

PRELIMINARY SURVEY REPORT:

Steelcase, Incorporated  
Grand Rapids, Michigan

SURVEY CONDUCTED BY:  
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U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES  
Public Health Service  
Centers for Disease Control  
National Institute for Occupational Safety and Health  
Division of Physical Sciences and Engineering  
Engineering Control Technology Branch  
Cincinnati, Ohio 45226

PURPOSE OF SURVEY:

To observe the processes involving adhesives, with emphasis on the method of application and the associated occupational health hazard controls.

EMPLOYER REPRESENTATIVES CONTACTED:

Mr. Al TenHoor, Manager, Safety and Industrial Hygiene

STANDARD INDUSTRIAL CLASSIFICATION CODE OF PLANT:

2522 - Metal Office Furniture

## ABSTRACT

Without appropriate controls some industrial adhesives may cause occupational health problems. This NIOSH research study should provide information for industry to more efficiently control the exposure of workers to the potentially harmful constituents of adhesives. The information gathered during this preliminary survey will enhance the effectiveness of future work on this project.

This preliminary survey focused on the use of adhesives in the manufacture of partitioning panels, chairs, and desks. Each manufacturing process involved spraying solvent-borne chloroprene contact adhesives, both flammable and nonflammable. Ventilation booths adequately controlled solvent vapor concentrations, although some work was done outside of the booths due to size limitations.

## INTRODUCTION

Industrial adhesives may involve agents such as formaldehyde, organic solvents, and a variety of additives which pose potential occupational health hazards. An appropriate implementation of control technology may prevent the overexposure of workers to these substances.

The Engineering Control Technology Branch of NIOSH is conducting a research study to document control methods associated with the industrial use of adhesives. The first phase of this project involves preliminary surveys to assess the application of control technology in conjunction with the use of adhesives in a number of industries. The information gathered will be used to focus future efforts on the industries which can benefit most from further study and to plan for a second, more detailed survey at those plants which are selected for an in-depth study.

On this preliminary visit, the NIOSH survey team met with Mr. Al TenHoor who is the Manager of the Safety and Industrial Hygiene program for Steelcase. The survey team also conferred briefly with Mr. Tom Moore, the safety engineer in the chair plant.

## DESCRIPTION OF FACILITIES

Steelcase produces metal-framed office furniture. Manufacturing Facilities and Corporate Headquarters are located 13 miles southeast of downtown Grand Rapids, Michigan in a flat, residential (partially commercial) district. The overall complex occupies a one square mile area of land. A total of 6,500 people are employed there, of which 4,500 are production workers.

The focus of the investigation during this preliminary survey was on the manufacture of partitioning panels, chairs, and desks where there were the largest utilizations of industrial adhesives. Each manufacturing process that was included in the study is situated in a separate building. The size of the panel plant is approximately 500,000 square feet. The chair and desk plants are both about one million square feet each, with the latter being the largest plant occupying one-fifth of the entire facility. All of the buildings are constructed of a steel-reinforced concrete framework. The panel, chair, and desk plants employed approximately ~~4,000~~<sup>400</sup>, 1,000, and 1,000 people, respectively, working in two shifts.

## PROCESS DESCRIPTION

Steelcase employs a number of processes in the manufacture of office furniture. Adhesives are used exclusively for covering metal panels with fabric, applying foam material and fabric to hard plastic forms, and laminating a plastic veneer on pressboard bases. Observations were made of those processes that directly involved the use of or exposure to these adhesives. The bonding materials utilized by Steelcase are chloroprene-based, flammable, and nonflammable varieties manufactured by the Pierce & Stevens Chemical Corporation. The commercial name is Hybond.

## Panel Plant

The flammable adhesive, Hybond C9156A, is sprayed onto a large piece of fabric inside a ventilated spray booth. The same adhesive is sprayed onto the metal frame of a partitioning panel. The latter operation is sometimes outside of the booth if the panel is too large, in which case Hybond C9693A (nonflammable) was substituted for C9156A. In both instances the bonding mixture is applied using a pressure-fed compressed air spray gun. The fabric is then manually positioned on the panel framework and secured in place. The edges are trimmed with a pair of scissors to finish the procedure.

For those panels that require insulating material, a hot melt adhesive is employed to secure the insulation to the supports. The adhesive, Borden HA-6044, is administered through a Foxmelt Mark III dispensing system at a temperature of 185°C.

