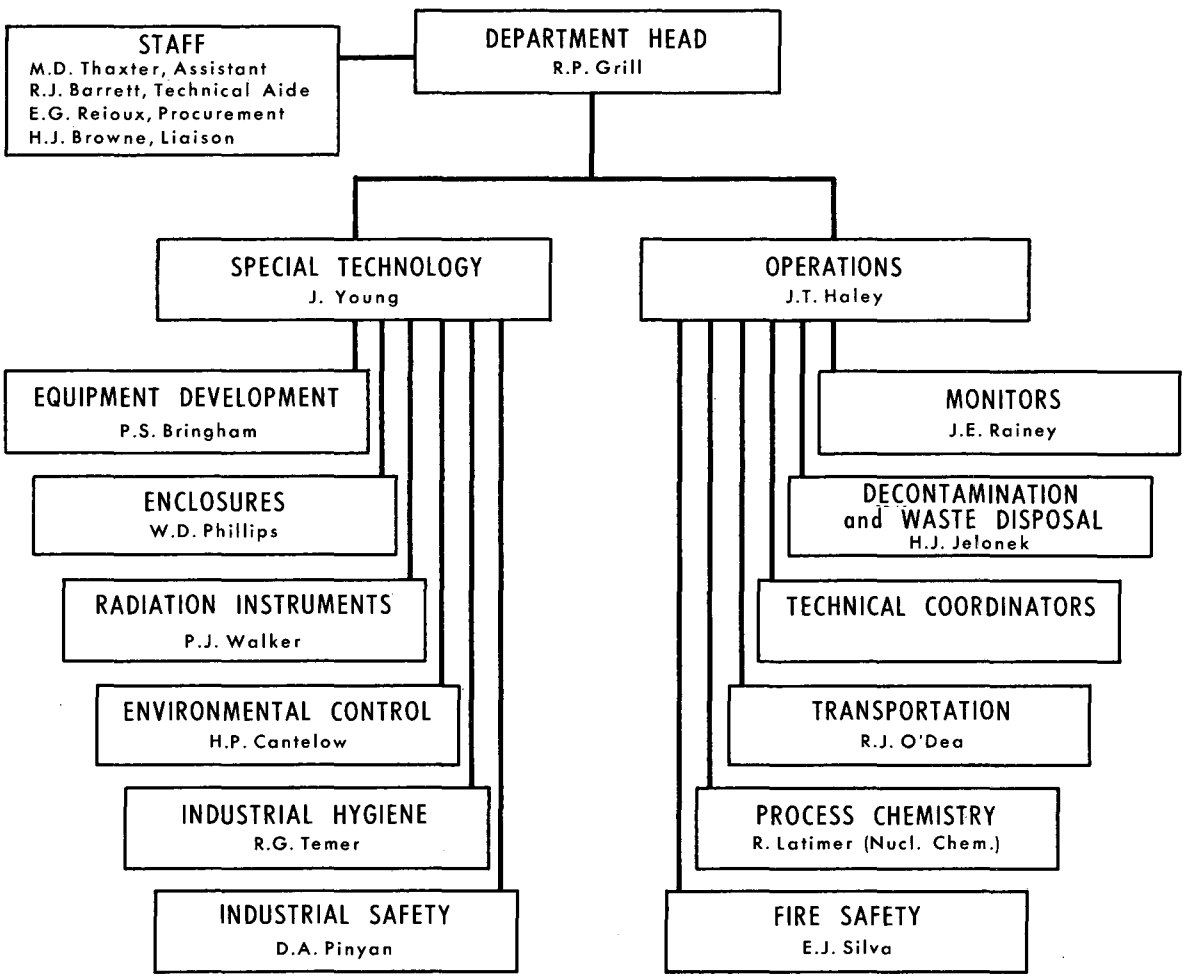
SAFETY SERVICES DEPARTMENT

(Formerly Health Chemistry Department)



Jan 23,1968

I. STRUCTURE AND FUNCTION

A. Introduction

The function of the Safety Services Department is to protect the personnel and the environment at this site from unwarranted exposure to hazardous materials. This is accomplished by providing an integrated program of engineering, support, and continuous surveillance services. To handle its responsibilities, the department is organized into two groups as shown on the accompanying chart:

1. Operations personnel provide on-the-spot, round-the-clock health and safety assistance, emergency services, and liaison with other departmental groups.

2. Special Technology personnel are a group of specialists in various disciplines who apply their special knowledge to solving problems. The results may lead to consultations with the party involved; to training sessions; to measurement and evaluation of abnormal environmental conditions; or to design, fabrication, installation, and maintenance of equipment for the safe handling of hazardous materials.

B. Operations Section

The Safety Services Operations Group maintains adequate personnel in areas convenient for the experimenter to report his plans and needs orally on all facets of hazardous research. The experimenter should inform Operations of any significant changes in his project. It is the Operations Group's responsibility to be located conveniently and to provide the following:

1. Constant surveillance of experiments and adjoining areas for surface and airborne contamination, penetrating radiation, and other safety considerations.

2. Help in planning or preparation of radiological or hazardous experiments and analyses of difficult safety problems during an experiment; provide personnel to monitor and oversee unusual and risky operations.

3. Instruction in the operation of enclosures, related engineered equipment, portable radiation-protection instruments, and other safety services.

4. Protective clothing and other necessary equipment and supplies for the safety of radiological or hazardous operations.

5. Arrangement for irradiations, decontamination, waste disposal, transportation services, industrial hygiene or safety services, and procurement of safe radioactive sources.

6. Assistance with radioactive or other hazardous spills, potential injuries, and other emergency situations.

7. Liaison between researchers and the Safety Services groups.

8. Operation of shielded master-slave cells for experiments requiring more shielding than conventionally available.

9. Fire protection and emergency services when called upon, and fire prevention and emergency training of Laboratory personnel at all times.

1. Monitoring

The Safety Services monitor performs a number of routine, systematic duties in addition to acquainting himself with all personnel working in his area. To ensure a safe environment he must perform accurately the following:

1. Stock Safety Services supplies and keep a daily operational log of all activities in his area; accurately monitor for surface and airborne contamination and penetrating radiation from radioactivity utilized in his area.

2. Be familiar with all hazards in his area and with all research operations regarding safe conduct.

3. Systematically monitor and change air samples and keep all survey instruments in good operating condition with the aid of the Radiation Instruments Section.

4. Instruct and inform all Laboratory personnel concerned with experiments in the operation of enclosures and related equipment, as well as Safety Services safety procedures and services.

5. Assist in radioactive pass-outs or other difficult remote control manipulations.

6. Assist all LRL craftsmen by ensuring a safe operating environment.

7. Maintain close liaison with all researchers and anticipate their requirements in an effort to have Safety Services services available, at all times.

8. Advise Fire Safety Section personnel of all hazards in the monitor's area, and assist in the control of all industrial-hygiene problems.

2. Technical Coordination

The Safety Services Technical Coordinator acts as a liaison between Safety Services services personnel and the researcher who utilizes radioisotopes, hazardous materials, or dangerous equipment. This is accomplished by:

1. Evaluating any unsafe practices during research programs based upon Safety Services standards, and at the same time considering both research programs and the safety of laboratory personnel and equipment.

2. Advising in the design of specialized equipment by Safety Services Engineering, ensuring its development and correct operation.

3. Coordinating the Safety Services Department with other Laboratory groups such as crafts.

4. Conducting research operations that pertain to Safety Services problems.

5. Advising and directing personnel in all health and safety emergencies in the coordinator's area.

6. Assisting all of his area monitors with technical support, ensuring a safe and smooth Safety Services service to research programs by adequate communication.

7. Establishing irradiation programs with interested researchers and local project engineers to ensure safe operation before, during, and after irradiation of material in a reactor, including proper dosage limits for Laboratory personnel. These responsibilities include:

a. Ensuring that radioactive targets being bombarded, together with their assemblies, do not exceed the limits of laboratory shielding for manipulating equipment.

b. Making calculations to ensure that heat-conduction capacity is adequate.

c. Inspecting and testing all target assemblies to ensure their integrity for the reactors.

d. Providing researchers with reactor statistics to help them achieve their objectives.

e. Keeping records on all Laboratory radiations, and considering proper accounts in relation to appropriate charges.

f. Ensuring maximum economy to the Laboratory by combining capsules and advising the researcher.

g. Providing a convenient, flexible liaison with reactor project engineers and Laboratory researchers for maximum service.

h. Coordinating irradiation with Safety Services Transportation and informing Safety Services Operations of all irradiation projects.

i. Maintaining a safe and reliable depository for all hazardous isotopes belonging to laboratory employees under A. E. C. contract W-7405-eng-48.

3. Decontamination

The Safety Services Decontamination Section evaluates contaminated laboratory equipment and reclaims it by chemical or physical decontamination; it also assumes the responsibility for equipment disposal based on economy and hazardous conditions. This is accomplished by:

1. Maintaining an adequate disassembly and decontamination facility and a dry and liquid active-waste-disposal area.

2. Properly collecting, packaging, and solidifying hazardous waste, and evaluating new waste-disposal methods.

3. Maintaining an up-to-date knowledge of new surface materials, equipment, and techniques used for decontamination.

4. Acting as a work pool for the Operations Group by assisting in monitoring and advising in all decontamination operations and hazardous disposal problems at the laboratory.

5. Assisting any private or public governmental agency in radiological incidents when assigned by the Department Head of Safety Services.

6. Assisting the Operations Group by transporting radioactive targets and deliveries, or acting as escort for radioactive waste.

7. Collecting and disposing of hazardous chemical wastes.

8. Maintaining decontaminating equipment for all hazardous spills.

4. Transportation

This Safety Services Section has a working up-to-date knowledge of the codes, laws, and regulations concerning transportation of materials, especially those that are radioactive or dangerous. The Section provides the following services:

1. Packaging, transporting or supervising the transportation of all project radioactive material; assisting in the packaging and transportation of other hazardous materials both on and off site.

2. Receiving, inspecting, and dispensing all radioactive material, stable isotopes, and certain hazardous materials received at UCLRL.

3. Storing, maintaining, and helping design all project radioactive shipping containers; recommending and assisting on the design of containers for hazardous materials.

4. Assure that Safety Services vehicles are serviced and maintained.

5. Aid Operation Groups in emergencies.

6. Advise upon request concerning applicability of regulations to specific shipments.

5. Processing

The Safety Services Processing Section is responsible for all remote-control water-cave operations under the guidance of a Chemistry Department representative. The group is responsible for the following:

1. Being well qualified in all cave operating parameters, which encompasses master-slave manipulations, shield maintenance, transfer systems, radioactive enclosures, filtration or absorption equipment, and chemistry preparations and assaying.

2. Training Safety Services personnel and experimenters in cave manipulations and equipment.

3. Aiding in design and development of all cave-room equipment and making final inspections of all primary enclosures, the manipulator, the cave area, and the surrounding room before each operation.

4. Monitoring penetrating radiation levels and airborne samplers as well as having proper contamination control during all pass-in and pass-out operations of cave and box facilities in this area.

5. Coordinating deliveries of radioactive materials prepared by cave processing with Safety Services Operations Group.

6. Minimizing all hazardous conditions in the surrounding operational areas.

6. Fire Safety

Fire protection and prevention, and emergency services in case of personal sickness or accidents are the prime functions of this section. Additionally, it is responsible for the following:

1. Fire education, training, and investigation.
2. First aid training.
3. Prevention of water damage to structures.
4. Coordination with Plant Engineering to ascertain that fire-code requirements are built into new or altered facilities.
5. Issuing of fire permits.

D. Special Technology Group

The Special Technology Group consists of a number of specialists, trained in a wide variety of disciplines, who can recognize a hazardous situation or material, measure the levels of contaminants, evaluate the hazard, and finally control it by design, fabrication, installation, and maintenance of appropriate equipment.

Services provided include the following:

1. Design, fabrication, and installation of specialized equipment for handling hazardous materials.
2. Fabrication, assembly, and loan of standard enclosures and associated hardware to contain and handle radioisotopes or other hazardous materials.
3. Hardware for ventilating enclosures and for removing contaminants from the air stream.
4. Air sampling devices and evaluation of air samples to monitor environmental conditions at the Laboratory.
5. Radioactive-source preparation.
6. Design and fabrication of specialized radiation-monitoring devices.
7. Evaluation of occupational chemical and nonionizing electromagnetic-spectrum hazards; noise and sound analysis.
8. General safety evaluations, including consultations and education, accident reports, electrical precautions, traffic safety, and laboratory and shop safety.

Requests for services are normally filled (1) in order of greatest potential hazard and (2) in order of receipt of the request. When manpower or budgetary limitations preclude filling all requests within desired due dates, the Safety Services Department representative will ask the appropriate research-department head to establish priorities on the basis of scientific importance of the experiment.

Costs of services of this group are normally charged as follows:

1. Design of new apparatus with potential applicability to a variety of programs is charged to the Safety Services development budget.
2. Design of new apparatus foreseeably applicable only to the requester is charged to the requester's operating budget.
3. Standard gloved-box components, including standard experimental apparatus, and the related gamma or neutron shields, are fabricated or purchased on the Safety Services equipment budget. The completed enclosures and shields are loaned to the user, whose operating budget is charged only for final assembly labor and for nonstandard experimental apparatus.

1. Equipment Development

Equipment Development is a mechanical design and engineering section consisting of mechanical engineers, mechanical designers, and draftsman. This Section develops and designs equipment and systems for protection against hazardous materials. The Section works very closely with other Sections in Safety Services for the design of more complex equipment and systems.

Areas of endeavor include:

1. Enclosures, shielded and unshielded, portable and stationary
2. Hot cells
3. Source holders
4. Integrated systems for hot or cold operations
5. Remote-handling equipment, including master-slave manipulation apparatus
6. Target-handling equipment.
7. Heat-transfer studies and systems
8. Vacuum systems
9. Target design
10. Casks for isotope handling, storage, and shipping
11. Hydraulic systems
12. Encapsulations for reactor irradiation
13. Inert-atmosphere systems
14. Mechanical development and design of special chemistry equipment
15. Strain-gage measurement.

2. Enclosures

This Section assembles enclosures for handling hazardous materials, maintains a stock of parts and commonly used associated equipment for standard units, and designs and fabricates enclosures of almost any size or shape as required. Materials commonly used for construction purposes include coated steel, stainless steel, asbestos-millboard laminate, plywood, and plexiglass. Additional fields of endeavor include:

1. Installation and maintenance of enclosures and associated equipment.
2. Fabrication of mockups of special shielding or apparatus.
3. Tests and evaluations of special coatings or materials.
4. Assistance to other groups in Safety Services in the design, fabrication, and installation of high-level enclosures, shielding, and associated equipment.
5. Design and fabrication of special equipment for use in connection with radioisotope enclosures.

3. Radiation Instruments

This Section provides detection instruments for Safety Services operations and for specialized research experiments. It also designs, fabricates, calibrates, and maintains the following:

1. Equipment used in the counting room by the Environmental Control Section.
2. Survey meters and hand-and-foot counters.
3. Radiation monitors for high-level sources and high-level caves.
4. Portable counters.
5. Test equipment and explosive-gas meters for the Industrial-Hygiene Section.

Other areas of endeavor include:

1. Dosimetry by means of thermoluminescent devices and pocket dosimeters.
2. Coordination with other Safety Services groups in the design and fabrication of electromechanical devices.

4. Environmental Control

Control and surveillance of radioactive discharges to the environment are the principal responsibilities of this Section.

The control aspect is directed particularly toward prevention of airborne contamination. Functions include:

1. Installation, maintenance, and testing of ventilation and air-cleaning equipment.
2. Cooperation with the other Safety Services groups in the design of special enclosures and hot cells.
3. Development of improved equipment and methods for air cleaning, including gas adsorption.
4. Measurements of air flow.
5. Design and fabrication of radioactive sources.

The surveillance aspect includes:

1. Maintaining an early-warning system for in-laboratory-air samples ("scan run").
2. Gathering environmental samples from stacks, air, rain, sewage, surface water, etc.
3. Preparing and assaying all such samples and maintaining records on them.
4. Publishing reports for AEC use and (or) for internal distribution.
5. Radiologically identifying contaminants and evaluating special samples.
6. Data processing and programming for special problems.

5. Industrial Hygiene and Toxicology

Recognition, evaluation, and control of occupational health hazards are the functions of this section. It is responsible for providing the following services:

1. Toxicology of occupational chemical hazards.
2. Control of nonionizing electromagnetic spectrum hazards, such as lasers, ultra-violet, infra-red, and microwave-radio-frequency radiation.
3. Evaluation of ventilation for comfort, dilution, and local exhaust.
4. Air quality control.
5. Noise and sound analysis.
6. Illumination evaluation.
7. Environmental sanitation, such as food, water, vector and pest control.
8. Measurement of physiological stresses, such as temperature extremes or abnormal pressures.
9. Provision of protective equipment, such as respiratory, hearing, and special eye protection.

6. Industrial Safety

General safety of the Laboratory is this section's primary concern. Its field of responsibility includes the following:

1. Investigation, statistical analysis, and review of personal injury, property-damage, and vehicle-accident reports.
2. Provision of protective clothing and equipment parts of the body such as eyes, head, feet, and hands.
3. Ensuring that proper protective devices are installed on electrical circuits and equipment.
4. Evaluation of material-handling and storage facilities, such as manual and mechanical handling devices, slings, ropes, chains, and hooks.
5. Review of design, layout, and code compliance of facilities and buildings.
6. Cryogenics safety.
7. Pressurized equipment and systems safety.
8. Ensuring proper use and care of ladders, ramps, elevated walks, and work platforms.
9. Traffic safety, such as traffic signs and marking, and traffic patterns and layout planning.
10. Safety around construction sites.
11. Facility inspection.
12. Vehicle inspection.
13. Qualifying drivers for operation of special vehicles.
14. Safety education and training.

II. SPECIAL TECHNOLOGY GROUP EQUIPMENT

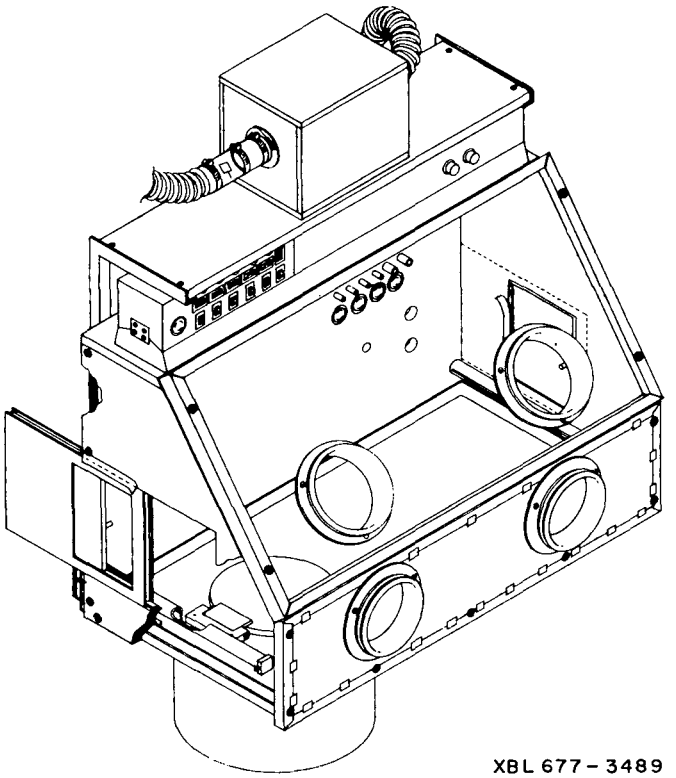
Equipment which is adequately engineered and properly used for a hazardous operation will enable a researcher to accomplish his task safely.

The equipment in this catalog has been designed and used over a number of years mainly for the safe handling of radioisotopes. With slight modifications to the equipment, however, many other hazardous materials or operations can be accommodated.

This catalog is not meant to show or to detail all the equipment available in the Safety Services Department. Its purpose is to show typical items which the Department has designed and used; it also indicates the scope of design problems encountered, and the techniques and skills available in the Department for solving difficult problems.

Contact a representative of the Special Technology Group for a detailed description of individual items, or items not listed in this catalog.

IIA. Basic Enclosures



XBL 677-3489

Item: Basic gloved box.

Description: Frame: Usually 1/8-in. asbestos-millboard laminated on both sides over 1/2-in. plywood. Other materials used are coated mild steel, stainless steel, plexiglass, fire-retardant plywood, Formica-lined plywood, or other if specified.

Window: 3/4-in. plexiglass G set in a metal frame.

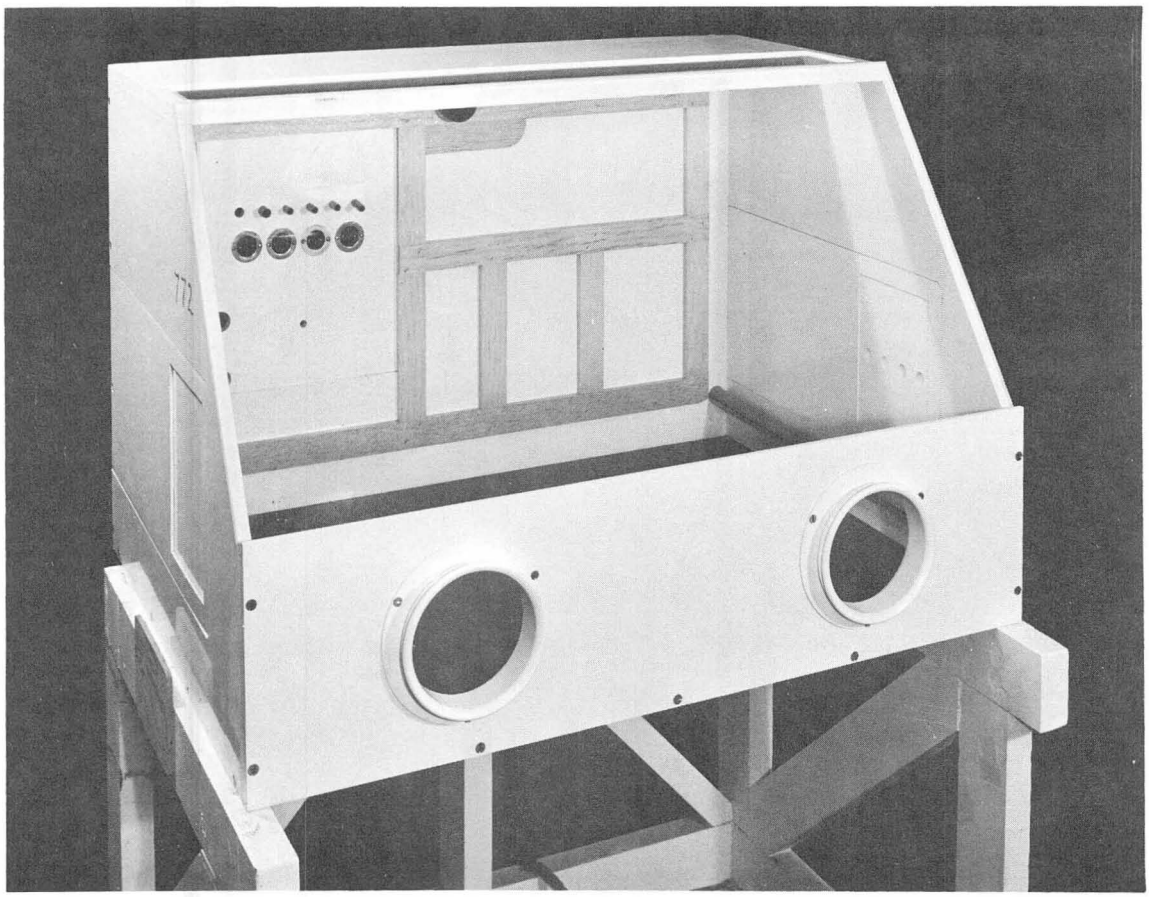
Modifications: With or without centrifuge, with two or four glove ports, and with any structural change specially requested.

Ancillary equipment: Shelves, ring stands, and other equipment in catalog.

Ventilation: The enclosure is maintained at a negative pressure with respect to the room by a manifold system. This consists of one operating exhauster and a standby unit. Prefiltered air is distributed through slotted tubes on both sides of the box and is cleaned by high-efficiency particulate filters before discharge to the environs.

Engineering drawing Nos:

12L 2874-fireproof standard gloved box
12L 3314-fireproof recess gloved box
12L 3504-fireproof shield box.

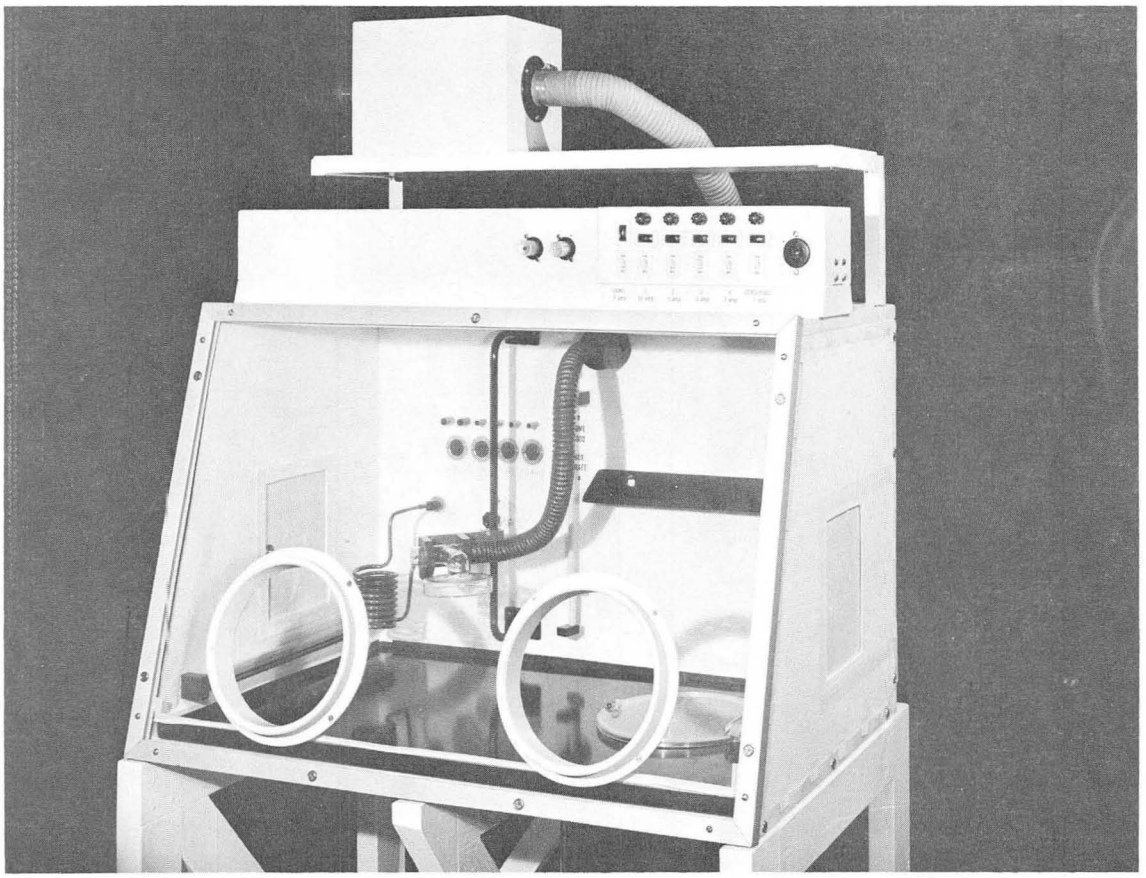


HP 789

Item: 25-in.-deep gloved box.

Description: 36¼ in. wide, 25 in. deep, 23½ in. high, with or without centrifuge located in well in bottom of box. A 17-in.-deep box is also available.

Engineering drawing Nos.:
- 12L 2874 - 17-in.-deep fireproof standard box.
- 12L 3314 - 25-in.-deep fireproof recess box.
- 12L 3504 - 25-in.-deep fireproof shield box.



HP 872

Item: Full-view gloved box.

Description: 34¼ in. wide, 21½ in. high, and 21 in. deep (inside), with 8-in. glove ports; with or without centrifuge.

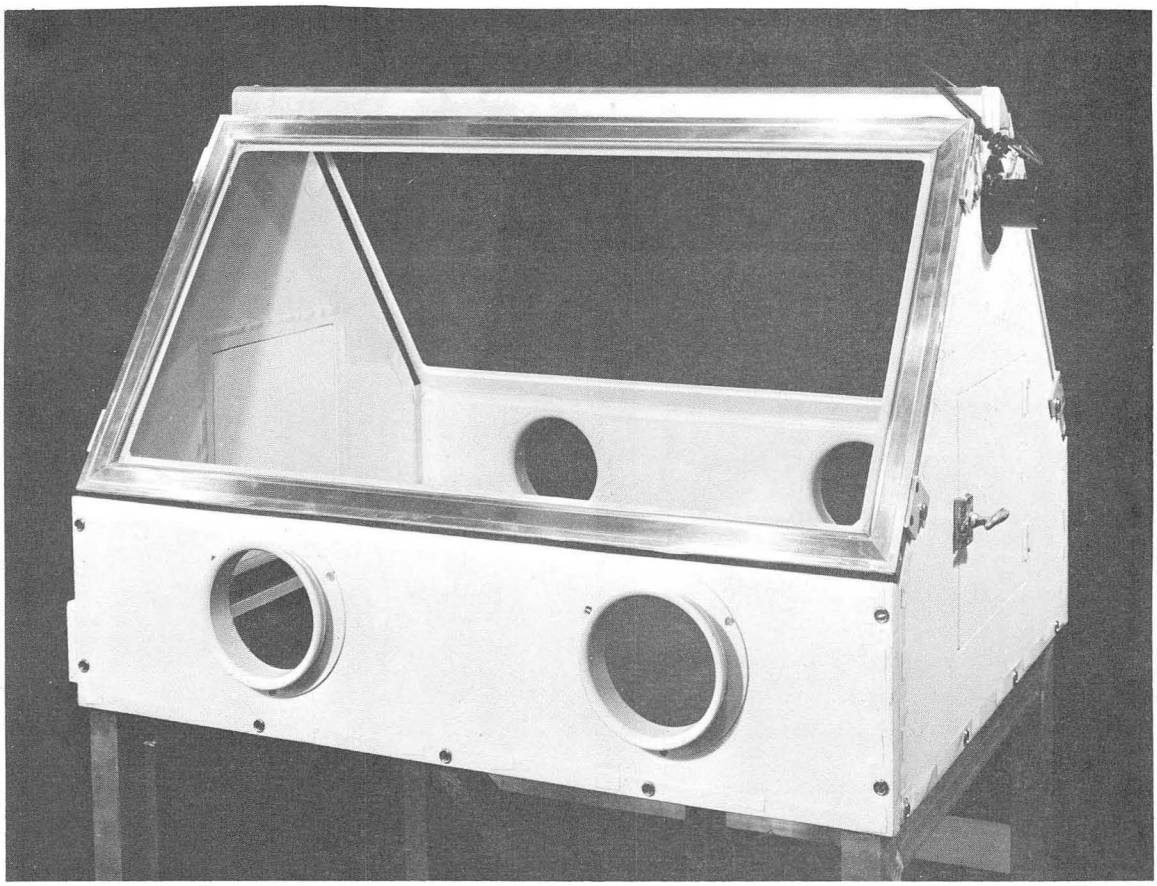
Engineering drawing No.:
HCD 42434.

HP 972

Item: Cupola-top gloved box

Description: Cupola added to standard 25-in.box to provide additional inside height. Glove ports for this model are usually located fairly high on the front window to permit the user to reach the top of a resin-bed column.

Engineering drawing Nos.:
12L 3314 - Fireproof-recess gloved box.
10J 3664 - Dome top.

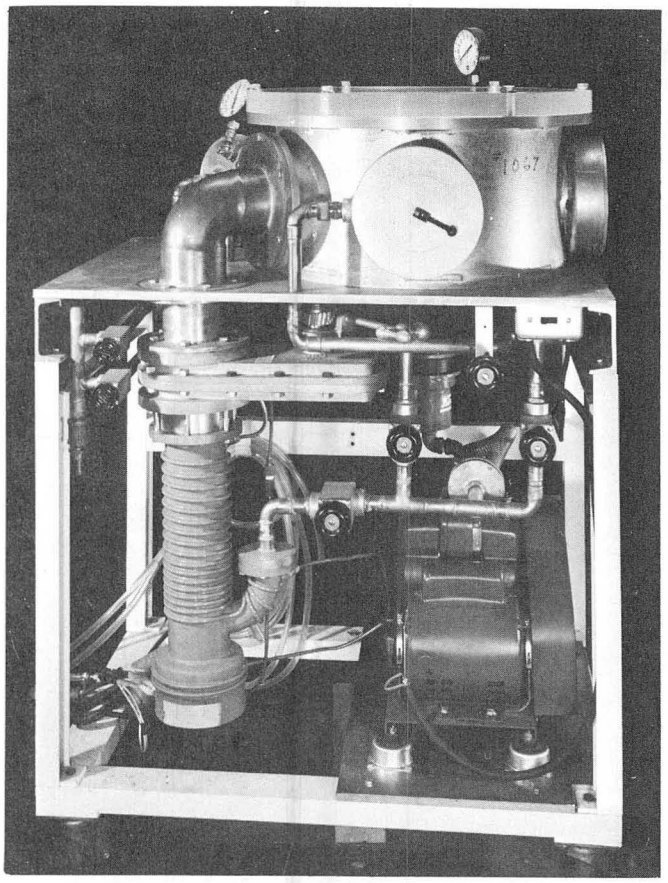


HP 937

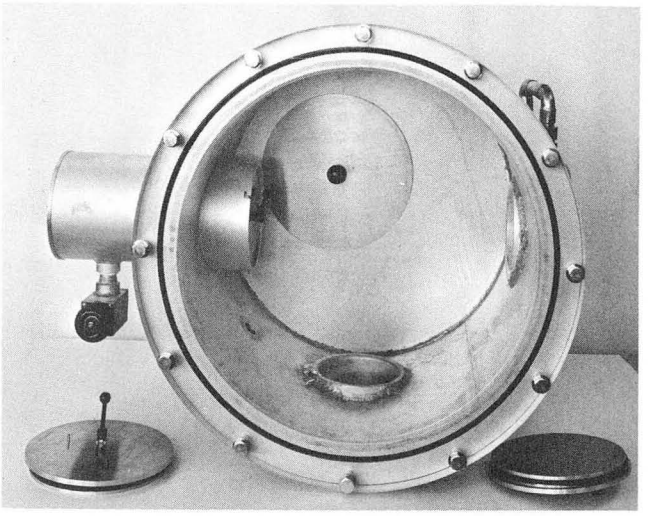
Item: Two-front gloved box.

Description: 36¼-in. wide, 23½-in. high, and 25-in. front to front.

Use: This unusual box makes it possible for two people to work in one box at the same time.



HP 1358



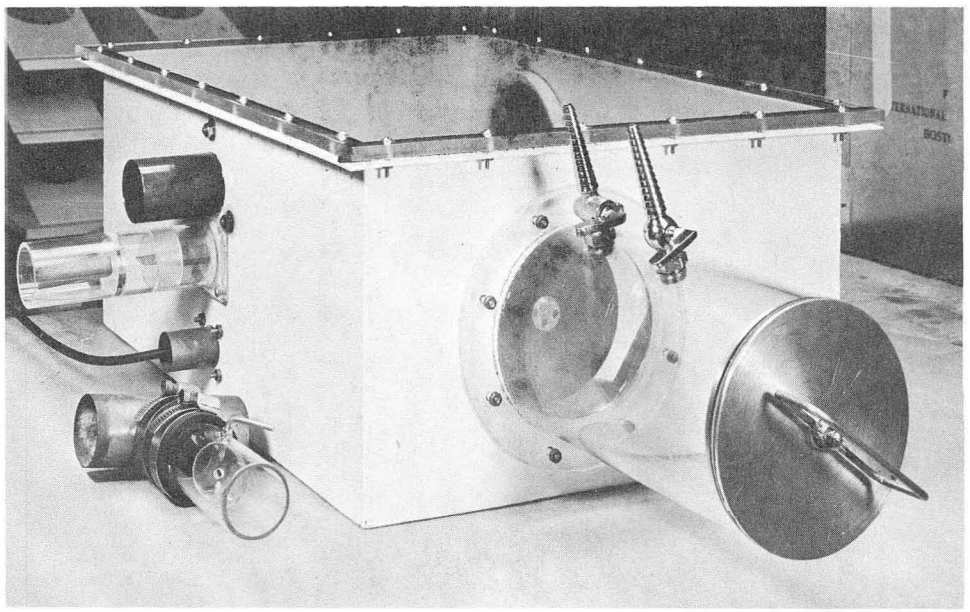
HP 1219

Item: Vacuum dry box.

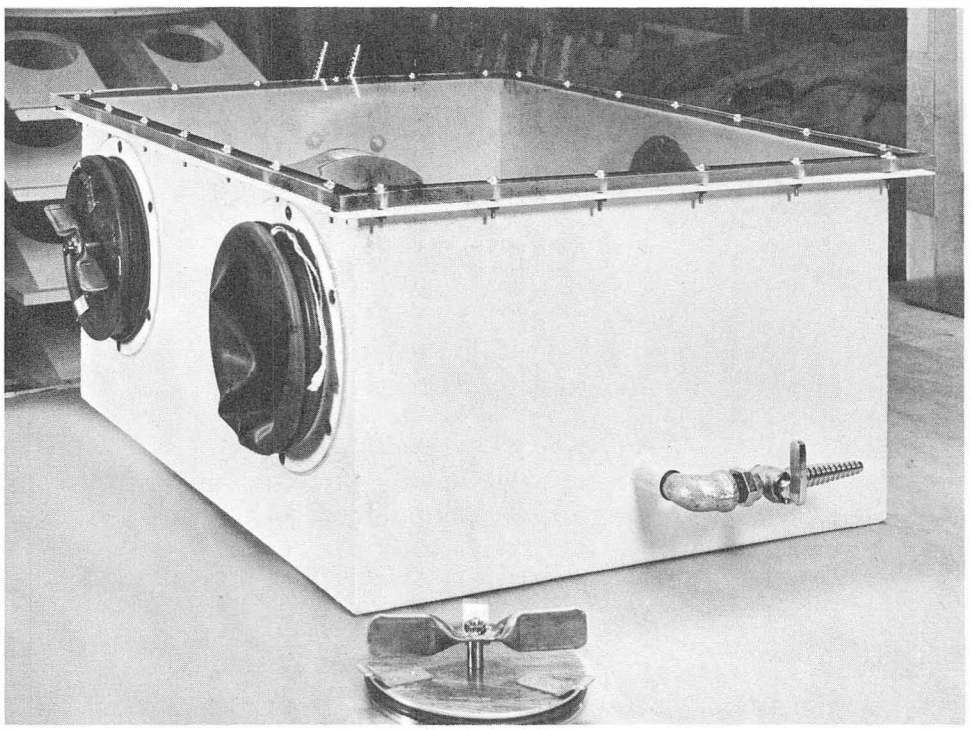
Description: Circular 20-in.-i.d. vacuum chamber with gloved ports, 6-in.-i.d. air-lock, and 1½-in. plexiglass top; height is 10 to 18 in., or as specified.

Use: For inert, dry, or oxygen-free atmospheres. The complete unit, including diffusion and mechanical pumps, is dolly-mounted and portable.

Engineering drawing No.:
HCD 39784.



HP 431



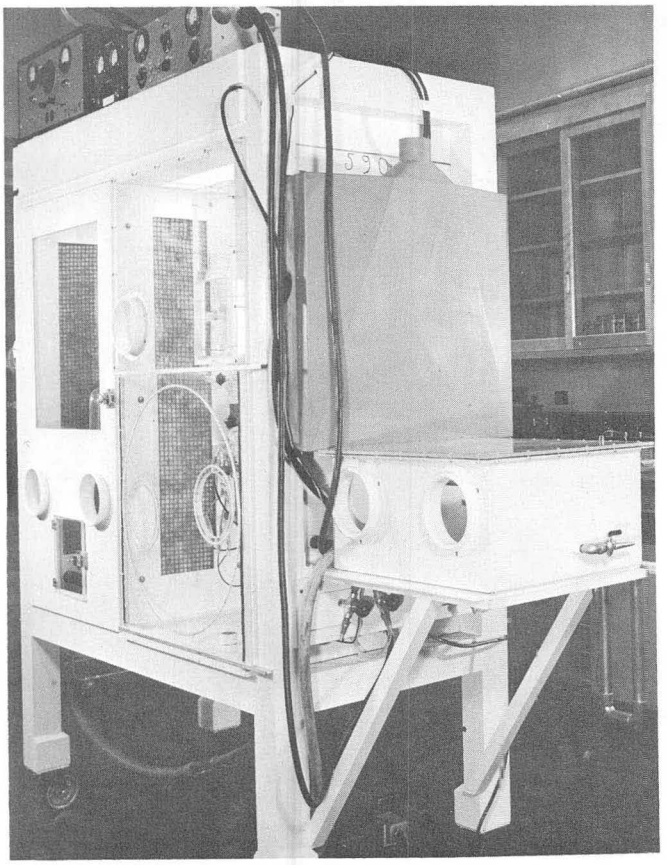
HP 430

Item: Inert-atmosphere box (compact).

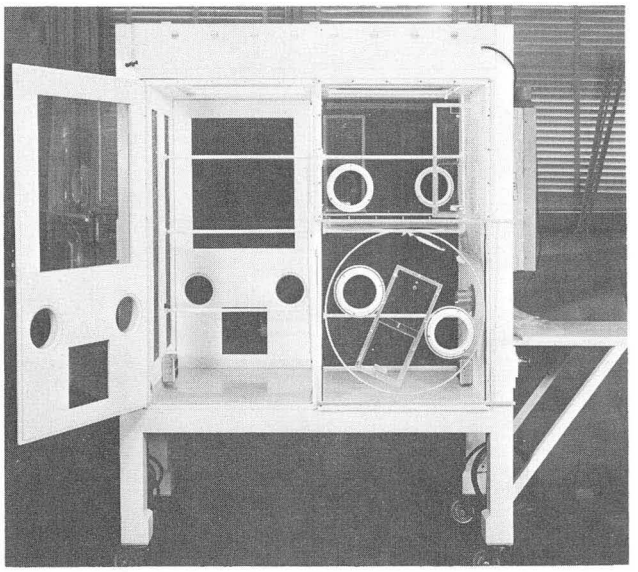
Description: 17-in. deep by 10-in. high by 21-in. wide; the air lock is 5½-in.-i.d. and any length; 2-in. hole for air-volume flushing and smaller ball check valve for bleeding of gas; ½-in. Lucite top.

Use: For a reasonably dry, inert, or specialized atmosphere.

Engineering drawing No.:
HCD 46986



HP 561



HP 573

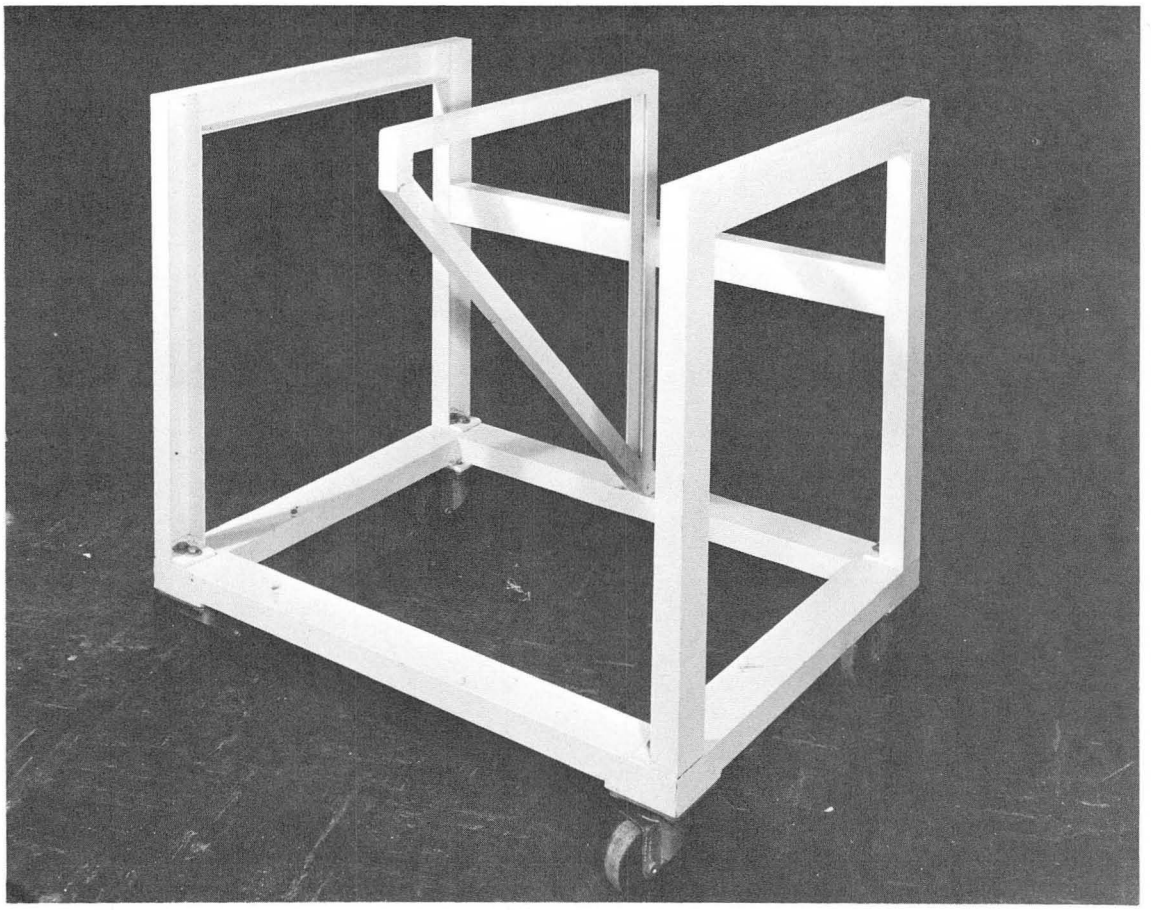
Item: 82-in., two-compartment vacuum-line box (piano box).

Description: A two-compartment facility. One side is maintained contamination-free; the other is "hot" . Compartment dimensions are 24 by 27 by 48 in. Additional features are monkey bars to hold equipment rotating panels and glove ports, sliding or swinging doors.

Use: Enclosure for radiochemistry utilizing high-vacuum conditions. Pumps and control equipment are located in one compartment.

Engineering drawing No.: HCD 42176

IIB. Enclosure Equipment



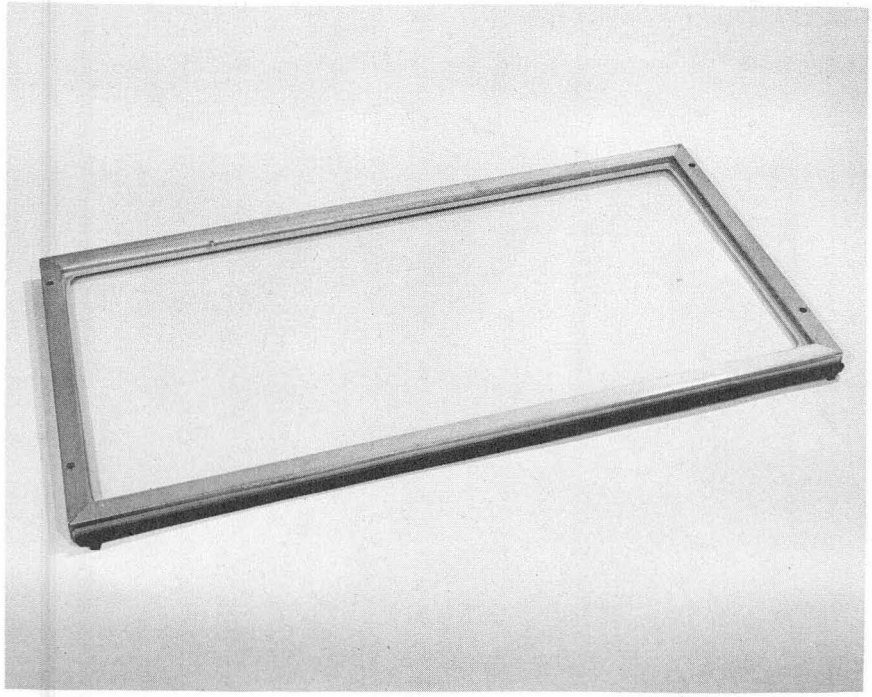
HP 1066

Item: Metal gloved-box dolly.

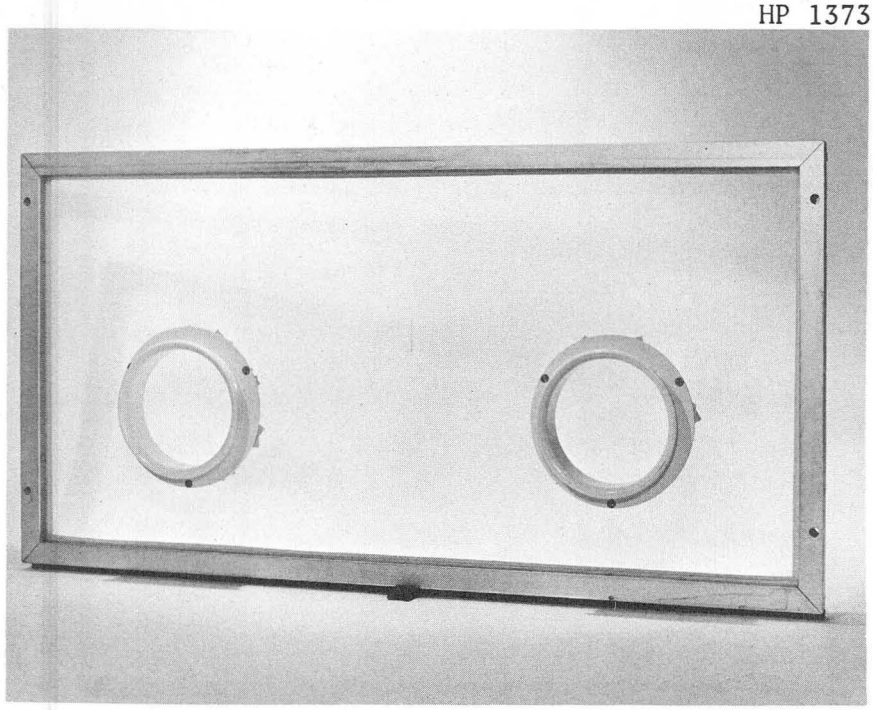
Description: All metal construction.

Use: Mobile support for gloved boxes. Center support section is removable.

