WALK-THROUGH SURVEY REPORT:

OF

PEARSON YACHTS COMPANY
PORTSMOUTH, RHODE ISLAND

SURVEY CONDUCTED BY:
William F. Todd, DPSE, ECTB

DATE OF SURVEY:
January 14, 1982

REPORT WRITTEN BY:
William F. Todd, DPSE, ECTB

DATE OF REPORT:
April 18, 1982

REPORT NO.:
ECTB 107-12a

Materials Processing Section
Engineering Control Technology Branch
Division of Physical Sciences and Engineering
National Institute for Occupational Safety and Health
Cincinnati, Ohio 45226

PURPOSE OF SURVEY:

The Pearson Yachts Company was visited to inspect the ventilation system which has undergone recent modifications. This plant was located on a follow up of information supplied by George L. Pettigrew, NIOSH, Region VI.

EMPLOYER REPRESENTATIVES CONTACTED:

Paul Boardman, Quality Control/Safety Manager; Manny Alegria, Industrial Engineering Manager; and Joseph Martins, Safety Officer, all of Pearson Yachts and Robert Mills, Director of Health and Safety, Grumman Allied Industries, the parent company.

EMPLOYEE REPRESENTATIVES CONTACTED:

None

STANDARD INDUSTRIAL CLASSIFICATION:

SIC 3732, Boatbuilding and Repairing

ANALYTICAL WORK:

None

Introduction

The production of fiber reinforced plastic (FRP) boats involves the use of a polyester resin containing 40% to 60% styrene monomer. A review of the health literature for this and other FRP industries indicates that the major health problems include irritation to the mucous membranes and solvent narcosis from exposure to styrene vapor and contact dermatitis from skin contact with solvents, fibrous glass, and the uncured polyester resin.[1,2] Changes in psychomotor test results were noted among subjects in styrene exposed workers at both high (82 +/- 44 ppm) and low (9 +/- 15 ppm) styrene concentrations, whereas eye and mucous membrane irritations was shown to be more frequent among individuals exposed to the higher range of concentrations.[3]