## Chair Plant

Using a siphon-type compressed air spray gun, the adhesive is applied to the hard plastic form base and the foam cushion. The two pieces are manually positioned and pressure is then applied mechanically to form a better bond. Subsequently, the adhesive is sprayed on both a piece of fabric and the top portion of the now bonded cushion. The fabric is stretched across the foam and secured with staples to the plastic base. Three adhesive products were used to attach the fabric and foam to the bases of the chairs: Hybond C9156A, C9693A, and another nonflammable (Hybond) adhesive.

## Desk Plant

Two-inch strips of formica-type veneer are coated with Hybond C9156A in a ventilated spray booth. These strips are then manually placed onto the sides of a rectangular section of particle board and edged with routers. The top surface of the particleboard is then sprayed with the same adhesive, and the board is placed on a conveyor belt parallel to another belt carrying similar-sized sheets of the laminated plastic veneer.

The two conveyor belts pass through an enclosed booth where only the veneer is subjected to a rotating spray of the flammable adhesive. The belts then enter an infrared oven to flash-off most of the solvent and decrease the time of the curing process. The two components are manually positioned and secured as they pass under rollers that apply pressure to the newly fabricated desk top. This top is edged with routers, which have local exhaust ventilation, to obtain the finished product.

## DESCRIPTION OF CONTROLS

Local exhaust ventilation booths are provided primarily to control the fire hazard presented by the solvents used in the flammable adhesive, Hybond C9156A. Dimensions of the booths vary according to the size of the components being assembled at a work station. However, not all work can be accomplished inside the booth. The nonflammable adhesives are used for those applications which are too large to fit inside a booth.

The ventilation booths were all of same basic design, cubical with an open front face. Air is drawn into slots at the rear of the booth and then passes through a plenum to the duct which extends approximately 20 feet to the ceiling of the plant. All fans are located on the roof of each individual facility. No make-up air is provided other than that entering through open doors in the warmer seasons and through the heating ventilation systems during the winter months. Air conditioning was not provided in any of the plants. There are presently no scrubbers for the cleaning of exhausted air, but the possibility is being analyzed. The spray guns with which the adhesive is applied are interlocked with the fans of the ventilation system so that the spray guns will not function if the fans are not operating.

Recycling of exhausted air is being tested on a trial basis on the infrared oven located in the desk plant. The basic concept is to reintroduce preheated but unfiltered air back into the system allowing for a high temperature with a decrease in the energy expended by the oven. An exhaust ventilation slot has been positioned over the opening through which the boards leave the oven. Most of the air escaping the oven should be drawn into this slot and ducted back to the center of the oven. However, the ventilation of this oven seems to be unbalanced, since more air seems to escape the oven as is drawn into the recycling slot.

No quantitative measurements were made during the preliminary study, although a smoke tube was employed to indicate the general effectiveness of the ventilation systems. The booths appeared to provide adequate control of the airflow. No strong solvent odor was detected and workplace concentrations of solvent vapors were reported to be less than permissible exposure limits.

#### DESCRIPTION OF PROGRAMS

The Safety and Industrial Hygiene Program is one of four that composes the Loss Control Department. The other three programs are: Workers' Compensation, Fire Prevention, and Security. Each plant employs one safety engineer full-time for the day shift, and there is one engineer for the entire complex on the night shift. There is one industrial hygienist. Periodic air sampling is performed on a yearly basis.

Personal protective equipment is not required for every worker, but is available if requested by the employees. The majority of the employees wear safety shoes and safety glasses. Gloves are also worn by those working with adhesives.

Each employee must undergo a pre-employment physical examination. Periodic examinations are given to those individuals working in a hazardous environment. For example, yearly audiometric examinations are given to those exposed to excessive noise levels. Annual pulmonary function tests are administered to those working in the painting or welding departments, and biennial chest x-rays are performed on those working in the plating department. There is no post-employment physical administered.

A hospitalization program is handled by the Kemper Insurance Company (who will also provide industrial hygiene assistance, if necessary). Primary care is the responsibility of the medical clinic, centrally located within the Steelcase

complex, which operates during all work shifts. A full time physician (urologist) is employed by the company, and two hand surgeons are available if the need arises.

#### CONCLUSIONS/RECOMMENDATIONS

Most adhesive spraying operations are performed inside or in front of a ventilated spray booth. The spray guns are interlocked with the ventilation systems. Solvent vapors appear to be adequately controlled. This company would be a strong candidate for an in-depth survey if the furniture industry is selected for a detailed study.