Engineering drawing No: HCD 22384



HP 1373

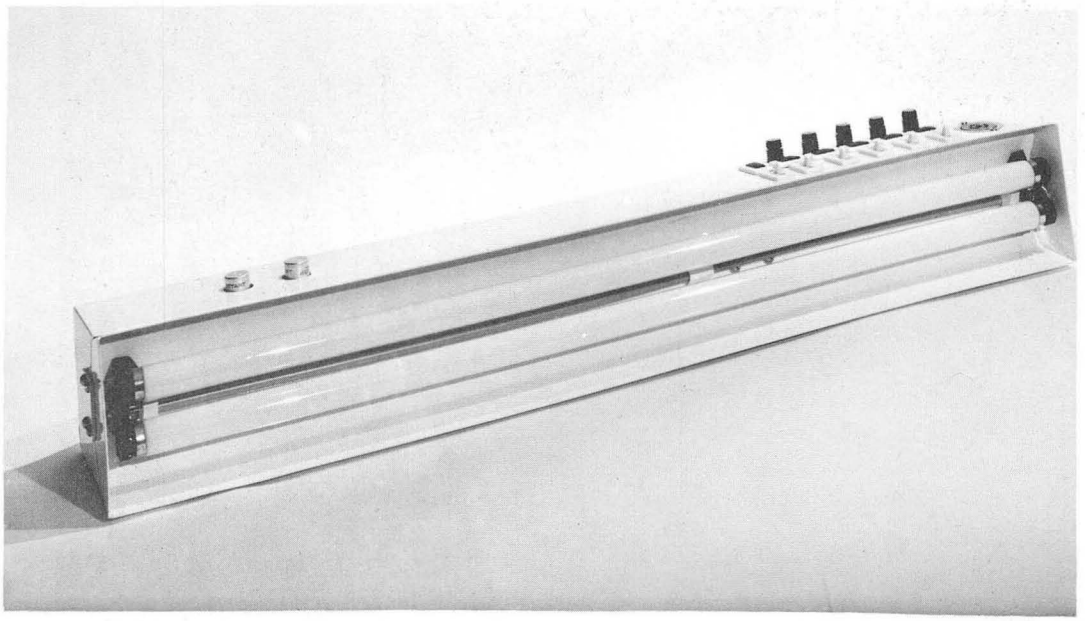


HP 1077

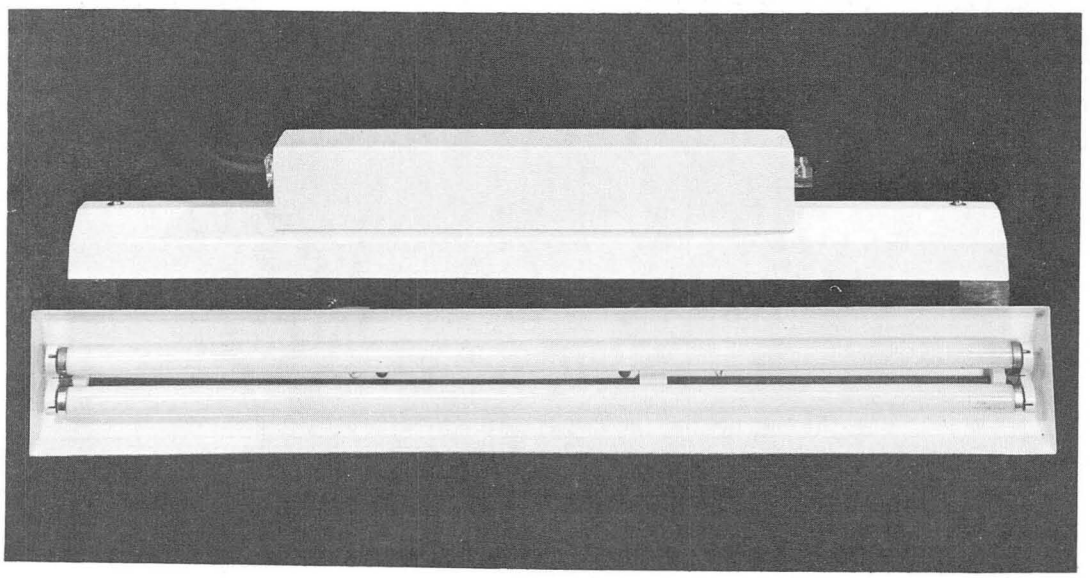
Item: Gloved-box window, with or without gloved ports.

Description: ¾-in.-thick acrylic-resin material set in aluminum frame.

Engineering drawing No.:
12J 3773 - Lucite gloved port window.
5J 1292 - Rolled edge, single-unit, gloved port.



HP 1076



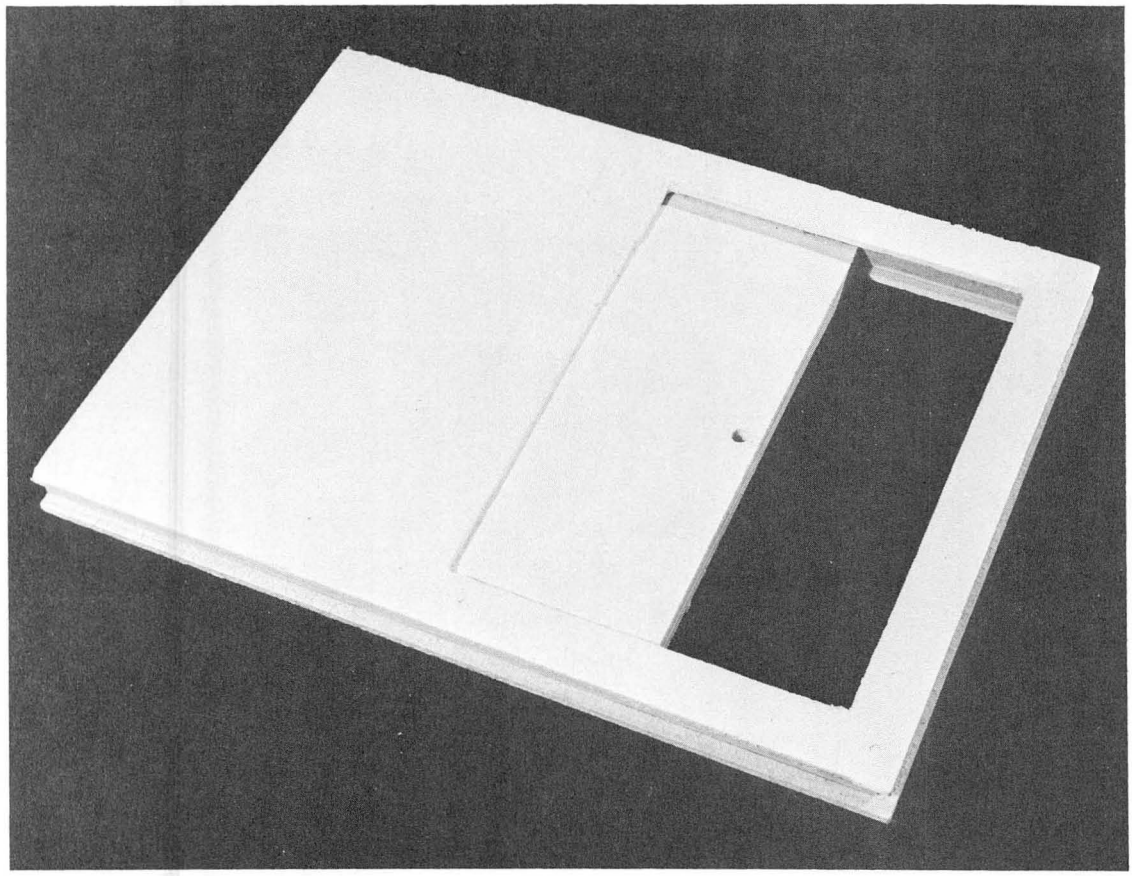
HP 324

Item: Fluorescent lights.

Description: 20-watt lamps. Upper: light with five built-in electric receptacles and switches. Lower: light only.

Use: To provide lighting through upper window of gloved box.

Engineering drawing No.:
Top - 9J 5994. Bottom - 5J 2584.



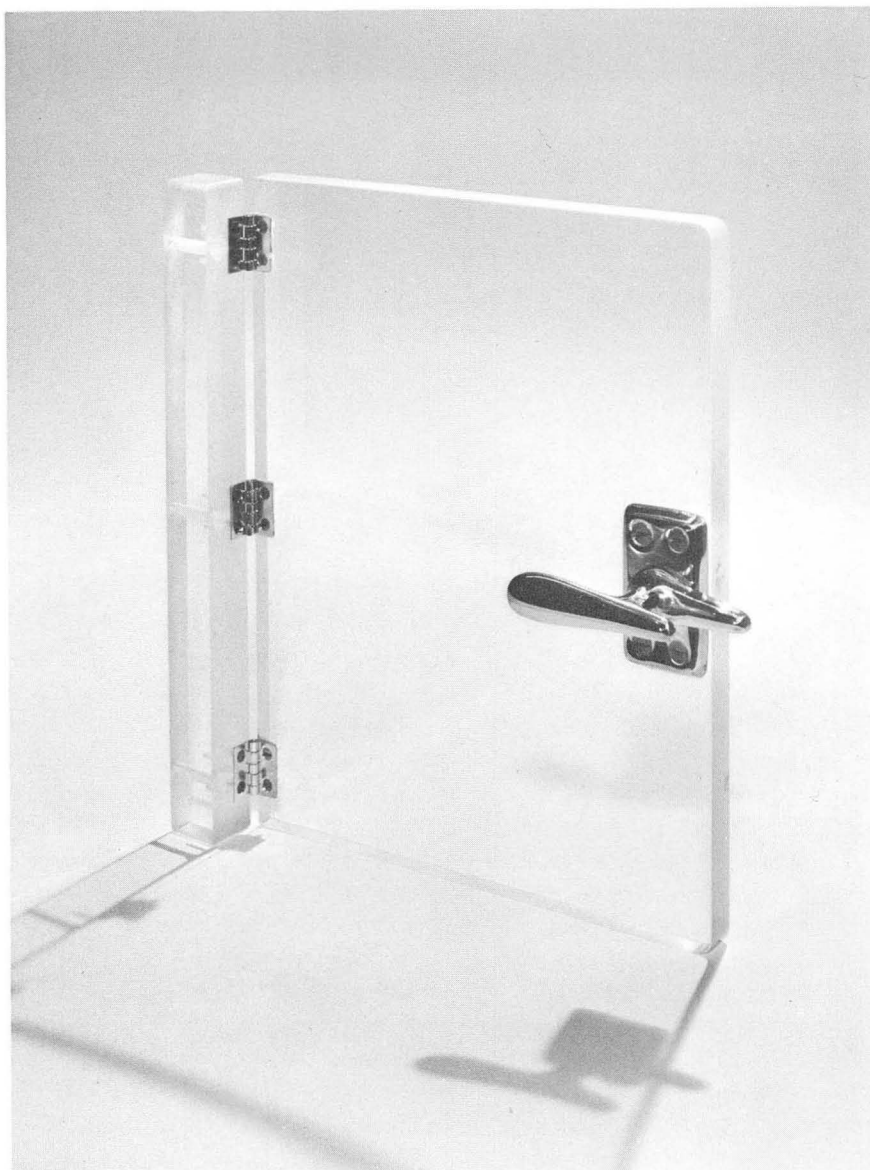
HP 1056

Item: Aluminum packaged door.

Description: Packaged sliding door.

Uses: Provides means for passing items into or out of gloved box.

Engineering drawing No.:
11J 7204.

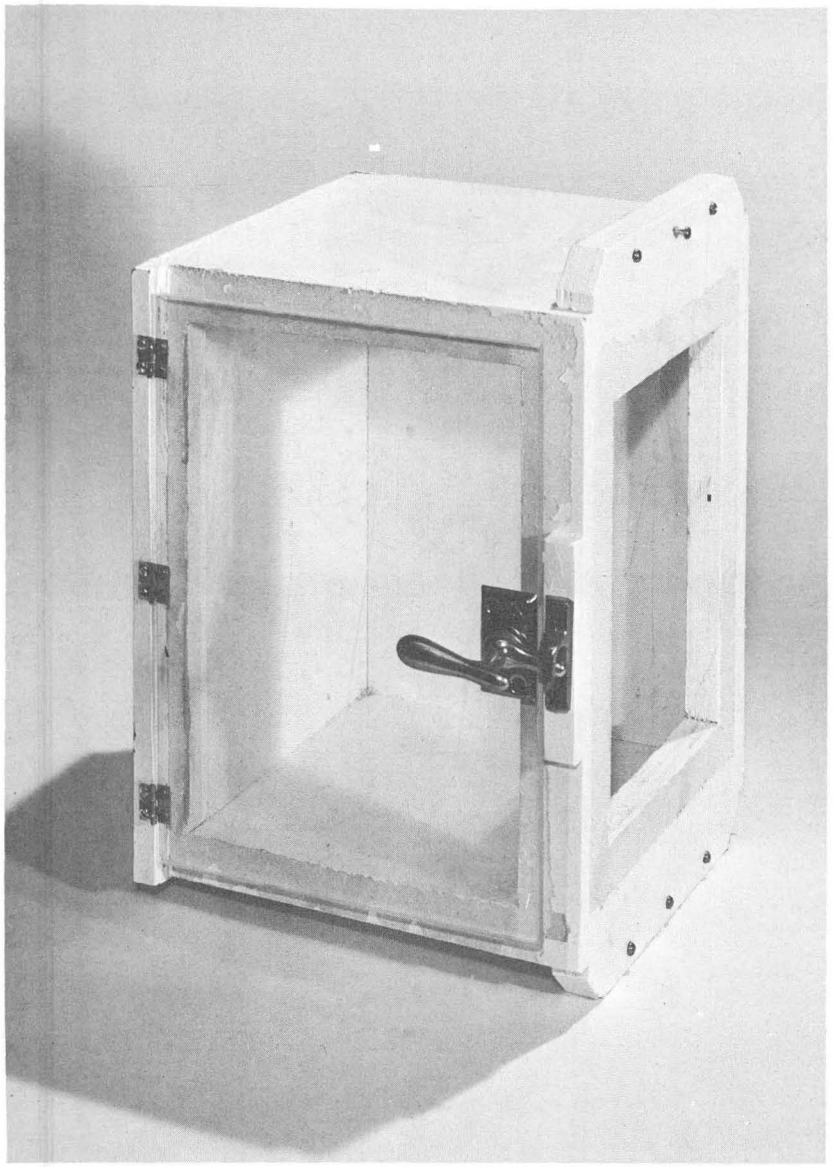


HP 1376

Item: Hinged clear-plastic door.

Use: Supplement to or substitute for the usual sliding door to prevent air leakage into gloved box.

Engineering drawing No.:
HCD 45363.

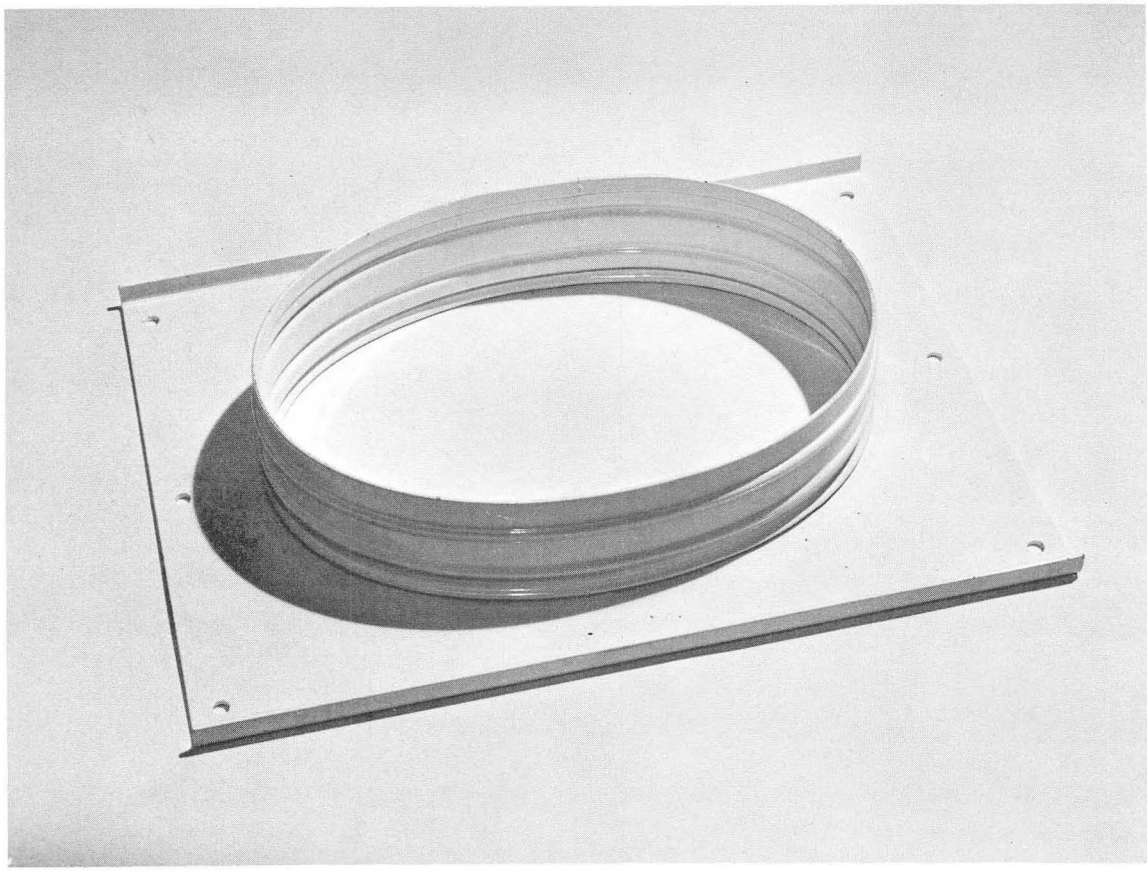


HP 1379

Item: End interchange box.

Use: Mostly for passing articles into contaminated gloved boxes. Serves as an additional safety measure and for temporary storage.

Engineering drawing No.:
10J 2204.



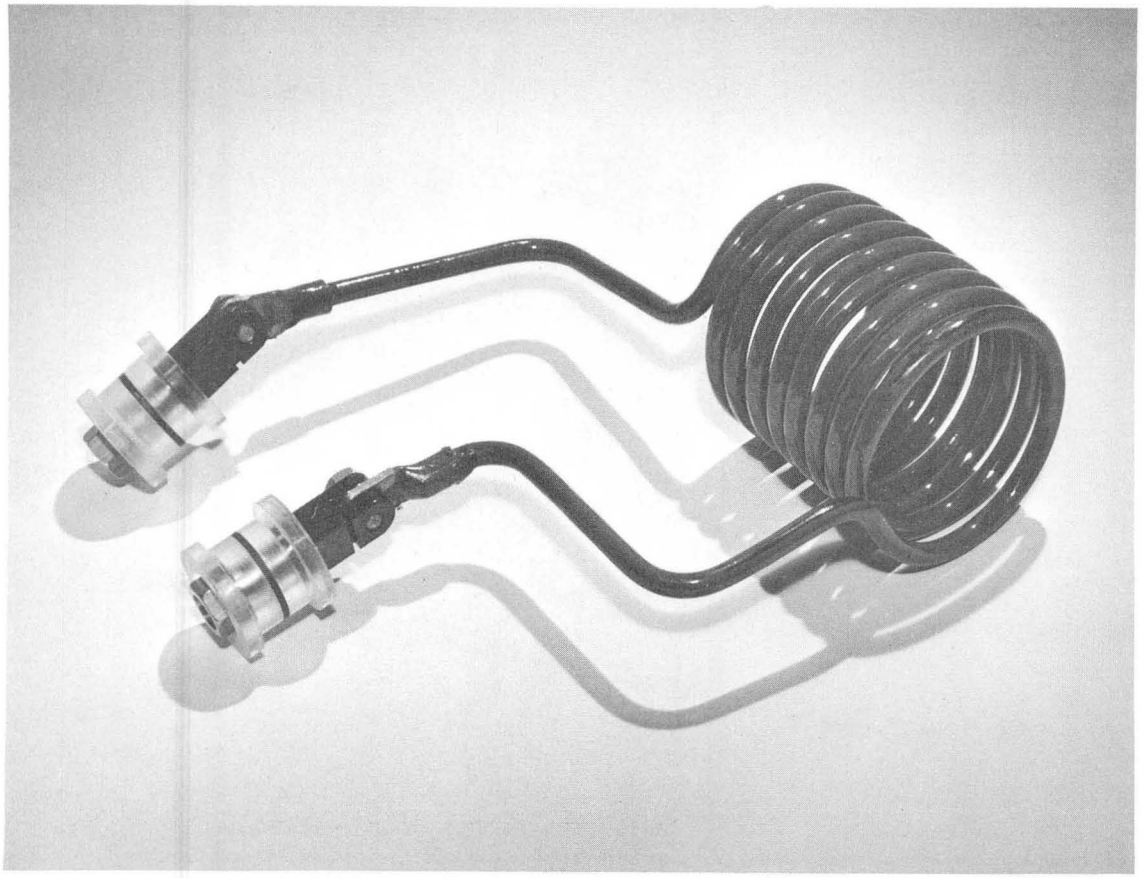
HP 1362

Item: Pass-out ring.

Description: Sealed-bag pass-out ring.

Use: Permits safe passing out from gloved boxes of alpha- or beta-contaminated articles. These articles are then sealed in plastic bags by means of a small heat sealer and disposed of.

Engineering drawing No.:
HCD 33014.

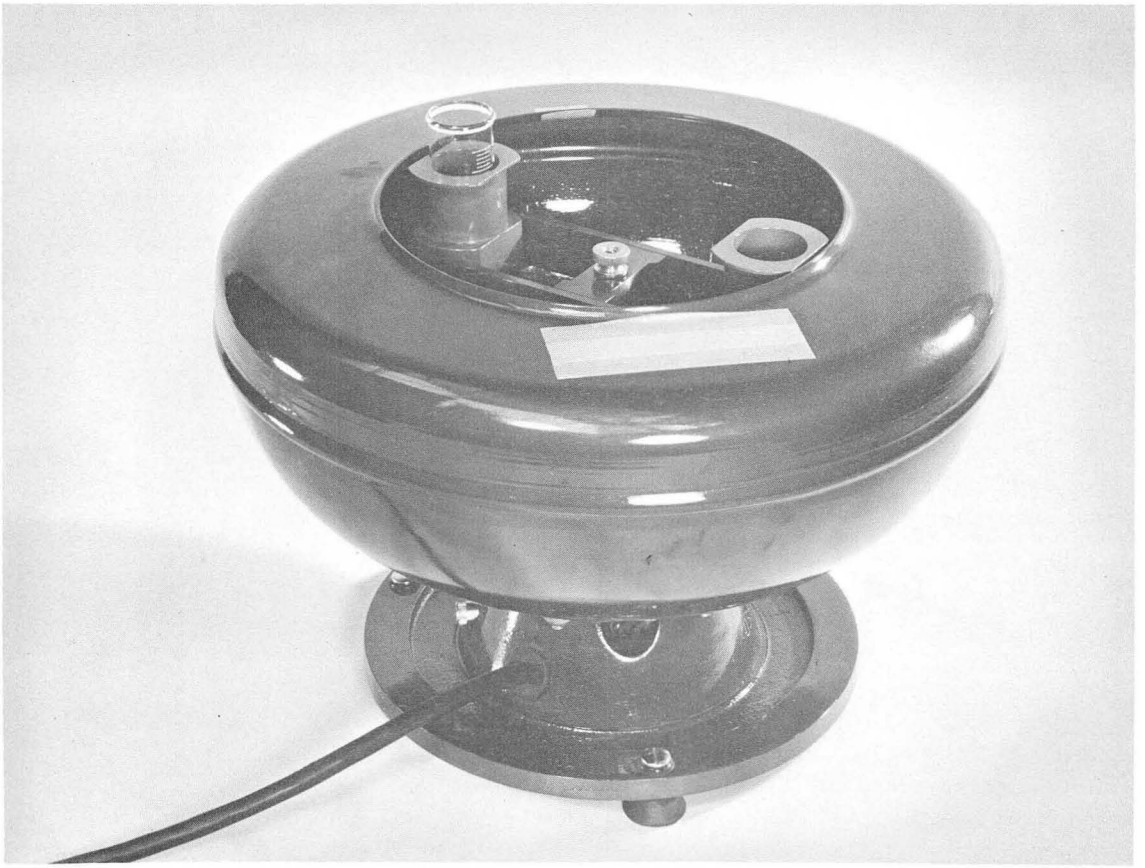


HP 1382

Item: Induction-heater coil (low set).

Uses: This coil is made to go in a Health Chemistry enclosure. It is used mostly for quickly heating counting discs. The coil connects with a power supply outside the enclosure.

Engineering drawing No.:
6J 7723.

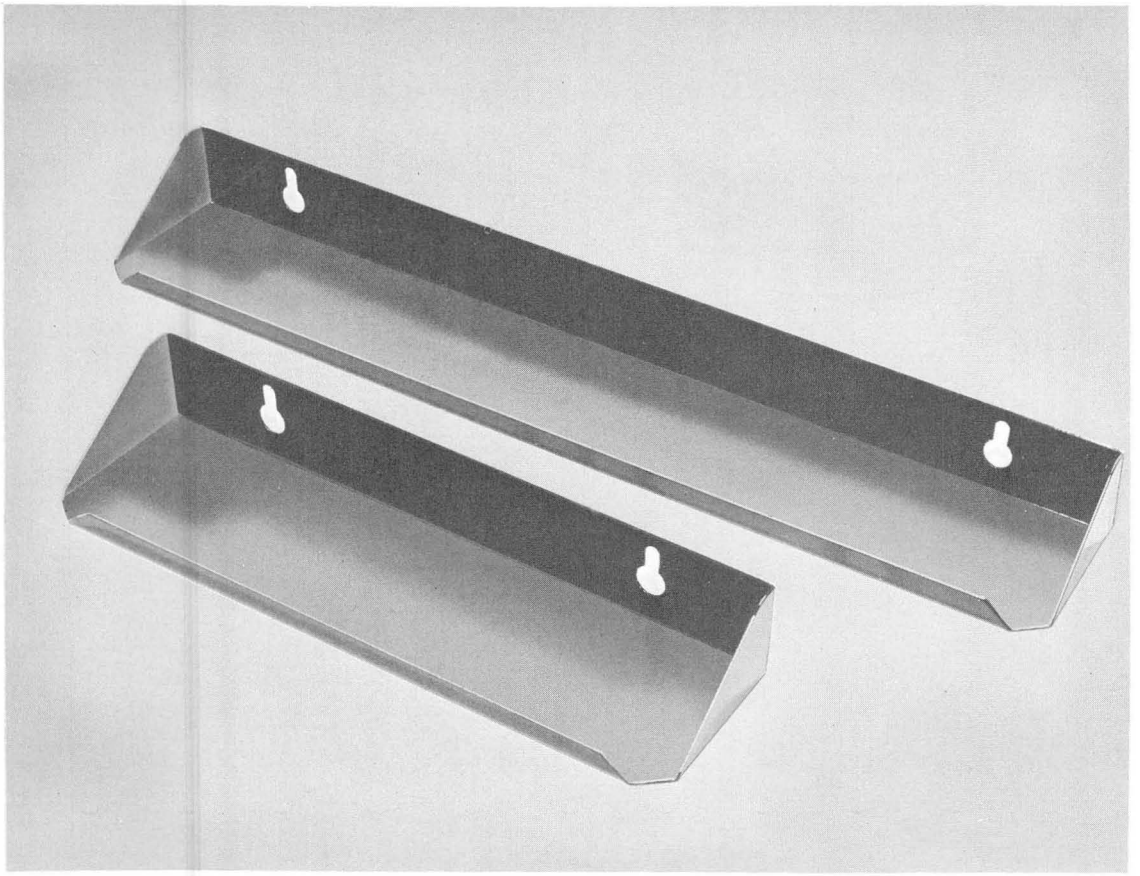


HP 333

Item: International clinical centrifuge.

Description: The centrifuge is normally located in a well on the tray of the gloved box. This model has been lowered to better fit the gloved box.

Uses: To separate precipitate from supernate.

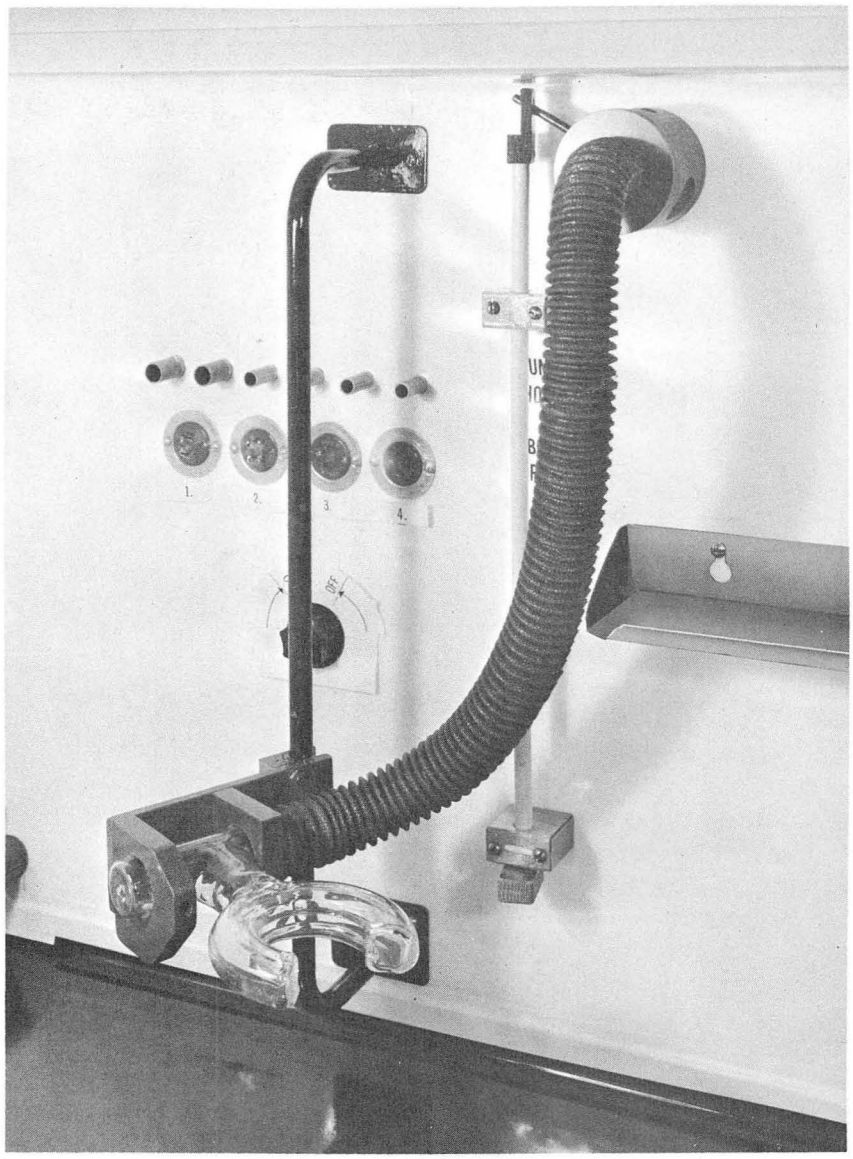


HP 1381

Item: Removable 11- and 18-in. shelves.

Use: To hold reagents and small items off the floor of an enclosure.

Engineering drawing No.:
2M 5972.



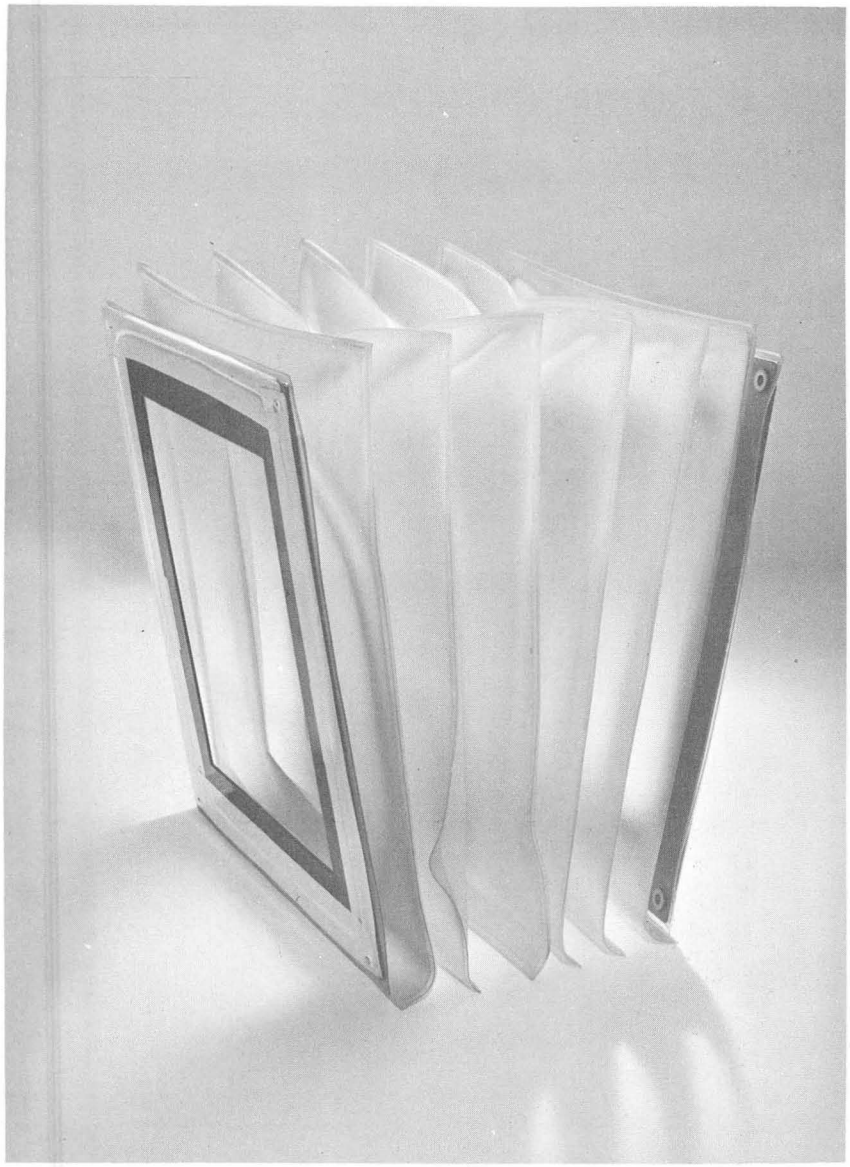
HP 964

Item: Fume hood (doughnut type).

Description: All-glass fume hood with adjustable-air-flow rotary valve. Other type hoods available.

Uses: To collect fumes from evaporation processes.

Engineering drawing No.:
HCD 30393.



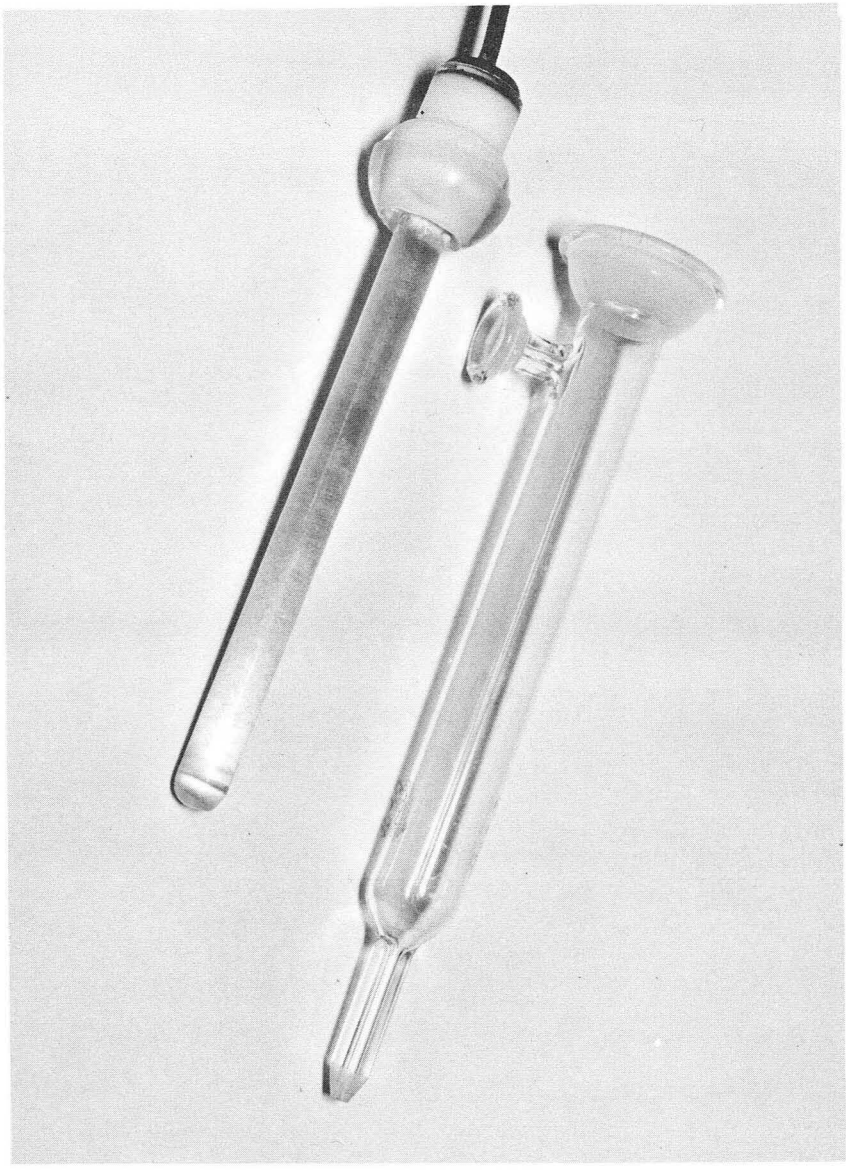
HP 1375

Item: Box-to-box sock.

Description: Accordian-pleated box-to-box connector.

Use: Permits two enclosures to be joined safely. Separation at a later date can be accomplished by welding off the connector.

Engineering drawing No.:
10J 5283.



HP 1387

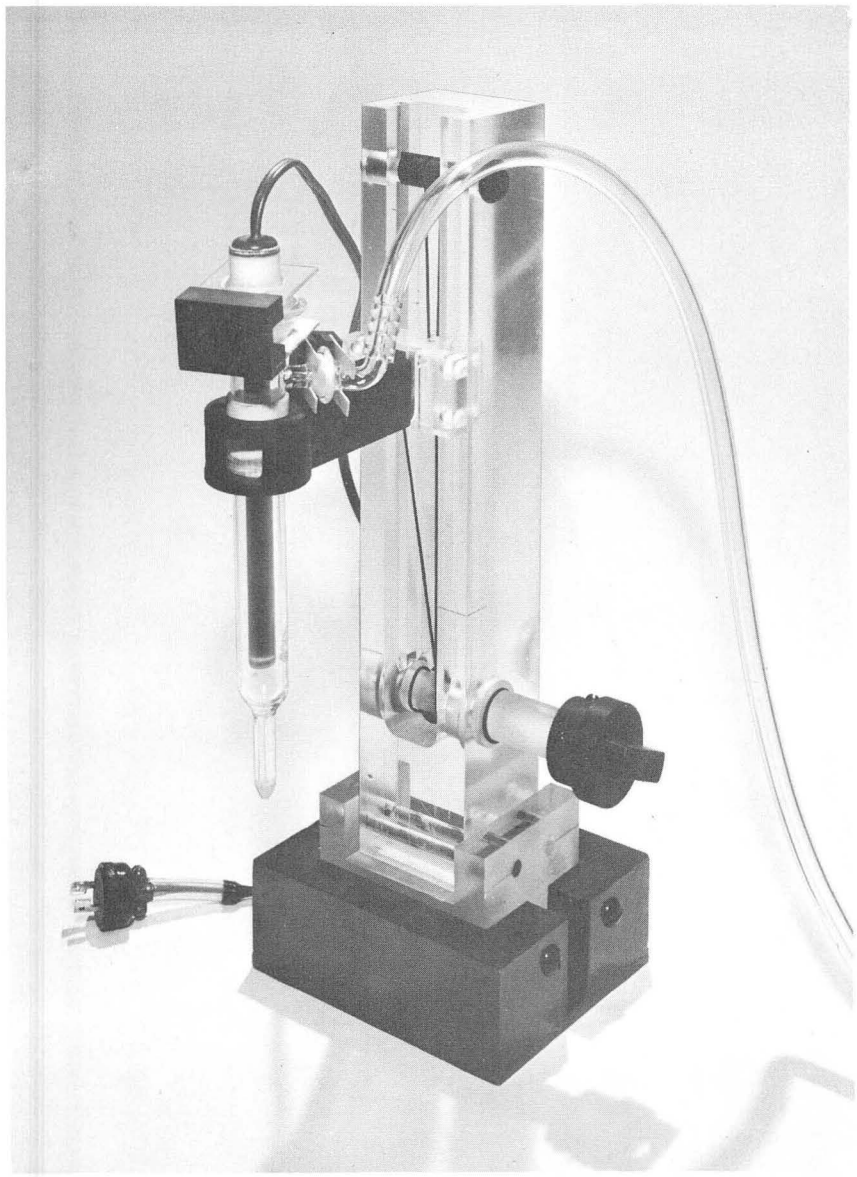
Item: Air heater.

Description: The Glo-quartz rod shown to the left fits inside the Pyrex tube. Air or gas passing through this assembly is heated on contact.

Use: As an aid in drying or concentrating solutions, particularly in centrifuge cones. Often used in conjunction with a hot bath.

Engineering drawing Nos.:

HCD 33662 - Air-heater assembly
HCD 33672 - Air-heater rod
HCD 15911
HCD 20641 } - Air-heater tubes.
HCD 20651



XBB 671-358

Item: Manipulator-operated air heater.

Description: The air heater is mounted on a remote manipulator stand. The heater is rigidly mounted and can be moved in a vertical direction by the manipulator. The complete stand is constructed of plastic for corrosion resistance.

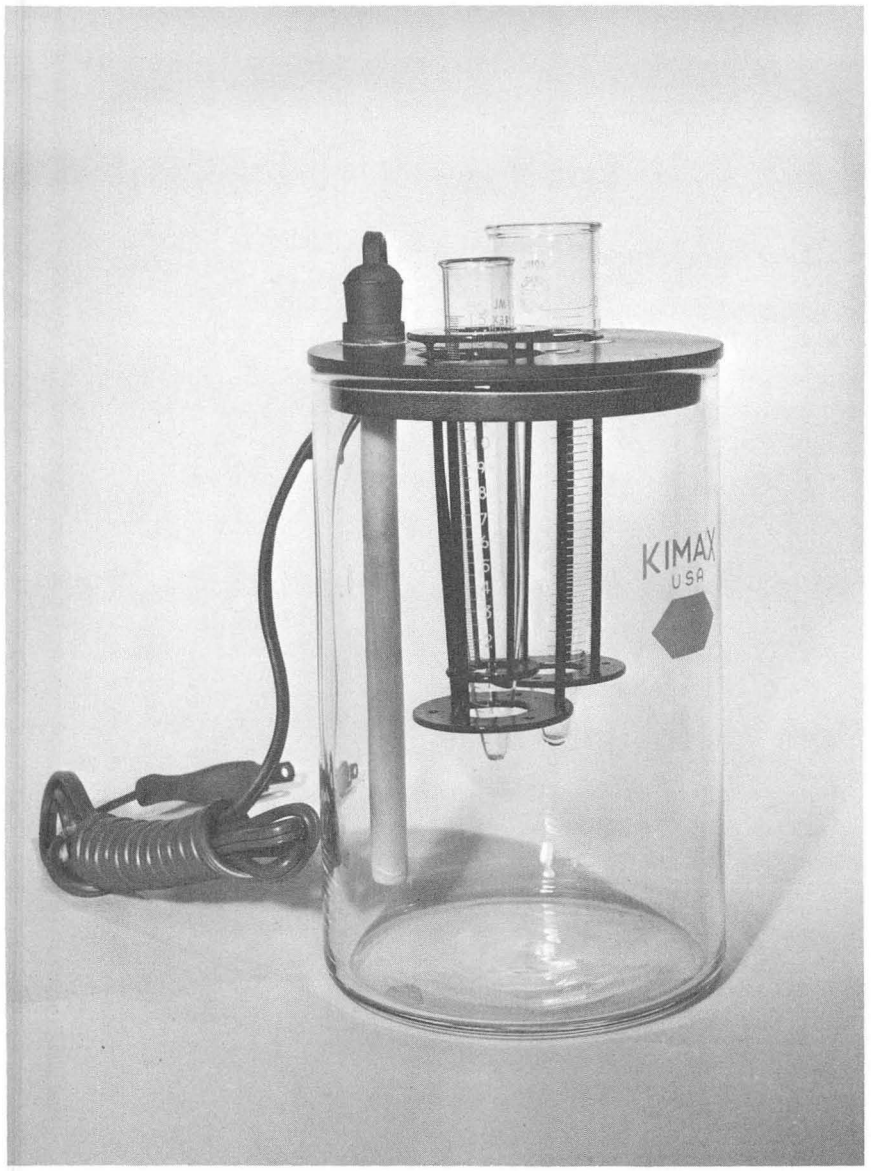
HP 1383

Item: Constant-temperature-cone hot bath.

Description: Small hot bath with heating element and thermostat.

Use: For maintaining constant water-bath temperatures for centrifuge cones and test tubes.

Engineering drawing No.:
4J 4813.



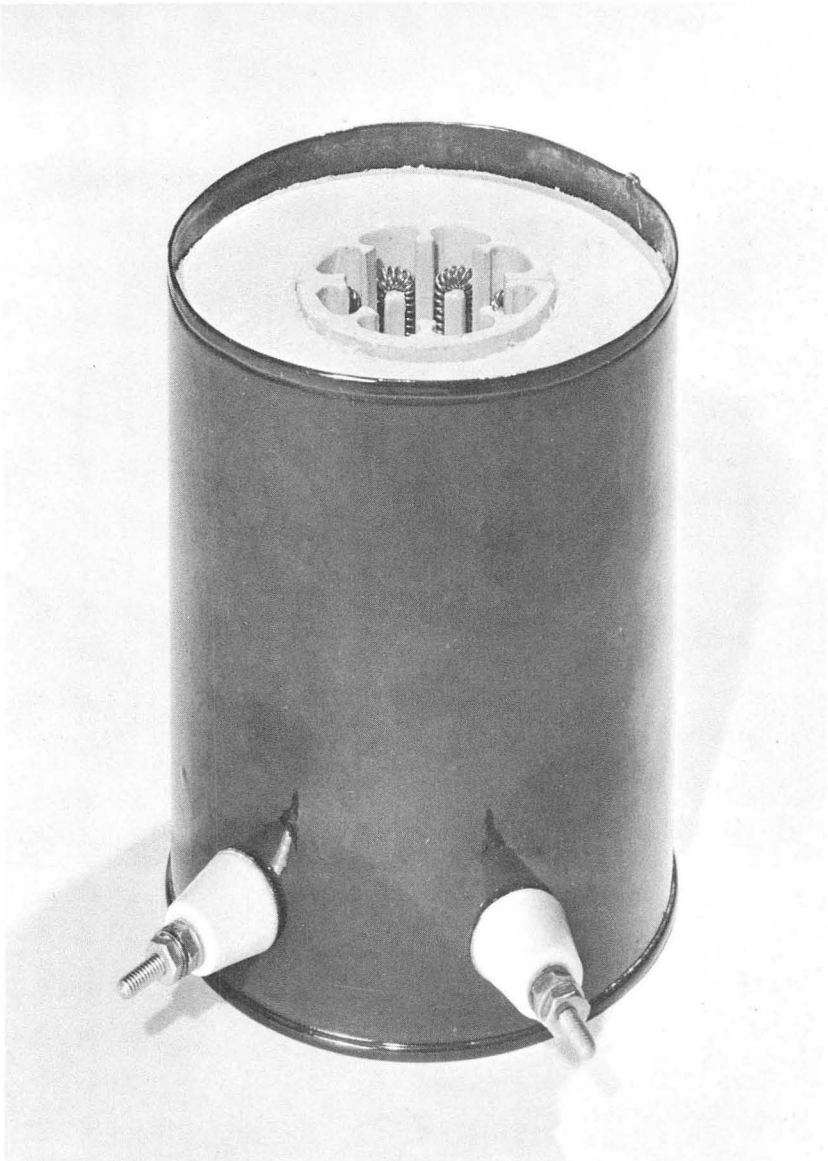
XBB 671-194

Item: Cone hot bath.

Description: Glo-quartz rod used to heat water in a Pyrex cylinder.

Use: Two 15- or 40-ml cones can be accommodated for evaporation of liquids.

Engineering drawing Nos.:
- HCD 31432 - Cone hot-bath top
- 10J 5261 - 1-ml cone adapter
- 10J 5271 - 3-ml cone adapter
- HCD 30482 - 5-ml cone adapter
- 6J 3791 - 15-ml cone adapter.



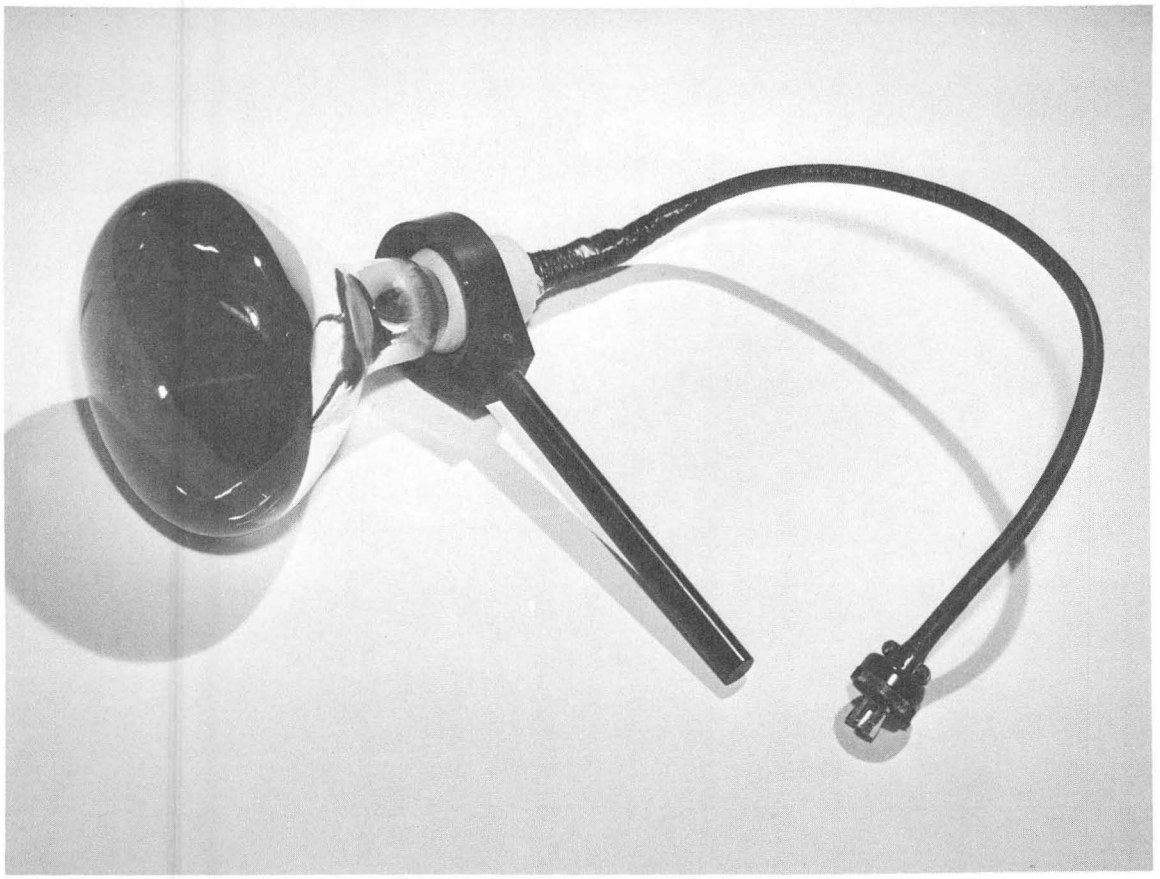
HP 775

Item: Can cone furnace.

Description: Hollow-core ceramic heating elements insulated in a sheet-metal can. Cavity dimensions: 1¼ in. i.d. by 4 in. long.

Uses: For heating centrifuge cones, tubes, or small crucibles.

Engineering drawing No.:
HCD 14622.



HP 1384

Item: Nonmetallic heat-lamp holder.