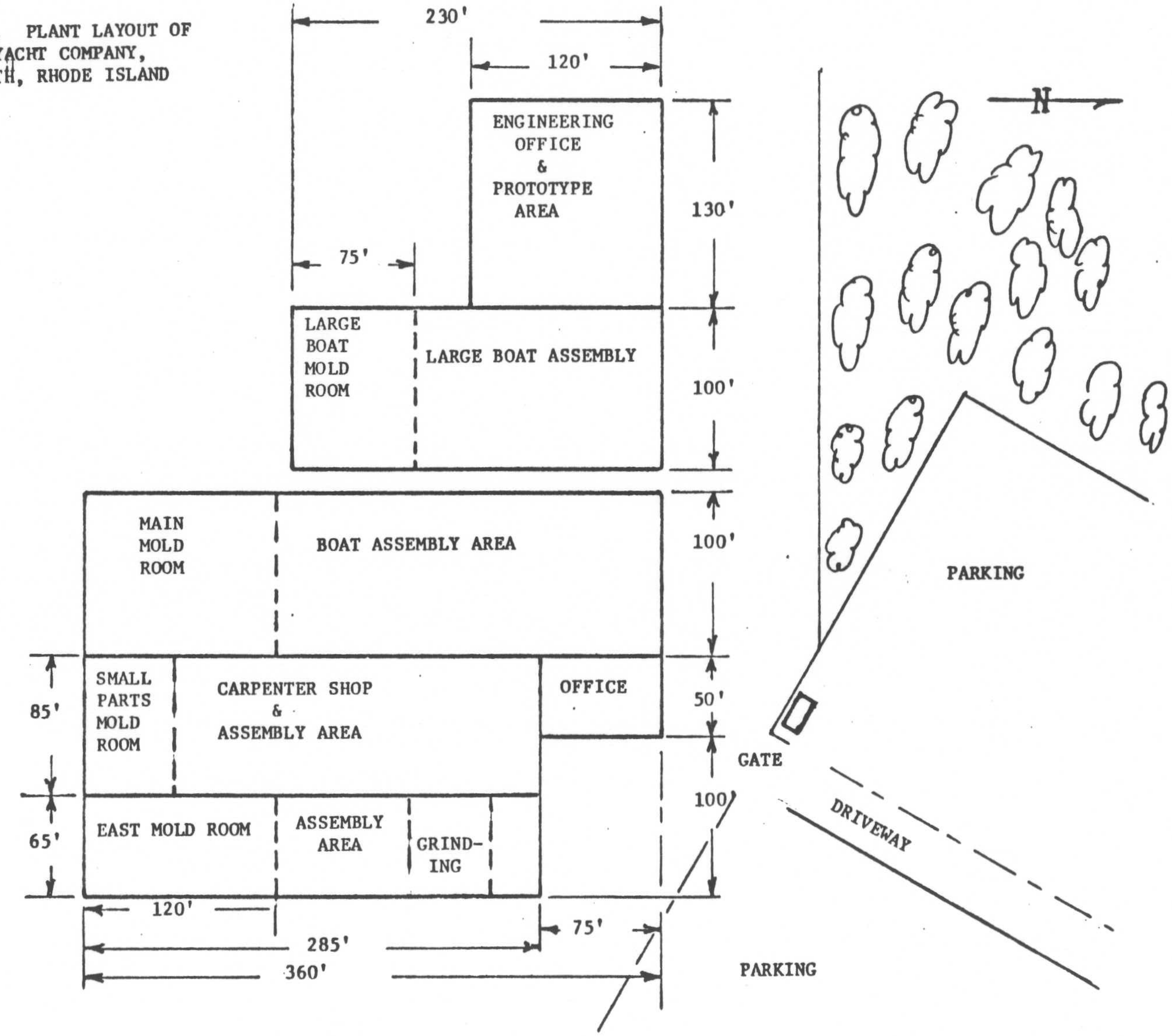
Industrial hygiene surveys carried out by NIOSH, Division of Surveilance Hazard Evaluations and Field Studies (DSHEFS) have indicated that 20.6% of the personal exposures in boatbuilding plants exceeded the eight hour TWA standard for styrene in seven plants sampled.[4] The Division of Physical Sciences and Engineering (DPSE) is conducting an assessment of ventilation and work practices in FRP boat building plants to document the best control systems.

The principal contacts at Pearson Yachts were Mr. Paul Boardman, Quality Control/Safety Manager and Mr. Robert Mills, Director of Health and Safety, Grumman Allied Industries, the parent company. During the visit, a tour was made of the entire plant, except the Prototype and Engineering Building, with the host group .

Description of Facilities

The Pearson Yachts Company has been in operation for 25 years. It began in 1956 in Bristol, Rhode Island. The company was purchased by Grumman Allied Industries in 1960 and a new plant was constructed at Portsmouth, Rhode Island on Narragansett Bay, the present location, in 1964, (see Figure 1). Boat

FIGURE 1. PLANT LAYOUT OF PEARSON YACHT COMPANY, PORTSMOUTH, RHODE ISLAND



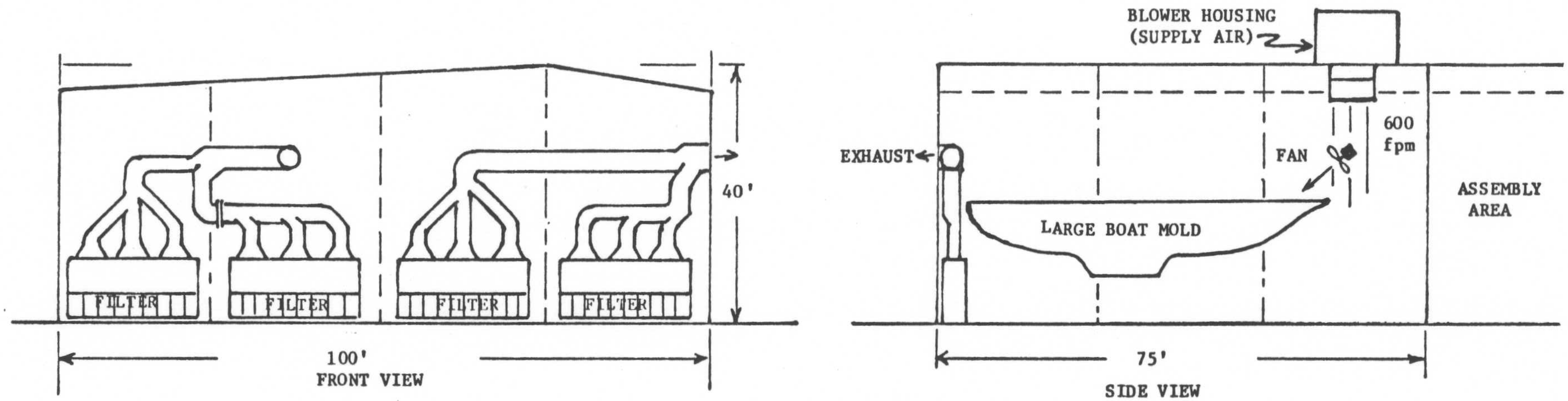
sizes produced increased over the years from the first 8 foot fiberglass dinghy to the present largest size of 53 feet. Pearson Yachts has produced some power boats in the past but currently markets only sailing yachts. The plant contains approximately 125,000 square feet, 43,000 of which are contained in recent construction. The larger hulls, 45 to 53 feet, are fabricated in the new Large Boat Mold Room.

The Large Boat Molding Room measures 100' by 75' and is 45' high. It is used for the molding of boats ranging from 45 to 53 feet in length. The boats move from the molding room into the assembly area and emerge as a complete boat without the masts and rigging. This room was shut down for an indeterminate period of time. Figure 2. shows the layout of ductwork in this room.

The Main Mold Room is an older facility measuring approximately 120' by 100' in which boats up to 42 feet are fabricated. As in the Large Boat Molding Room, the boat hulls proceed directly into the assembly area after being pulled from the mold. The dimensions of most of the plant buildings were estimated from an aerial photograph of the plant based on dimensions of the Large Boat Molding Building supplied by plant personnel.

The Small Parts Mold Room is a separate area designed to control fumes from chopper gun spray-on operations. This room, measuring approximately 85' by 50', has two spray booths for lamination and one for grinding. Polyurethane foam operations are also carried out in this room. The ventilation system in this room is modular to accommodate several levels of demand.

FIGURE 2.
SKETCH OF DUCTWORK IN LARGE BOAT MOLD ROOM
PEARSON YACHT COMPANY, PORTSMOUTH, RHODE ISLAND



The East Mold Room which measure approximately 65' by 120' is used mainly for the production of non-boat equipment. Electronic cabs for marine environment computers on oil drilling platforms are produced here.

Two other areas in the plant are specialized, one for grinding of small parts and the other for varnishing of wood interior components. The grinding area has recirculation of filtered exhaust air to conserve energy.

Description of Boat Construction

FRP boats are fabricated from glass fiber woven roving and chopped glass strand cemented with a styrene polyester resin. The boat mold is an inverse shape of the hull; it is referred to as a female mold because the boat hull is laid-up inside the mold with the gel-coat or finish coat applied first. The glass fiber woven roving is then applied in a series of laminations, each layer is glued with styrene resin and air bubbles are removed with rollers and squeeges. Stringers (braces) and bulkheads (partitions) are made of plywood or balsawood. These are secured with roving and resin. The boat hull, when removed from the mold, has the polished finish of the waxed mold. Stripes, names and designs can be molded into the hull finish by use of masking tape or gummed paper masks. After removing the masking tape, overspraying with a tinted gel coat produces a design in the boat finish to match the gummed paper template. Acetone is used as a clean-up solvent for both equipment and workers. Although the PEL is 1000 ppm for acetone, potentially high exposures during cleaning operations suggest that acetone be considered as a co-hazard with styrene.