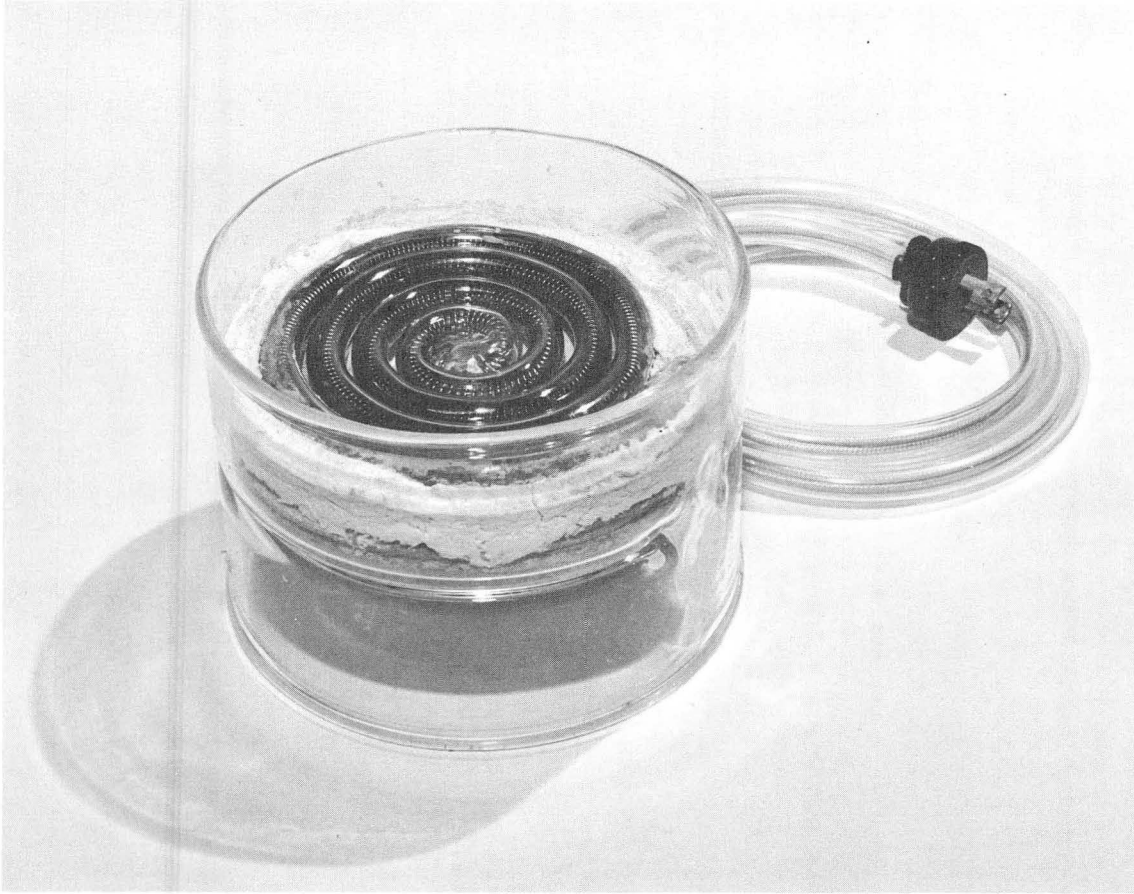
Description: Rubber-covered light socket fits into Bakelite holder.

Engineering drawing No.:
HCD 17671.

HP 1369

Item: Corrosion-resistant hot plate.

Description: Small hot plate with temperature controller. It is coated to resist corrosion.



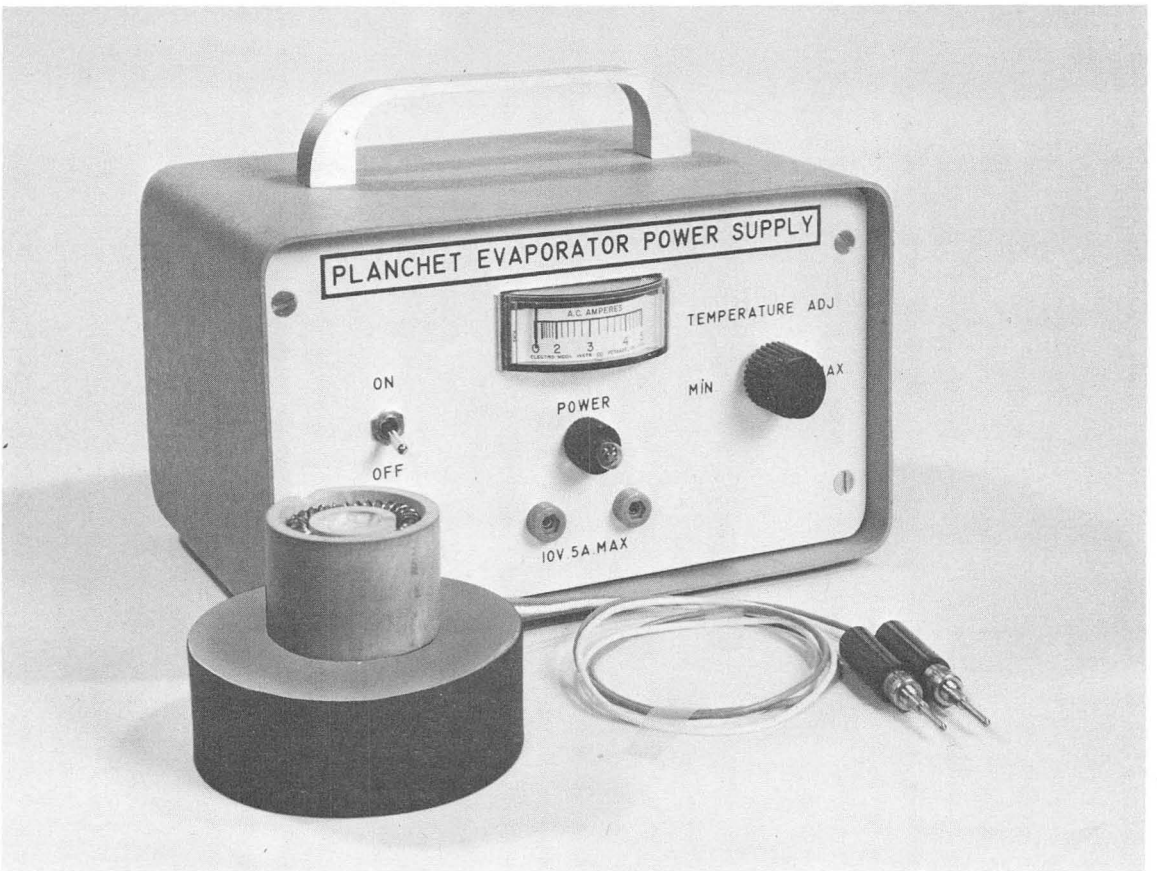
XBB 671-357

Item: Quartz-glass hot plate.

Description: Noncorroding hot plate. Resistance-wire coil enclosed in quartz-glass tubing. The heating element is bedded in asbestos.

Use: Heat source wherever metal corrosion is a serious problem.

Engineering drawing No.:
HCD 51903.

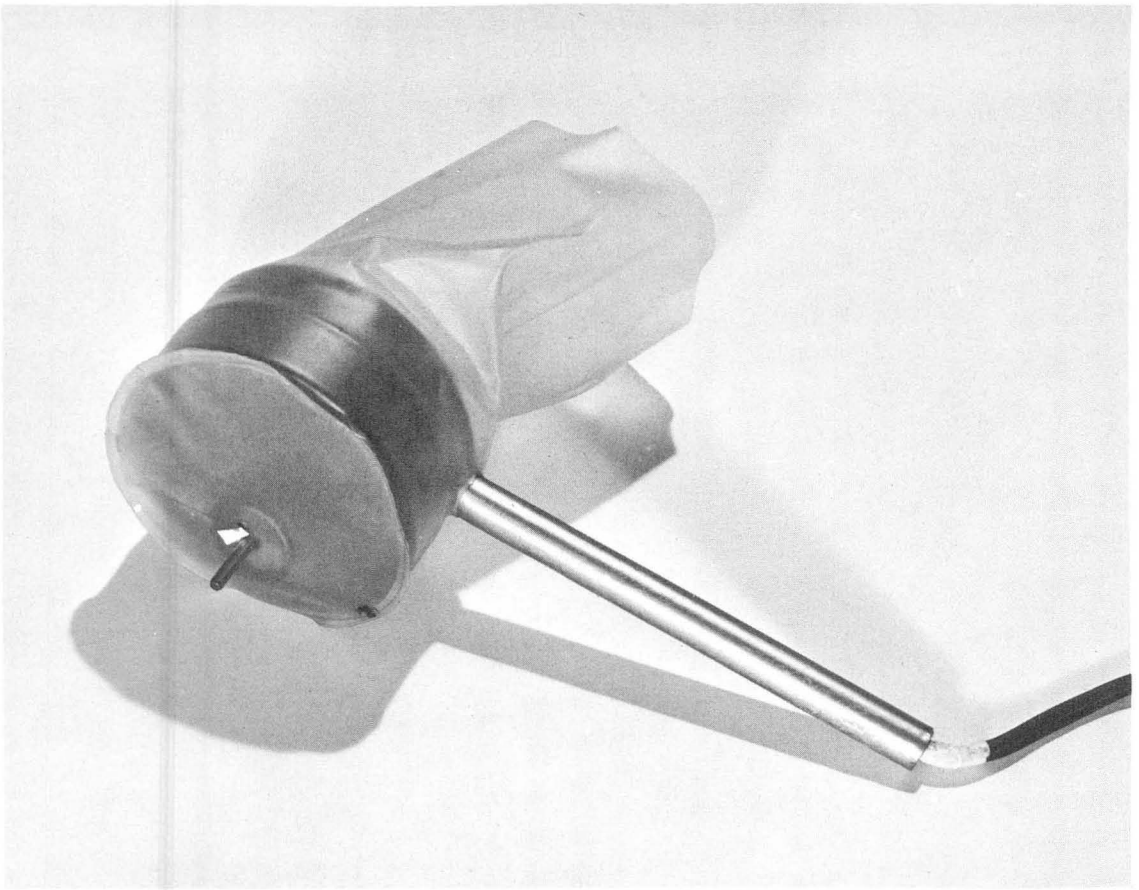


XBB 675-2959

Item: Solid-state, low-voltage planchet evaporator.

Description: Evaporation proceeds from the outside towards the center of the planchet. At a typical 2-A setting, it will evaporate about 50 λ/min of water. Stainless steel top (not shown) is easily removed to prevent cross-contamination. May be fitted with Pyrex or quartz watch glasses or practically any type of top material. Continuously adjustable from 0 to 50 W. Heater element can be unplugged and exchanged, even with tongs, in seconds.

Use: Primarily designed for controlled evaporation of 1-in. planchets.



HP 1380

Item: Model I, 110-V, Eastern stirrer.

Description: The stirrer is packaged in vinyl to resist corrosion.

Use: For stirring solutions in gloved boxes where corrosion is a problem.

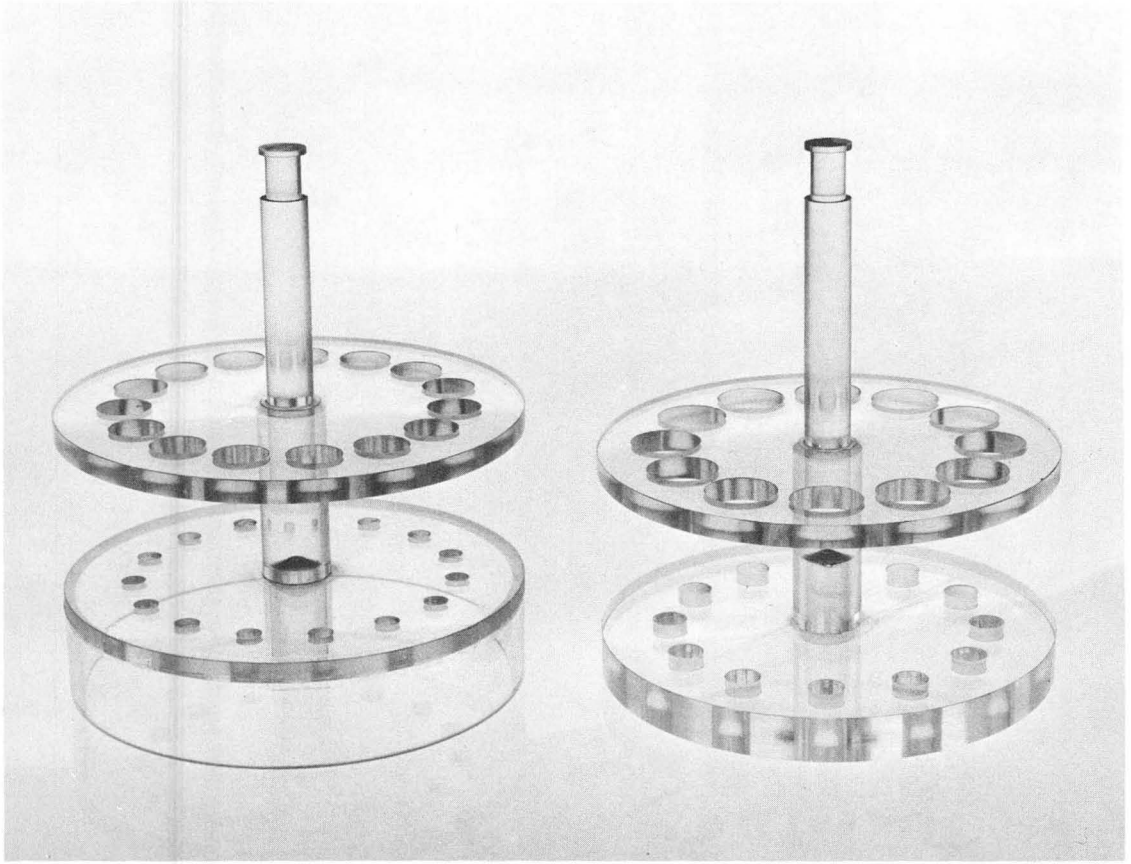
Engineering drawing No.:
HCD 13761.

HP 1367

Item: 12-V stirrer motor.

Description: The motor is covered with vinyl to resist corrosion.

Use: For stirring solutions in manipulator boxes where premium of space and corrosion-resistance are necessary.



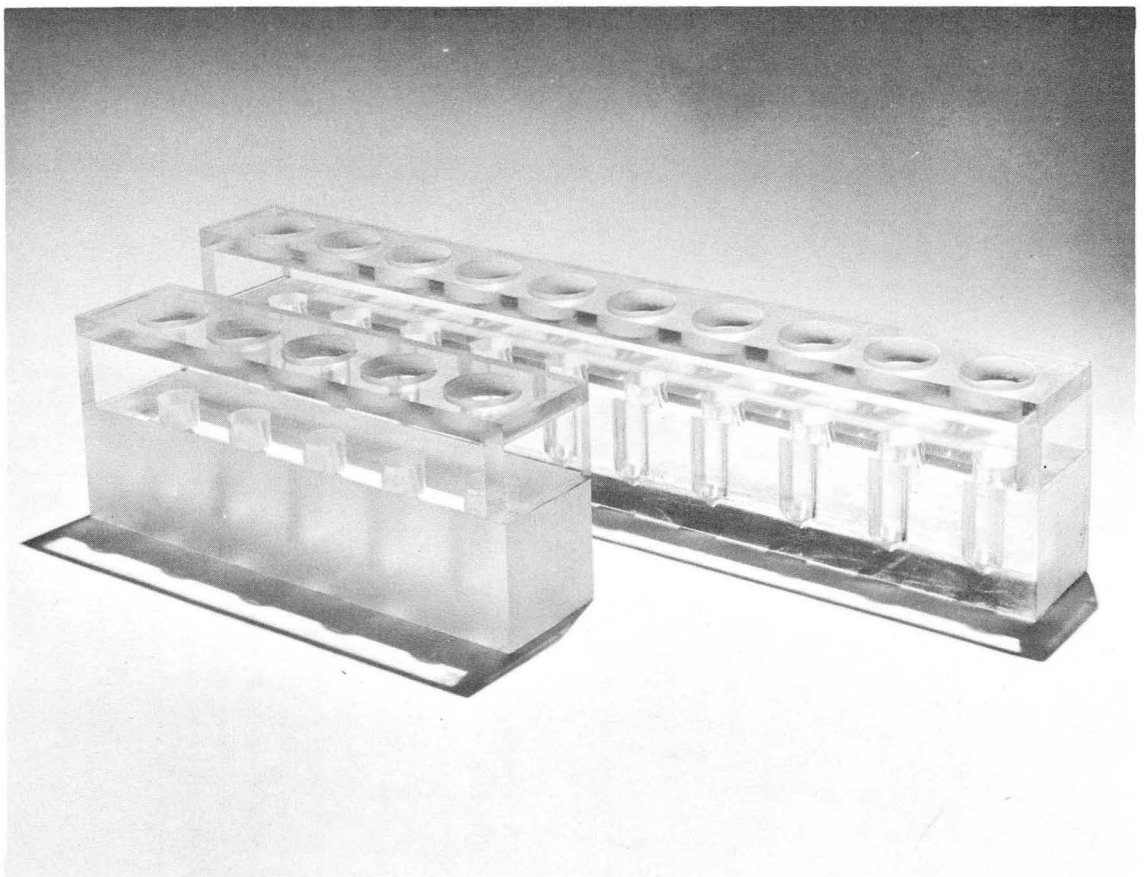
HP 1363

Item: 15-ml and 40-ml cone holder.

Description: Rotating cone holder. Circular acrylic resin racks in various sizes to fit 15- to 50-ml cones.

Use: To hold centrifuge cones in a vertical position and permit maximum visibility.

Engineering drawing No.:
HCD 20903.

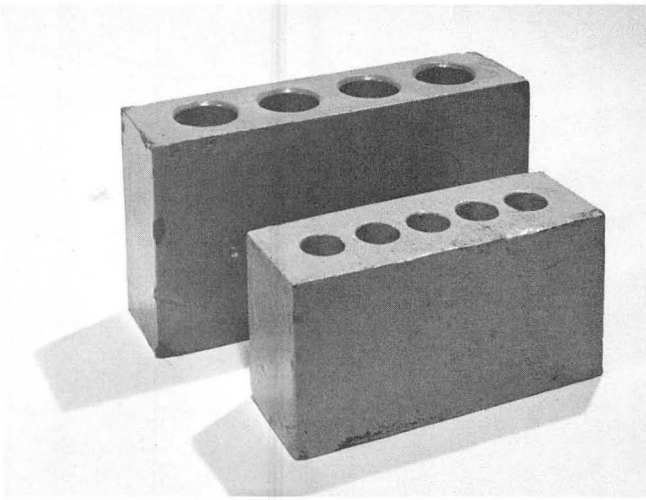


XBB 671-427

Item: Cone holders.

Description: 5- or 10-hole 40-ml centrifuge cone holder, useful for beta shielding if solution is located at bottom of cone.

Engineering drawing No.:
HCD 33932.



HP 1372

Item: Lead-shielded cone holders.

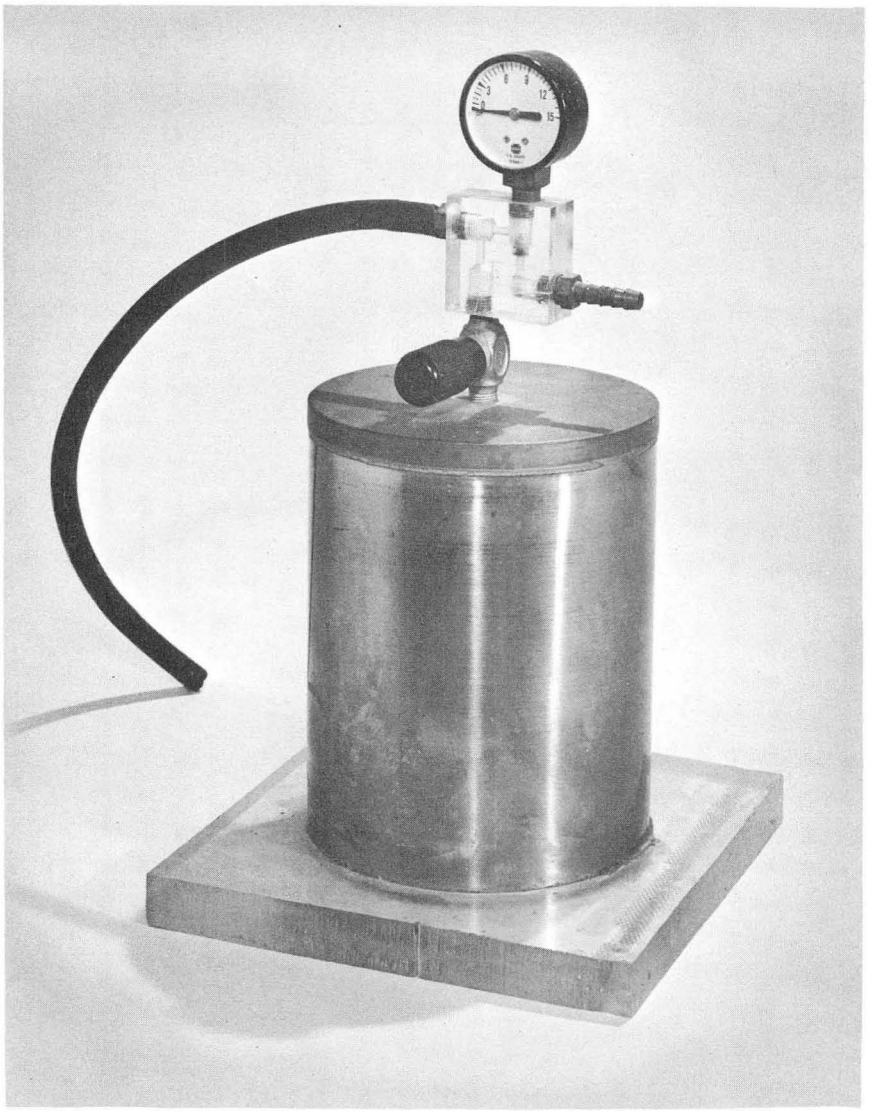
Use: Shielded storage for centrifuge cones or test tubes.

Engineering drawing Nos.:
HCD 28-2861 or 28-2871.

HP 1389

Item: Circular lead-shielded cone holder.

Use: Shielded storage for centrifuge cones or test tubes.

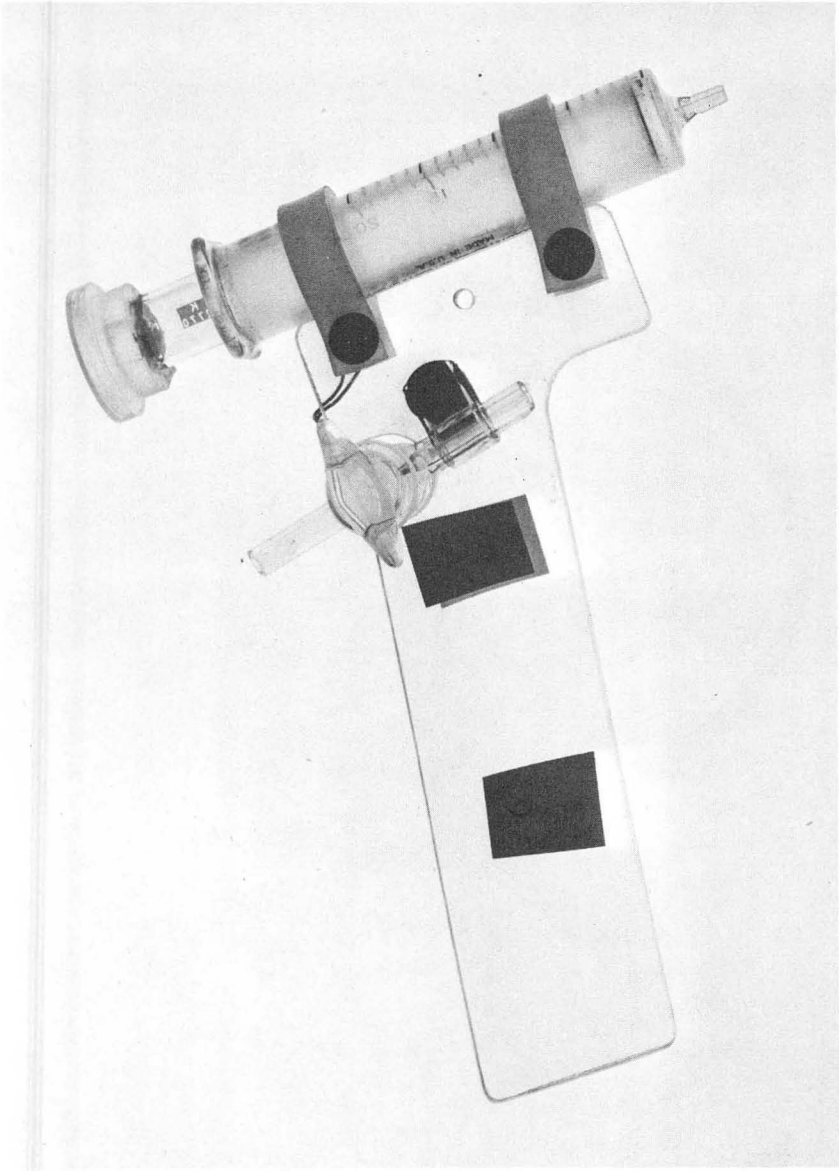


HP 1374

Item: Low-air-pressure pot.

Description: Air pressure is developed in the pot by means of a small hand pump. This air pressure can be applied to resin columns through a valve system.

Use: Portable source of low-pressure air.



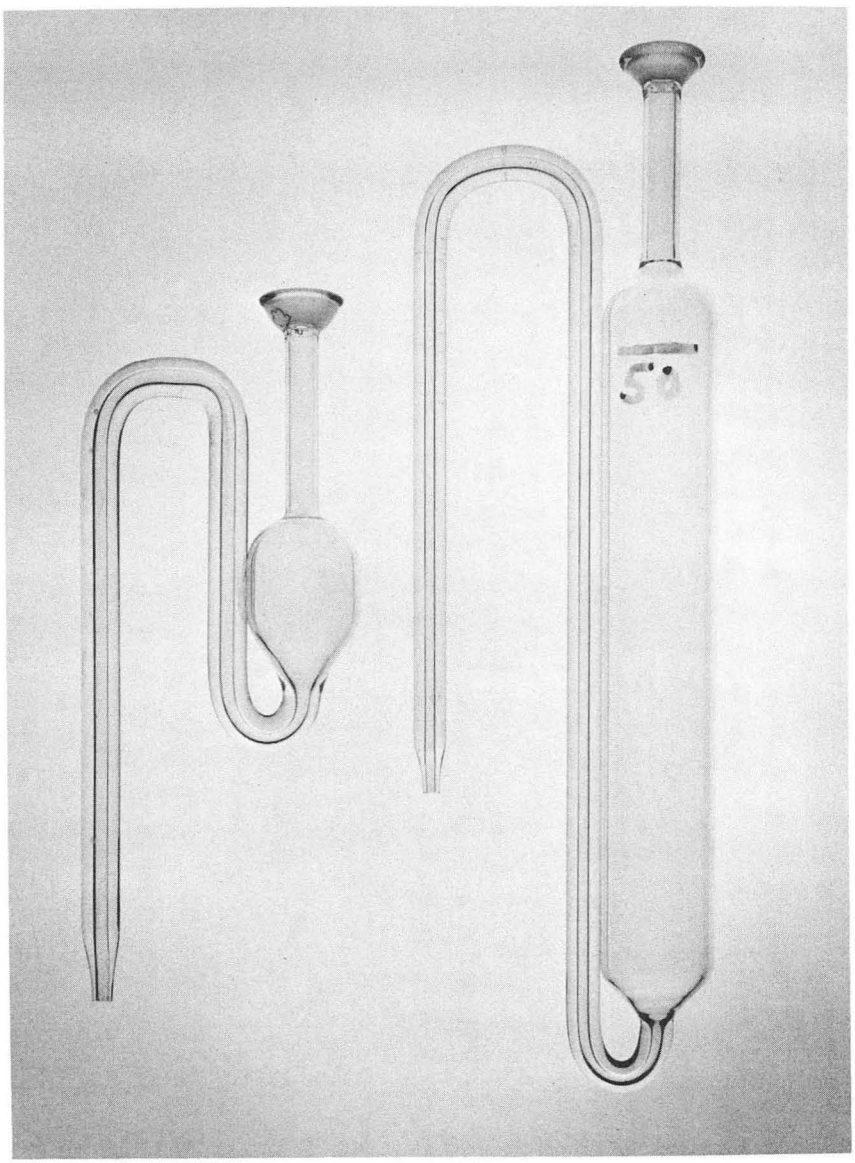
HP 1364

Item: Syringe holder.

Description: Acrylic mount for syringe and two-way stopcock.

Use: Provides handy means of holding syringe and stopcock for use with gooseneck and other pipettes.

Engineering drawing No.:
HC 14842.



HP 1361

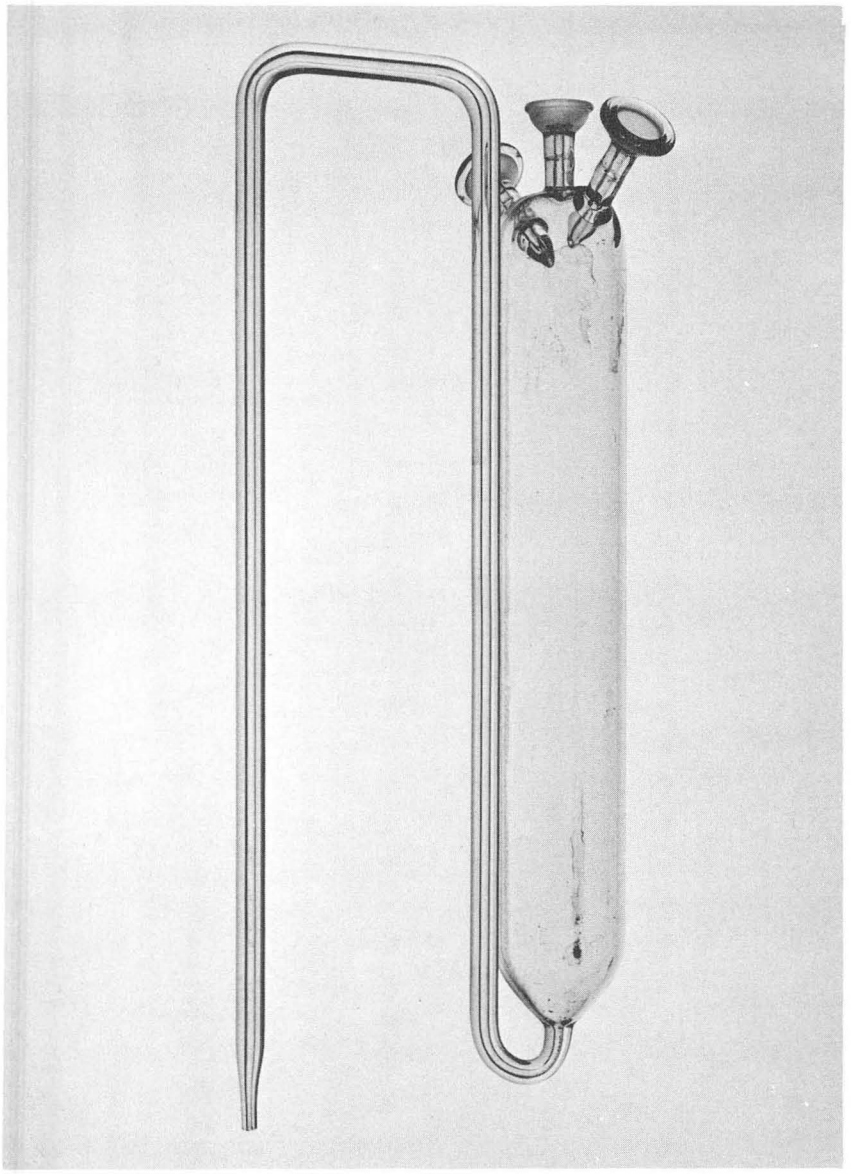
Item: Gooseneck pipette.

Description: Various sizes of Pyrex pipettes made with various sizes of tubing.

Uses: Provides a means of storing, transferring, or mixing liquids by using vacuum or air pressure as a transfer medium.

Engineering drawing Nos.:

HCD 22942
HCD 28762
7J 7092.

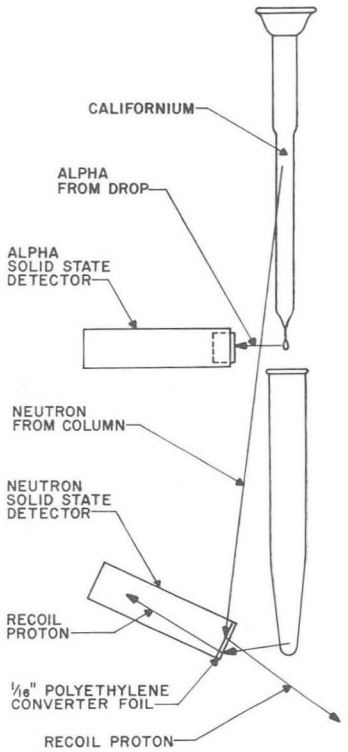


HP 1365

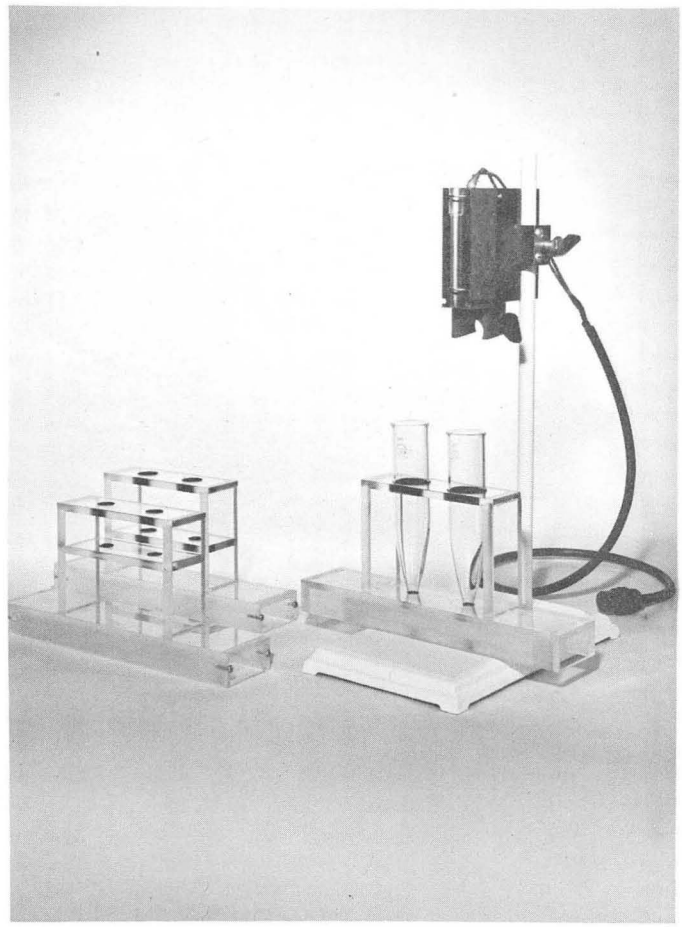
Item: Mixing-type gooseneck pipette with multiple inlet nipples.

Uses: For mixing, washing, separating, and storing liquids.

Engineering drawing No.:
HCD 33943 .



MU-33470



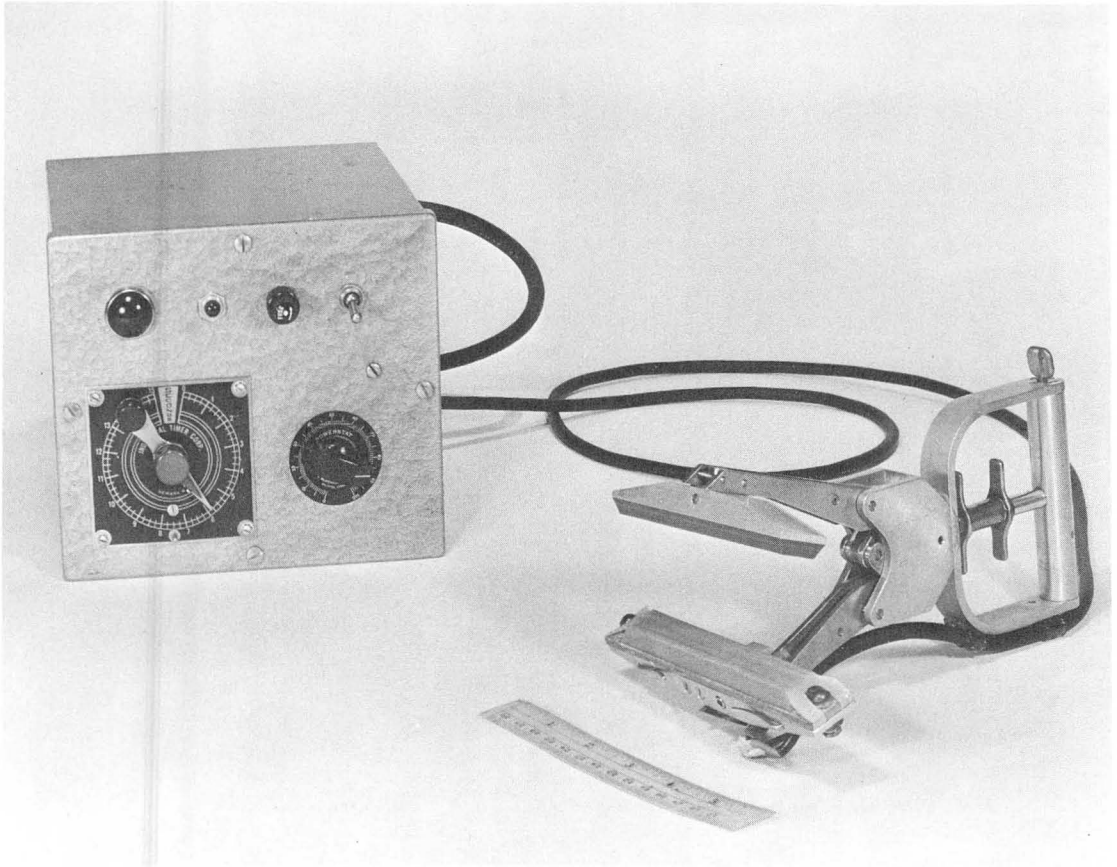
XBB 671-195

Item: ^{252}Cf drop counter.

Description: A solid-state alpha-detection system capable of counting the surface activity of drops coming from separation or cleanup columns, plus a directional fast-neutron detector.

Uses: Intended for heavy-element chemistry and chemistry of ^{252}Cf. The counting rate of the alpha detector indicates the different elution peaks. The neutron detector can be used for "in box" neutron monitoring or examining the column for the position of the ^{252}Cf band.

Engineering drawing No.:
HCD 40423.



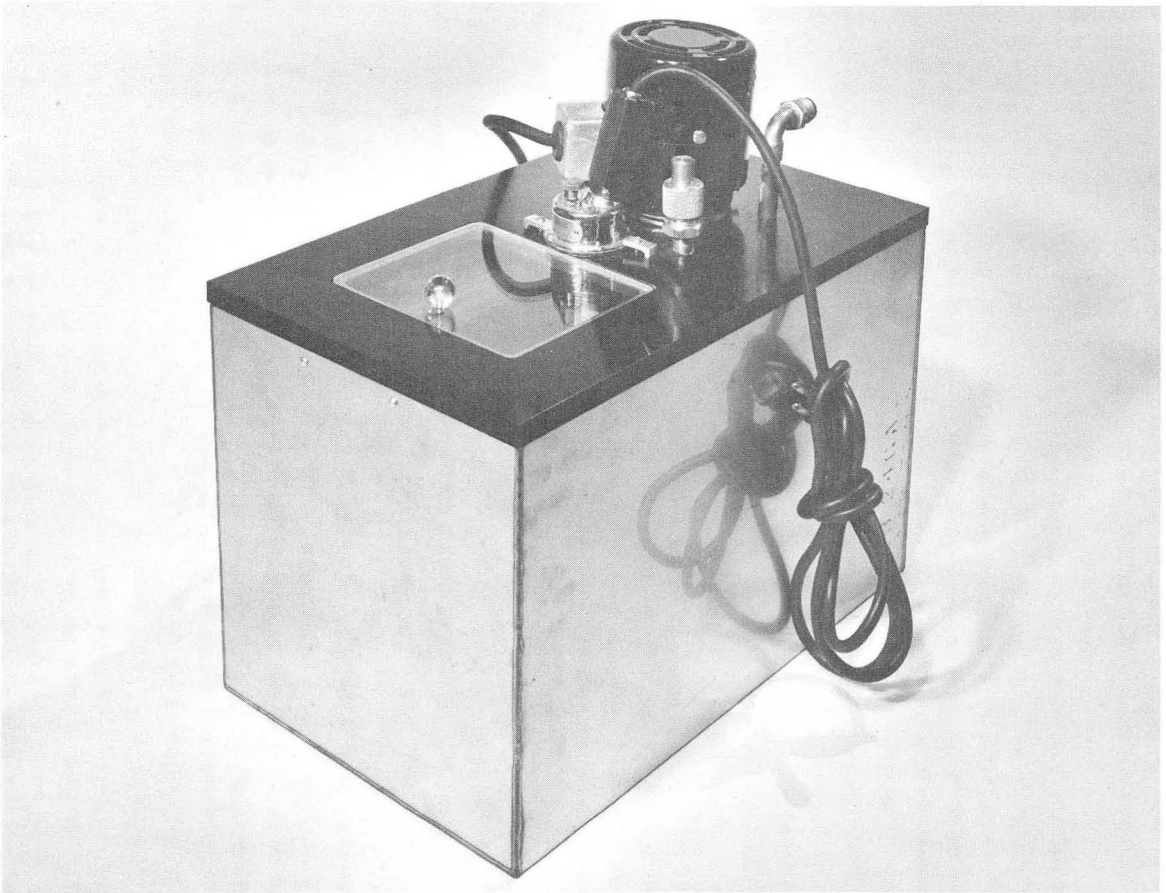
HP 706

Item: Universal heat welder.

Description: Hand-operated heat sealer with power source.

Use: Heat seal polyethylene bags. Bags may contain radioactive waste, sources, or material for storage.

Engineering drawing No.:
9J 7024.



XBB 672-853

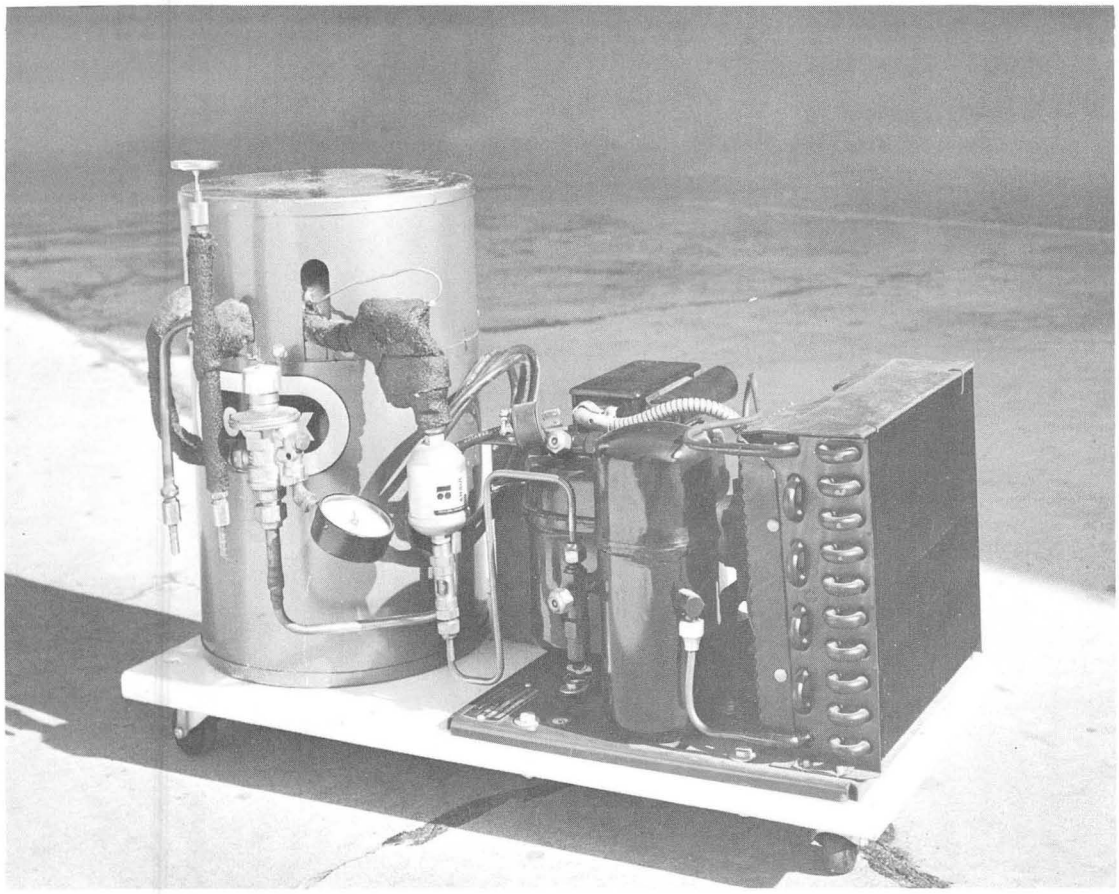
Item: Recirculating hot or cold water bath.

Description: Resistance heater coil with thermostatic control can maintain preset hot water temperature. For cold water, the heating element is removed and a portable refrigerator is connected. A water pump is used to recycle water through the experimental apparatus.

Dimensions: 10 in. wide by 16 in. deep by 15 in. high overall.

Use: To supply hot or cold water to experimental apparatus.

Engineering drawing No.:
HCD 52304.

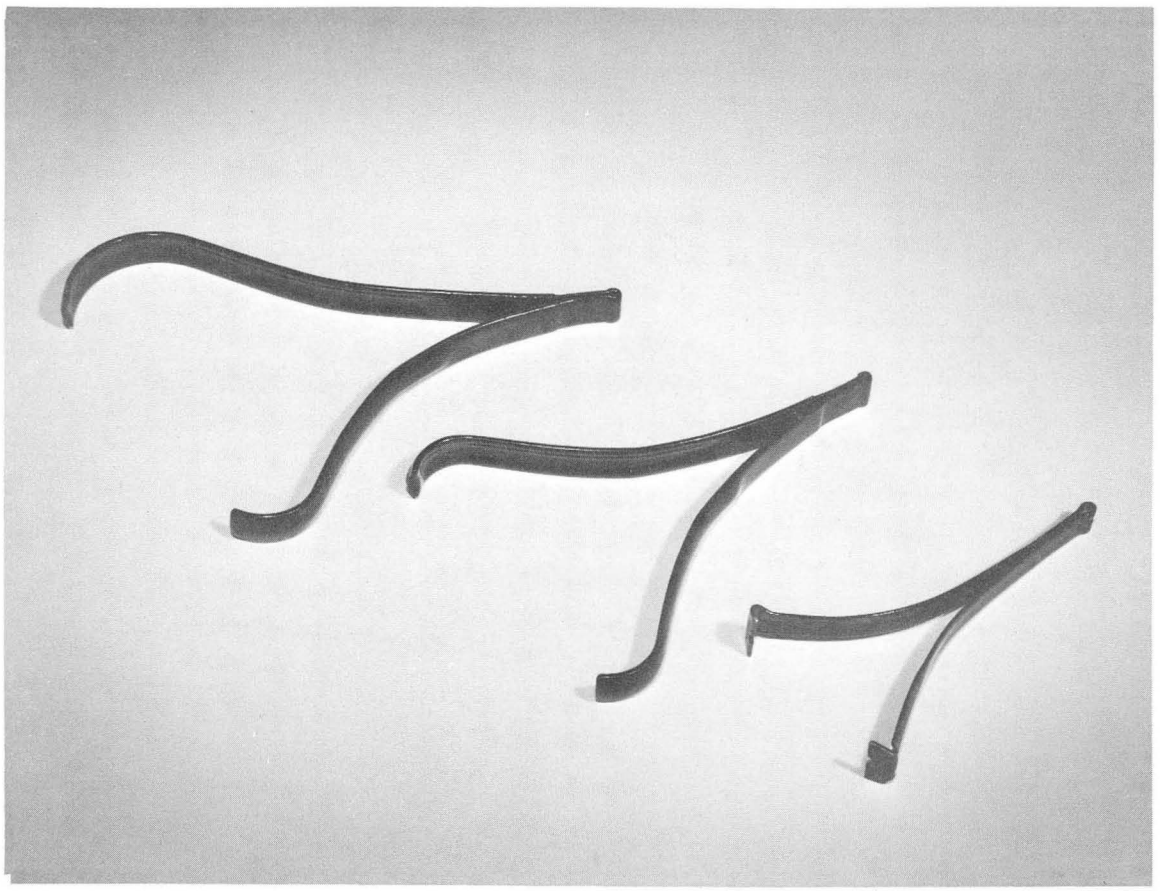


XBB 672-910

Item: Portable refrigeration unit.

Description: Dolly-mounted compressor and heat exchanger. Can supply about 2 to 4° C cold water.

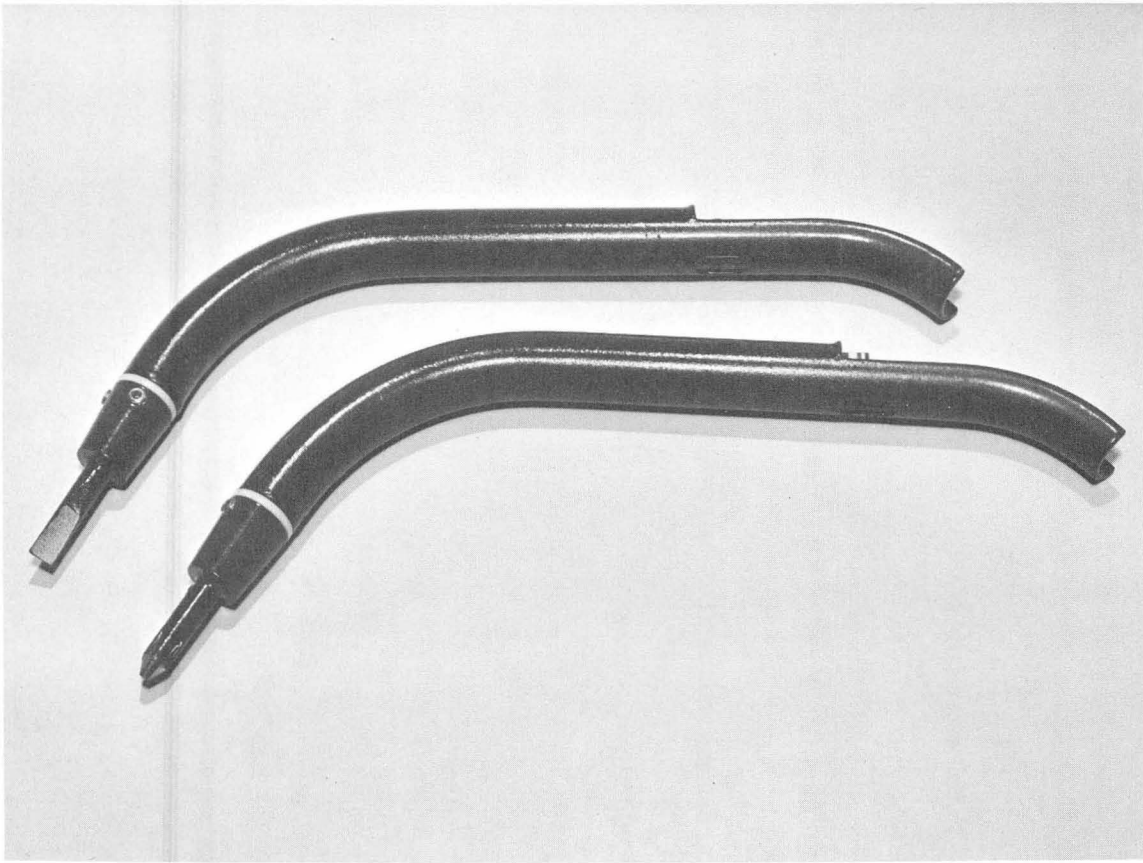
Uses: For experimental equipment where a closed-cycle heat exchanger is required. Used with recirculating cold-water bath.



HP 1366

Item: Manipulator tong fingers. Top: overlapping BeCu fingers; middle: equal-length BeCu fingers; bottom: aircraft fingers.

Engineering drawing Nos.:
7J 5051 - BeCu fingers (overlapping).
HCST 2001 - BeCu fingers (equal).



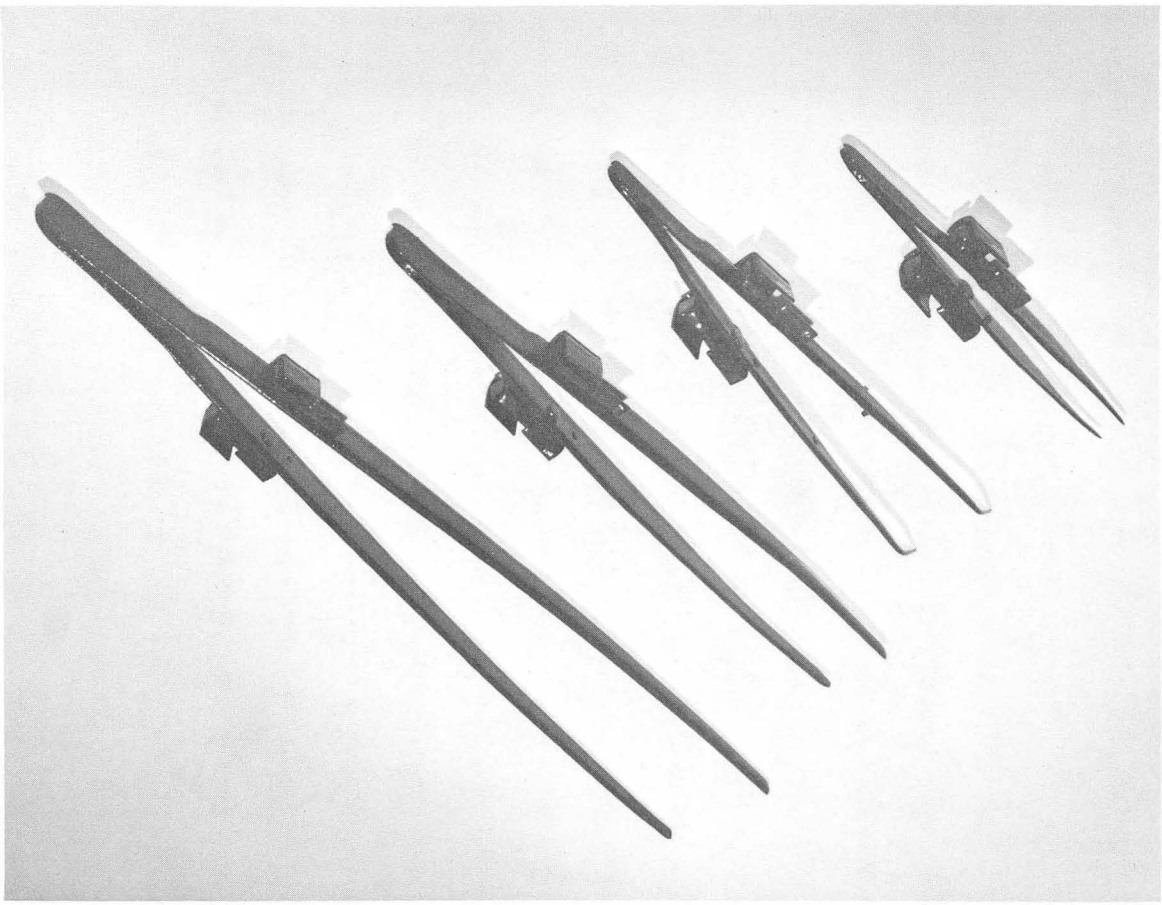
HP 1377

Item: Vertical screwdriver.

Description: 45-deg screwdriver extension.

Use: Can be attached remotely to tong manipulators for turning screws through a shield.

Engineering drawing No:
HCD 6422.

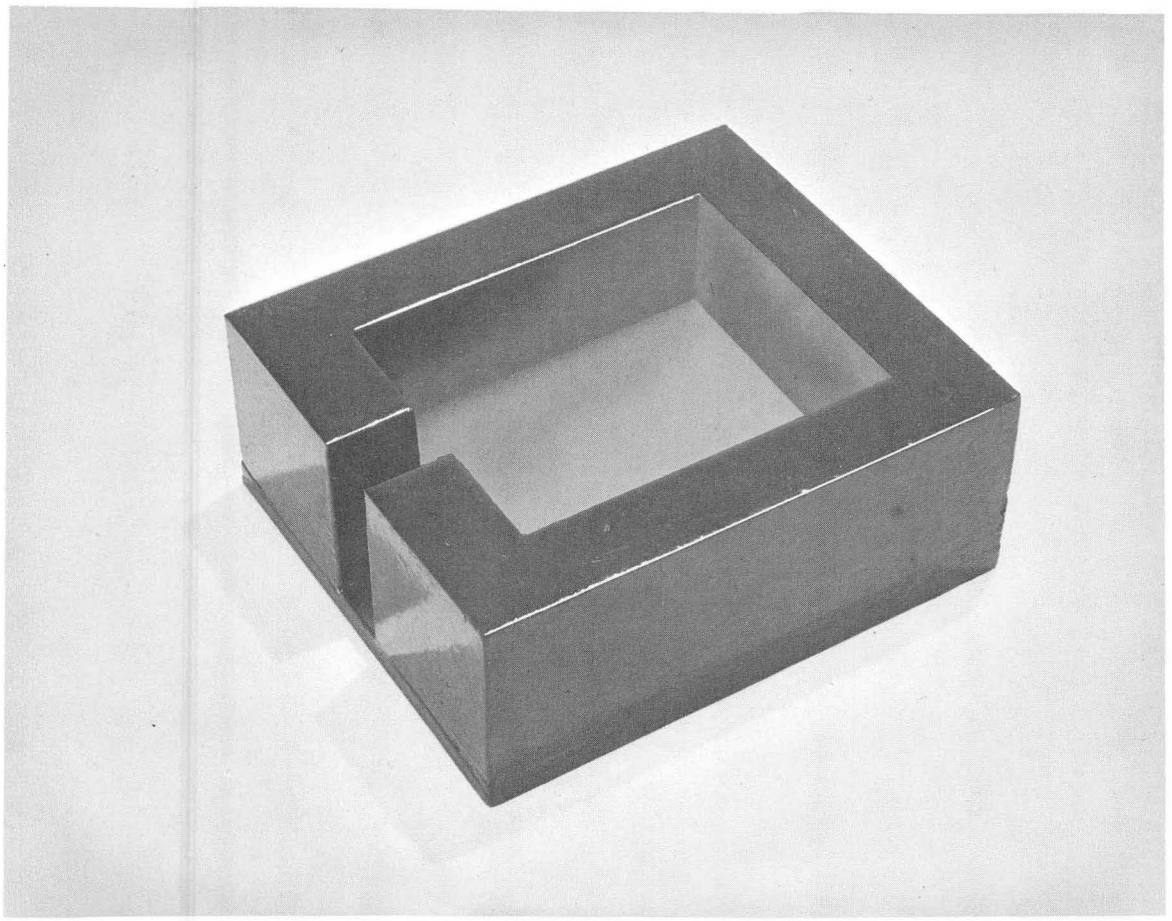


XBB 671-429

Item: Tweezers.

Description: Various size tweezers adapted for tong use and coated for corrosion resistance.

Engineering drawing Nos.:
- 9J 3042 Tong small tweezers.
- 9J 3651 8-in. and 12-in. modified forceps.
- 9J 6412 6-in. tweezer.



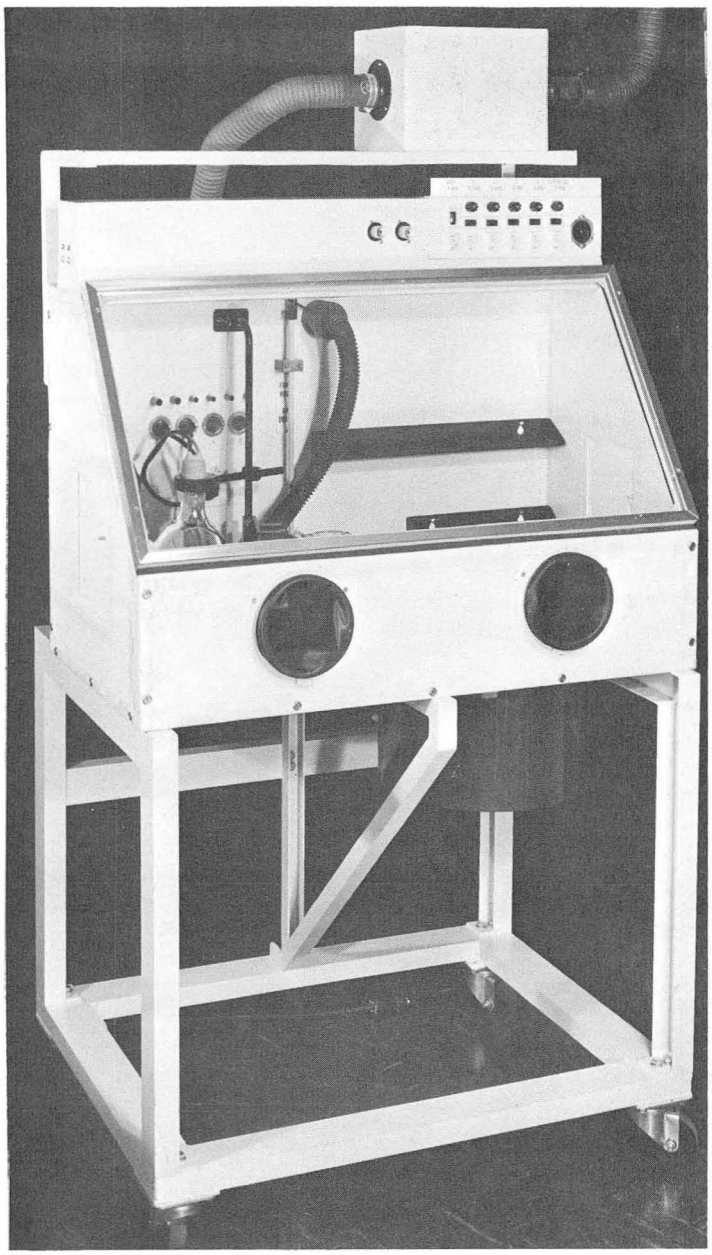
HP 1371

Item: 88-In.-Cyclotron target-foil frame holder.

Use: Permits opening of targets in gloved boxes with manipulator screw driver.

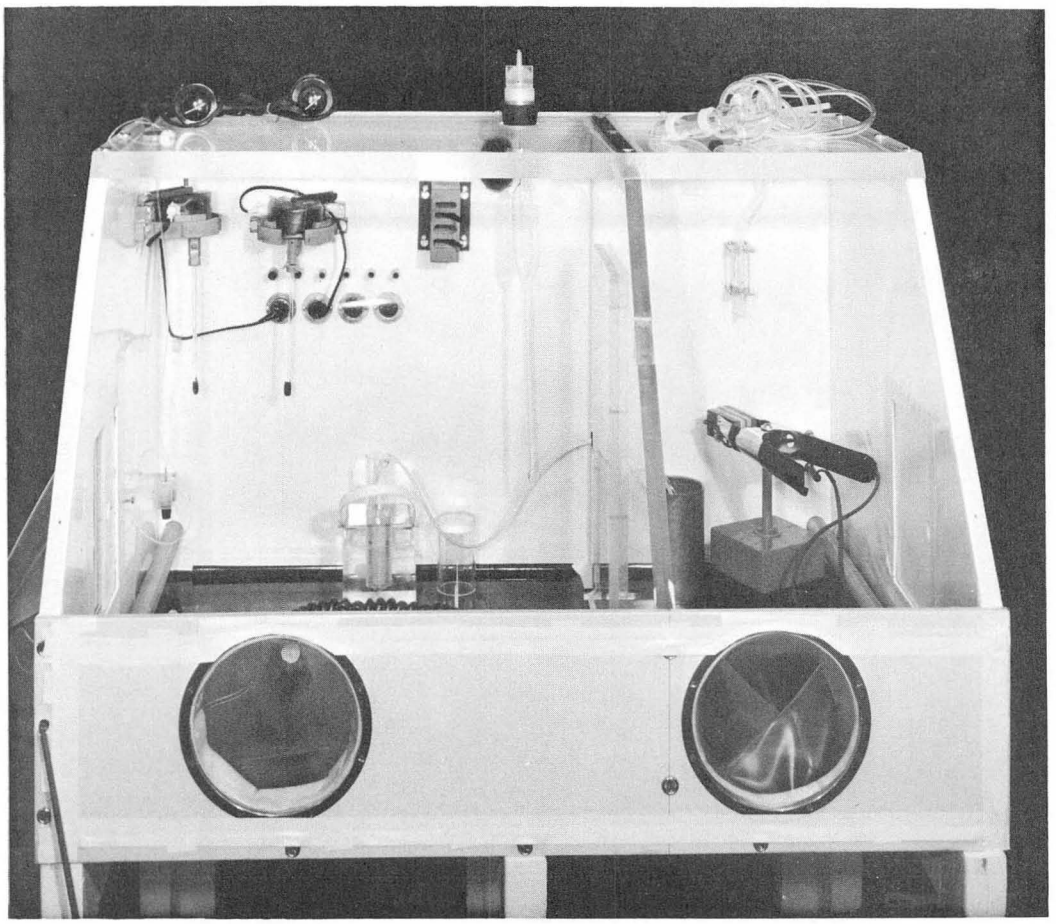
Engineering drawing No.:
HCST 8542.

IIC. Fitted Enclosures



HP 963

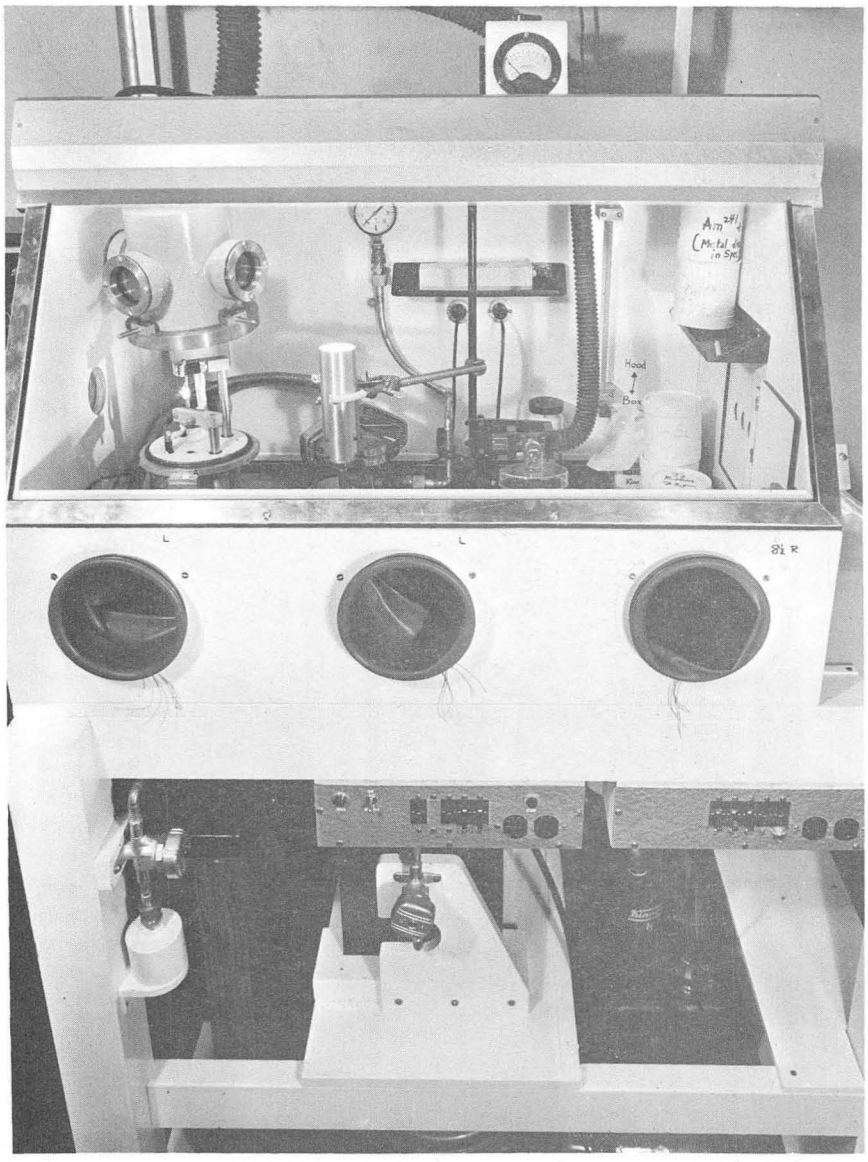
Item: Standard gloved box.



HP 938

Item: Two compartmented gloved-box.

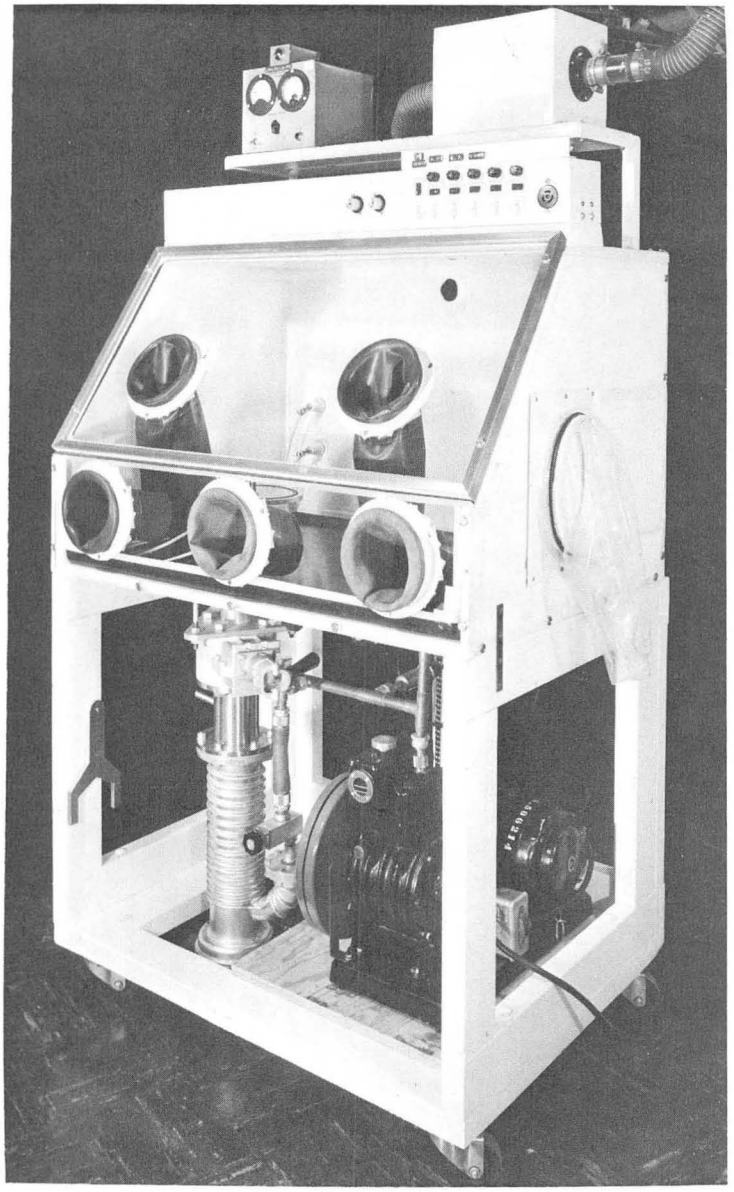
Use: Final assay box for ^{90}Sr-^{90}Y separation.



HP 616

Item: Three gloved-port standard box. The outside is covered and the inside lined with white Formica.

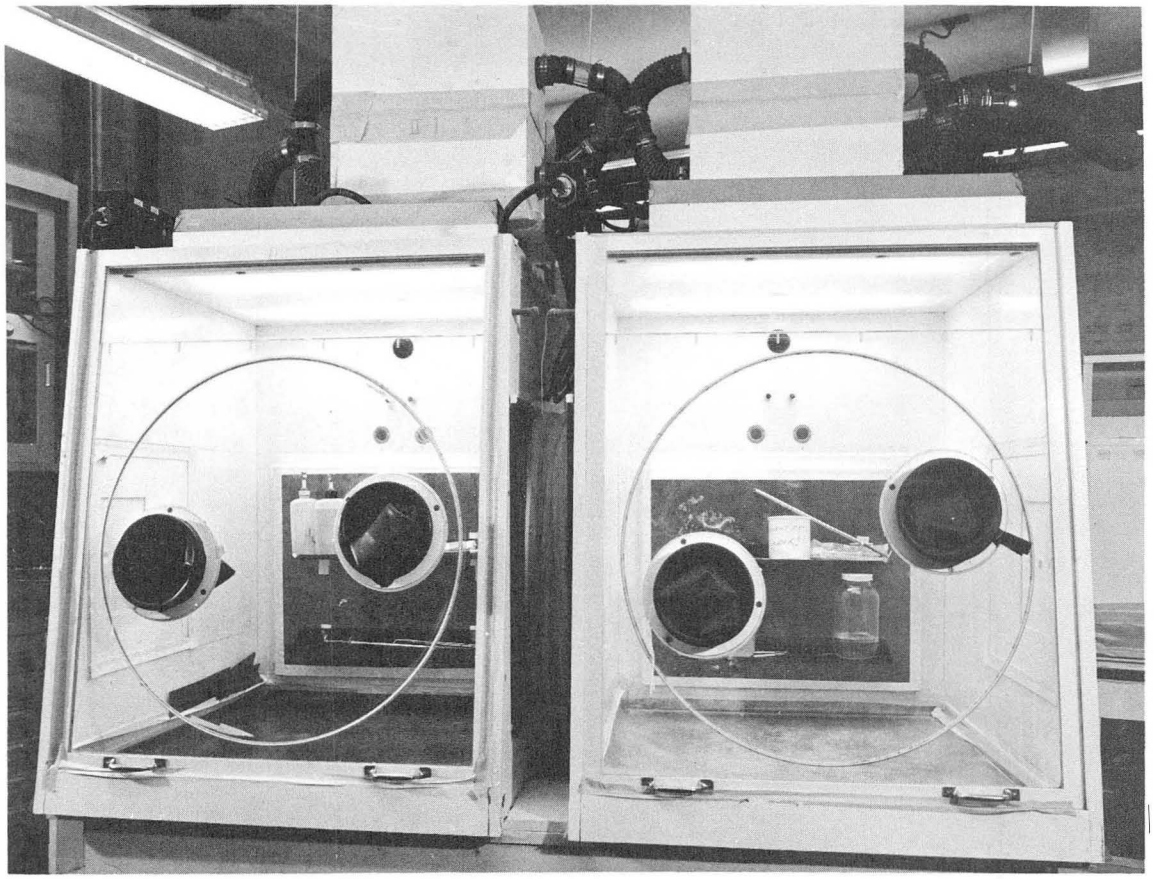
Use: Emission-spectra sparking.



HP 966

Item: Five-gloved-port box.

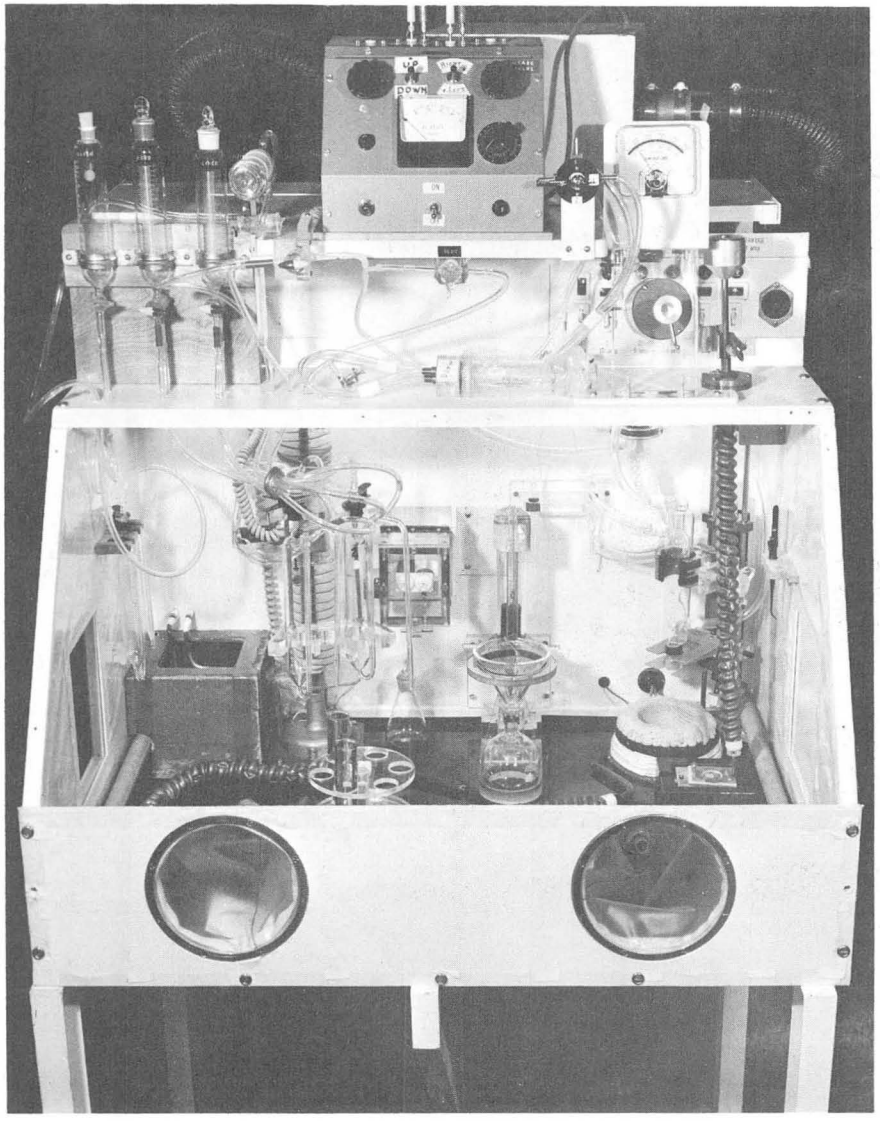
Use: Vacuum-equipment enclosure.



HP 795

Item: Full-view decontamination box with rotary glove ports.

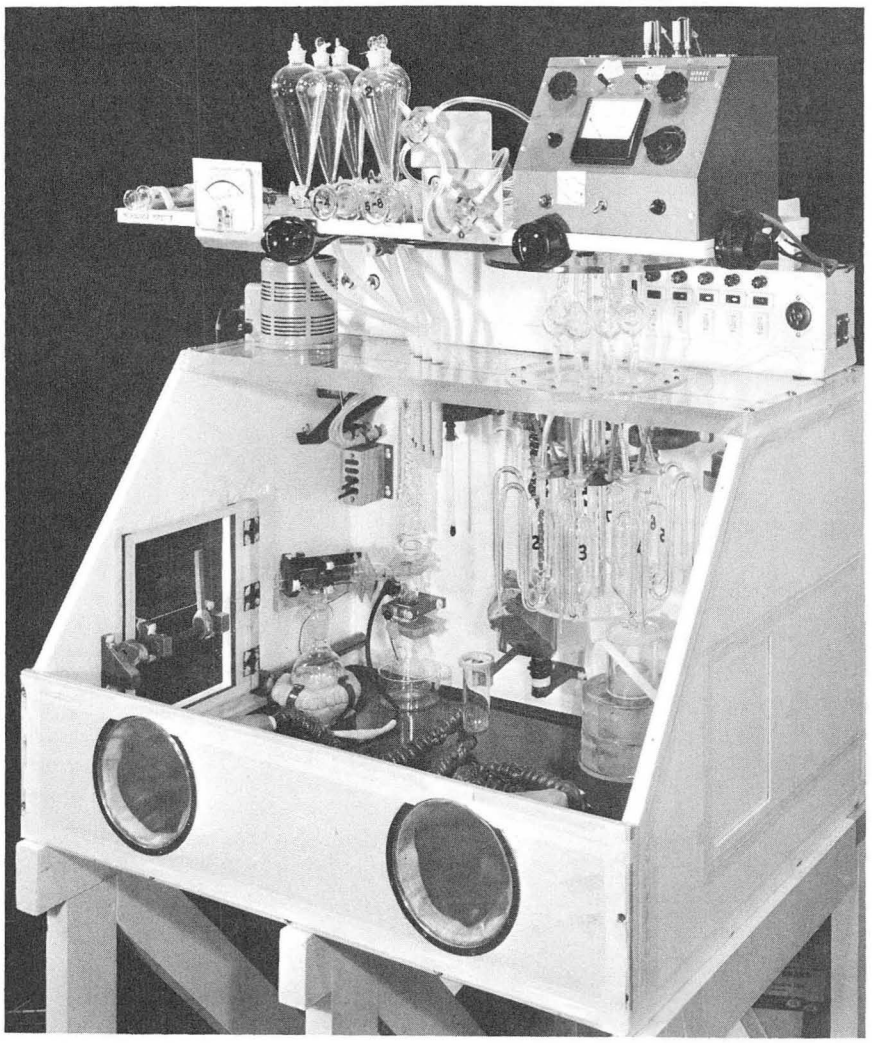
Use: Decontamination of equipment.



HP 1151

Item: Fire-retardant 2-in. lead-shielded box (junior cave box).

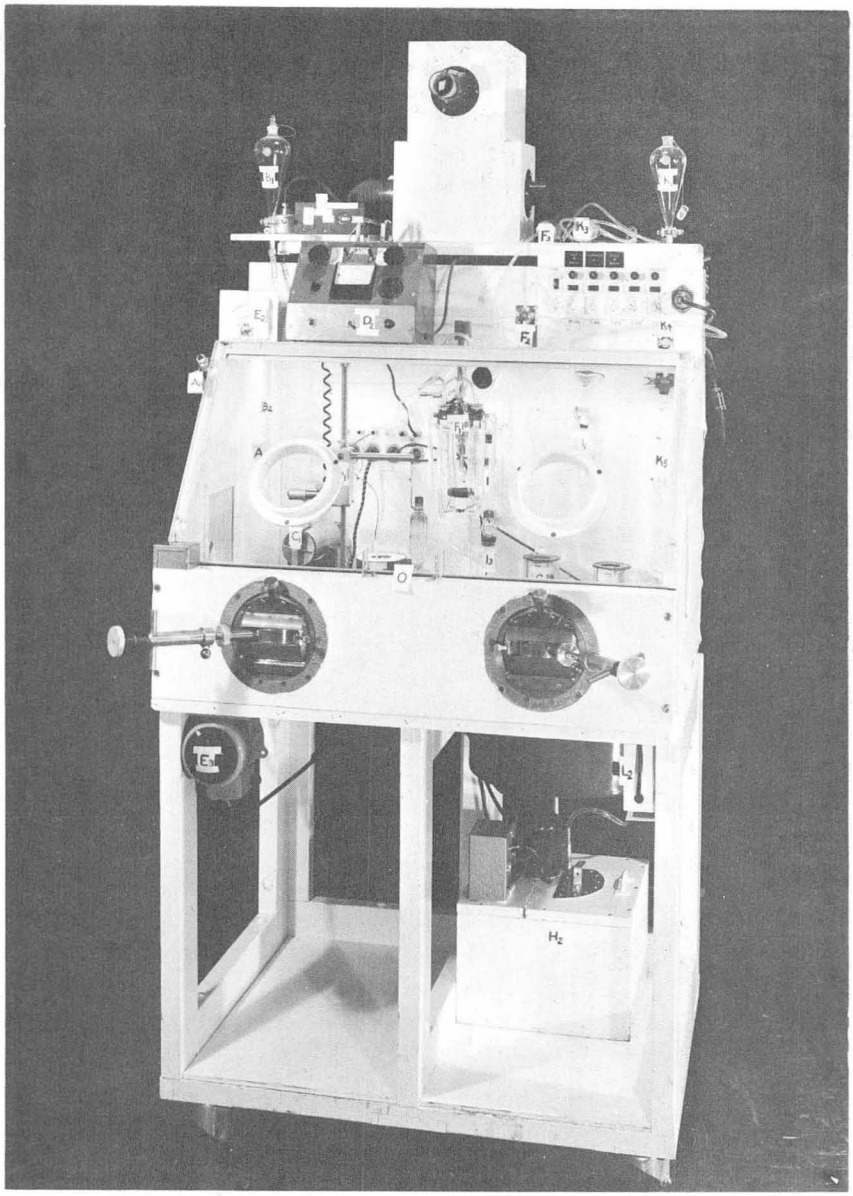
Use: ^{52}Fe separation.



HP 939

Item: Fire-retardant 2-in. lead-shielded box (junior cave box).

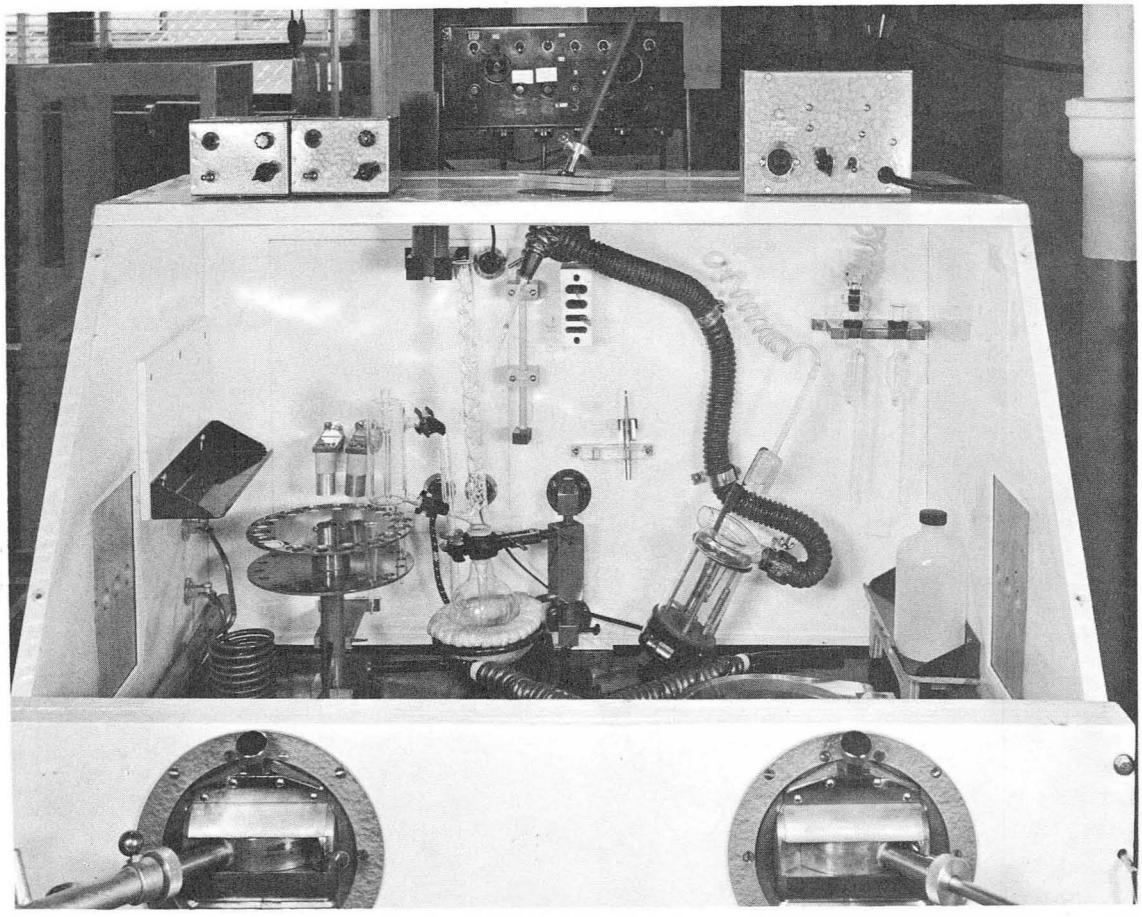
Use: ^{90}Sr-^{90}Y separation.



HP 918

Item: Beta-shielding box.

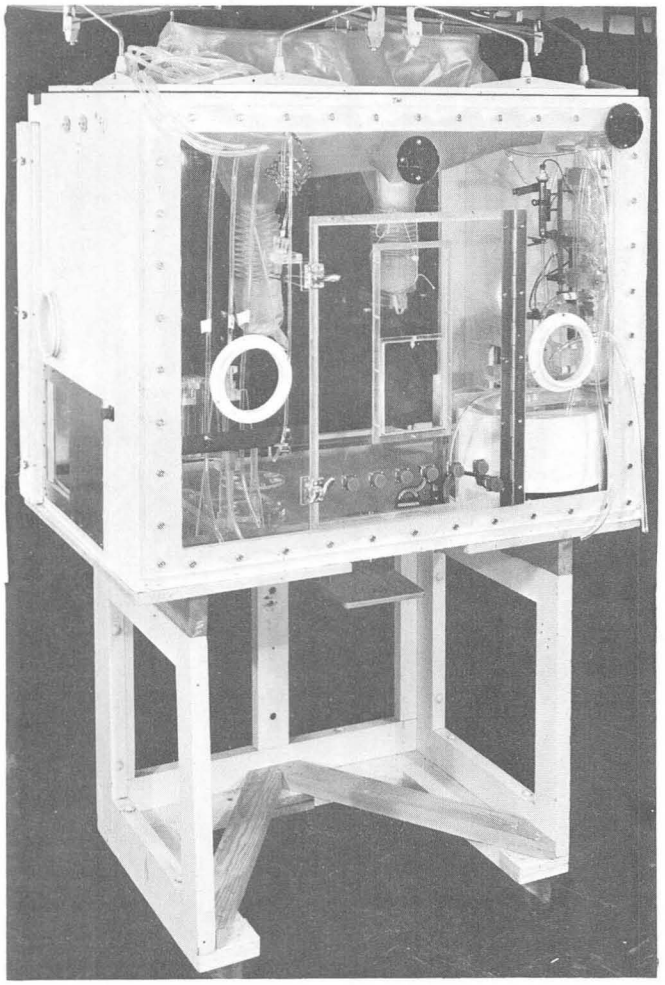
Use: Chromium phosphate purification.



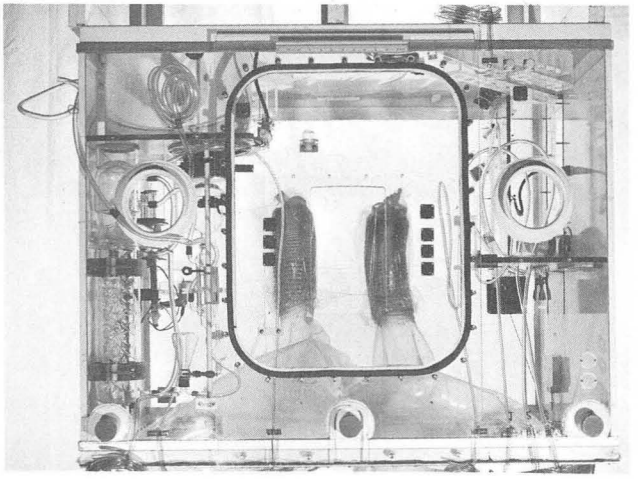
HP 556

Item: Fire-retardant shielded box (junior cave box).
Neutron shielding is required.

Use: ^{252}Cf purification.



HP 1092

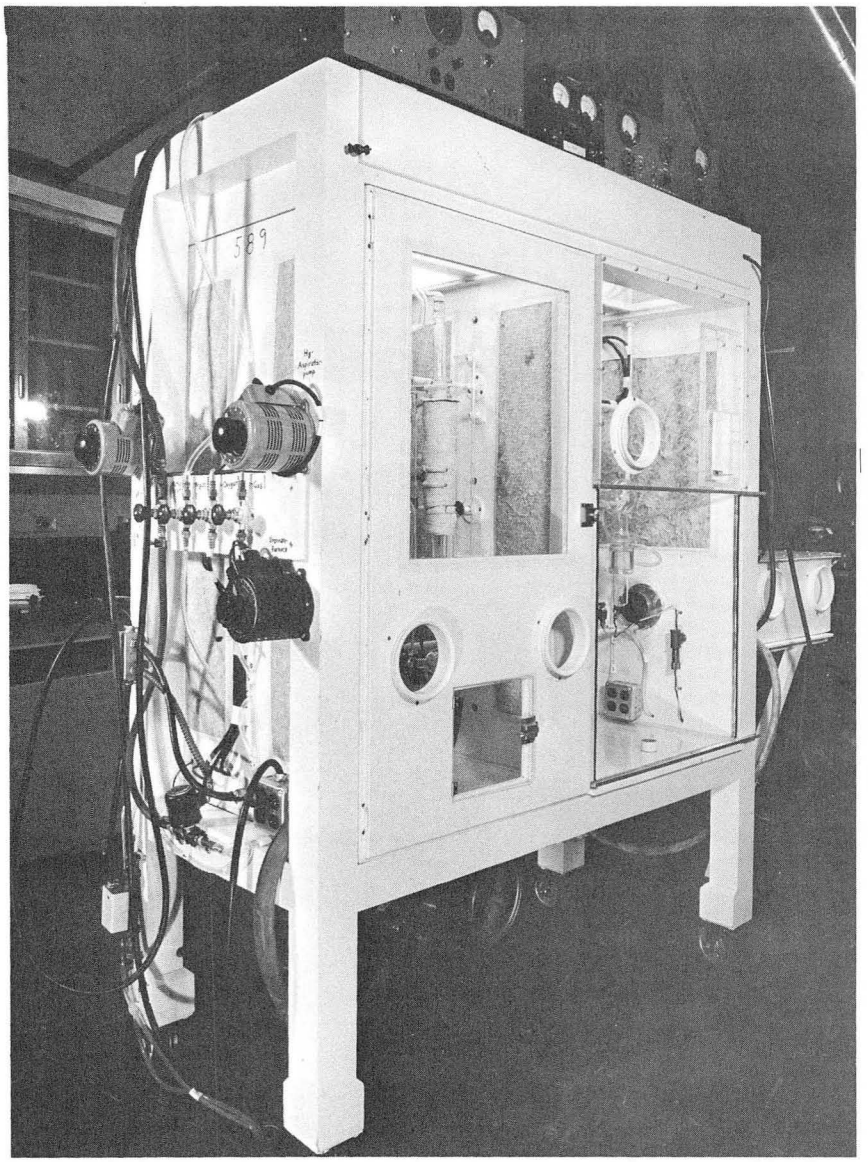


HP 1280

Item: Chemistry boxes used in 4- and 6-ft water neutron facilities.

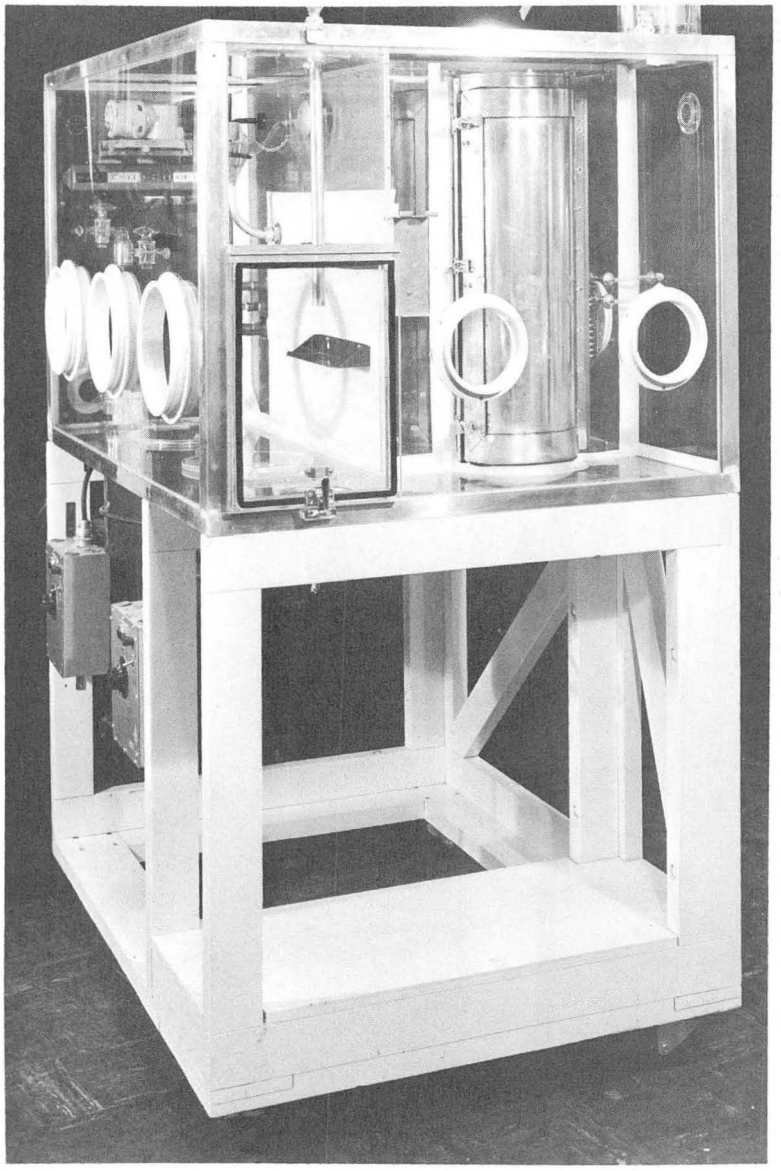
Right photo: Low-leak enclosure for use with curie quantities of alpha emitters. The leakage rate is less than about 0.1 cfm.

Left photo: High-leak enclosure for use with less than curie quantities of alpha emitters. Air flow is about 10 to 20 cfm.



HP 560

Item: 82-in. two-compartment vacuum-line box ("piano" box) combined with inert-atmosphere box.



HP 1062

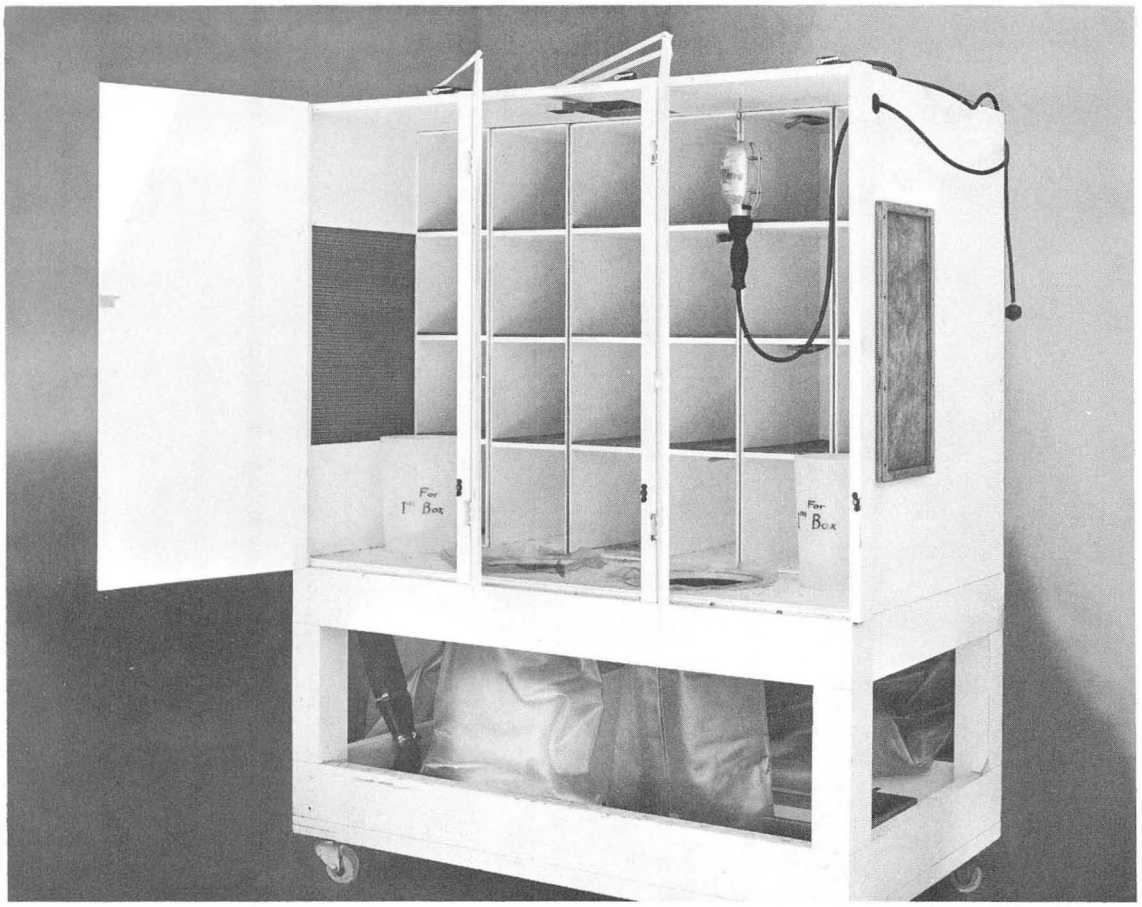
Item: Two-compartmented, all Lucite enclosure, with lazy-Susan interchange.

Use: ^{14}C plant enclosure.

JHL 3317

Item: Animal holding cages.

Use: Irradiation with highly radioactive isotopes.



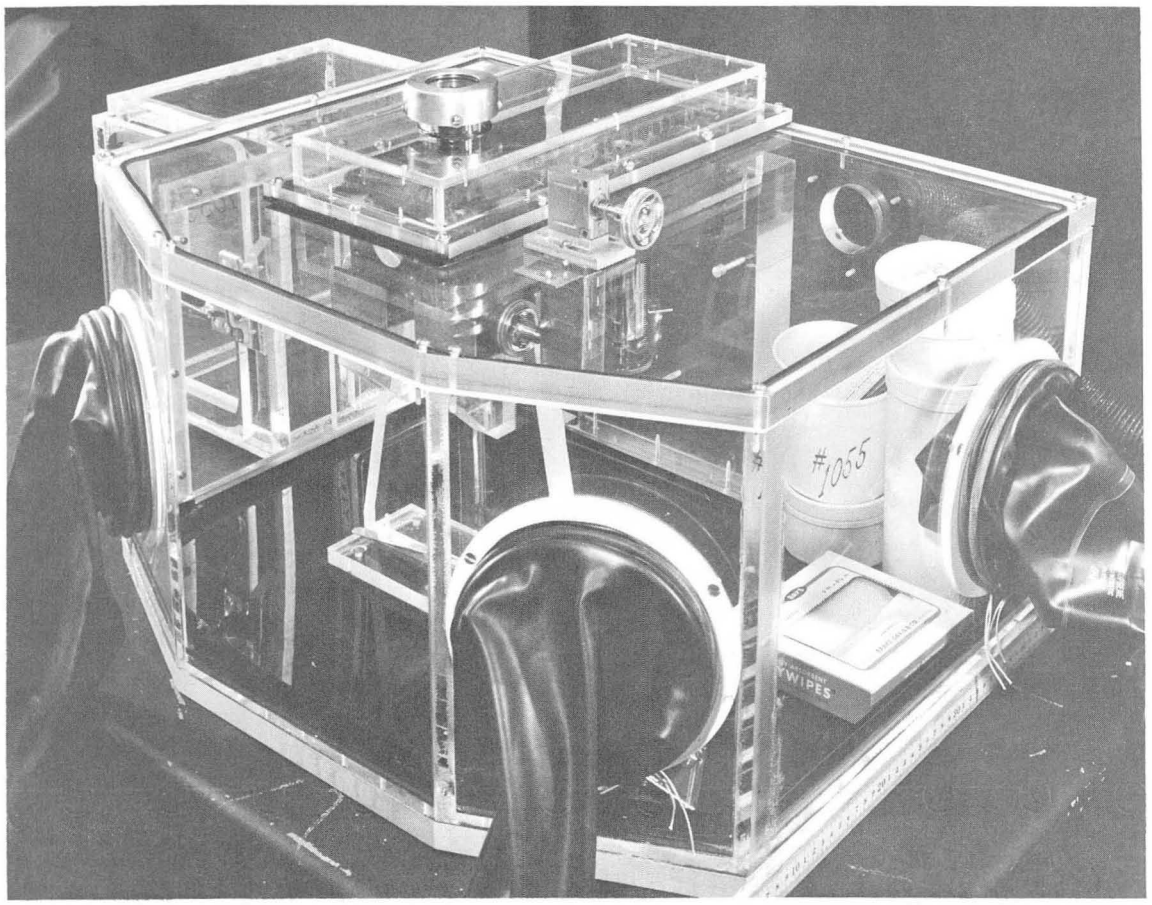
HP 538

Item: Ventilated animal cabinet.