Boat decks and small parts are also laid up in waxed and polished female molds. The lay-up of decks uses the same lamination techniques as used for hulls except they are not as thick. Decks are laid up in the open areas and depend upon general ventilation to disperse the styrene vapors. The small parts lay-up uses a chopper spray-gun and a minimum of woven roving to reduce cost where the high strength of woven roving is not warranted. Small parts lay-up is done in hoods designed to contain the styrene vapors. There is no apparent exposure problem in this operation. The emissions from chopper spray guns are thought to be generally higher than with spray nozzles for woven roving lay-up but the control problems are not so difficult.

Assembly begins with the installation of bulkheads, engines, plumbing, interiors and auxilliary equipment as the boat hull moves along the line. Grinding of small parts is necessary to remove rough edges from molded parts and to grind edges for perfect mating of these parts to the hull.

Description of Controls

Styrene vapors are controlled in the Large Boat Molding Room by cross flow dilution ventilation. The supply air is 80,000 CFM and flows from the top rear of the room to the floor level intakes at the opposite side. The air flows across the 75' dimension of the room at an average velocity of 20 FPM. Air is blown into the boat hull by a fan to supply clean air. No air flow rates were measured during this plant visit. All air velocities and volumetric flow rates were obtained from plant personnel. Reference again to Figure 2. shows the ductwork layout.

The main molding area uses general ventilation which has two functions. The area ventilation is maintained at 100 FPM velocity with large fans pulling air from the mold pit and from the opposite end of the building. The mold pit is about 6 feet deep having staging set around each hull being layed up in the pit (see Figure 3). The staging brings the work level to about three feet below the hull gunwale. Large exhaust blowers pull air from the bottom of the pit, creating a downward air movement around each hull (see Figure 4). There are from 6 to 7 hull molds in the pit. Currently, the room is used for laying up 27 foot sailboats in nontiltable molds but it can handle up to 42 foot boats. The air is also pulled into the suspended ductwork located between the molds about 6 feet above the staging (see Figure 5).