Use: Compartmented enclosure for housing small laboratory animals.

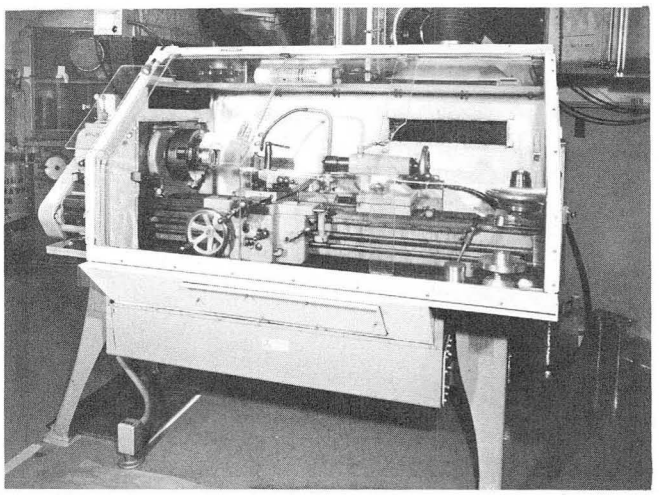
HP 1279

Item: Personnel decontamination enclosure.

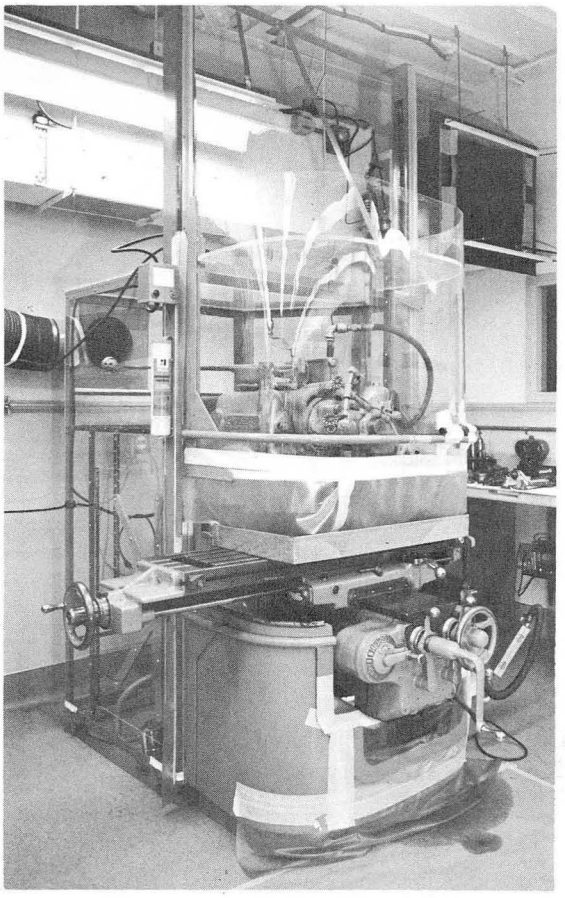


HP 1341

Item: Microbalance enclosure.



XBB 671-65



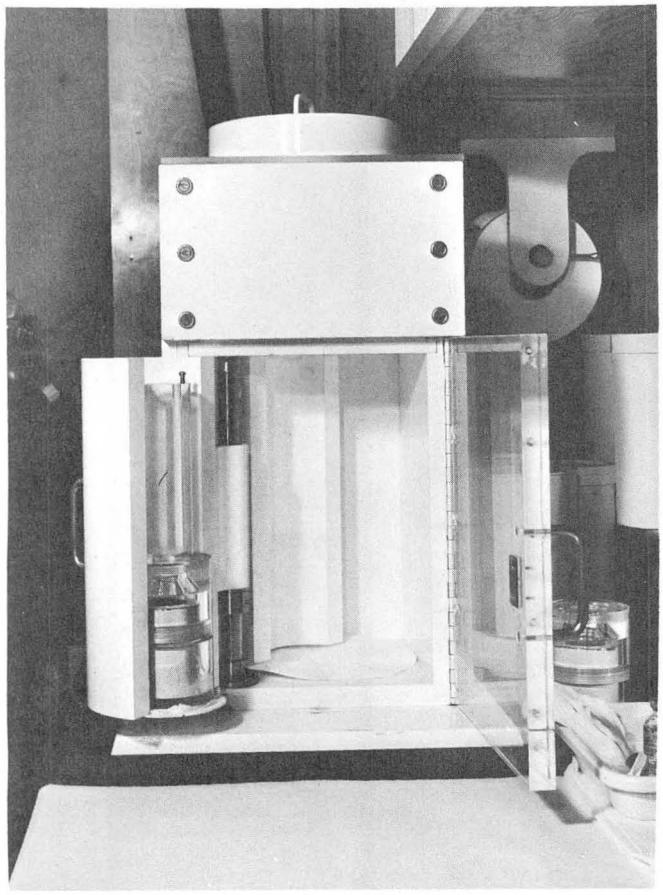
XBB 671-67

Item: Machine enclosures.

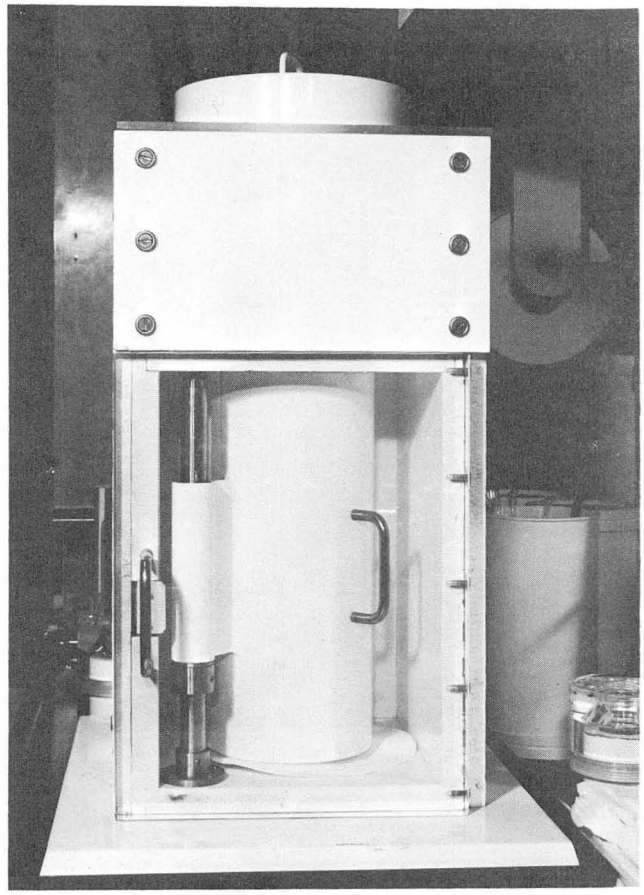
Use: Enclose machines used to fabricate parts from hazardous materials.

Left photo: Lathe enclosure.

Right photo: Milling-machine enclosure.



XBB 671-354

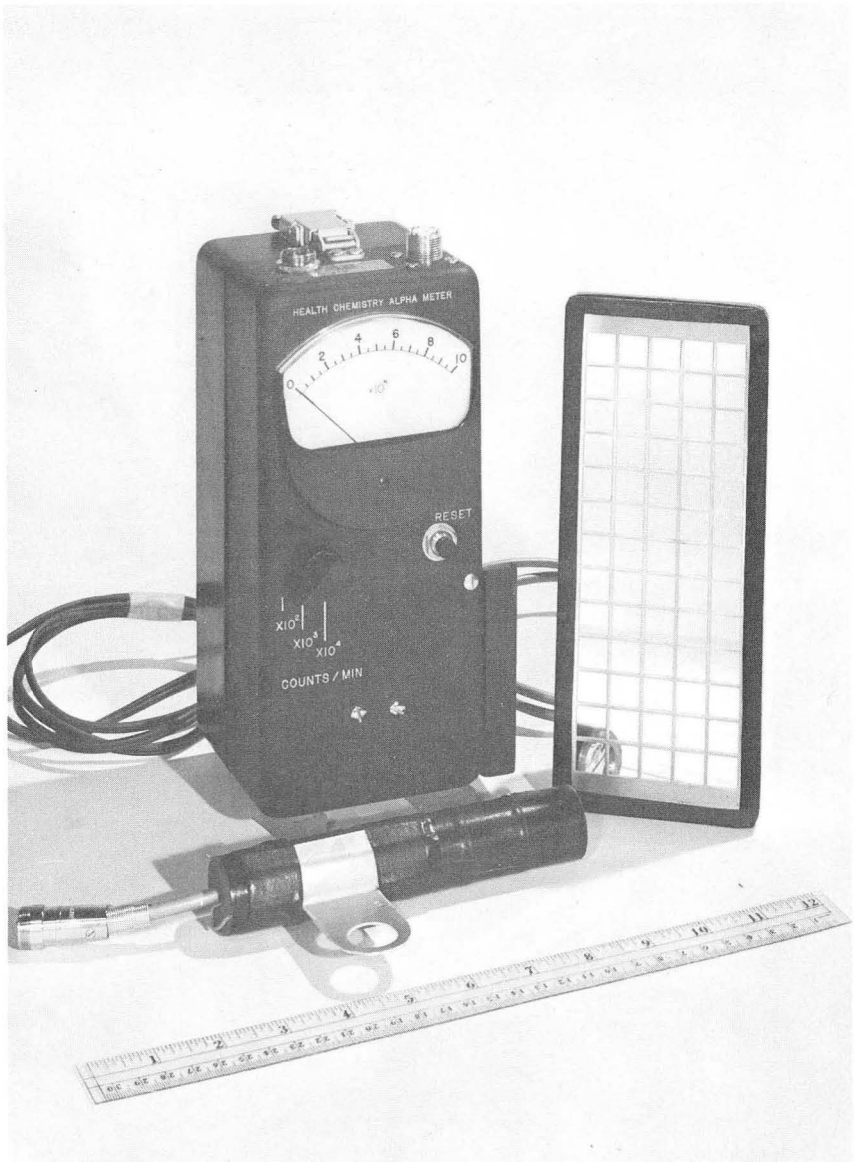


XBB 671-356

Item: Shielded enclosure for ^{99m}Tc or ^{68}Ge-^{68}Ga positron cow.

Use: The ^{68}Ga is milked from the parent ^{68}Ge to obtain a sterile, isotonic solution for intravenous injections into patients. The method is rapid and simple.

IID. Electronic Equipment



HP 1000

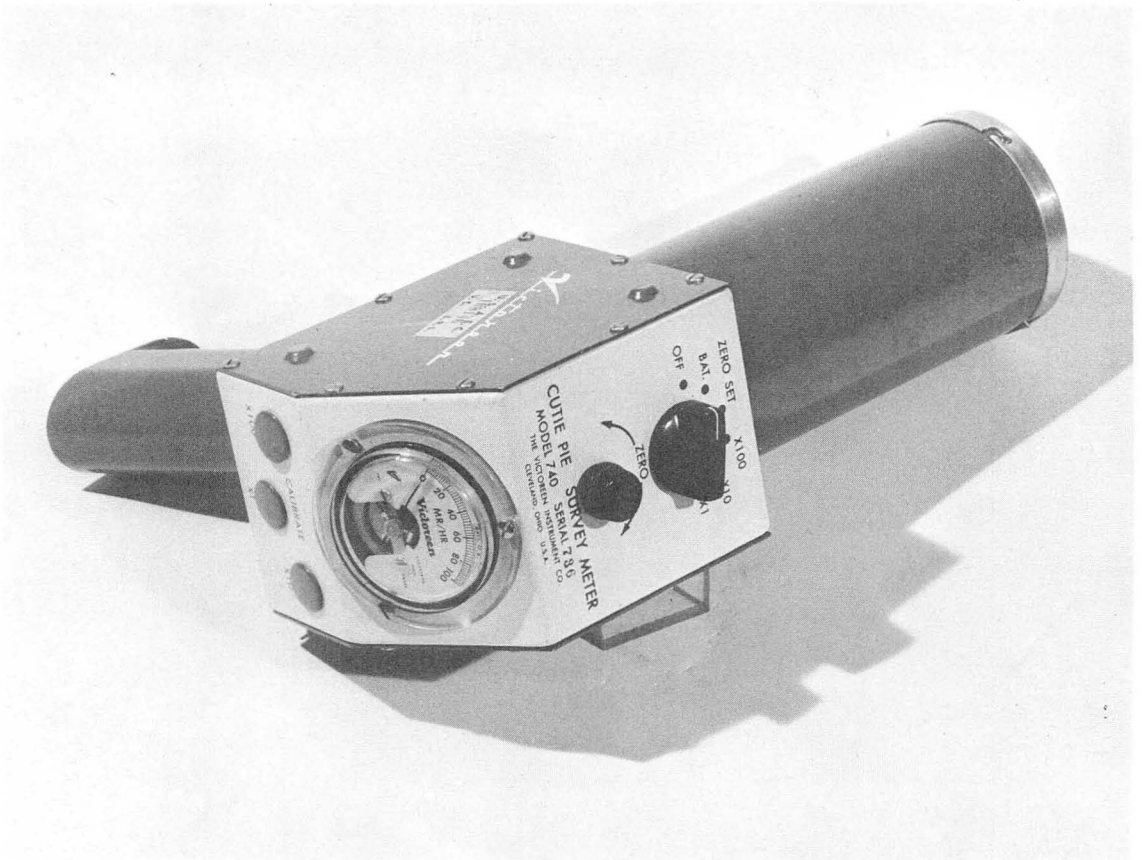
Item: Alpha survey meter.

Description: Transistorized, multi-range, count-rate meter. May be used with large air proportional probe or solid-state probe. Battery or ac powered models available. For portable or fixed use. Meter readout and audio indication.

HP 960

Item: Beta-gamma survey meter.

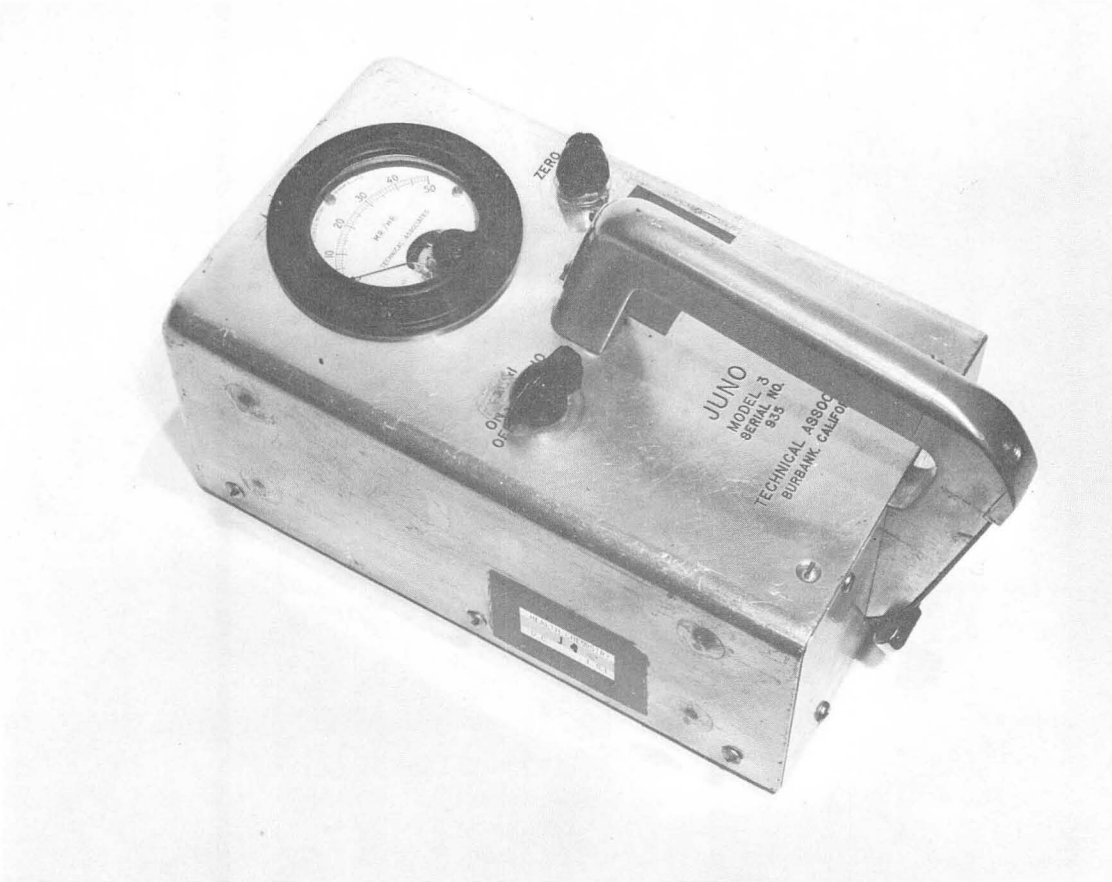
Description: Count-rate type covering 0 to 50 mR/hr; equipped with 30 mg/cm^2 steel GM tube or 1.4 mg/cm^2 mica-end-window GM tube for soft-beta survey work.



HP 1026

Item: Beta-gamma survey meter.

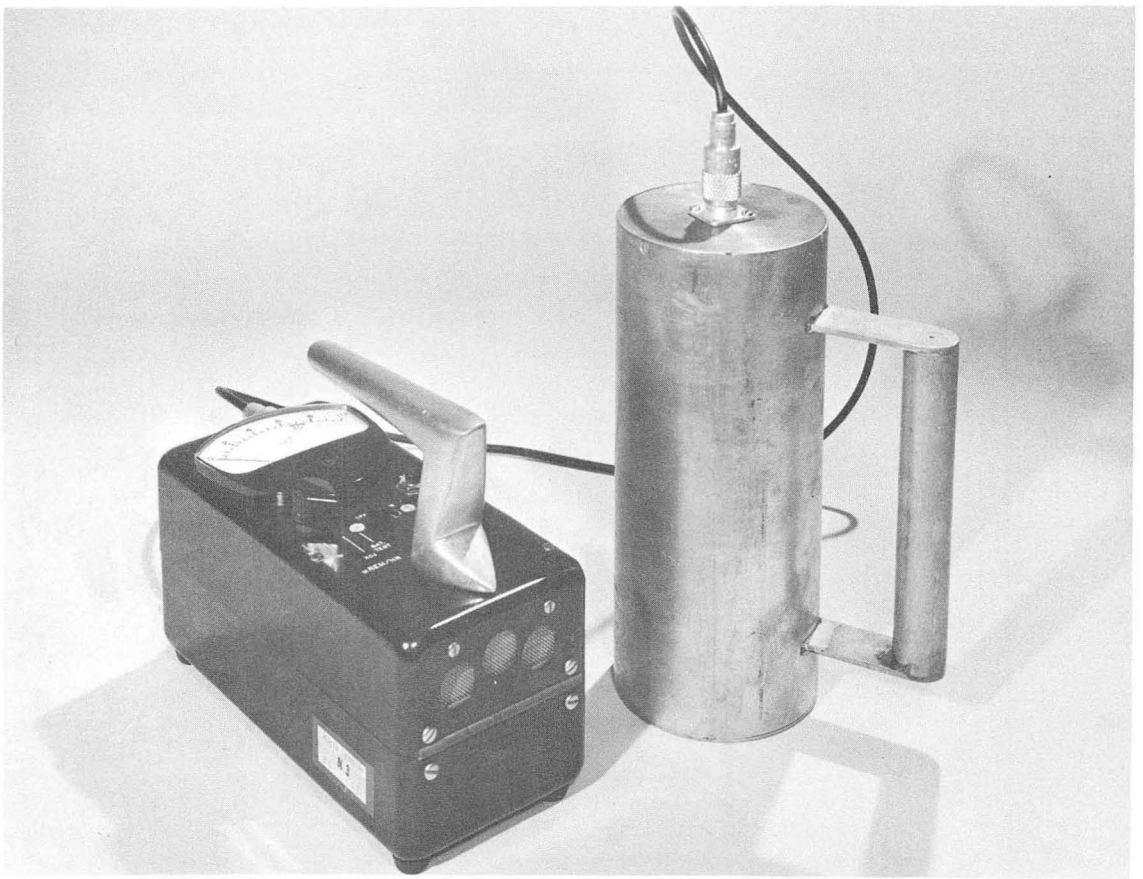
Description: Ion-chamber type. Three decade scales cover 0 to 10 R/hr. Commonly known as "Cutie Pie". Battery-operated only. Primarily intended for measuring gamma dose rates in the energy region from 0.1 to 2 MeV.



HP 1009

Item: Beta-gamma survey meter.

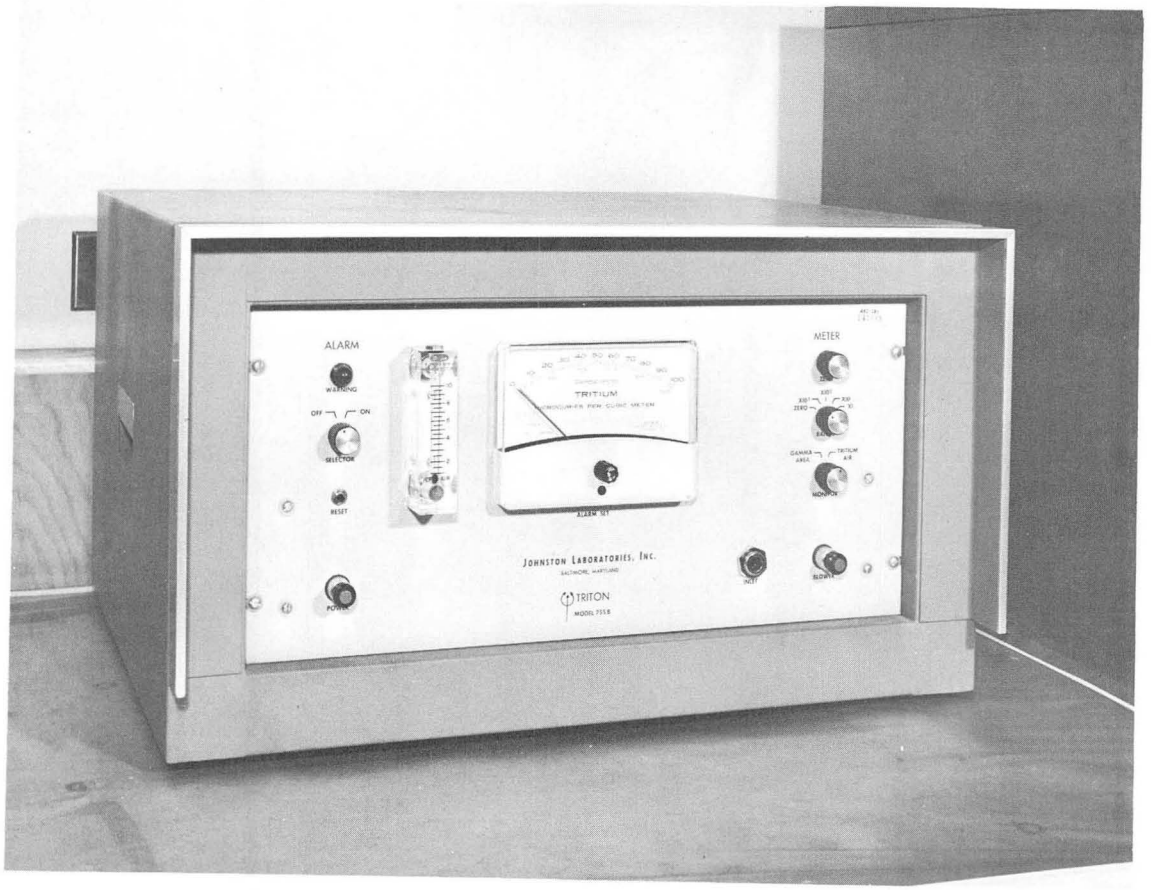
Description: Ion-chamber type known as Juno. Very similar to a "Cutie Pie" in range and energy response. Becoming less available since a "Cutie Pie" is more practical.



HP 906

Item: Fast-neutron survey meter.

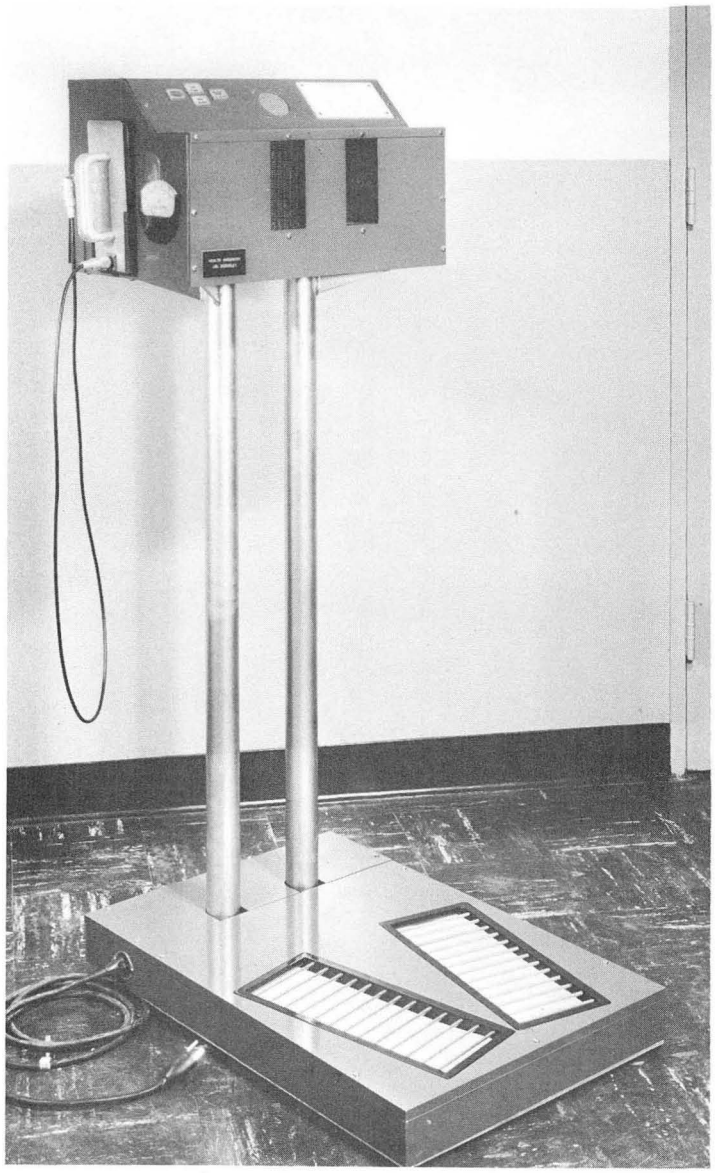
Description: Moderated BF_3 type. Primarily intended for monitoring the use of ^{252}Cf. Covers 0 to 1 rem/hr in four decade ranges. Battery or ac models available.



XBB 672-909

Item: Tritium monitor.

Description: Shielded double ionization-chamber unit. Will compensate for uniform gamma fields up to 5 mR/hr. Four-decade scale, reads in $\mu Ci/m^3$.



HP 1113

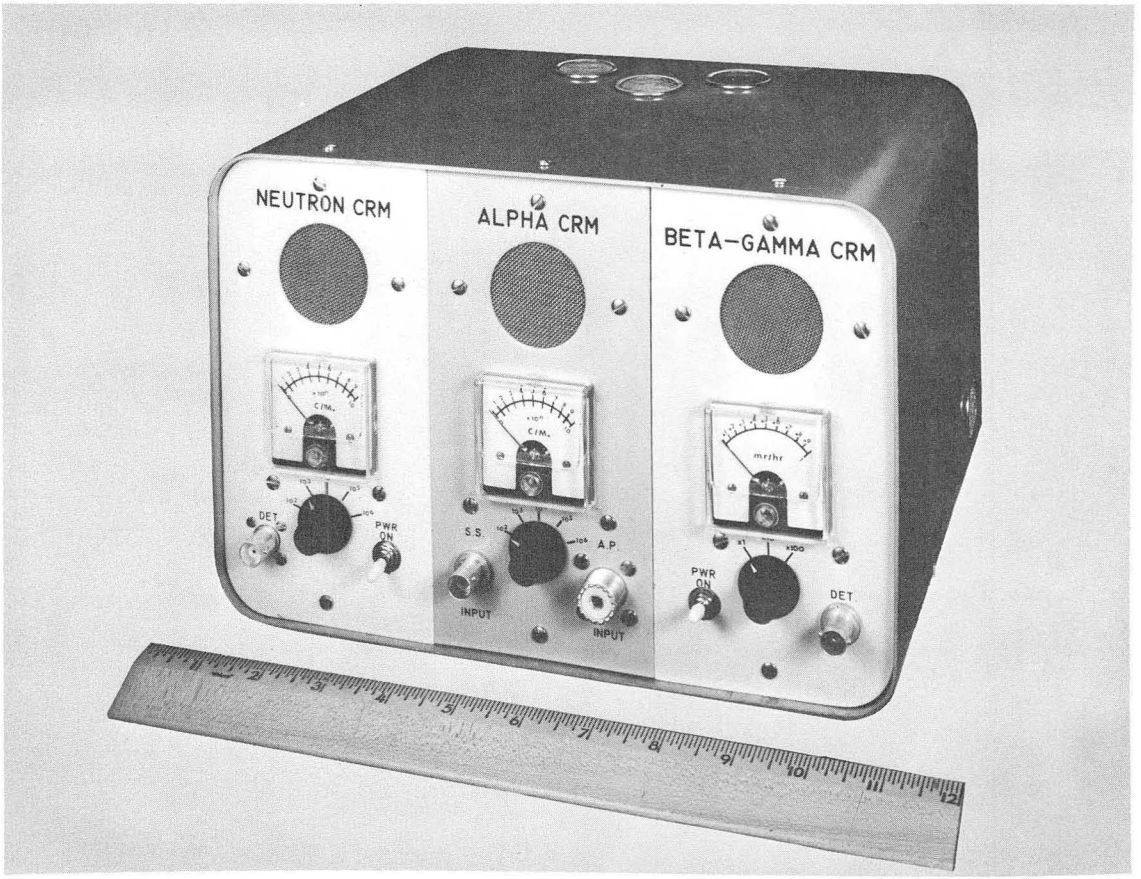
Item: Alpha hand and shoe counter.

Description: Scaler type, with separate hand and shoe alarms. All detectors are air proportional with 1 mg/cm^2 mylar covers. Audio output on front panel.

HP 1106

Item: Beta-gamma hand and shoe counter.

Description: Count-rate-meter type, separate alarms for hands and shoes. Frisker probe and all other detectors are 30 mg/cm^2 steel GM tubes. Useful for detecting contamination on hands and shoes. (Not for soft beta.)

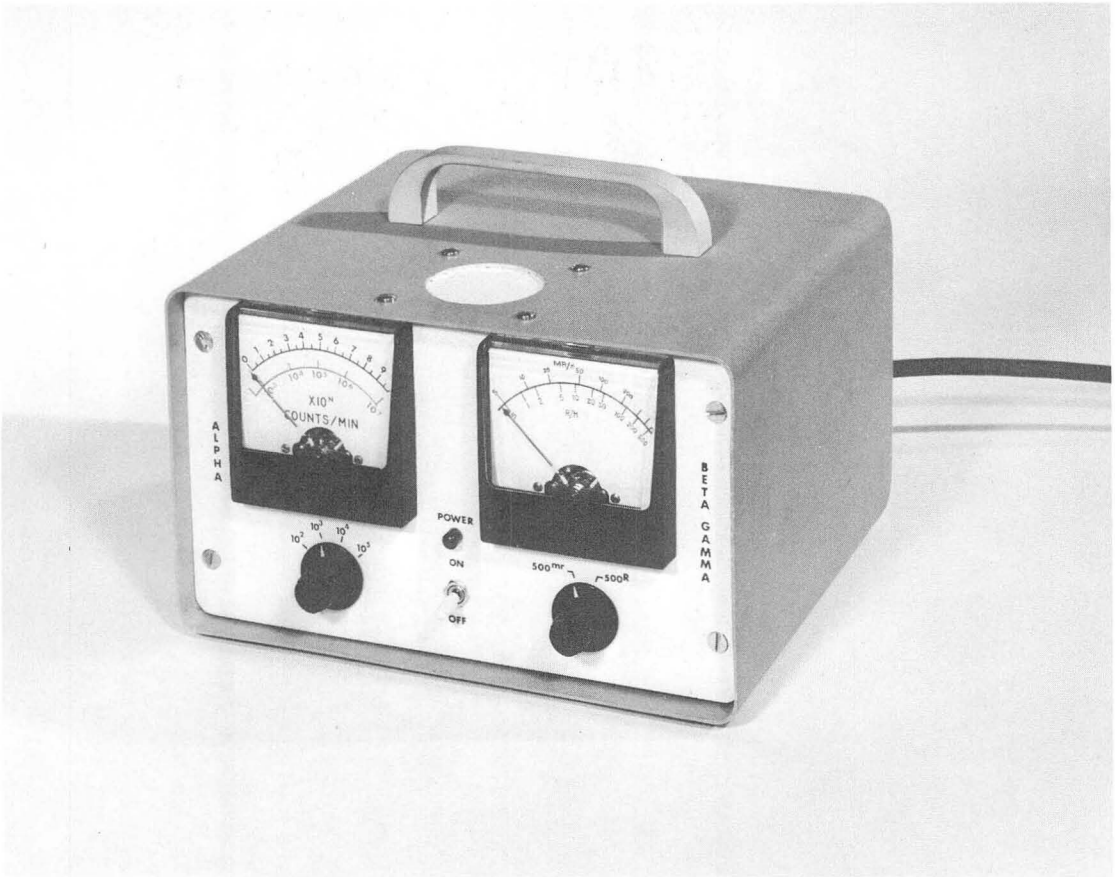


HP 1238

Item: Integrated survey meter.

Description: Fixed ac survey meter for fast-neutron, alpha air proportional, alpha solid-state, and GM detectors.

Uses: Mainly used for heavy-element chemistry facilities, capsule-opening caves, or any multi-emitter work in or out of enclosures.

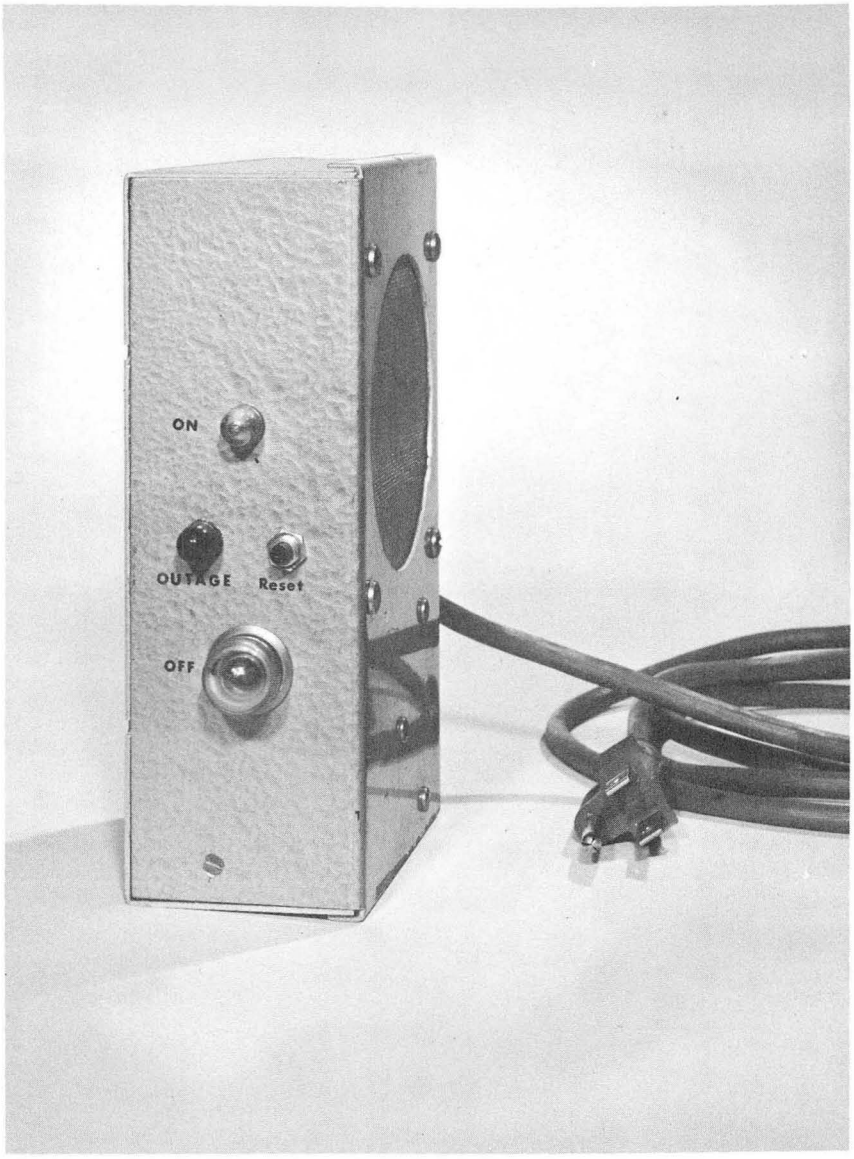


HP 1338

Item: AC alpha, beta-gamma count-rate meter (CRM).

Description: Alpha CRM using solid state or air proportional detectors plus 0- to 500-R beta-gamma ion chamber.

Uses: Alpha "in box" survey or hood survey, for beta-gamma dose-rate measurements in ranges of 0 to 500 mR and 0 to 500 R.

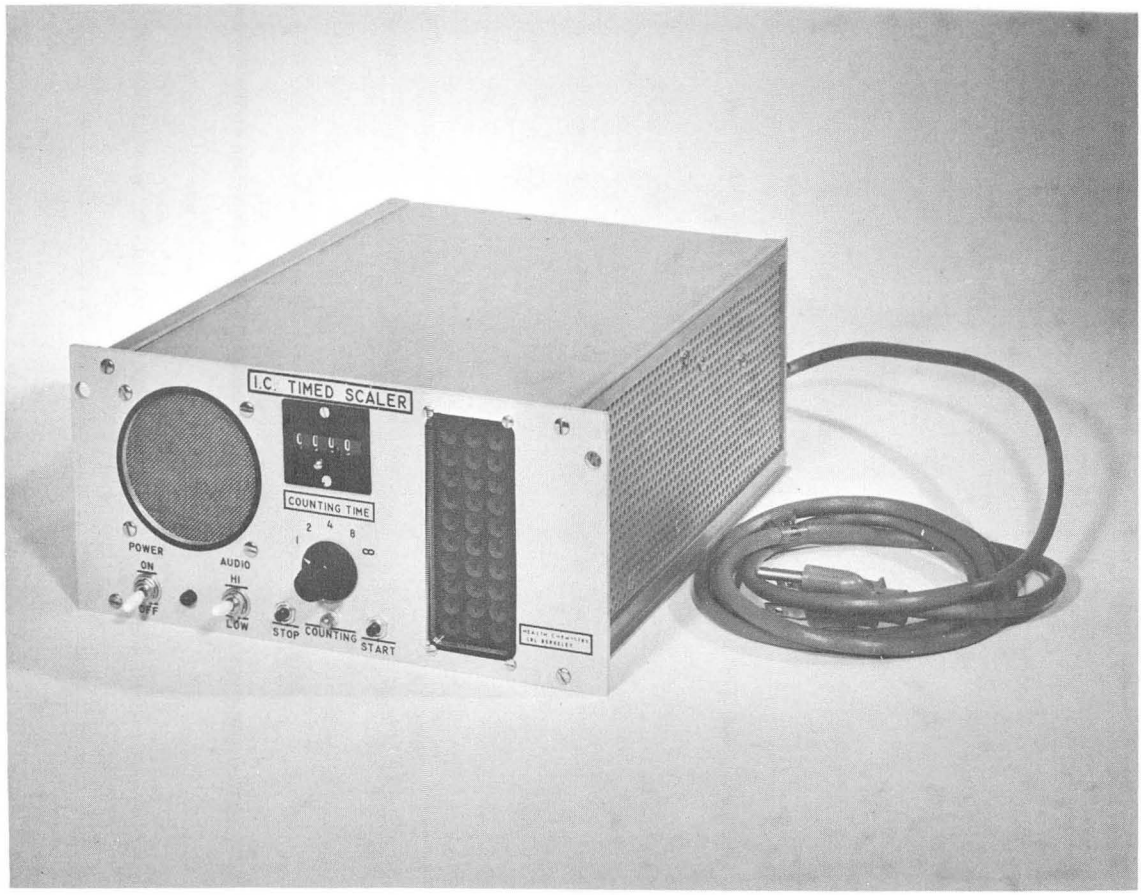


HP 1405

Item: Power-outage alarm.

Description: In the event of a power failure, where power failure could cause a hazard, an audible tone and flashing light are activated by a rechargeable battery. After power is restored the alarm must be reset before the warning ceases. A time delay prevents alarms due to momentary line dips.

Use: An alarm for any 110-V ac powered equipment whose failure to function could cause damage or danger.



HP 1339

Item: Timed scaler.

Description: 10^8-count capacity scaler with built-in timer, high-voltage supply, and audio. Integrated-circuit-type construction.

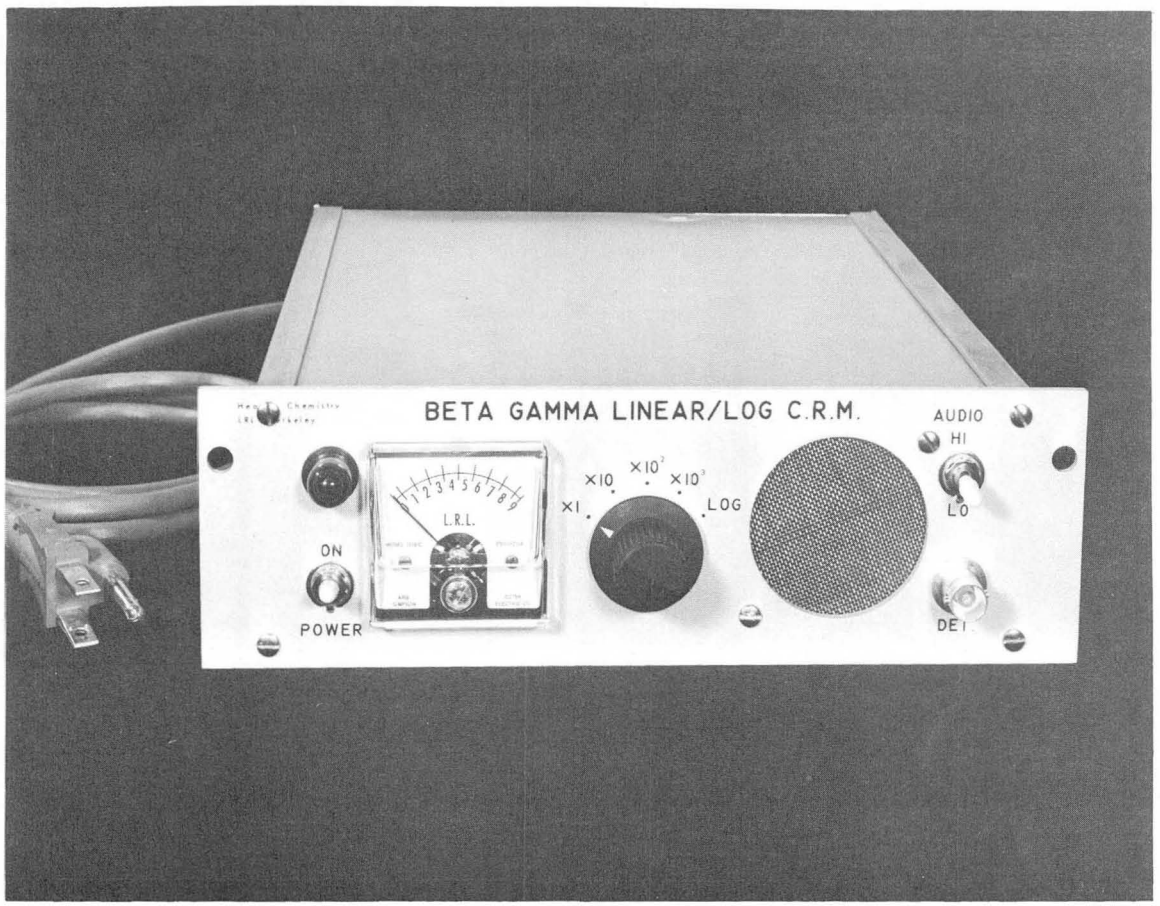
Uses: May be used with air proportional or solid-state detectors for quantitative alpha counting. Useful for counting low levels of alpha where precision is needed.

HP 1251

Item: Solid-state detector count-rate meter(CRM).

Description: A log-linear CRM for solid-state detectors, primarily for alpha detection but also capable of fast-neutron detection.

Uses: Hood, gloved-box, or shielded-enclosure survey work counting column drops to locate separate elution peaks. Survey of hard-to-reach places such as holes inside of pumps or vessels etc. By adding a converter foil (n,p), the detector has a moderage fast-neutron response that is highly directional--a useful tool for ^{252}Cf chemistry.

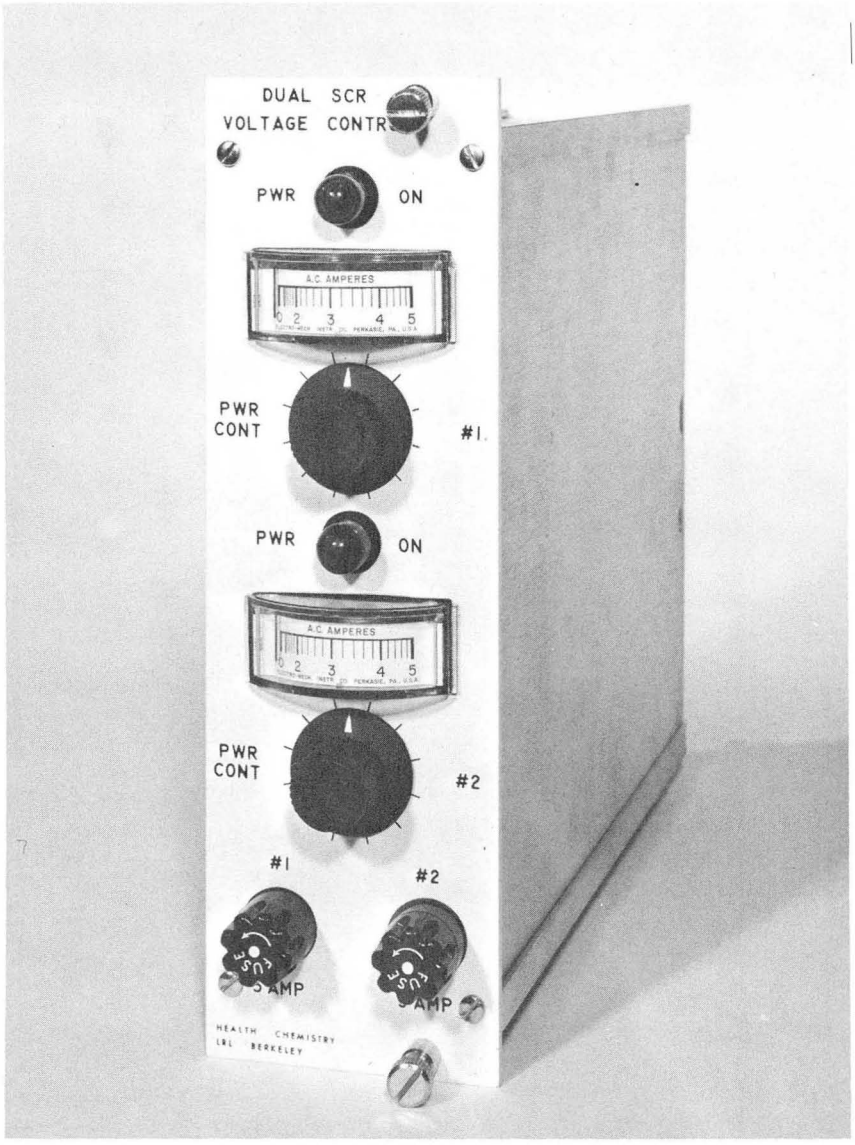


HP 1288

Item: Count-rate meter (CRM).

Description: Log-linear CRM for use with GM detectors. Includes high-voltage supply and audio.

Uses: Used mainly for fixed-location survey work, such as a gloved box or hood.

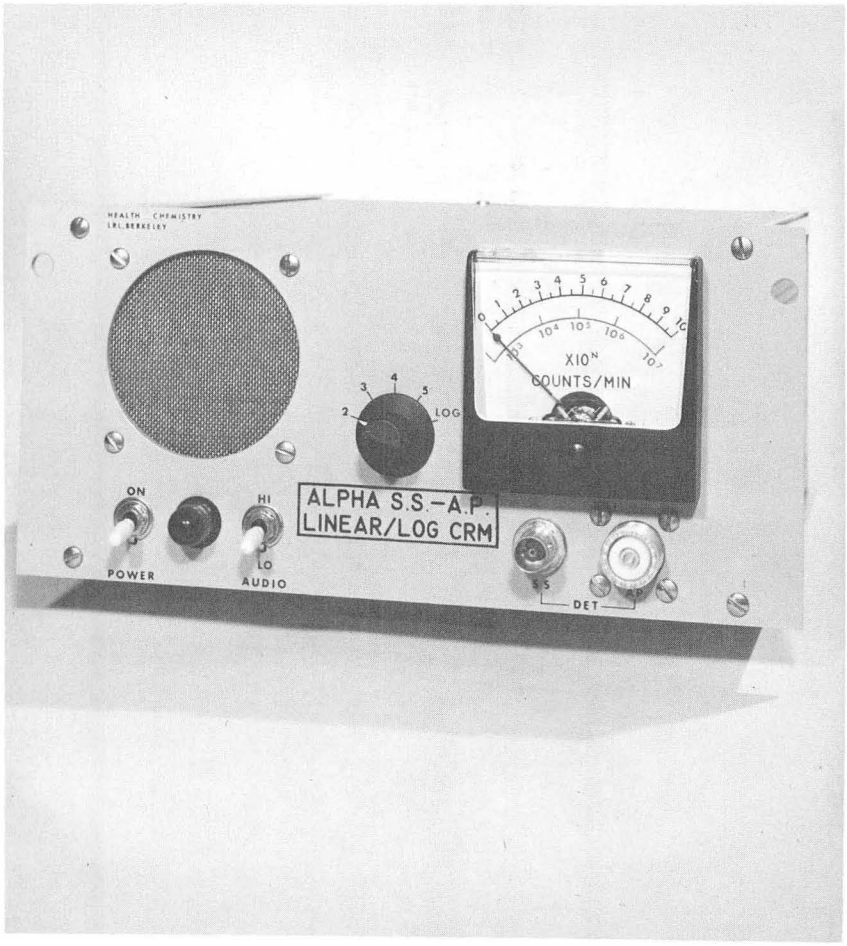


HP 1393

Item: Dual silicon-controlled rectifier (SCR) control.

Description: Two 5-A, SCR controls in a P-2 bin. One of a series of general and special control modules for cave, hood, or gloved-box use.

Uses: Power control for various ac loads.