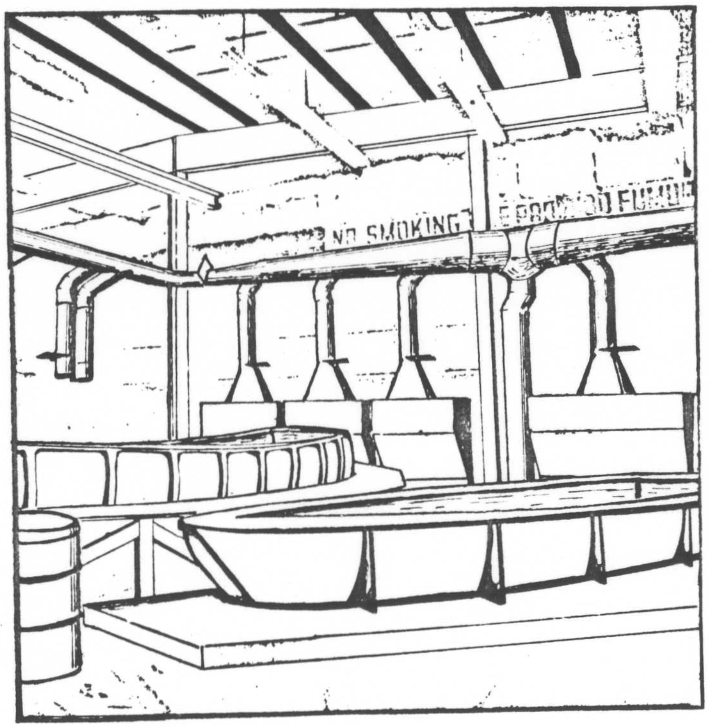


FIGURE 3. MAIN MOLD ROOM
VENTILATION SYSTEM

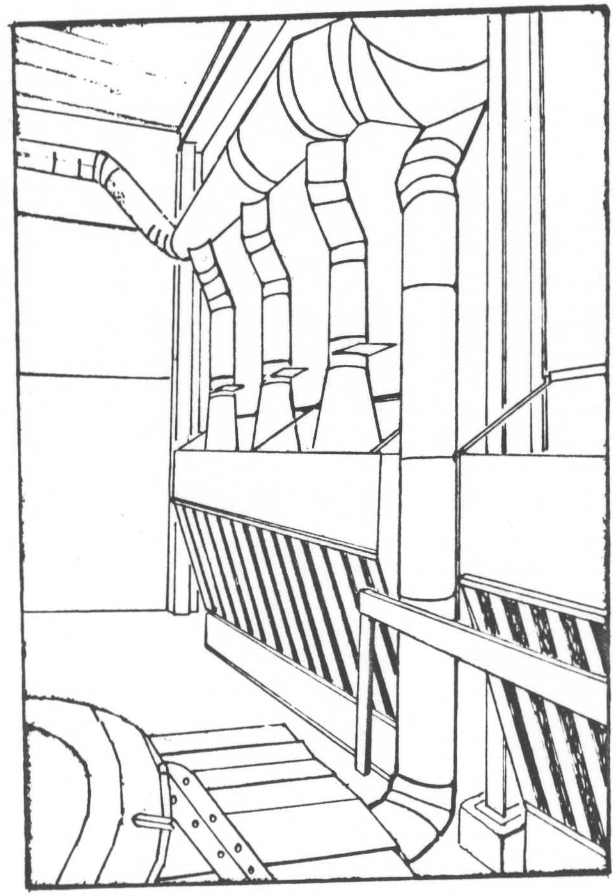


FIGURE 4. MAIN MOLD ROOM
PIT VENTILATION DUCT

One feature of the main mold room is the protection afforded the gelcoater who uses an air supplied respirator and is completely clothed in protective garments. The gelcoat system and the gelcoater are suspended from gantry cranes. The gelcoater is suspended in a boatswain's chair during this operation. This was a routine practice and a good one because it isolates the worker almost completely from the resin spray. The gel coating of decks is done in the various parts of the room; all vapors are, according to plant personnel, swept to the rear of the room by the 56,000 CFM of ventilation air at an average velocity of 20 FPM. Figure 6. shows the flexible ducting used up to 1975 for ventilating the boat hulls. These ducts are supported on swinging booms so the mold could be cleared for pulling the hull. This concept was used beginning in 1964 and according to plant personnel, may be used again.

There are four hoods in the small parts room. Two hoods control emissions from chopper gun lamination of small parts (see Figure 7); one controls emissions from grinding operations by recirculation of air through fabric filters; and the third hood controls emissions from a polyurethane foam operation. The two lamination hoods are about 15' x 8' in frontal area and pull about 12,000 CFM of exhaust air at full load. The face velocity in the hoods is about 100 FPM. The hoods operate only when the resin is being applied, this being accomplished by placing pressure sensitive switches in the spray gun supply air line. The blowers are programmed to run at about 1/2 the maximum flow rate for a short period of time after spraying ceases so as to vent the booth of residual styrene vapors. The supply air unit is designed for about 29,000 CFM to supply the spray booths and also the polyurethane operation.

The East Mold Room is being used for non-boat items, namely, the production of Schlumberger Cabs used as all-weather computer control units on offshore oil drilling platforms. The room has the dimensions of 65'W x 120' L x 28'H. The ventilation system design is basically the same as in the other mold rooms. The Schlumberger Cab molds have additional 2000 CFM individual exhaust systems which produce a negative pressure in the building