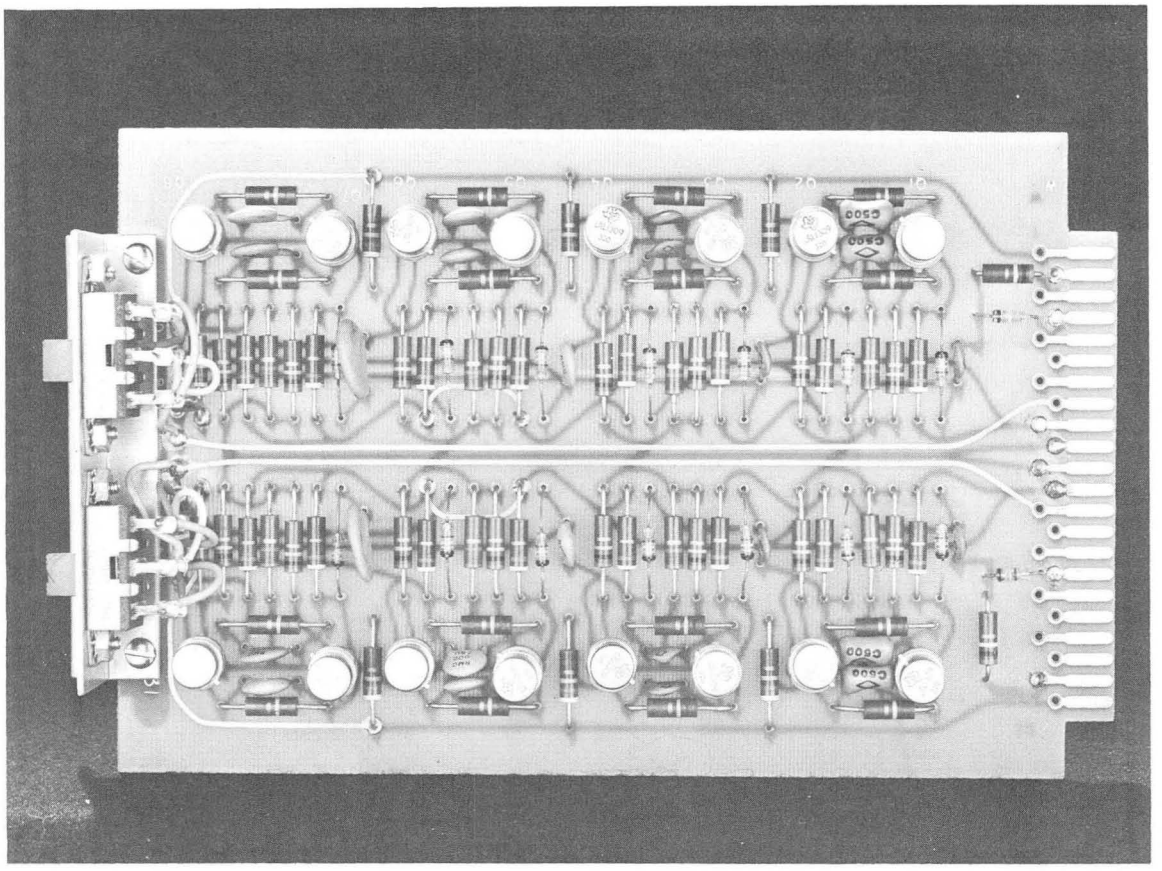


HP 1398

Item: Count-rate meter (CRM).

Description: A log-linear CRM for simultaneous use of solid-state and air proportional alpha detectors. Includes solid-state bias, high-voltage supply, and audio.

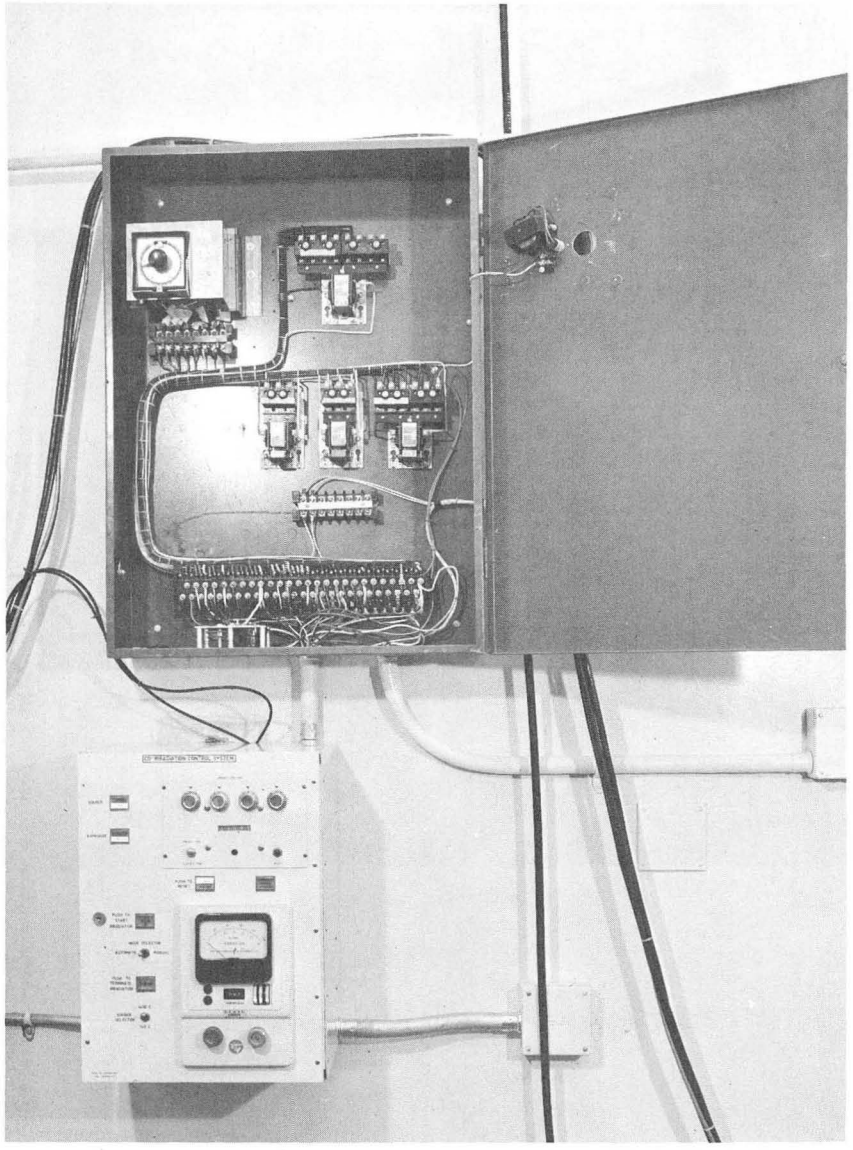
Uses: Mainly for hood and gloved-box alpha chemistry but also useful in many alpha-handling situations.



HP 1123

Item: Printed-circuit boards.

Description: An example of the kind of circuitry used in Health Chemistry equipment, in this case an alpha hand-and-shoe counter.



HP 1139

Item: ^{60}Co control system.

Description: A fail-safe electric drive and entry-door control. Manual or automatic timing and dose-rate integrator. An ion-chamber controls a drop-out solenoid, preventing entry into treatment room when source is exposed. In case of power failure, the solenoid relaxes, barring entry. If the source ruptures and pellets fall out, the ion chamber cuts off the solenoid power and prevents entry.

THERMOLUMINESCENT DOSIMETRY

We offer a thermoluminescent dosimetry service using dosimeters of the following forms and properties:

LiF - Teflon discs. 1.3 cm. diameter by 0.4 mm. Tissue equivalent response from 20 keV to 10 MeV. Dose ranges from 0.05 to 10^5 R. Dose rate is essentially independent. Discs may also be supplied in ''bandaid'' holders for finger and hand dosimetry.

LiF - Teflon rods. 1 mm diam by 6 mm. Tissue equivalent response from 20 keV to 10 MeV. Dose ranges from 0.1 to 10^5 R. Longer rods are also available.

LiF powder. In 3/16-in.-diam by 3/4-in. compensated polyethylene holder. Flat energy response from 10 keV to 2 MeV. Dose ranges from 0.01 to 10^5 R.

All dosimeters have a standard deviation of ±15% at 0.05 R down to ±3% from about 1 to 10^5 R. Immediate readout of dosimeters or assistance in making measurements can be arranged.

STRAIN GAGES

A strain gage is a small metallic conductor (smaller than a postage stamp) that is bonded to a specimen to measure the strain in that specimen when it is subjected to a load, which may be tension, compression, bending, torsion, etc. Strain is directly converted to stress by employing the modulus of elasticity of the specimen.

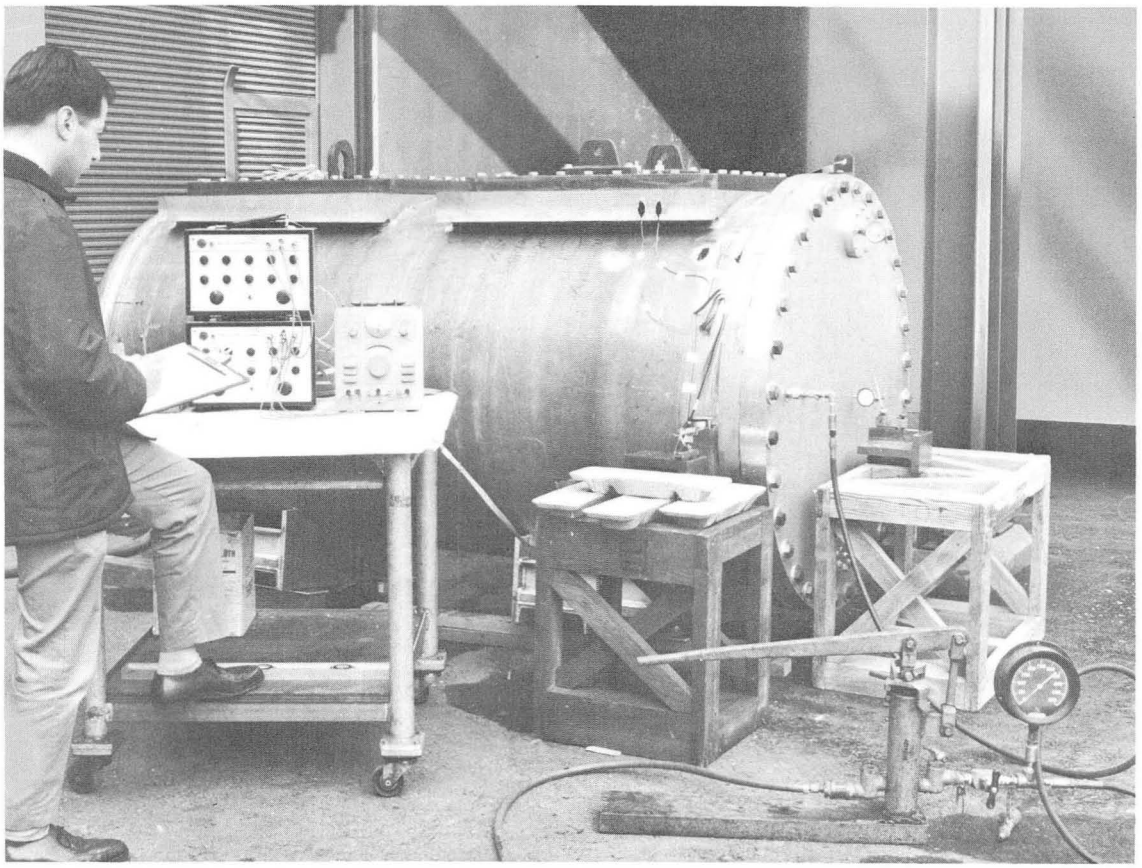
Strain gages can be used on almost all metals, on concrete, glass, bricks, bones--both living and dead, wood, rubber, and plastics. They have been used on operating gas turbines, reciprocating engines, airplanes, submarine hulls (on the outside), cranes, earth-moving equipment, and automobiles.

They can withstand environments from liquid-hydrogen temperatures to 2000°F. They have operated submerged in sea water on ships's hulls for periods of years and at hydrostatic pressures above 50 000 psi.

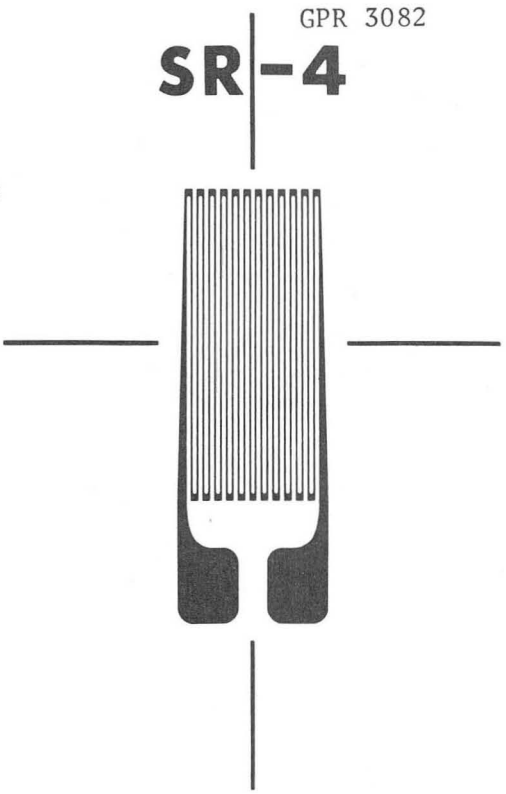
They can faithfully follow strains from zero frequency (static strains) to over 50 000 cycles per second. They have withstood 600 000 g on rotating machinery and signals have been obtained from them while mounted on parts rotating at 100 000 rpm.

Strain-gage-based transducers have exhibited accuracies better than 0.1% for 20 years. These transducers can measure force, torque, pressure, acceleration, surface finish, speed, displacement, straightness, dimension, blood pressure, and many other variables.

We offer a consulting service to anyone at LRL who desires experimental strain-gage stress analysis--from installation of the gages through data acquisition and analysis.



GPR 3082

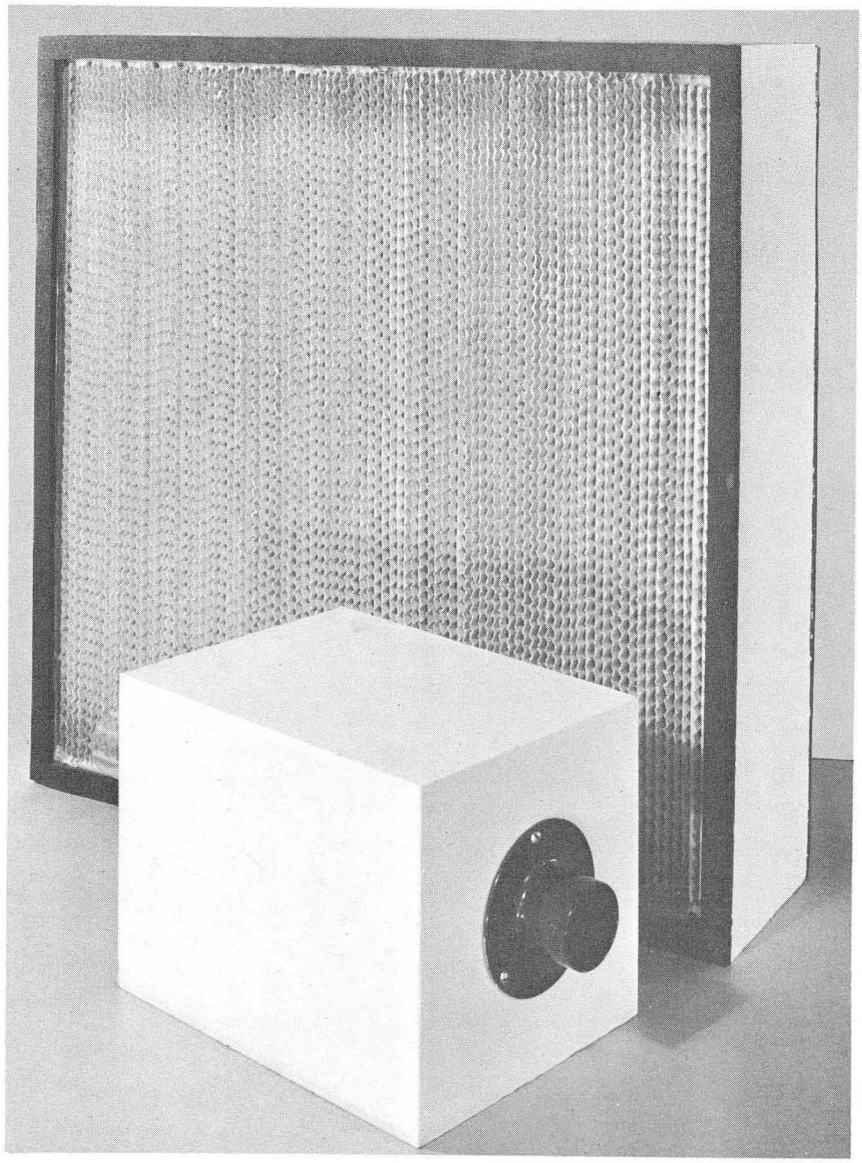


Strain gages.

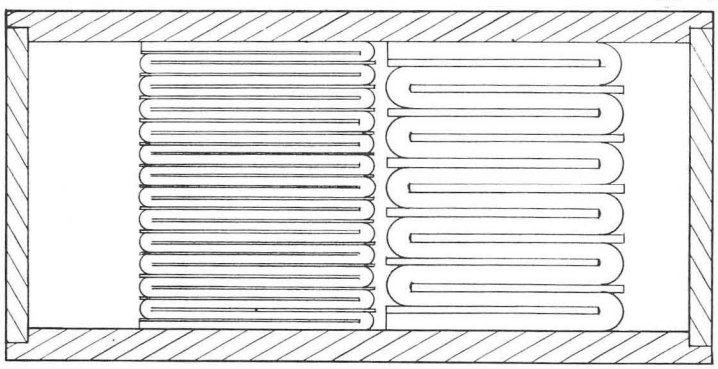
Above: Pressure vessel around Cherenkov counter. The stress of the weld under pressure is being analyzed.

Right: SR-4 strain gage. Dimensions 1/8 by 5/16 in. Smallest strain gage is 1/64 in. square.

IIE. Ventilation Equipment



HP 967

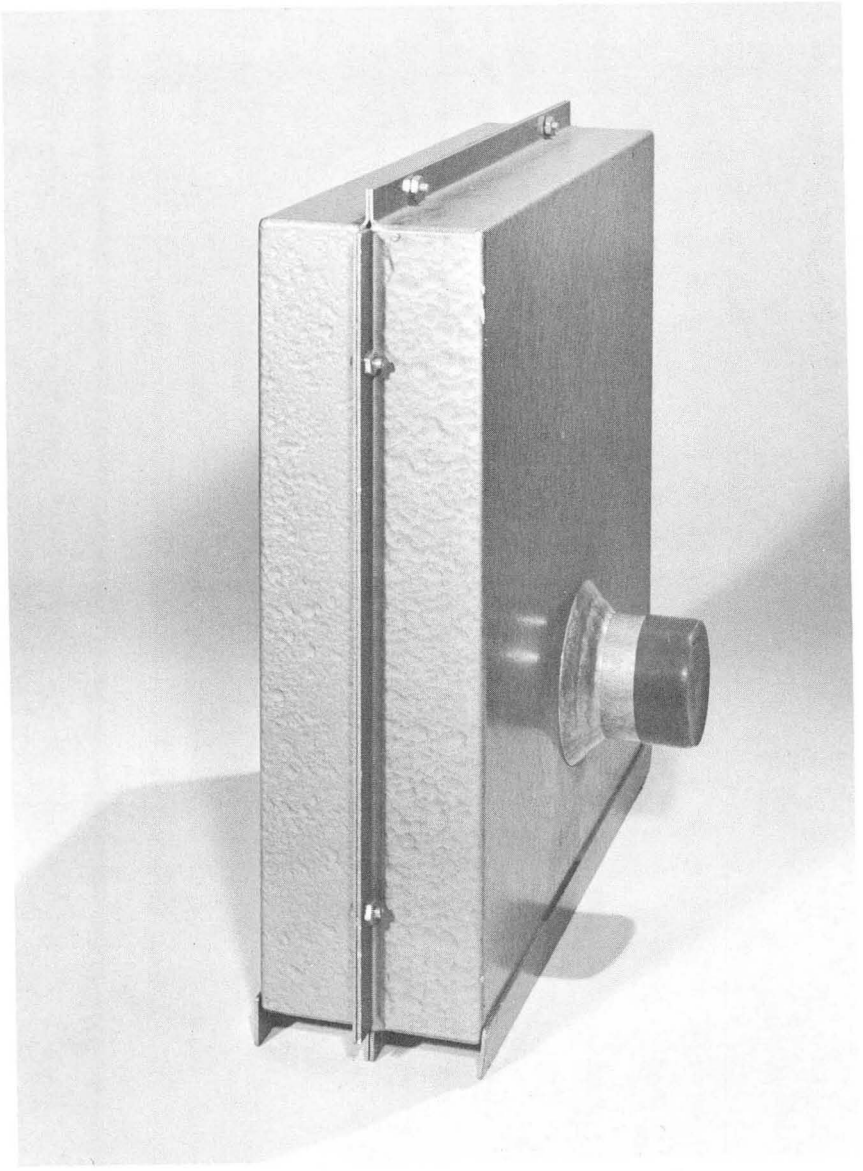


XBL677-3490

Item: High-efficiency filters.

Description: Air filters rated at 99.97% efficient for 0.3-micron dioctyl phthalate (DOP) smoke.

Use: To clean radioactive effluents from enclosures.

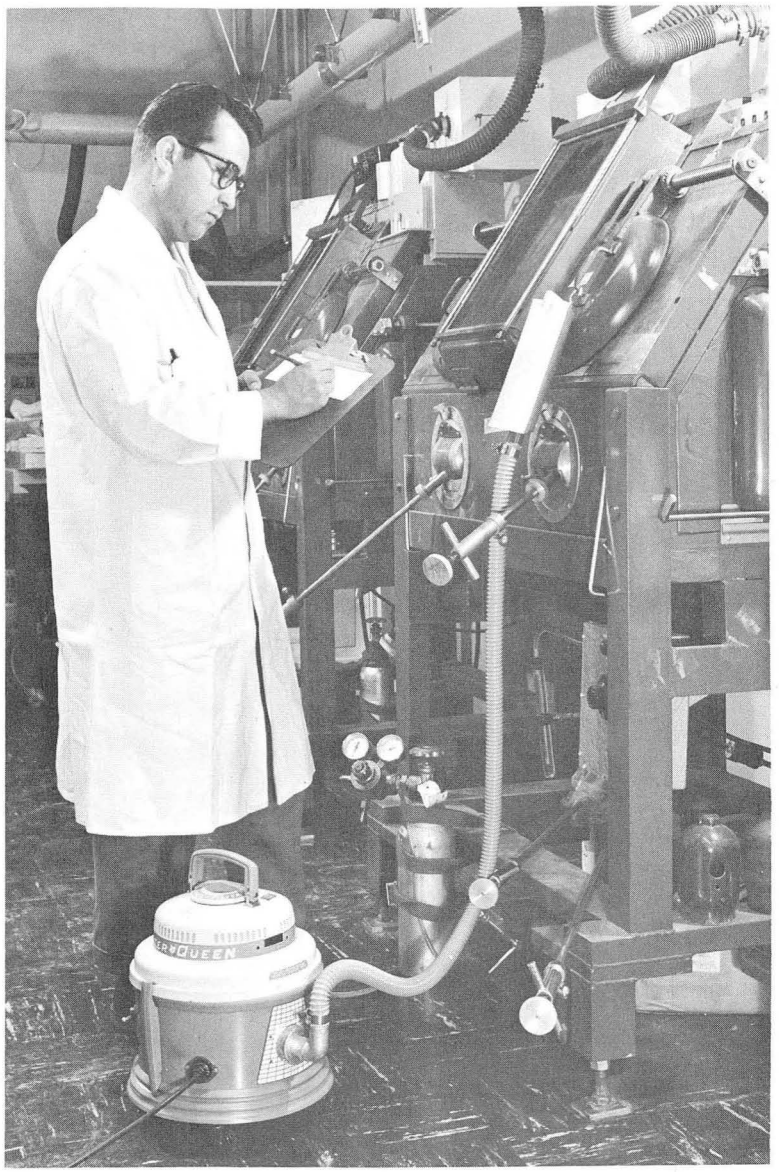


XBB 672-854

Item: 48-cfm charcoal filter.

Description: 1-in.-thick flat activated-charcoal canister set in holder.

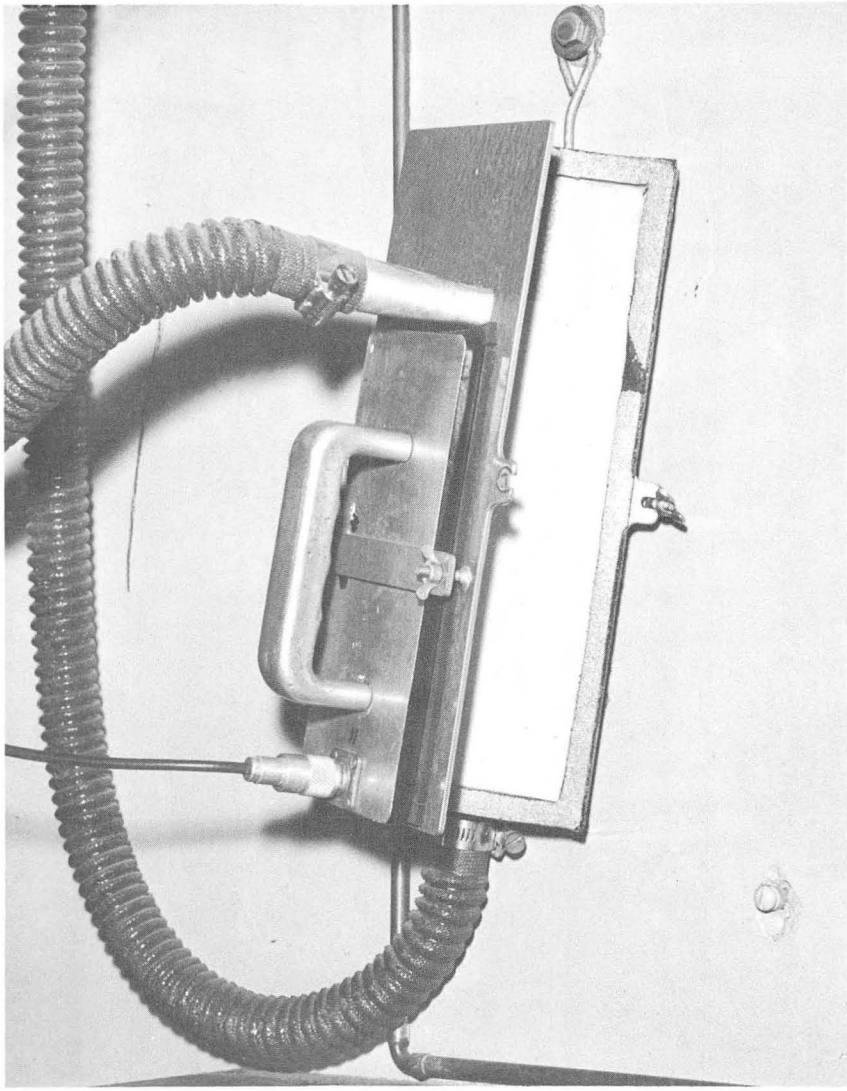
Use: Removal of radioiodine or other similar gases from an air stream.



HP 891

Item: Filter Queen air sampler.

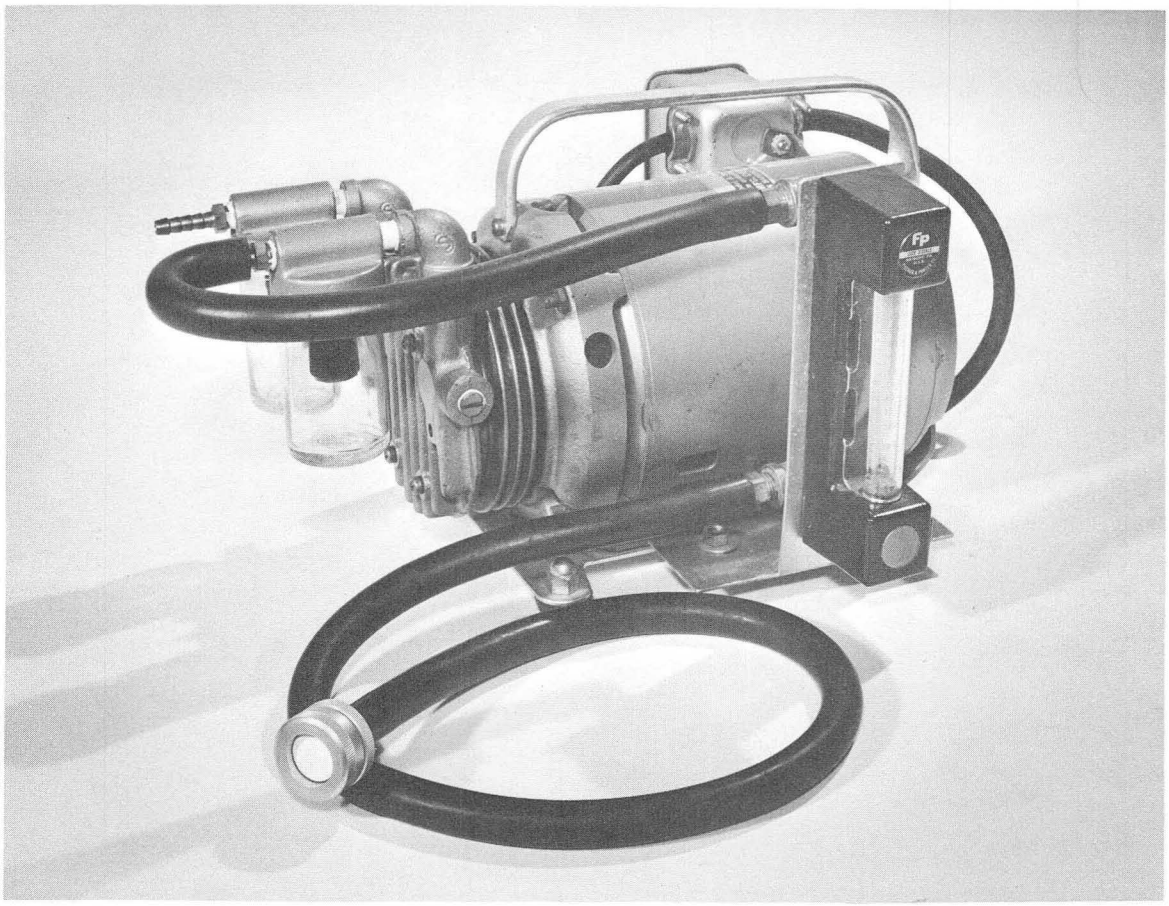
Description: 4 cfm air is drawn through a high-efficiency particulate filter to monitor in-laboratory environment. A switch can be turned to obtain a higher sampling rate of 15 to 20 cfm.



HP 996

Item: Air monitor for alpha emitters.

Description: Remote area is being sampled with a closed-head filter-paper holder. Buildup of alpha emitters can be monitored with a standard alpha-meter probe.

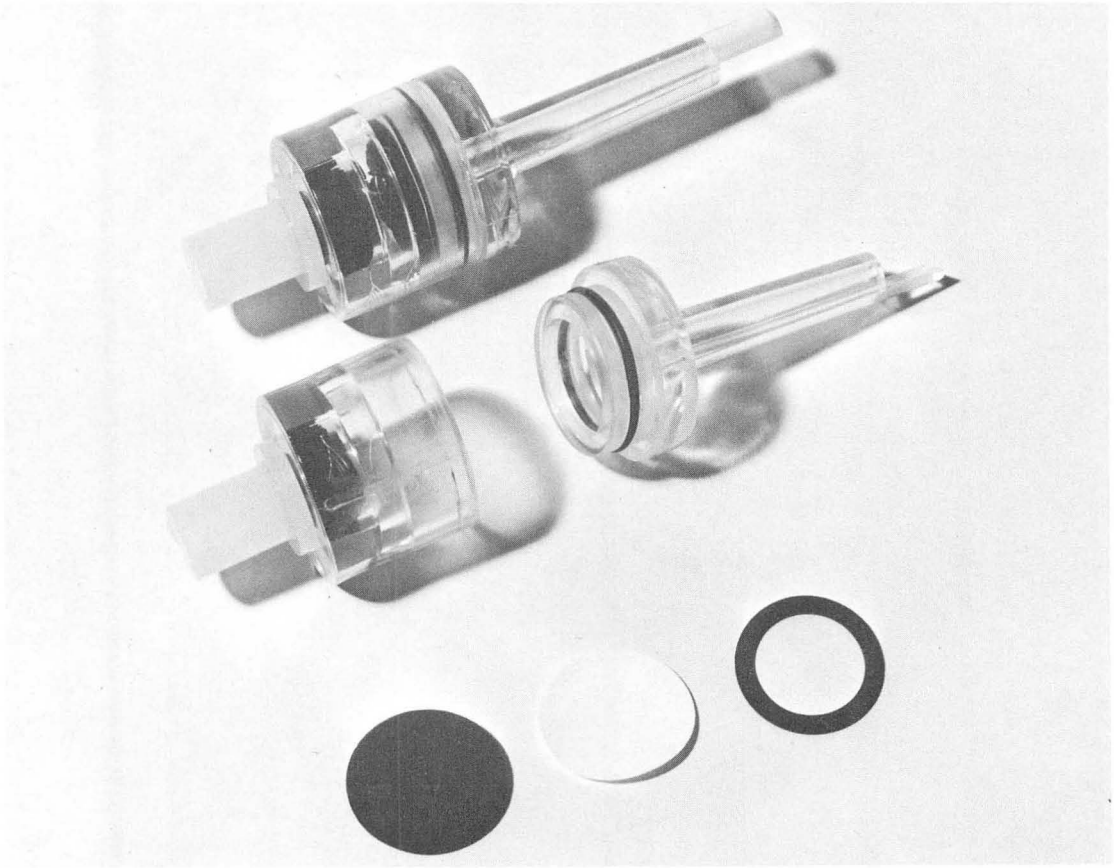


HP 1390

Item: Portable air sampler.

Description: A small carbon vane pump is used to pull air through a membrane filter and (or) a carbon disk at about 0.8 l/min.

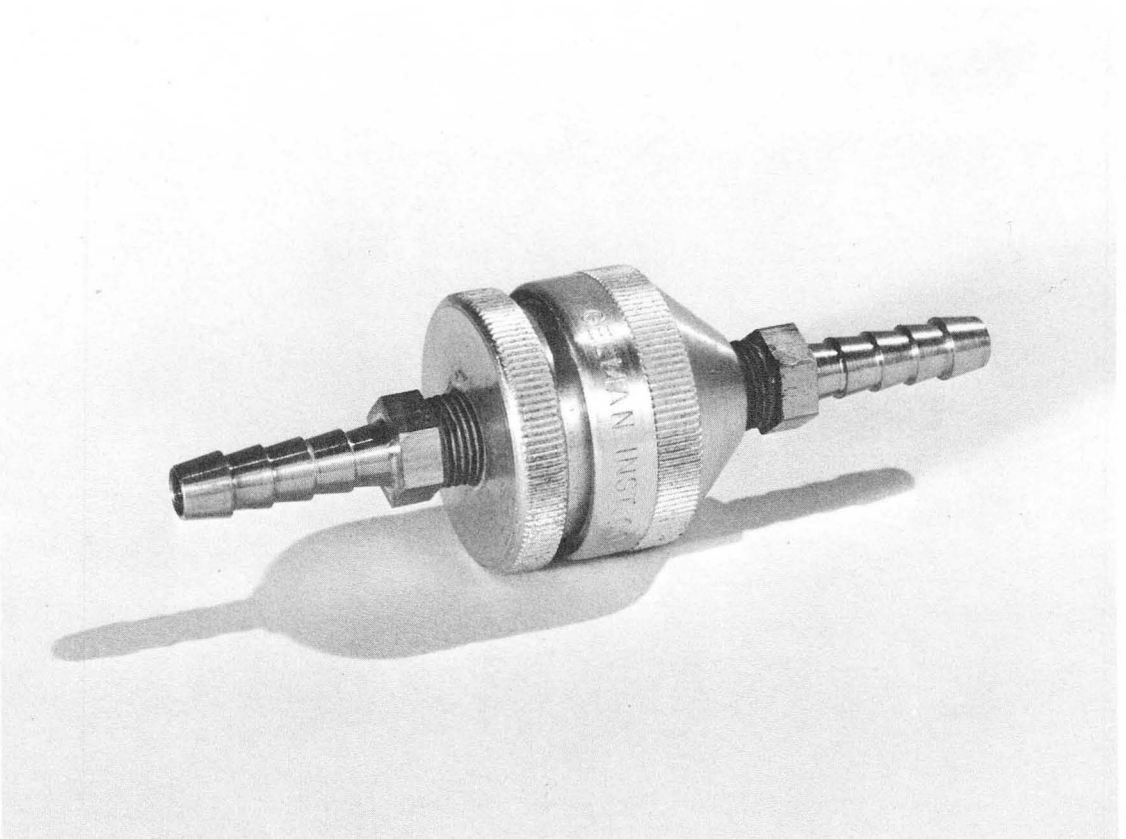
Use: To sample air in suspect areas for toxic dusts or for radioactive gases.



HP 1392

Item: Stack sampler.

Description: Plastic holder to house membrane filter and activated-carbon disk. These units are usually located at the roof and are used to monitor stack exhausts. The sampling rate is usually 2 l/m. Samples are checked for radioactive particulate matter and radioactive gases.

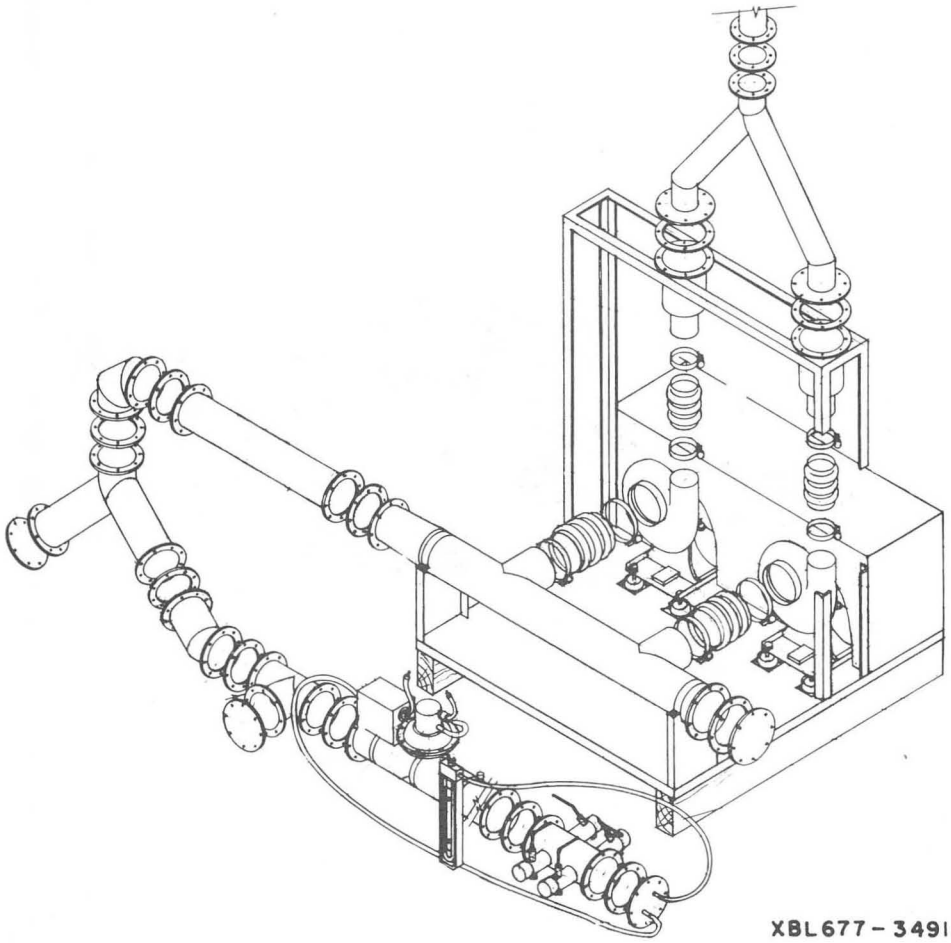


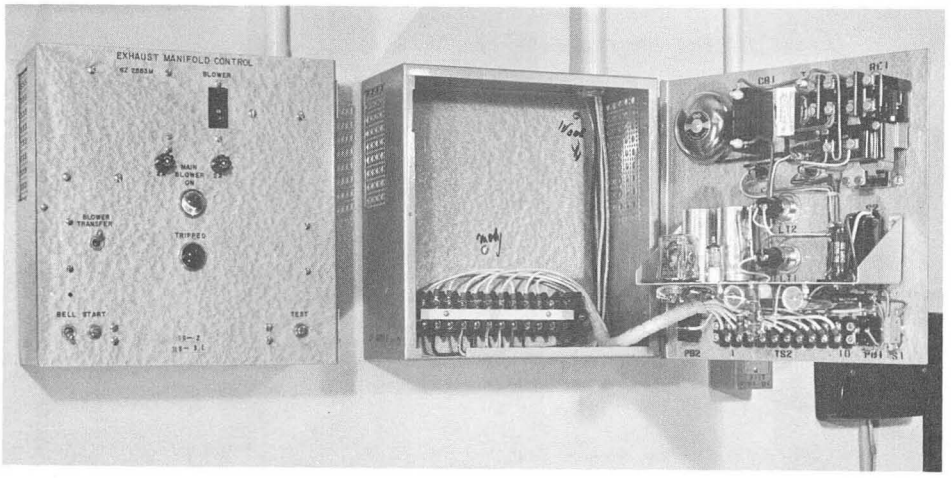
HP 1391

Item: In-line membrane filter holder.

Description: Aluminum holder to house a 1-in.-diam membrane filter.

Use: To monitor suspect areas for toxic dusts.



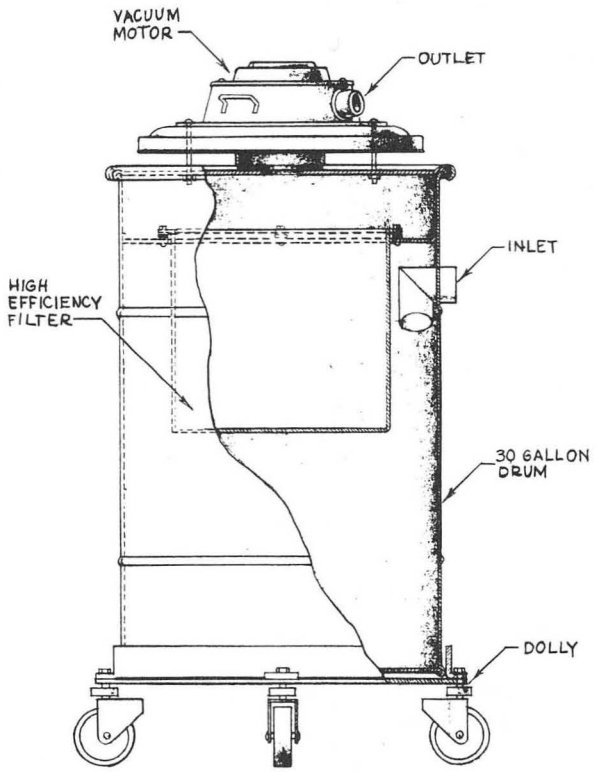


HP 968

Item: Berkeley-box manifold system.

Description: Coated metal duct to which gloved-boxes are connected for ventilation. The control unit assures continuous air flow at all times. If the manifold pressure should fall below a preset level due to failure of the primary exhauster, a standby exhauster is automatically activated; additionally, a red light and bell will sound an alarm.

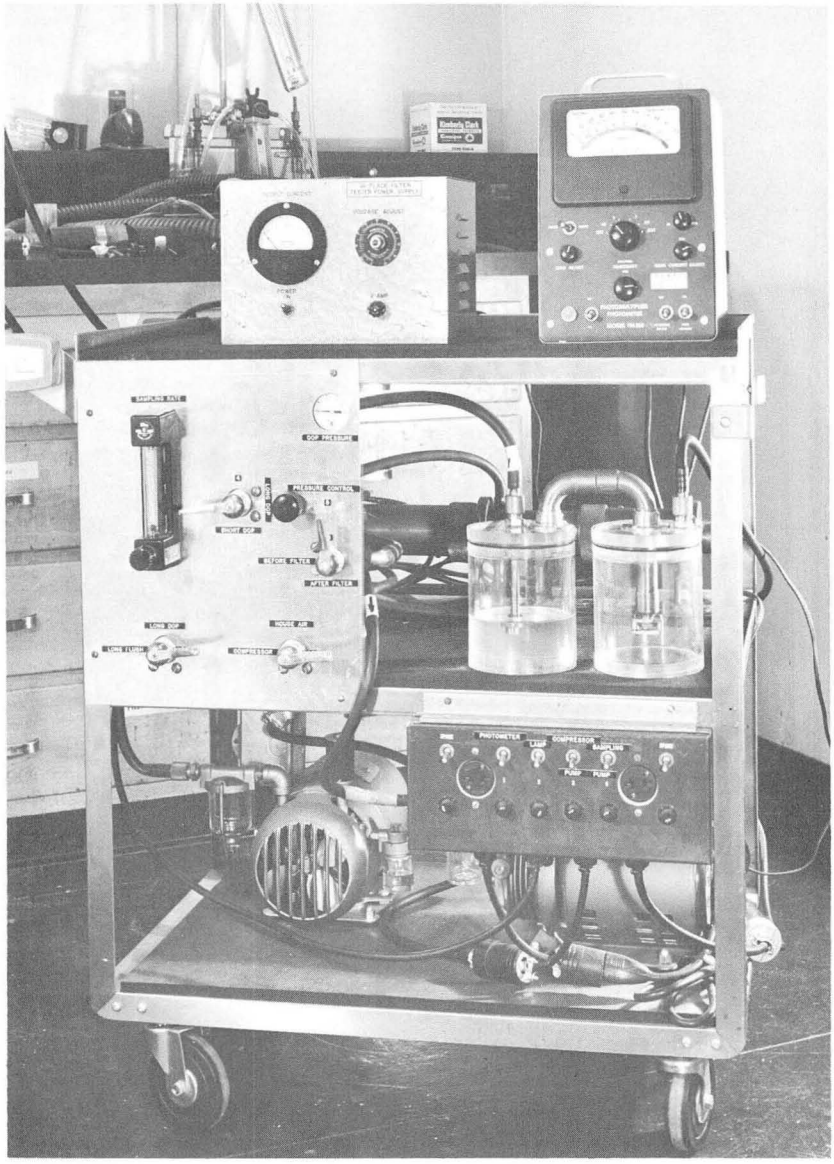
RADIOACTIVE DUST COLLECTOR



Item: Radioactive dust collector.

Description: This special vacuum cleaner consists of a cylindrical high-efficiency particulate filter built into a 30-gal drum. The drum is the reservoir for collected material. When the drum becomes full, or if the filter plugs up, the motor is removed and the drum is disposed of as active waste.

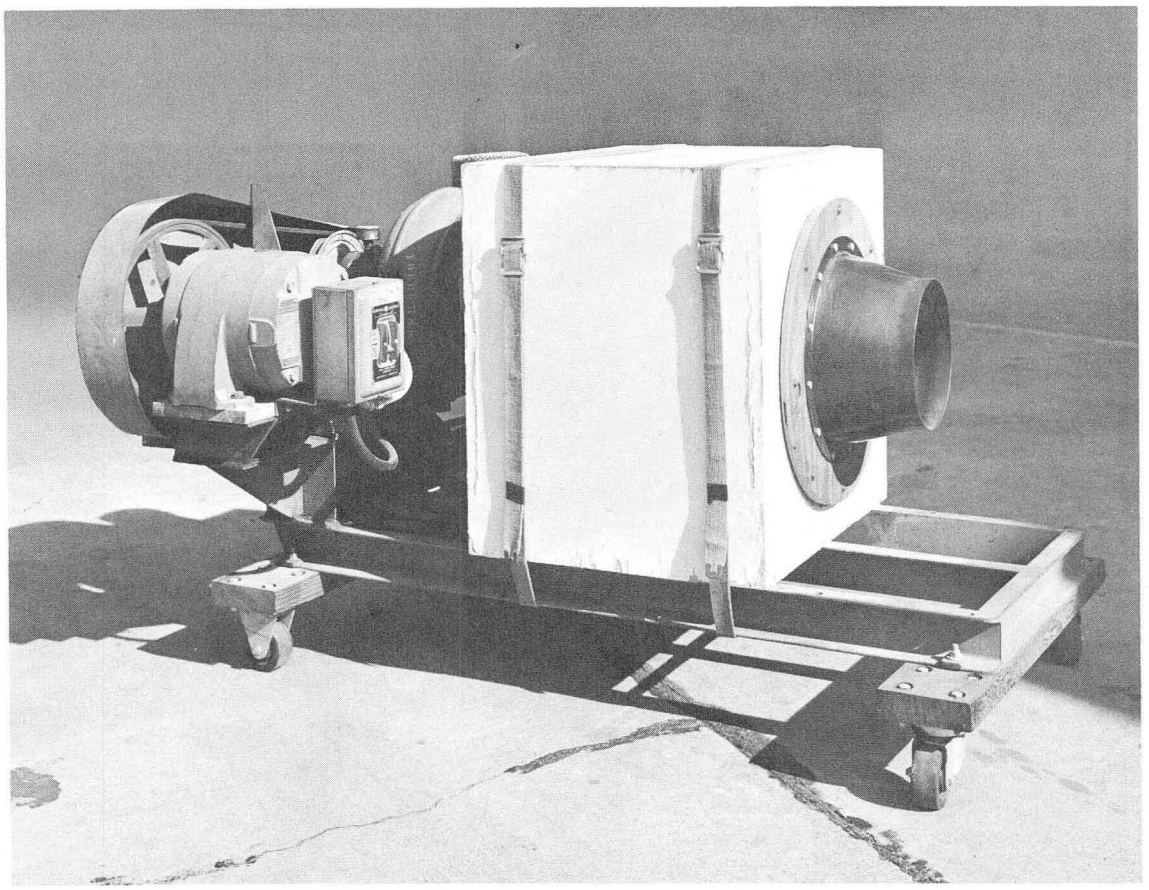
Use: To remove loose particulate contamination from large surfaces.



HP 1028

Item: Dioctyl phthalate (DOP) filter test apparatus.

Description: High efficiency particulate filters are periodically checked for efficiency with (DOP) smoke. The apparatus consists of a DOP generator, a forward light-scattering chamber, and a photomultiplier photometer.

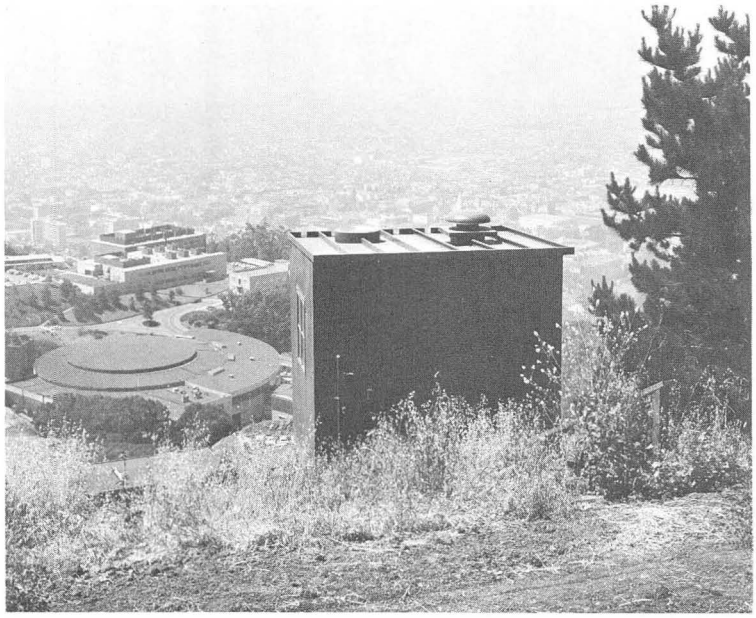


XBB 672-911

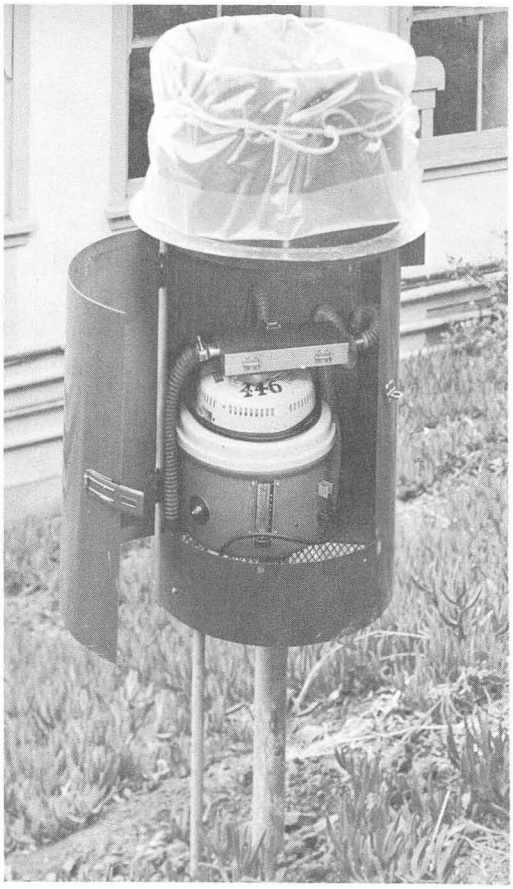
Item: Portable high-efficiency filtered exhauster.

Description: High-efficiency particulate filter and exhauster mounted on dolly. Capacity about 600 cfm.

Use: To exhaust an air space containing airborne radioactive contaminants.



HP 1002



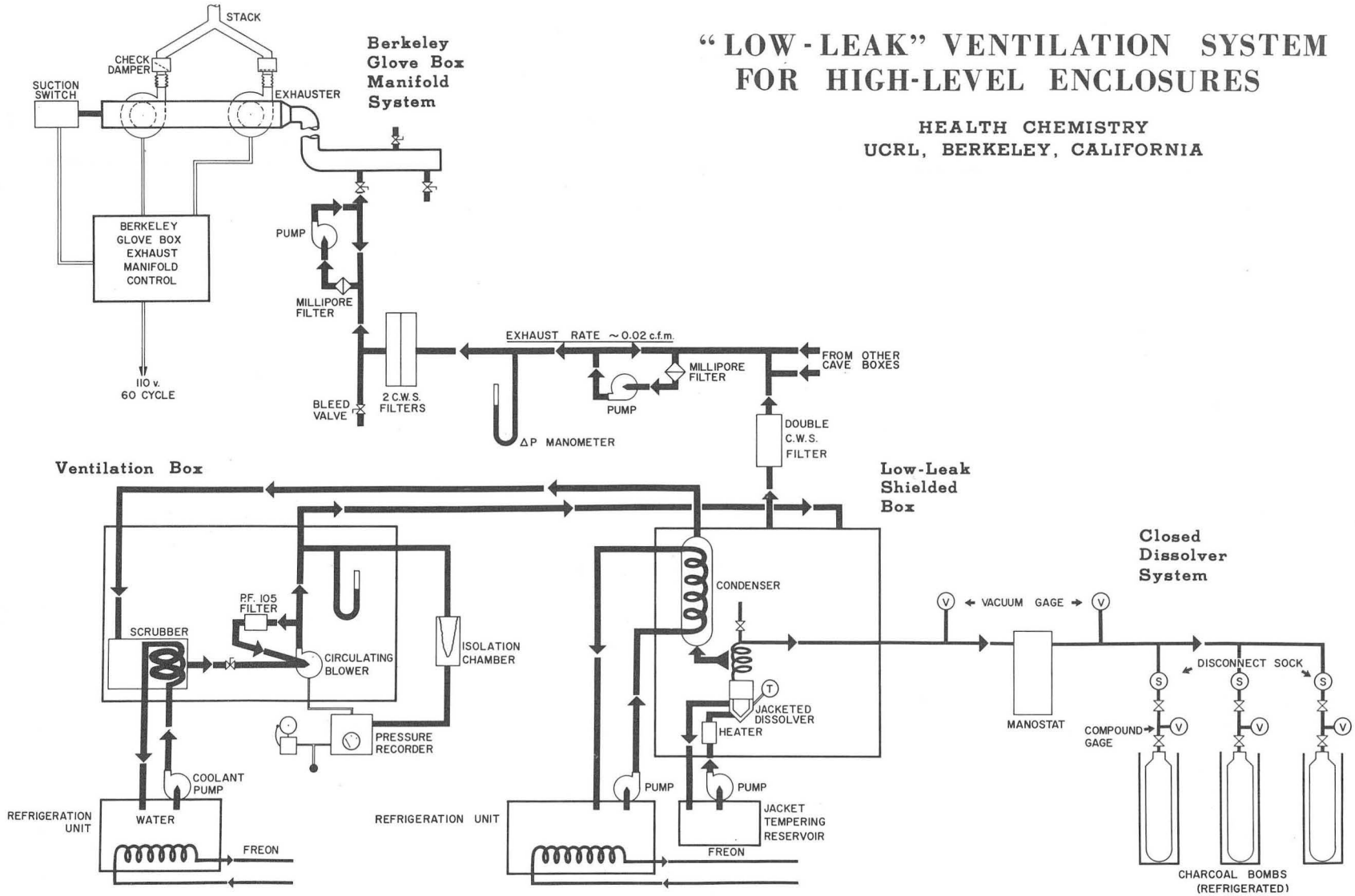
HP 981

Environmental Sampling Stations

These stations are scattered at various locations around the Lab. Rain, deposition, and air samples are taken. The purpose is to assess the amount of radioactivity contributed to the environs by the laboratory's operations. Fallout from atomic-weapons tests is also assessed.

"LOW-LEAK" VENTILATION SYSTEM FOR HIGH-LEVEL ENCLOSURES

HEALTH CHEMISTRY
UCRL, BERKELEY, CALIFORNIA



VENTILATION FOR LOW-LEAK SYSTEM

LOW-LEAK VENTILATION SYSTEMS ARE USED FOR HIGH-LEVEL SHIELDED ENCLOSURES BECAUSE FILTRATION EFFICIENCY IS GREATER WHEN FACE VELOCITIES THROUGH THE FILTER ARE LOW.

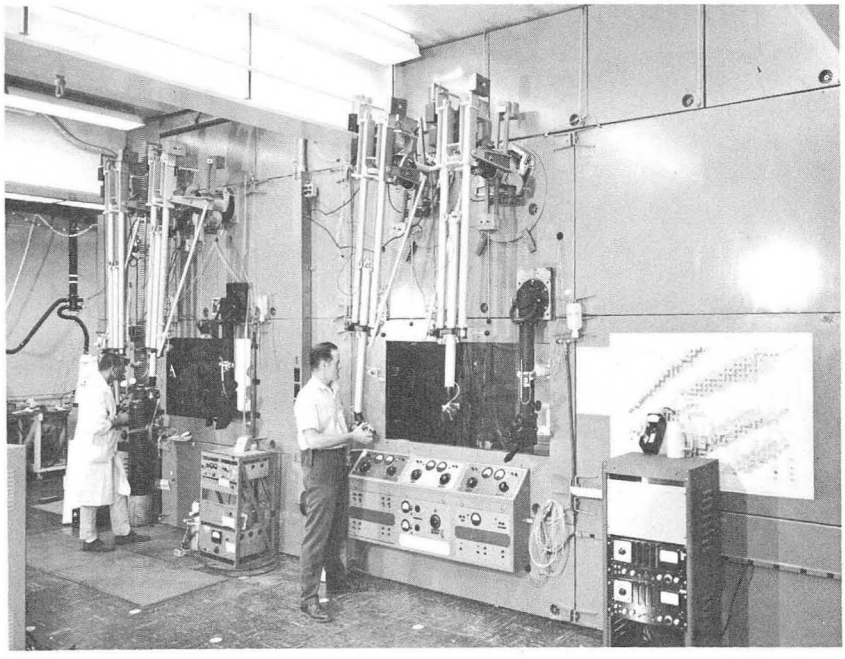
EACH ENCLOSURE IS EQUIPPED WITH AN INDIVIDUAL SCRUBBER UNIT FOR REMOVING CHEMICAL FUMES (PRODUCED IN MANY OF THE PROCESSING STEPS IN THE ENCLOSURE) AND EXCESS MOISTURE. THE AIR FROM THE ENCLOSURE CIRCULATES REPEATEDLY THROUGH A BUFFERED SCRUBBER SOLUTION (FOR REMOVING BOTH ACIDIC AND BASIC FUMES).

AT THE SAME TIME, AN EXHAUST SYSTEM TO WHICH ALL THE ENCLOSURES ARE CONNECTED MAINTAINS A SLIGHT VACUUM SO THAT AIR LEAKS GRADUALLY INTO THE ENCLOSURE FROM THE SURROUNDINGS. THE EXHAUST IS TAKEN FROM THE ENCLOSURE THROUGH A CWS FILTER, THEN THROUGH A LOOP (WITH ITS OWN PUMP) WHICH PASSES IT REPEATEDLY THROUGH A MEMBRANE FILTER AT 0.6 CFM; A FINAL BLOWER MOVES THE EXHAUST THROUGH A LARGE DOUBLE CWS FILTER INTO THE ATMOSPHERE AT A RATE OF ABOUT 0.02 CFM.

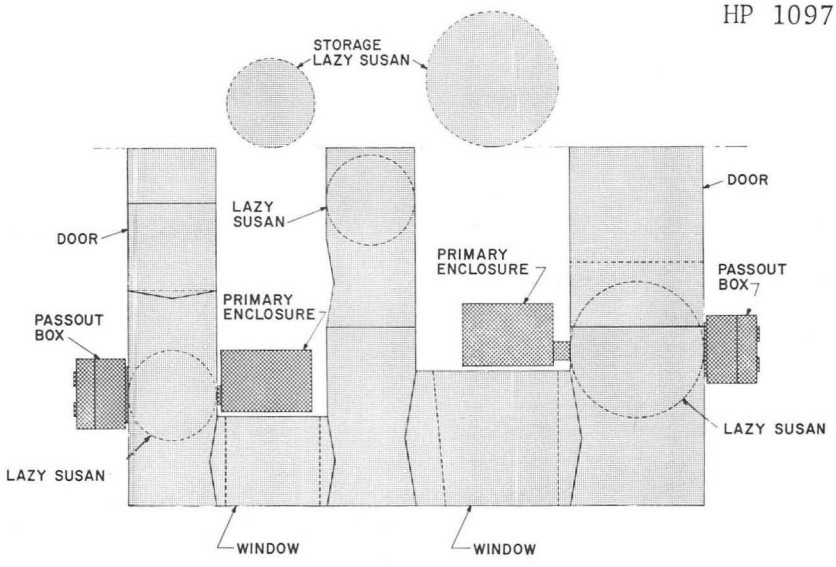
CLOSED DISSOLVER SYSTEM

THE RADIOACTIVE GASES AND OTHER BY-PRODUCTS LIBERATED OR PRODUCED DURING THE DISSOLVING OF A PILE-IRRADIATED SLUG ARE COMPLETELY CAPTURED BY A BOMB CONTAINING 170 G ACTIVATED CHARCOAL. THE BOMB IS REFRIGERATED BY A MIXTURE OF BUTANOL AND SOLID CO_2, WHICH PRODUCES A TEMPERATURE OF -77° C. AT THIS TEMPERATURE THE VOLUME OF GAS THE BOMB CAN ABSORB IS 40 TO 45 TIMES ITS OWN VOLUME. SUCTION IN THE CLOSED DISSOLVER IS MAINTAINED AT 5 INCHES OF HG BY A MANOSTAT. THE CHARCOAL BOMB ITSELF IS EVACUATED TO 30 INCHES OF HG BEFOREHAND. UPON COMPLETION OF THE DISSOLVING STEP, THE BOMB AND ITS CONTENTS ARE TREATED AS SOLID RADIOACTIVE WASTE.

MUB-339

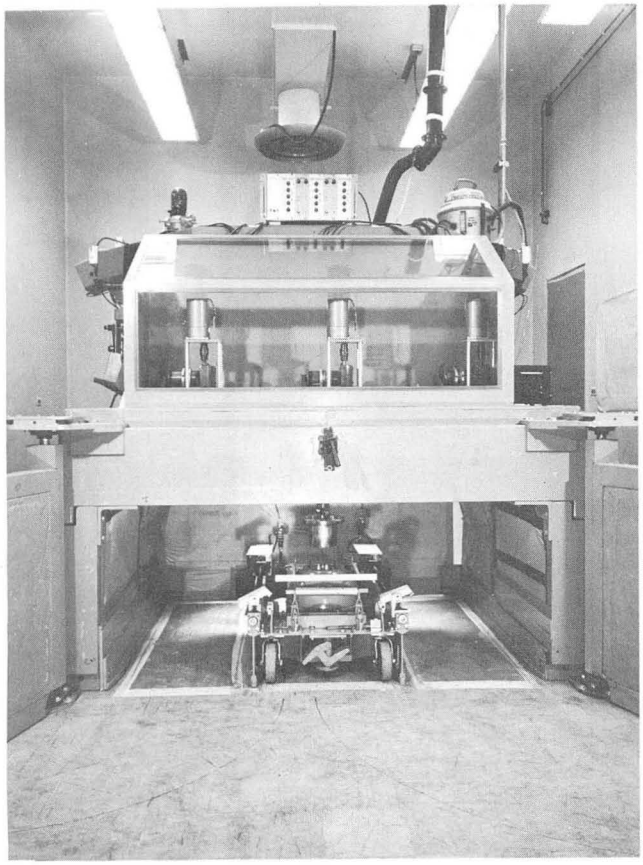


HP 1097

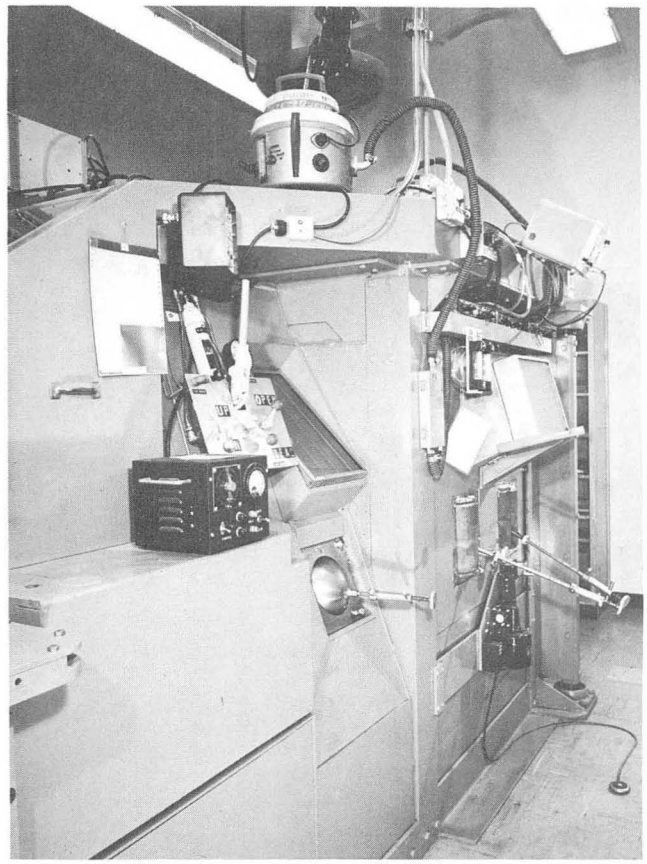


Water-Shielded Cave Facilities

This represents an efficient, flexible, and relatively simple system of enclosures for the handling of multicurie amounts of alpha, gamma, and neutron-emitting isotopes. This system consists basically of interlocking 4-ft or 6-ft water tanks that form the shielding around the leaktight primary enclosure in which operations are conducted by means of totally socked master-slave manipulators. This facility has been successfully used for procedures ranging from multicurie chemical separations to highly refined microtechniques. It has served equally well for metallurgical examinations and remote machinery and welding procedures.



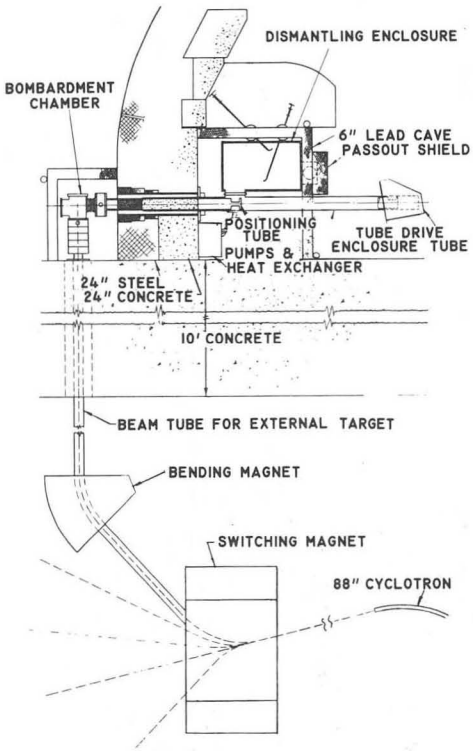
XBB 676-3342



CBB 676-3343

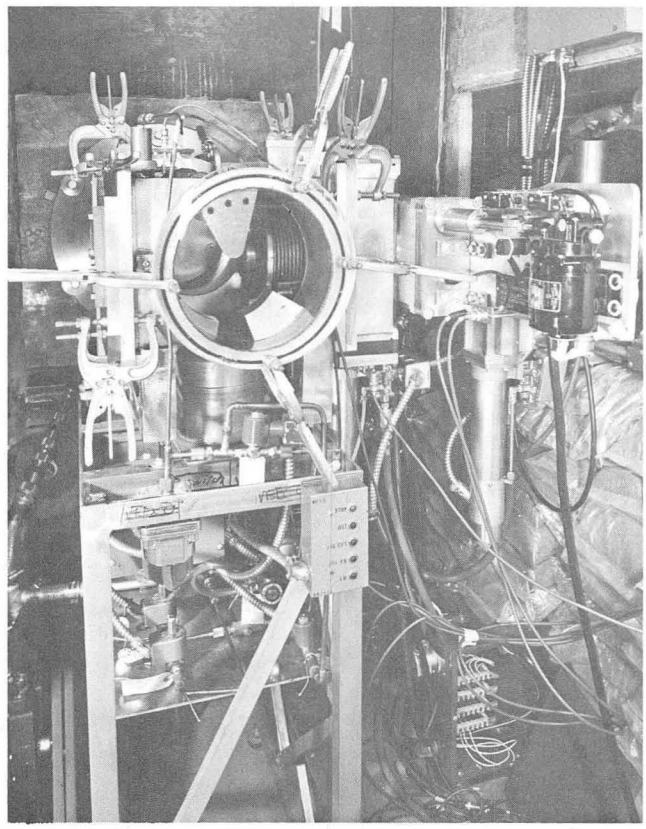
6-Inch Lead Capsule-Opening Cave

This cave is operated by Health Chemistry for remotely opening, repackaging, and dividing irradiated material from the reactor. This service enables the researcher to receive any portion of his irradiated material in a clean container for his experimental work and saves the cost to the individual researcher of having his own elaborate remote-handling facility.

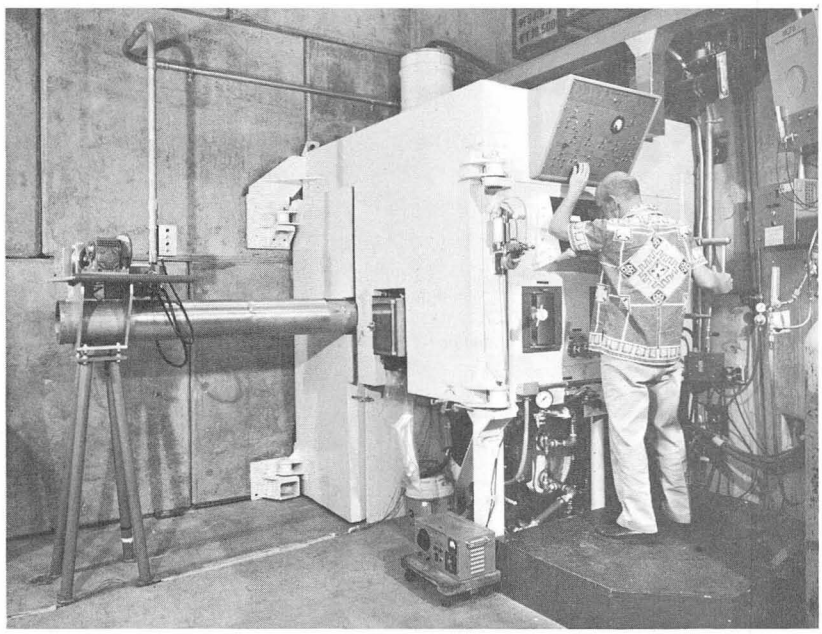


EXTERNAL TARGET SYSTEM OF 88" CYCLOTRON

MUB-1028



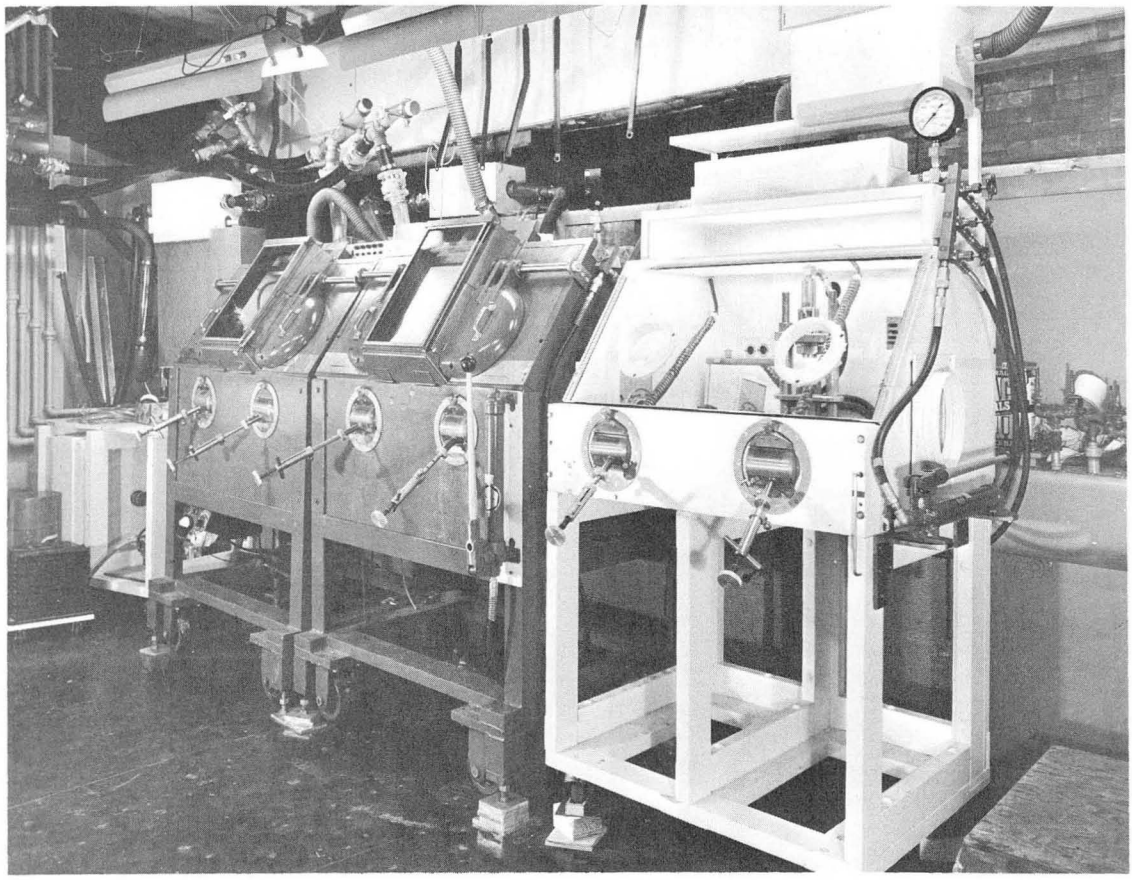
HP 1094



HP 1096

88-Inch-Cyclotron Target Handling System and Dismantling Cave

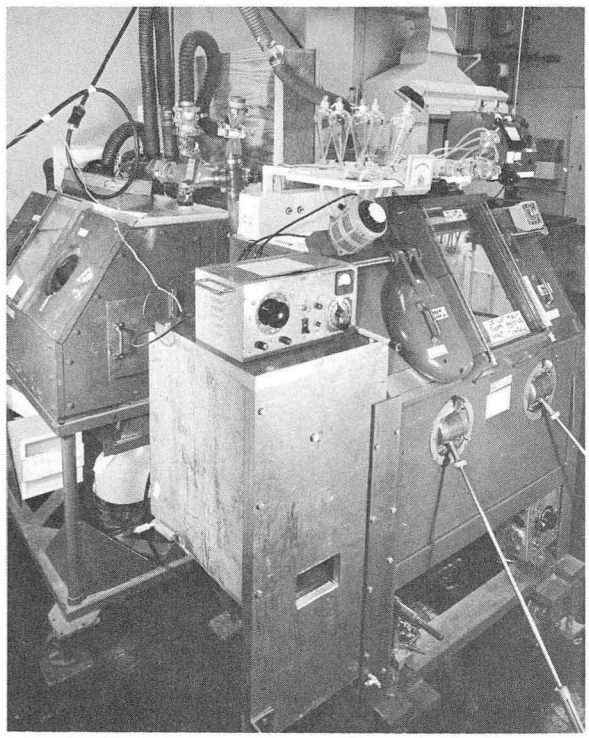
System carries water- and helium-cooled targets to bombardment position and back by remote control. Targets are dismantled behind a 6-in. lead enclosure and are then passed out into lead containers.



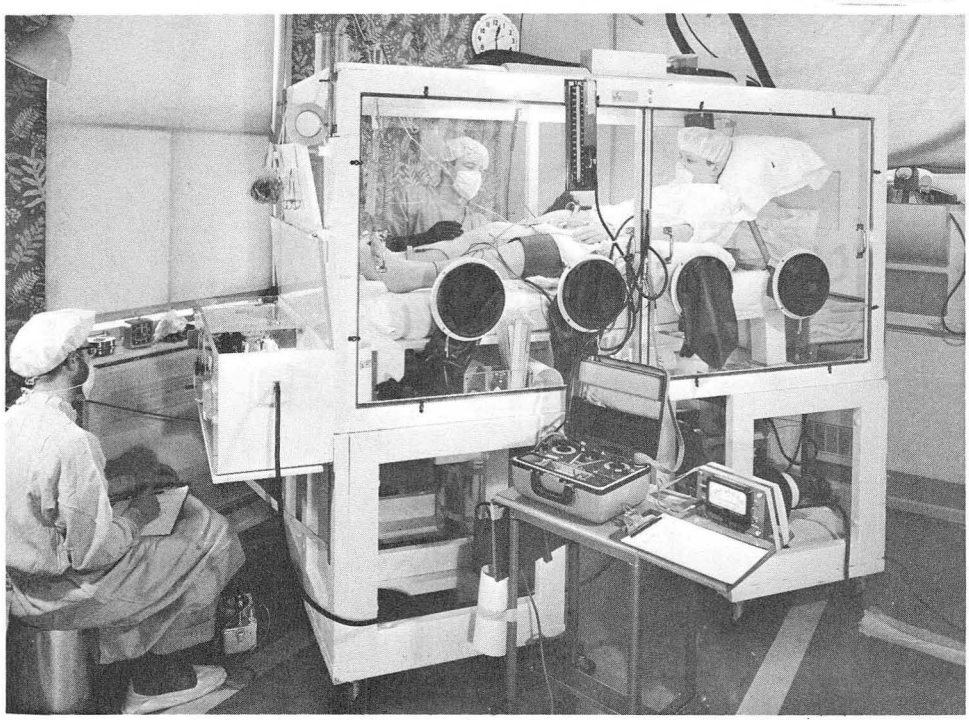
HP 717

Encapsulation Train

Multicurie quantities of alpha emitters processed from the water-shielded facility are packaged into capsules in this train. The capsules are then sent back to various reactors for further enrichment in higher radioisotopes. This train consists of a chemistry box, an encapsulation box, and a final capsule box.



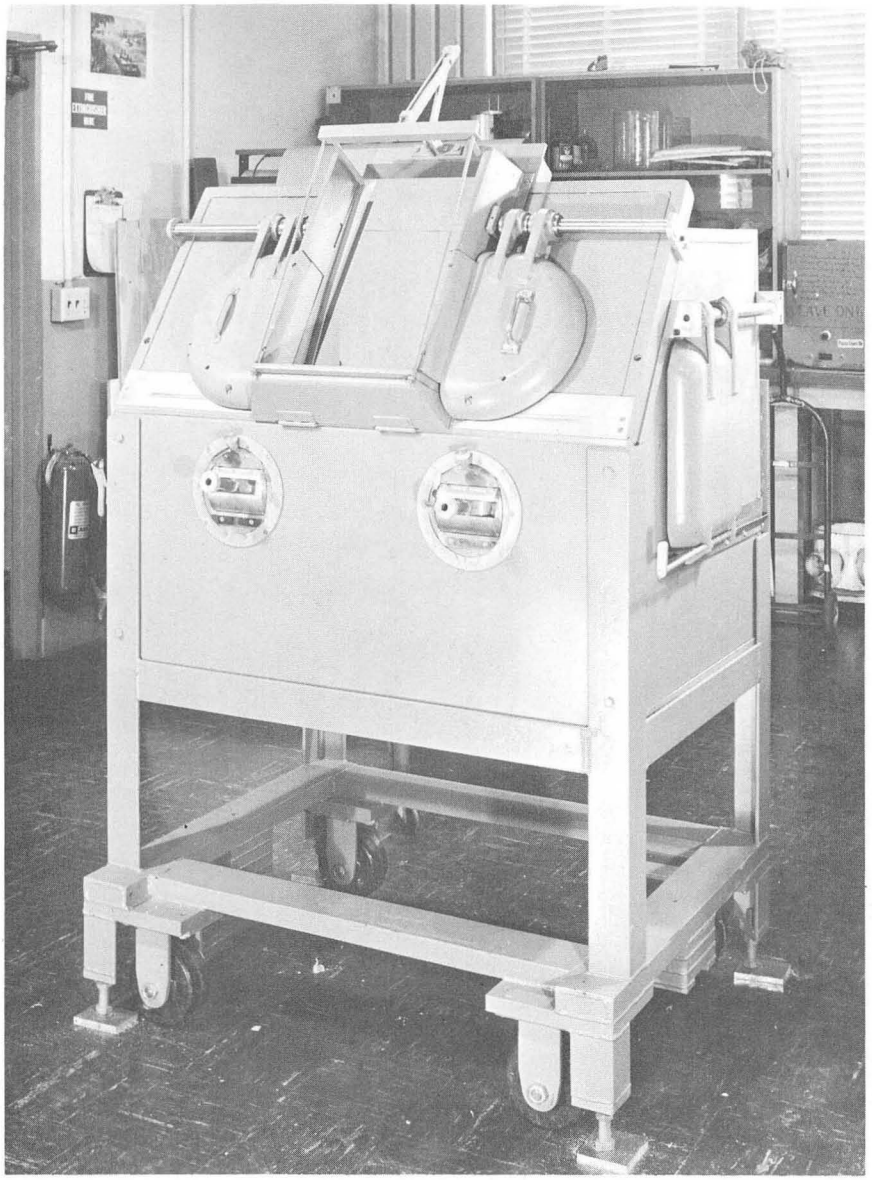
JHL 3096



JHL 3075

Human Irradiation Facility

The upper photo shows the processing train for separating ^{90}Y from a multicurie ^{90}Sr cow. The highly purified ^{90}Y is then injected into a human (lower photo) to arrest the antibody response of the lymph system to foreign bodies. In this case the operation is a kidney transplant in a human.

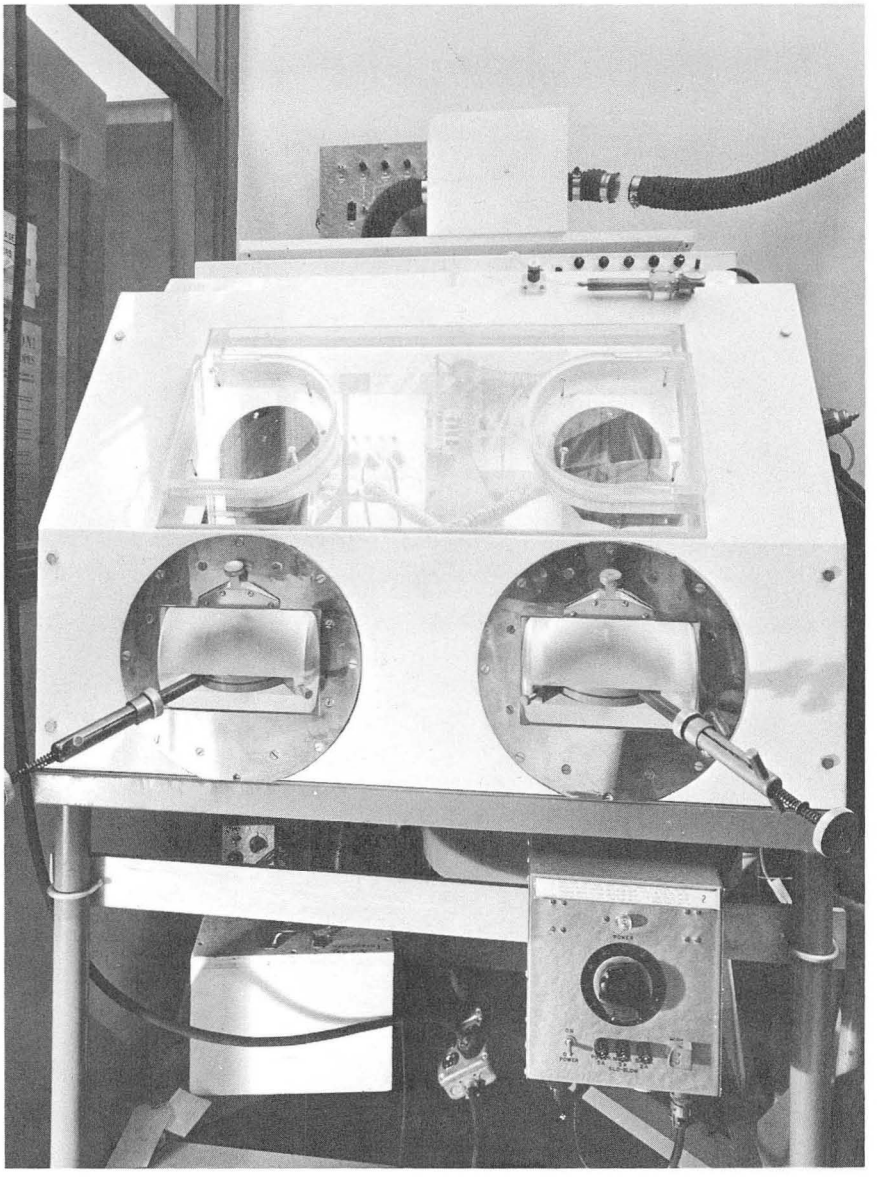


HP 1008

Item: Health Chemistry 2-in. lead shield (junior cave).

Description: Gloved box is housed behind 2-in. lead shielding with castle manipulators.

Use: Shielding against beta and gamma radiation.

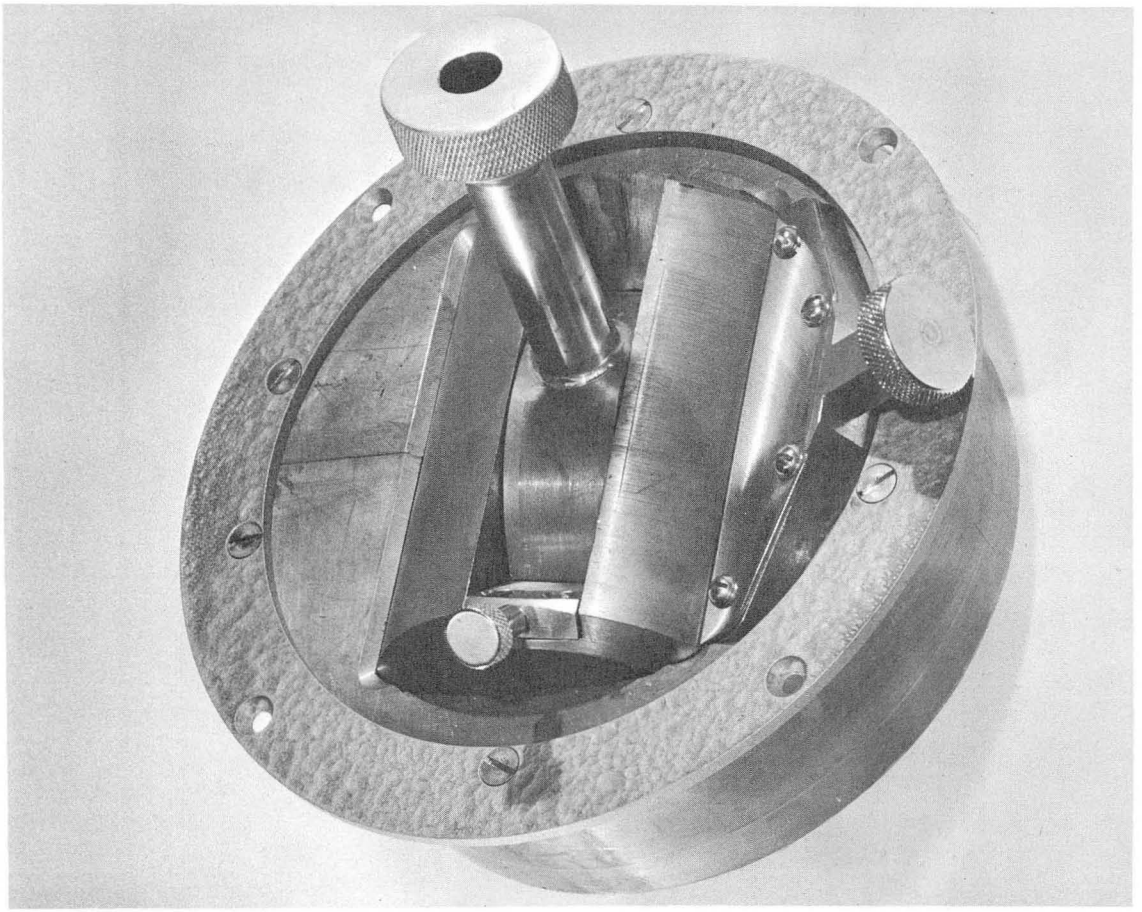


HP 788

Item: 4-in. Lucite and paraffin shield for neutrons.

Description: Gloved box is housed behind 4-in-thick Lucite shielding with castle manipulators.

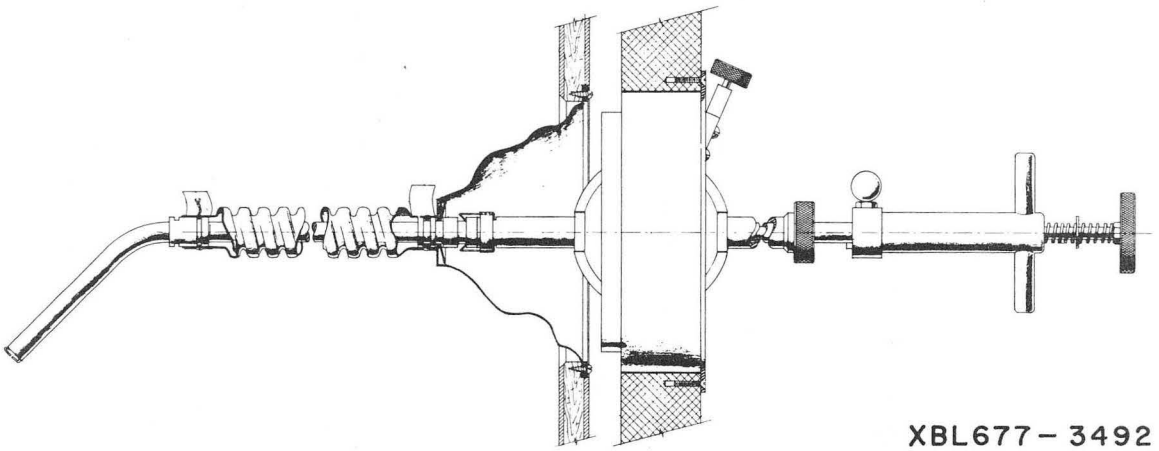
Use: Shielding against neutrons.



HP 529

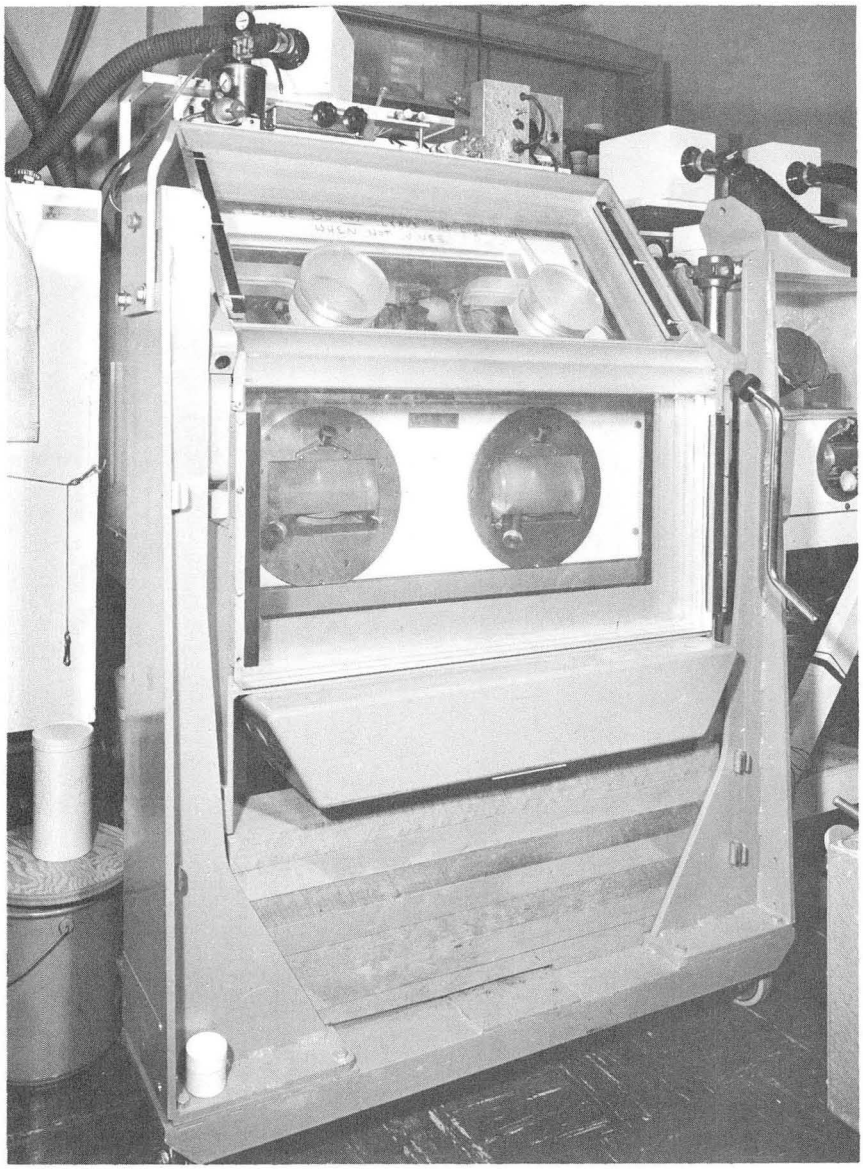
Item: Castle manipulator.

Description: A tong is inserted through the opening in a castle manipulator to provide remote access into a shielded enclosure. The tong has x, y, and z motion. Manipulators are made for 2- or 6-in. lead shields for gamma shielding or 4-in acrylic resin for neutron shielding.



Item: Tong, sock, and castle manipulator assembly.

Use: Socking technique used to protect tong and castle manipulator from contamination.

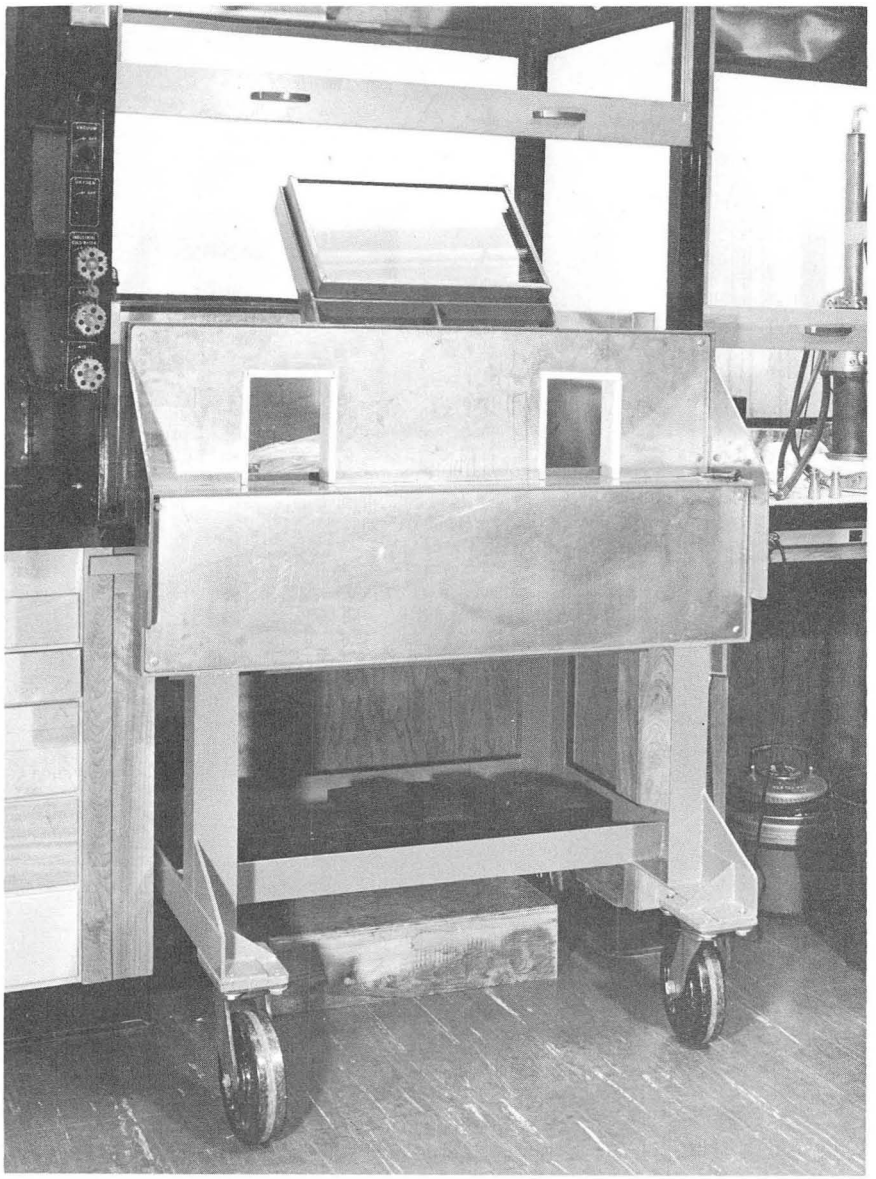


XBB 671-70

Item: Movable gloved-box neutron shield.

Description: 4-in.-thick acrylic-resin shielding; movable in vertical plane; upper portion can tilt up to 90 deg from vertical.

Use: Shield can be moved up to an unshielded box to provide protection from neutrons.

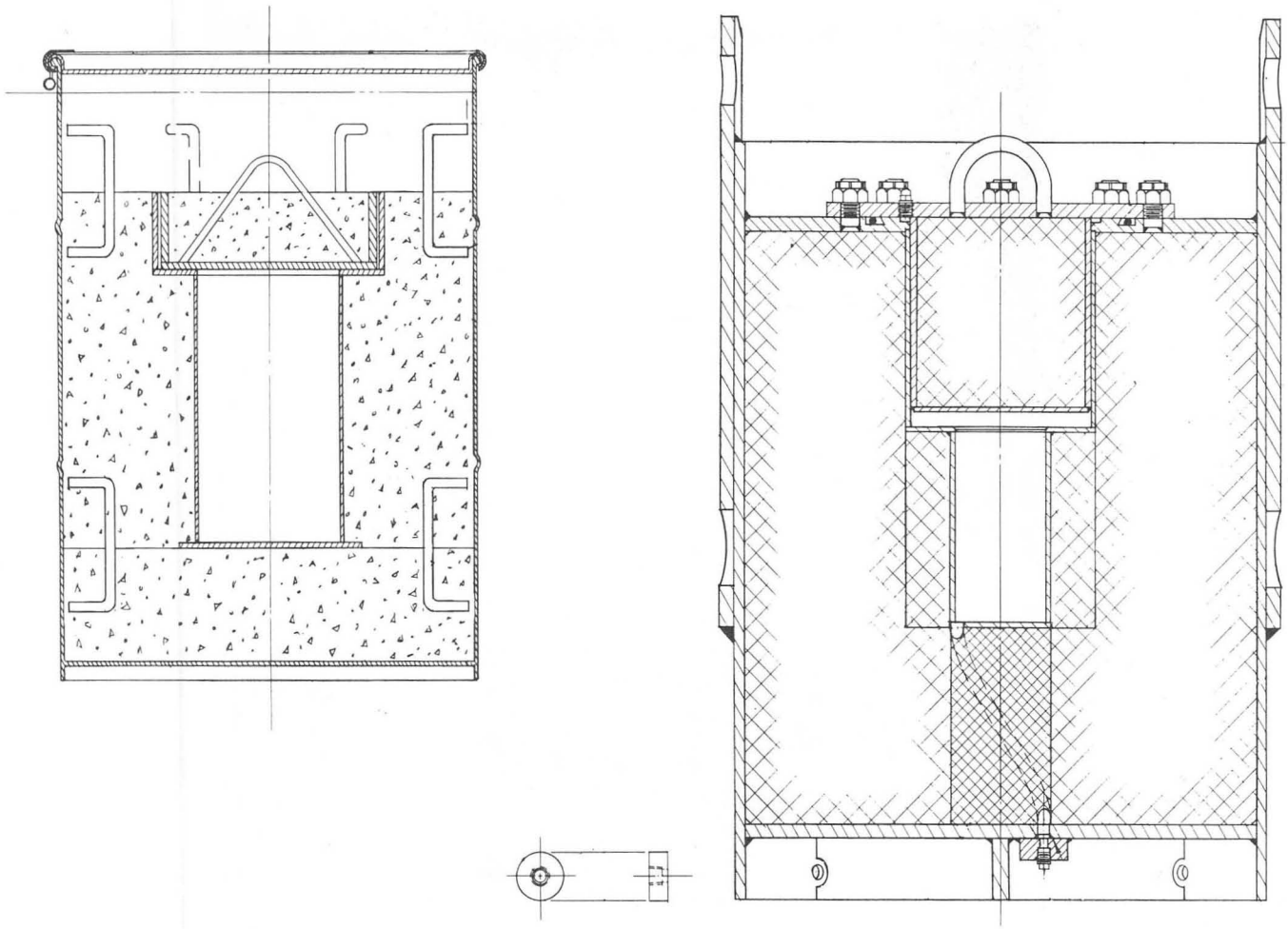


XBB 671-72

Item: Portable hood shield.

Description: 2-in.-thick lead shielding on oversized casters for easy movement.

Use: For body protection from gamma radiation from work in hoods.