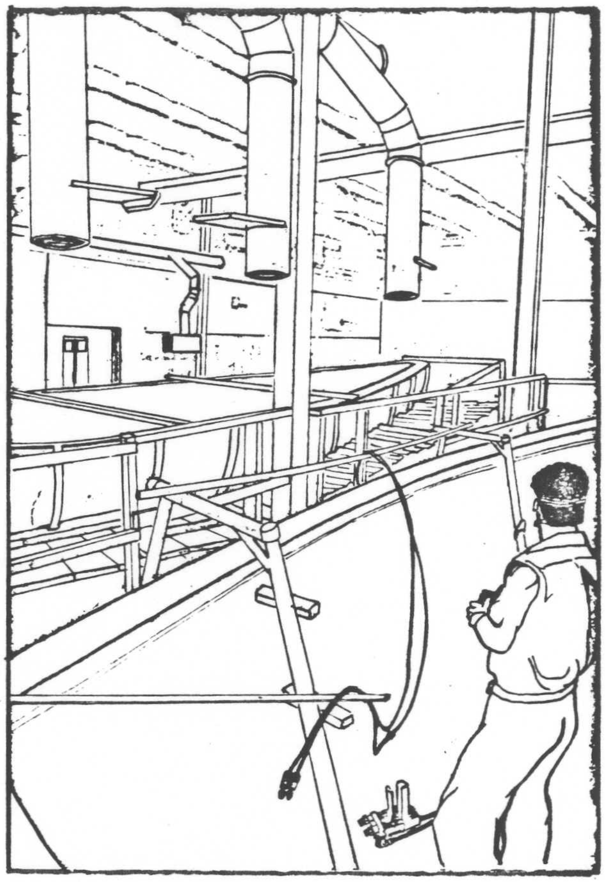


FIGURE 5. MAIN MOLD ROOM
SUSPENDED DUCTWORK

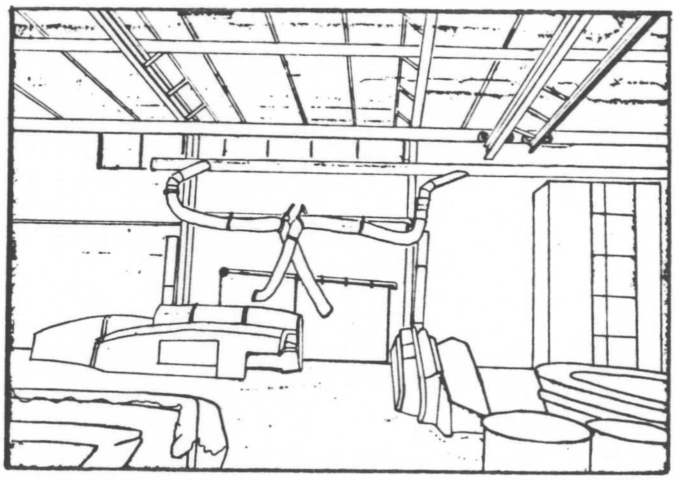


FIGURE 6. FLEXIBLE DUCTING, MAIN MOLD ROOM

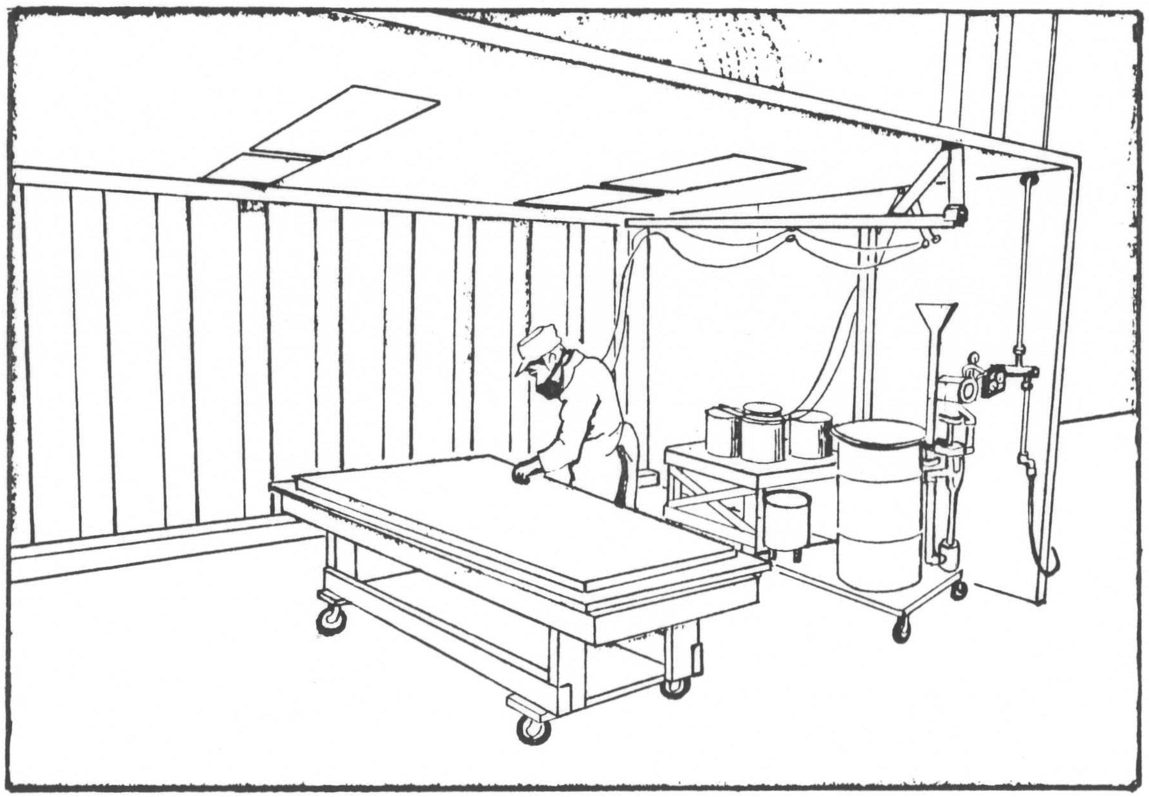


FIGURE 7. BOOTH IN SMALL PARTS MOLD ROOM

Two additional systems were observed. One is the small parts grinding area which uses recirculated air; the air is passed through fabric filters to remove resin and fiber particles. The other system was is the wood finishing shop; it has cross flow ventilation for two varnishing spray booths.

The grinding shop uses an air recirculation system having two blower and filter units of 12,000 and 7,500 CFM plus one make-up air unit of 4,000 CFM. The added make-up air vents into the adjacent assembly room in the East Mold Room.

The use of personal protective equipment is evident in all spraying operations. Respirators and gloves were observed being used by personnel performing lamination operations. The aforementioned air supplied respirator used by the gelcoater in the main mold room is an indication of management's intent to protect the worker form exposure to gelcoat overspray.

CONCLUSIONS/RECOMMENDATIONS:

This boat builder has well designed ventilation systems. The good quality of the ventilation systems is accounted for by engineering services supplied by Grumman Allied Industries. The work practices observed were very good. Respirators were used by most of the lamination workers.

A letter from Mr. Robert Mills, Director of Safety and Health, Grumman Allied Industries, February 10, 1982 stated that their industrial hygiene survey of November 1981 indicated a styrene level (time weighted average basis) in the Small Parts Room, Main Mold Room, Schlumberger and Main Assembly areas as being non-detectable or less than 20 parts per million. It also states that these low levels are attributed to the new ventilation control systems recently installed. An in-depth study of the main mold room and a minor evaluation of the small parts molding room which uses spray hoods is recommended.

References

1. International Labour Office, 1972, Encyclopedia of Occupational Health and Safety, Vol II, McGraw-Hill Book Company, New York, New York.

2. Bourne, L. B. & Milner, F. J. M. 1963, Polyester Resin Hazards, British Journal of Industrial Medicine, 20: 100-109

3. Brooks, Stuart, M. D., Associate Professor of Environmental Health and Medicine, Kettering Laboratory, University of Cincinnati, "Investigation of Workers Exposed to Styrene in the Reinforced Plastic Industry." 1979, 330 pp. This report was performed for the Society of Plastics Industries.

4. Crandall, M. S., "Extent of Exposure to Styrene in the Reinforced Plastic Boat Making Industry." DHHS (NIOSH) 82-110, March, 1982