XBL 667-3493

Typical shipping containers

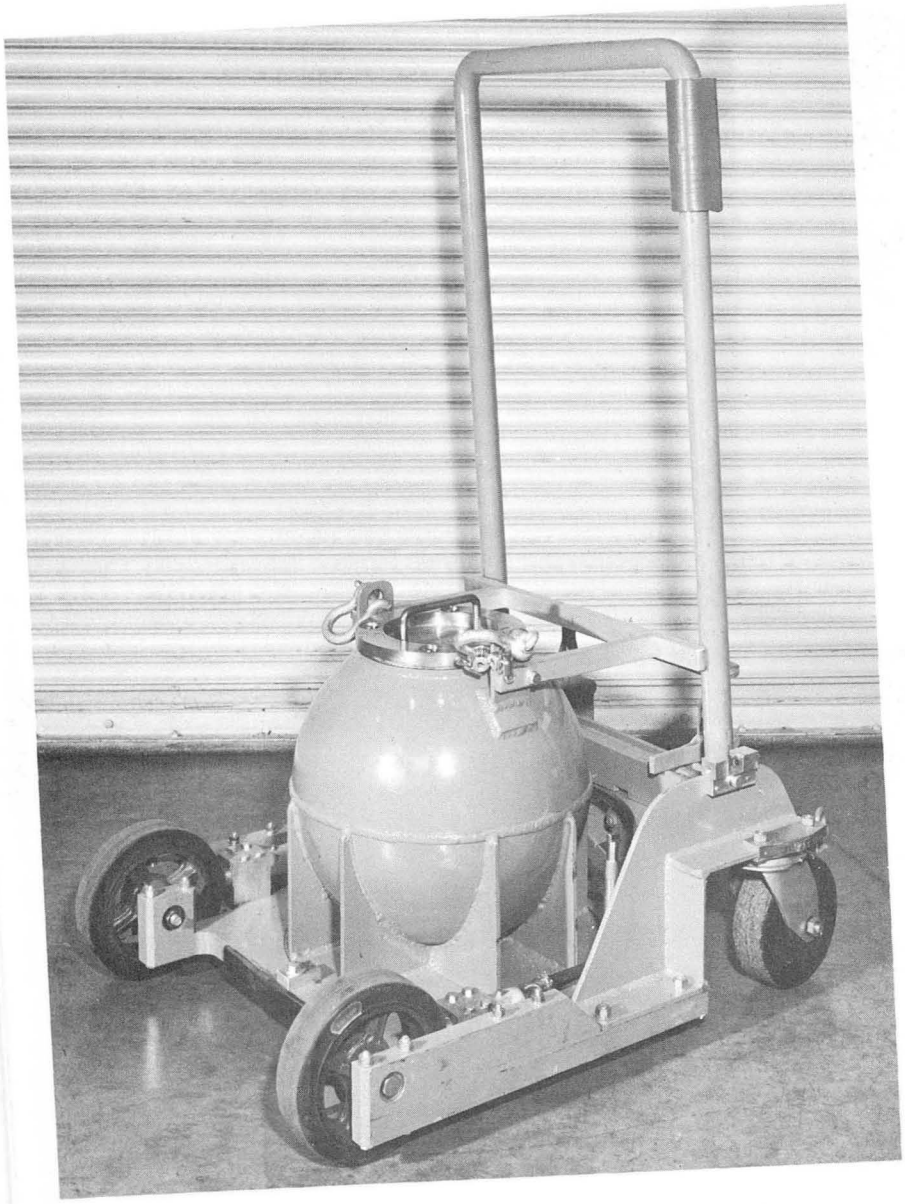
Containers used to ship high-level radioisotopes from one site to another. They conform to Interstate Commerce Commission (I.C.C.) regulations.

HP 494

Item: Nested shipping containers.

Description: Natural uranium construction, lined with stainless steel. Smallest unit can be used separately, or nested within intermediate or largest unit to provide additional shielding. Cavity sizes (left to right): 1-1/2 by 3 in., 3-3/4 by 5-1/4 in., 8 by 9-3/4 in.

Use: Safe transportation of highly radioactive materials.

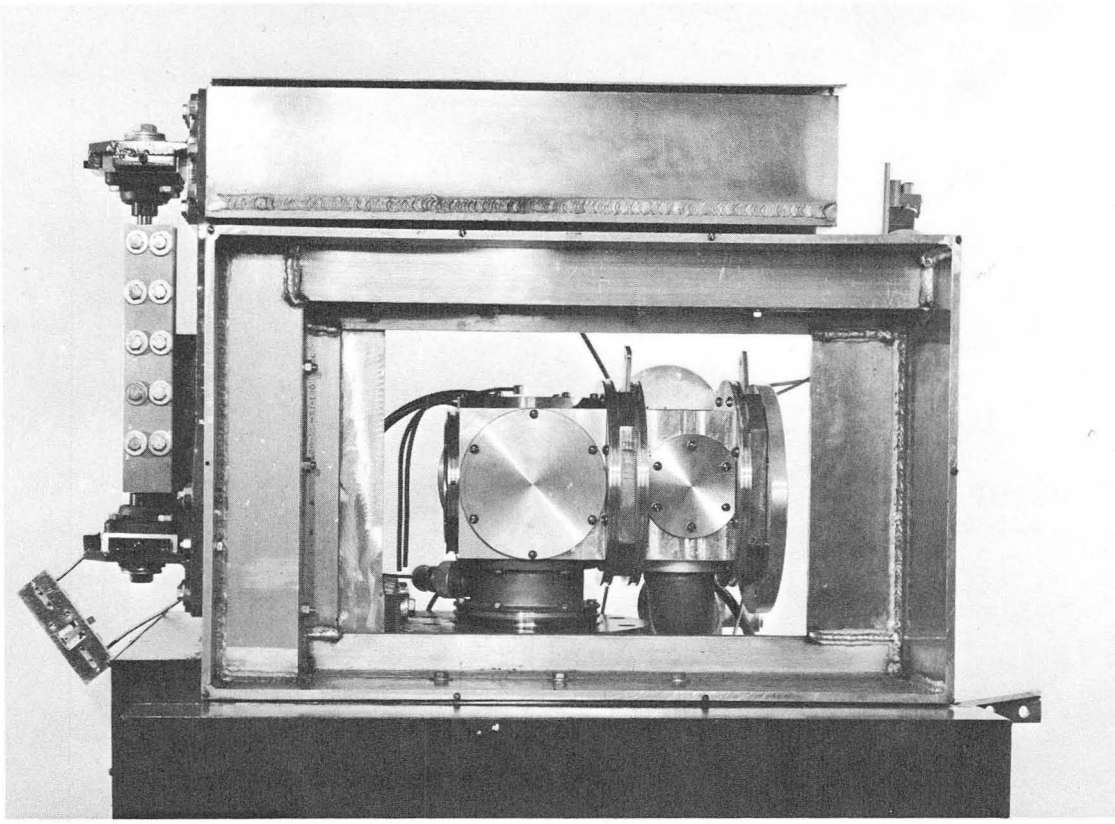


XBB 671-59

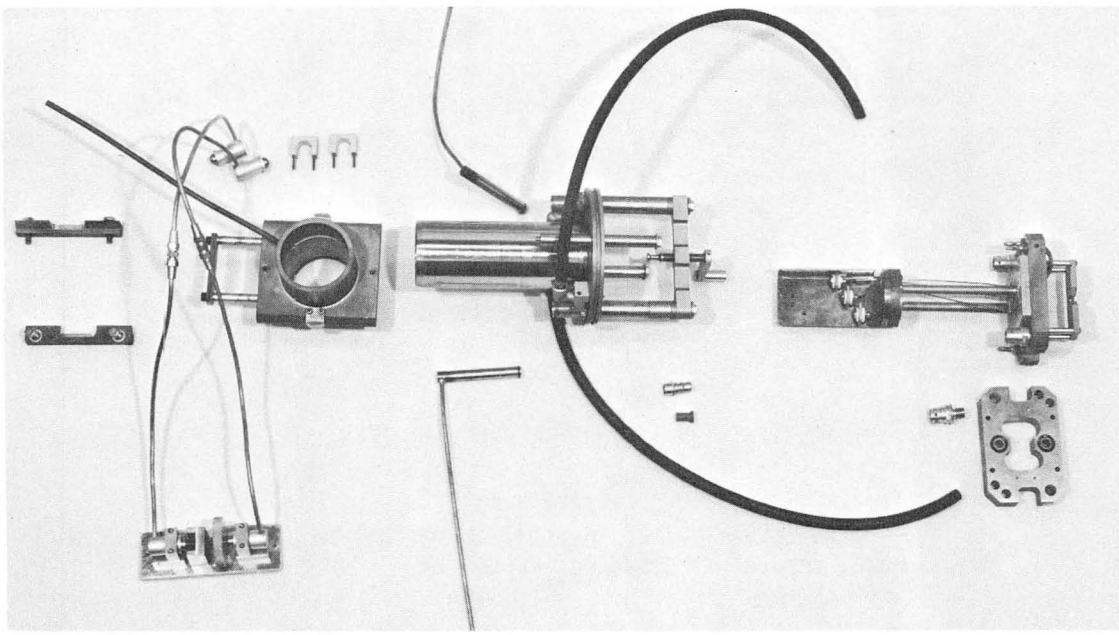
Item: 88-Inch-Cyclotron capsule-shipping cart.

Description: Spherical 6-in. lead shielding container mounted on dolly. Cavity size: 3¼ in. i.d. by 4 in. long.

Use: To transport highly radioactive targets from the 88-Inch Cyclotron to the researcher.



HP 1322



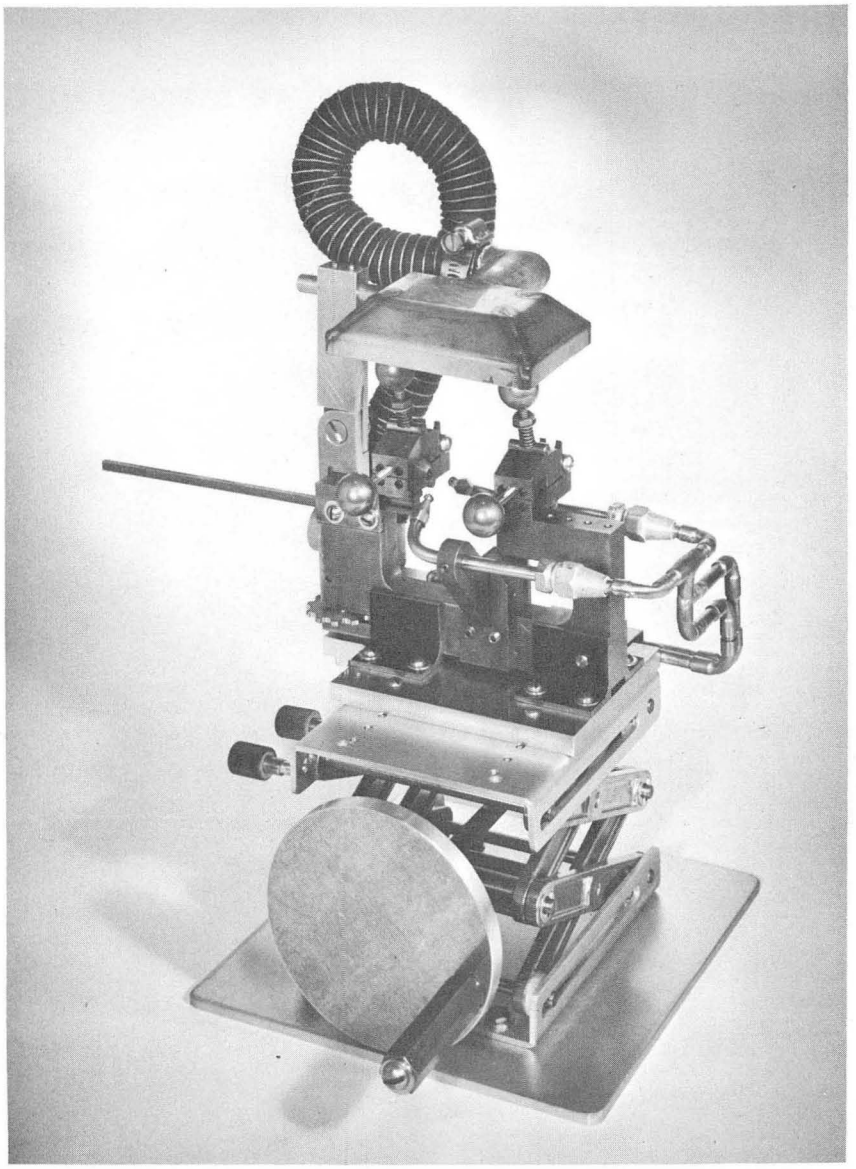
HP 1333

Item:

Upper: Atomic beam shielding frames and chambers.

Lower: Oven-loader elements.

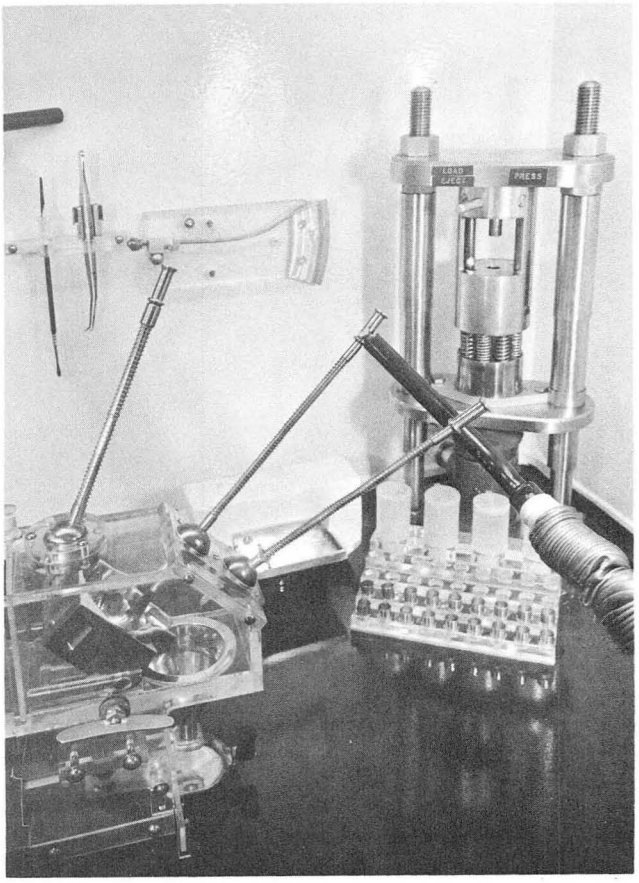
Use: Apparatus for shielding against gamma radiation and for remote manipulations on the atomic-beam machine.



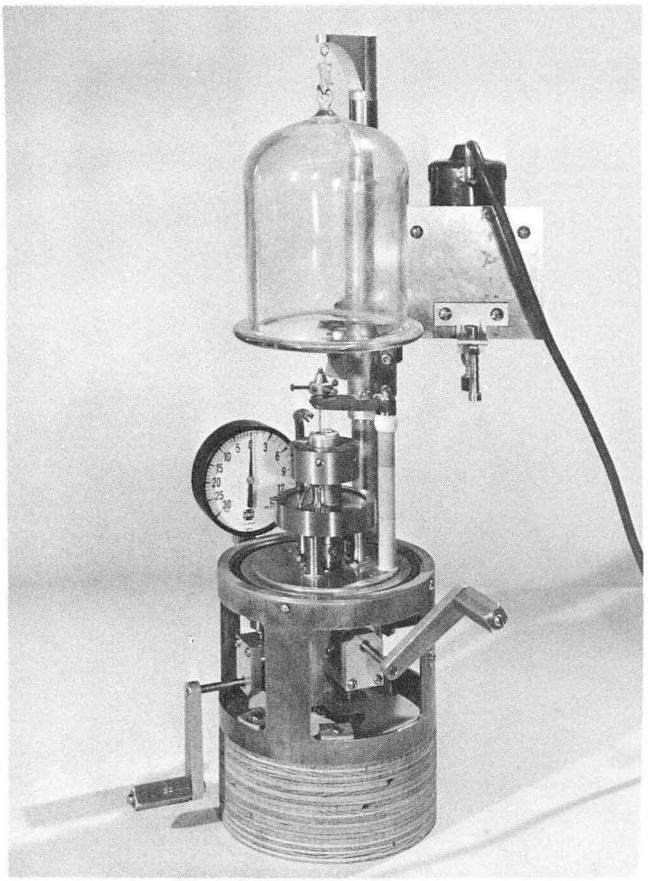
HP 1211

Item: Californium-iodide capsule seal-off apparatus.

Description: Remote operation done in 4-ft-water neutron facility. The quartz tube containing CfI under vacuum was sealed-off with a gas flame.



HP 720



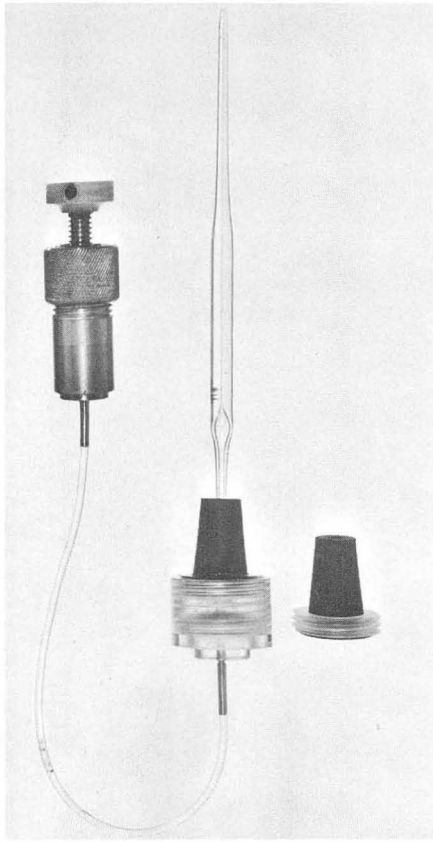
HP 935

Item: Slug-encapsulation apparatus.

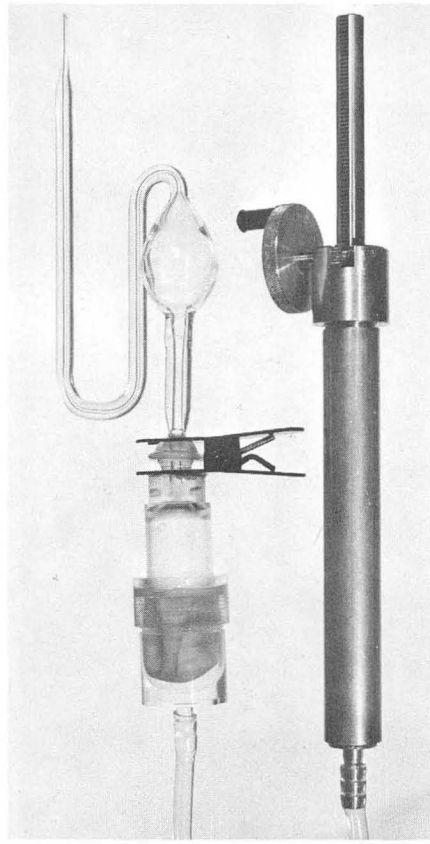
Description:

Left: Remotely operable powder mixing mechanism and briquetting press for use with aluminum powder and heavy elements.

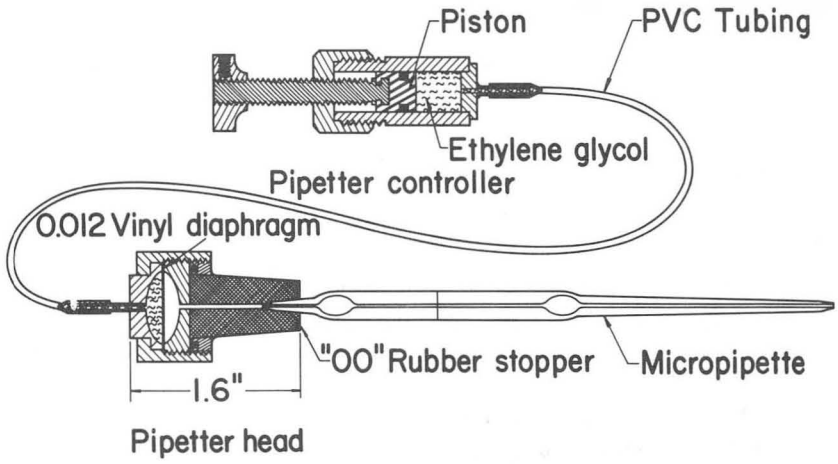
Right: Remotely operable capsule-welding mechanism. Refrigerated capsule collet; tungsten-inert-gas welding process. Assures helium atmosphere inside capsule.



HP 874



HP 875



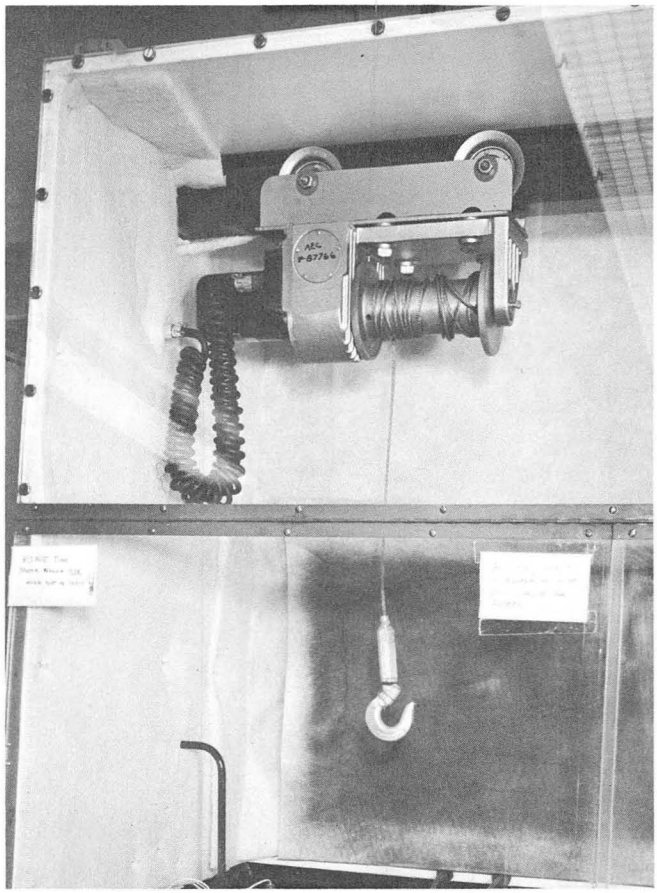
Hydraulic micropipetter

MUB-2506

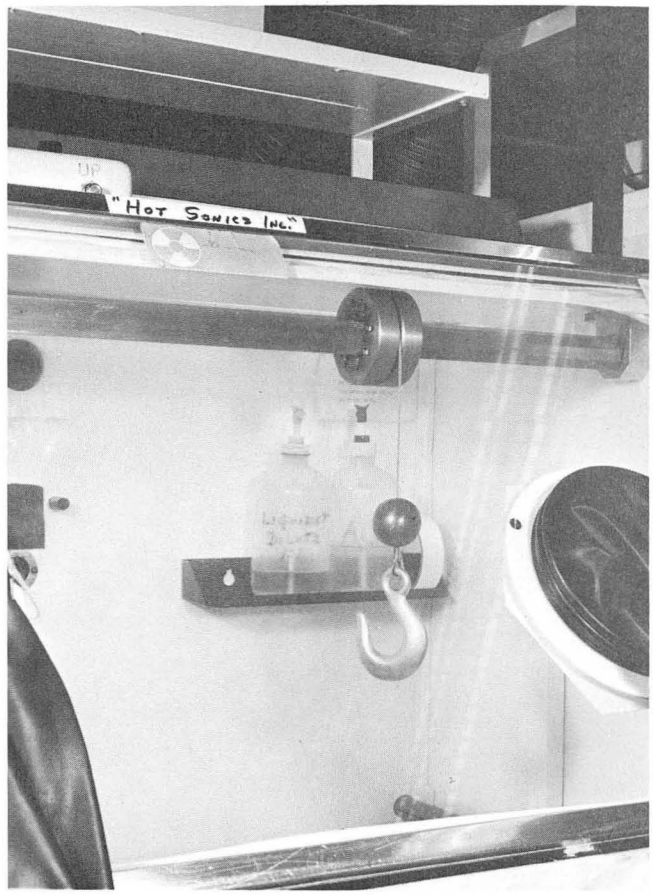
Item: Hydraulic micropipetter.

Description: Hydraulically operated pipet. Vinyl diaphragm prevents spread of activity.

Use: To take samples in the 4- and 6-ft water caves, or other shielded enclosures. Very precise, remote manipulations can be accomplished.



XBB 671-64

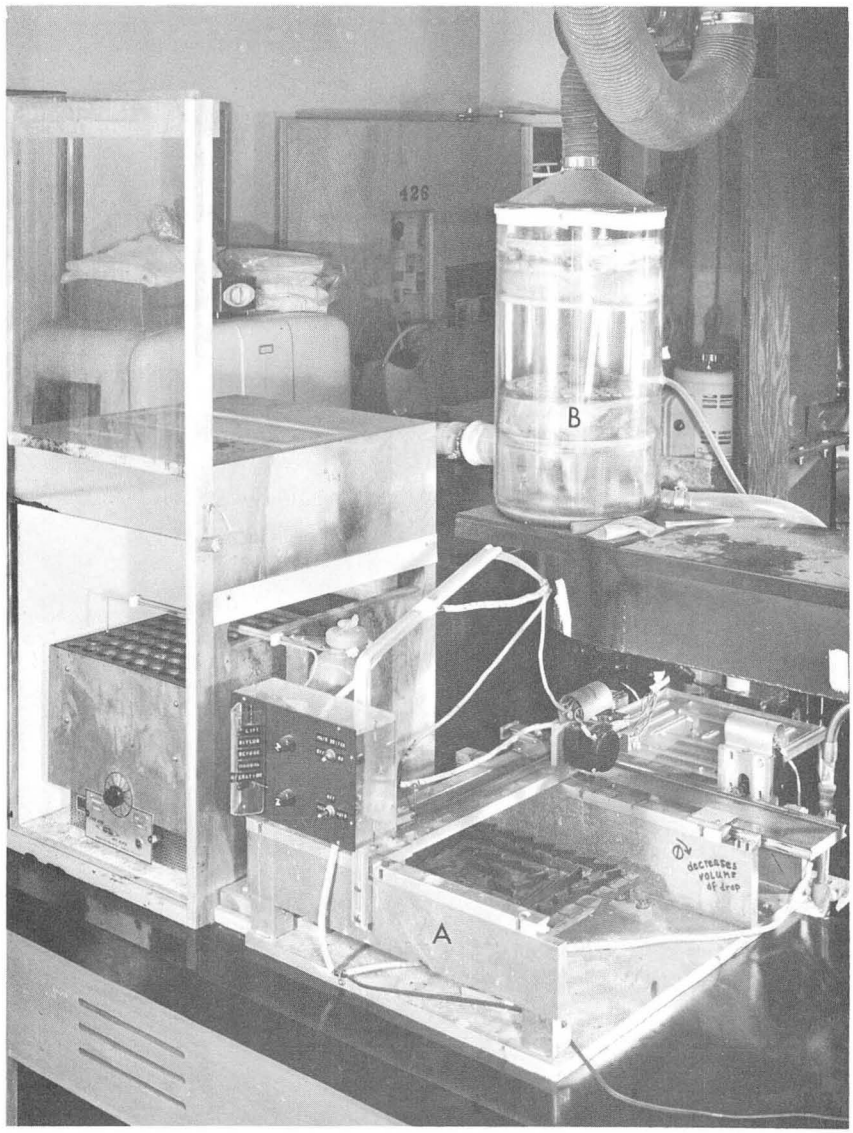


XBB 671-63

Item: In-box cranes.

Description: Lifting cranes built into enclosures.

Uses: For lifting heavy objects inside of gloved boxes. Similar units are available for use outside gloved boxes.



HP 1356

a. Item: Chloric acid dropper.

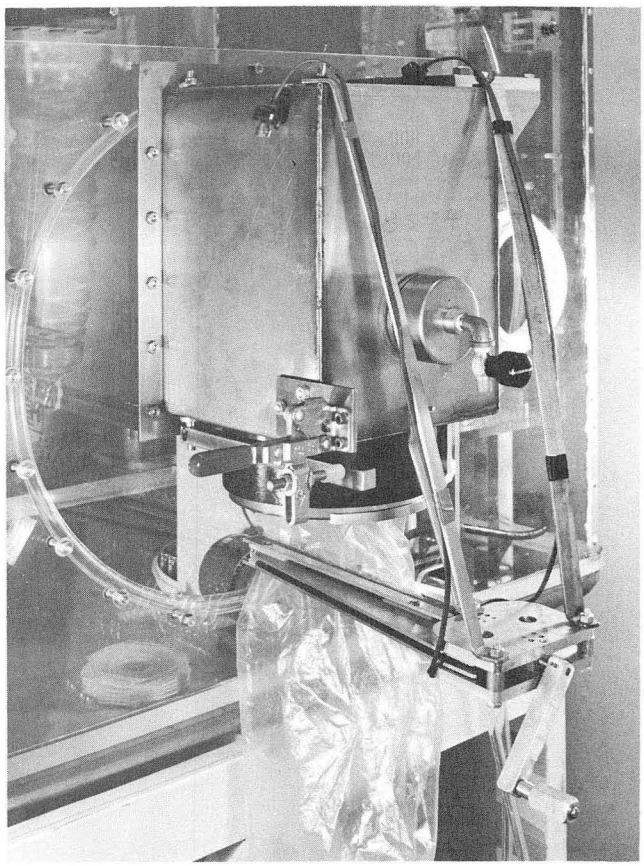
Description: Automatic acid-dispensing machine.

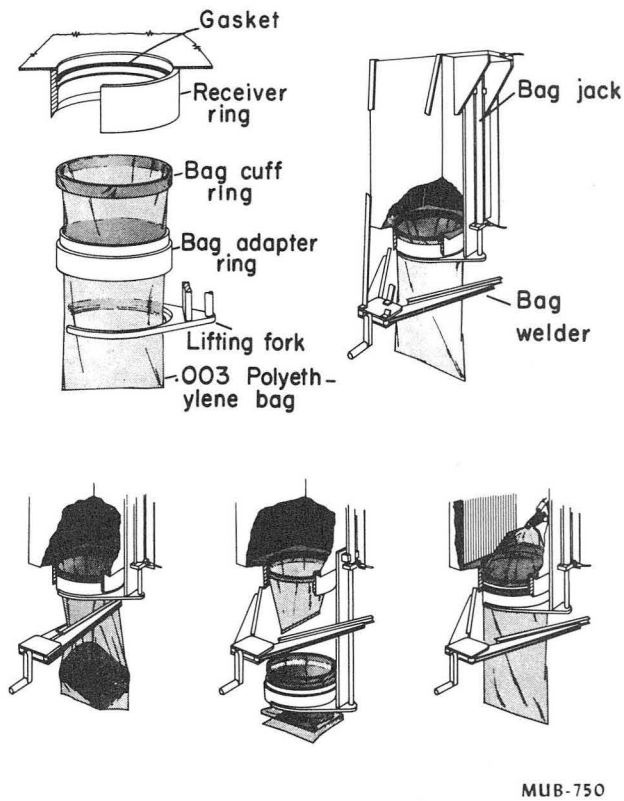
Purpose: To add drops of acid to a large number of cones arranged in a rectangular pattern, and to repeat the pattern in a given period. The result is a controlled digestion rate of the serum culture.

b. Item: Chloric acid scrubber.

Description: Countercurrent air flow over fiberglass wet pad. Water used for scrubber solution; fiberglass demisters.

Purpose: To scrub chloric acid from air before discharge to environs.





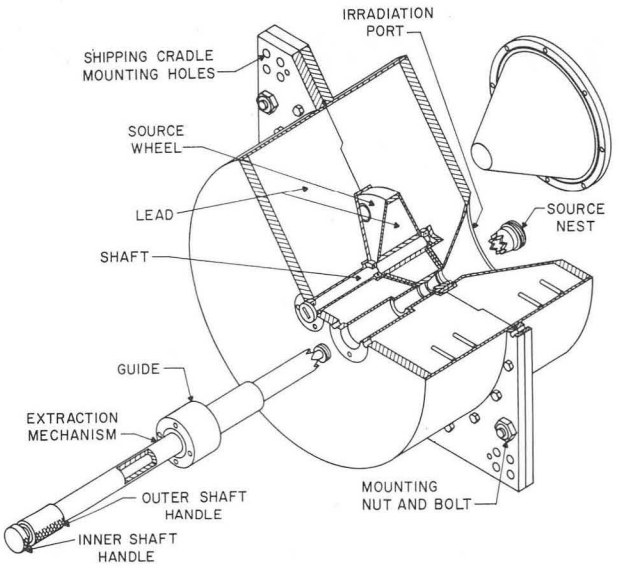
HP 927

Item: Remote sealing operation.

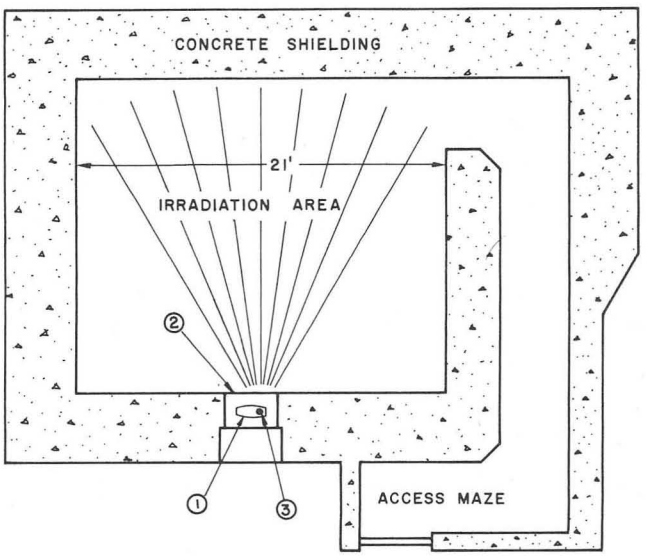
Description: Interchange attached to hot cave box, passout bag, and remotely operated heat welder and bag cutter.

Use: For passout of very highly contaminated material from caves.

IIG. Radioactive Sources



MU-27337



① WHEEL CONTAINING SOURCES
② IRRADIATOR
③ SOURCE CAPSULE

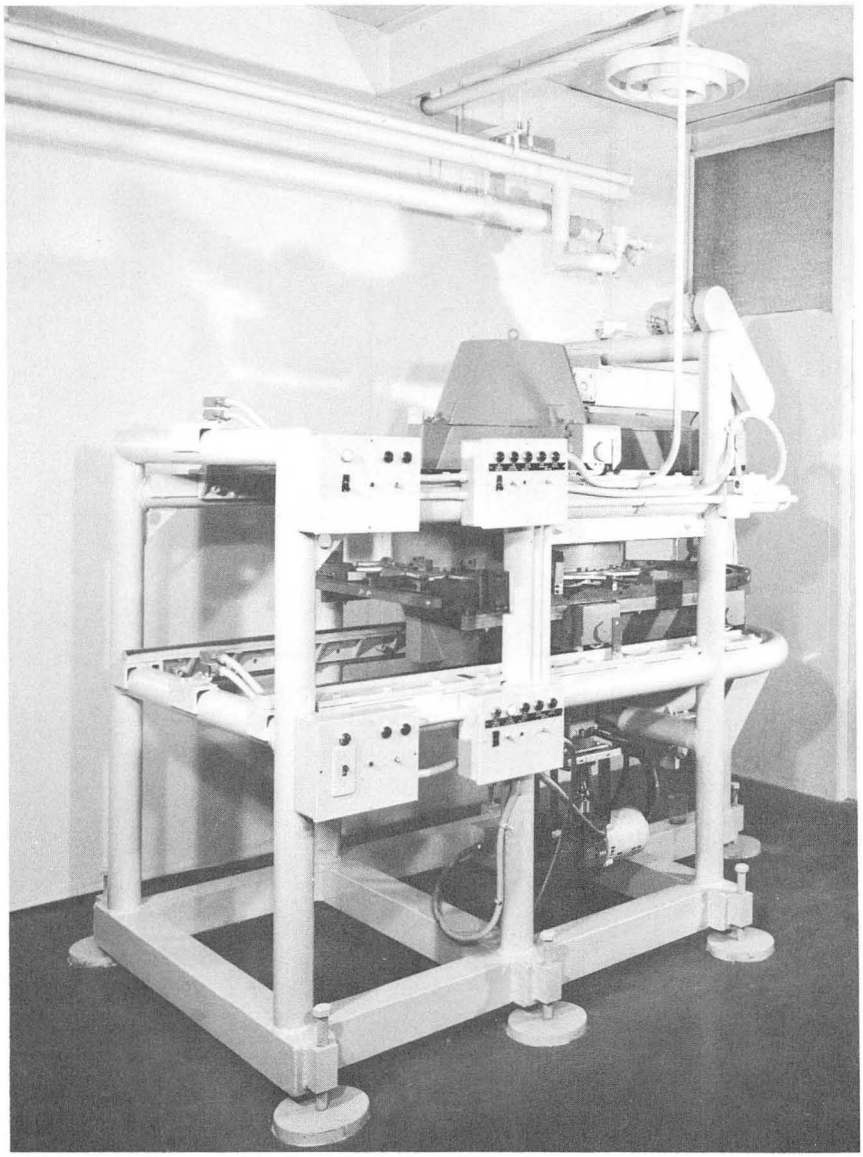
MU-26497

Item: 1500-Ci ^{60}Co biomedical irradiator (7/62)

Description: Two sources are employed; both are cylindrically encapsulated in double-walled and welded containers. One capsule contains 1400-Ci ^{60}Co and the other 140-Ci.

Dose rates:

1400-Ci source	140-Ci source
2000 R/hr at 1 meter	200 R/hr at 1 meter
70 R/hr at 18 ft	7 R/hr at 18 ft

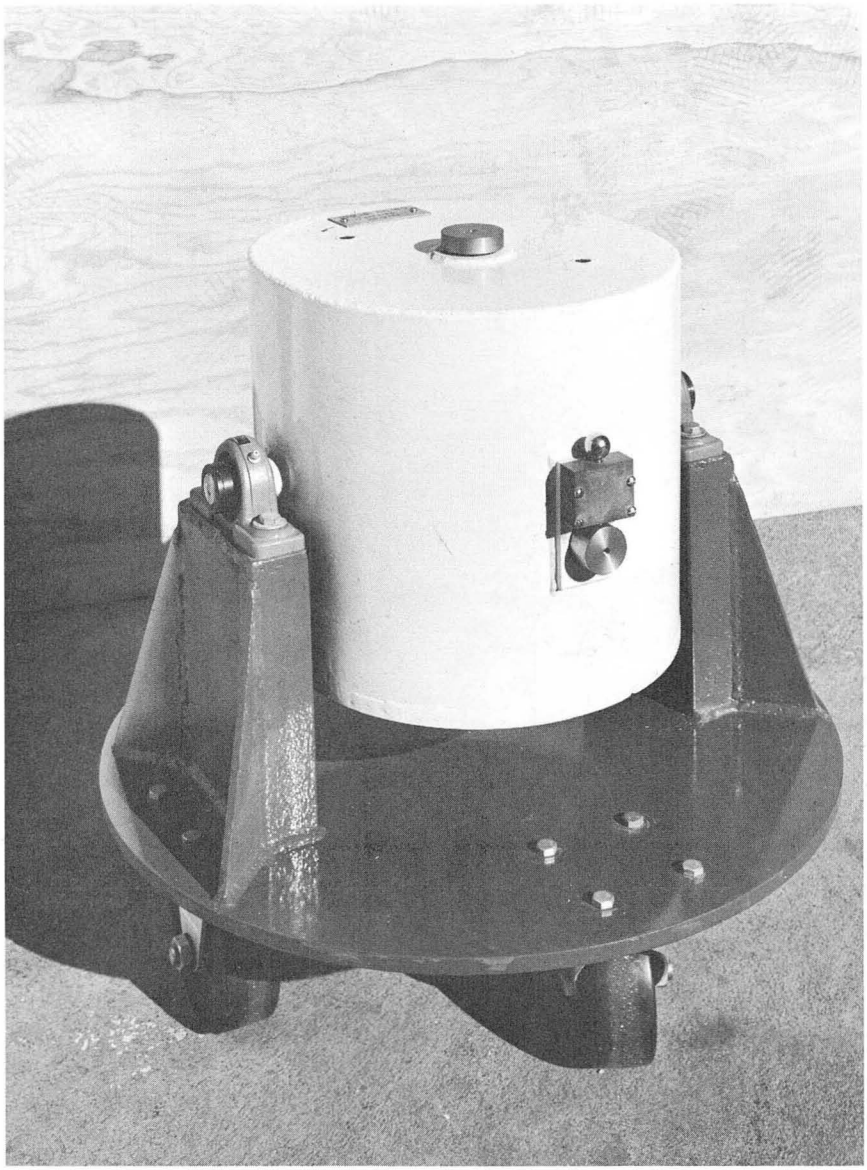


HP 1215

Item: 3100-Ci (7/64) ^{60}Co irradiation facility.

Dose rates: 6.7×10^5 to 1.34×10^7 R/hr.

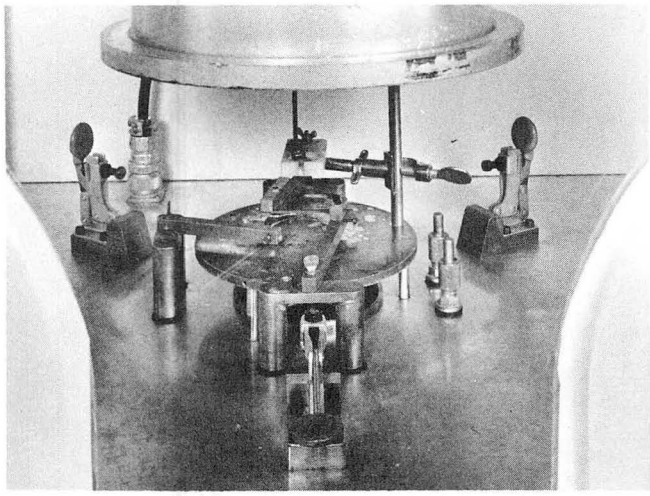
Uses: Physiochemical studies and research on genetic responses, and inorganic radiation effects.



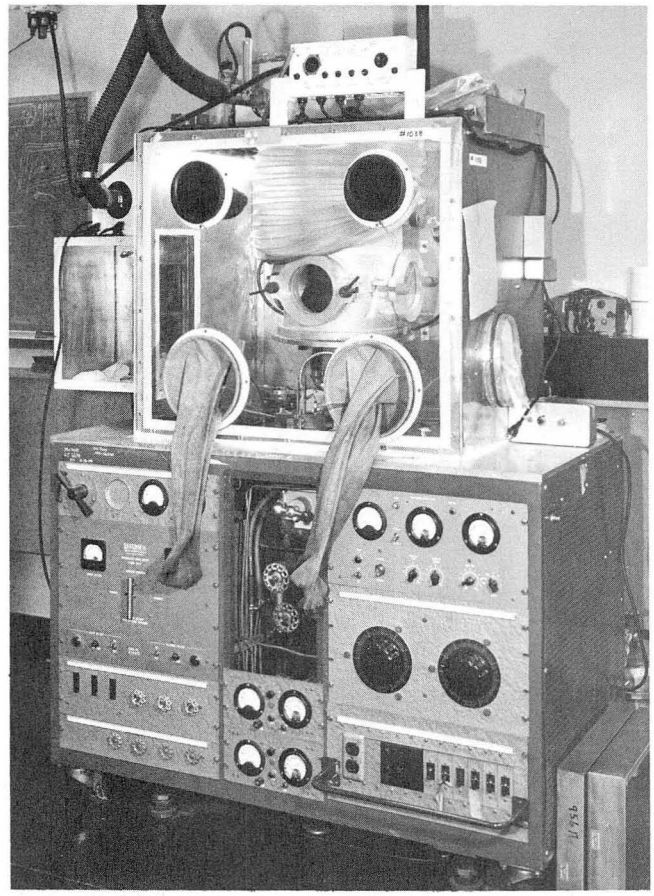
XBB 671-58

Item: 100-mCi ^{60}Co source.

Description: This is illustrative of the radioactive source capabilities of Health Chemistry. The radioisotope capsule and necessary shielding can be designed and fabricated by our technical groups.



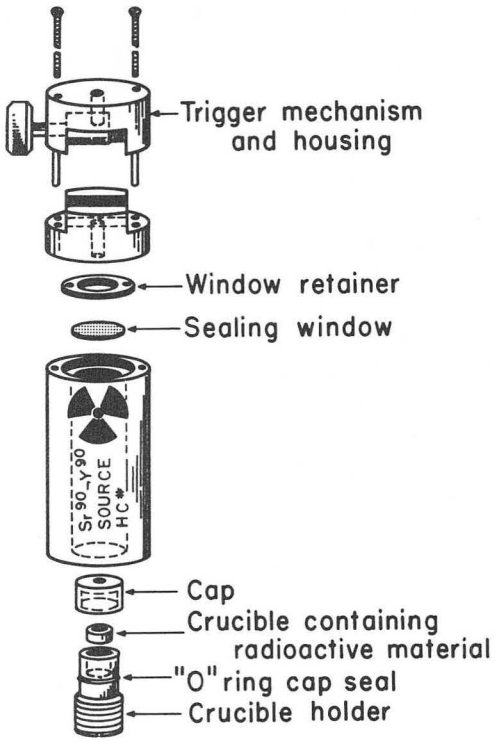
HP 483



XBB 671-61

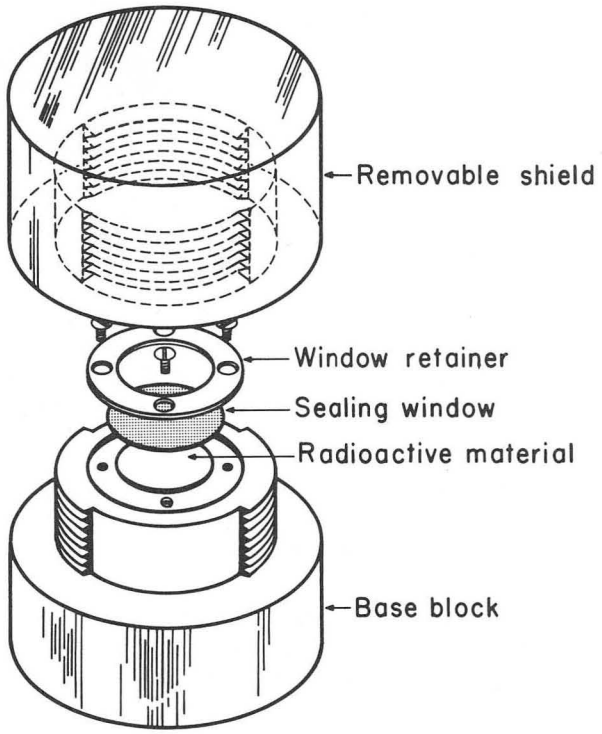
Item: Radioactive-source fabrication apparatus.

Description: Radioactive sources are prepared in this apparatus by evaporating the nuclide in a vacuum and condensing it on a cold surface.



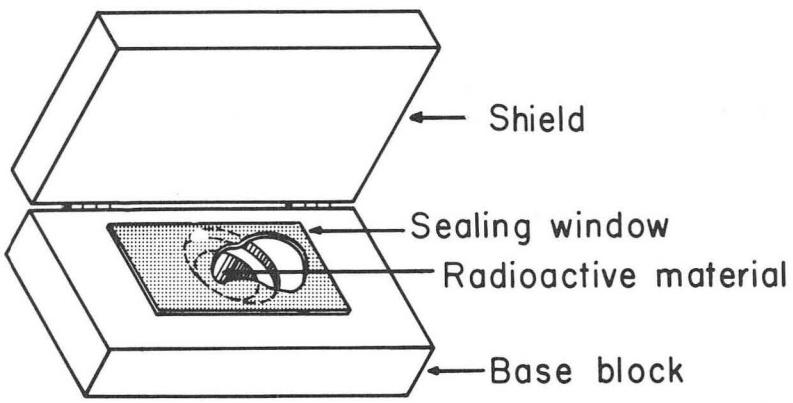
Beta Ray Gun

MU-18882



Portable Beta Source Holder

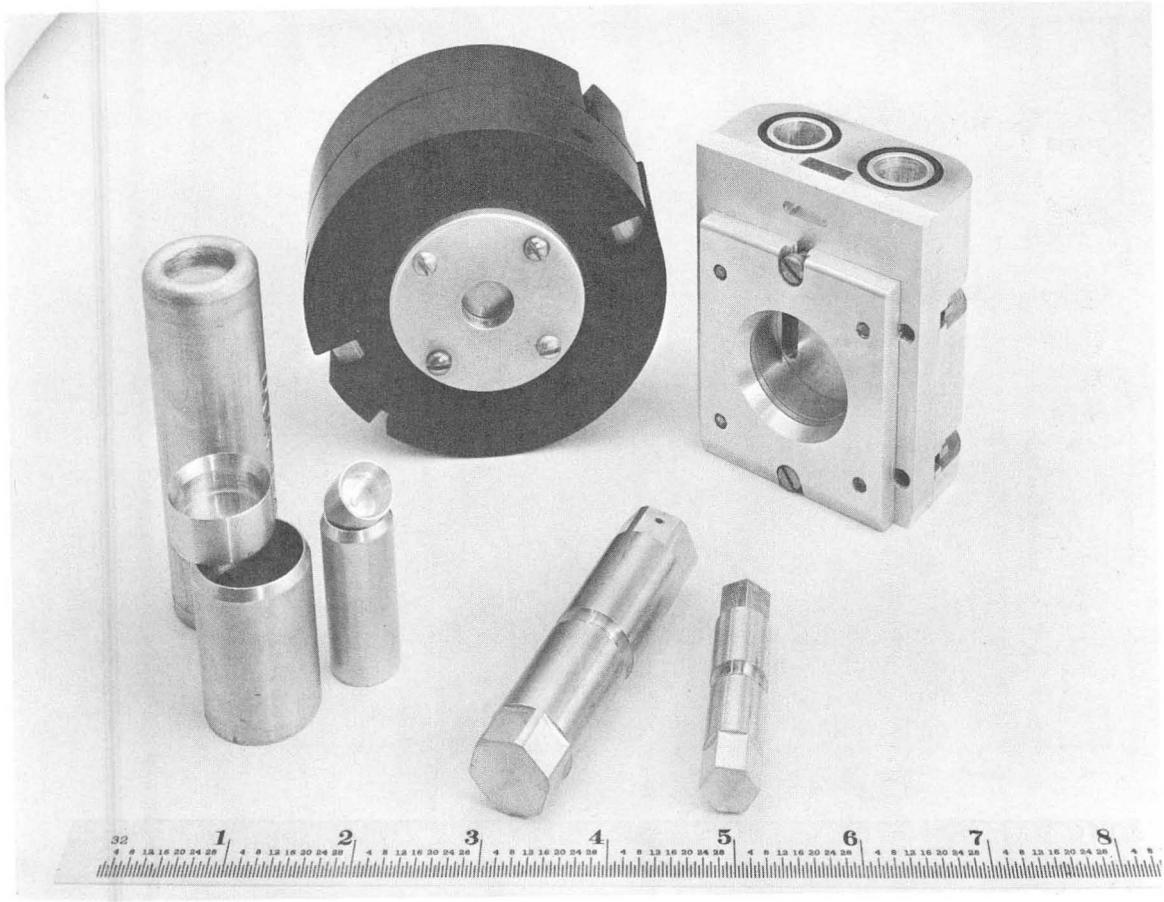
MU-18880



MU-18879

Item: Typical radioisotope sources.

Description: A multitude of different alpha, beta, or gamma sources can be fabricated. Special shapes, holders, and radioisotopes can be used.



HP 971

Item: Various cyclotron target holders, and capsules containing materials for irradiation in reactors.

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