

PRELIMINARY SURVEY REPORT:

Converse Shoe Plant  
Lumberton, North Carolina

SURVEY CONDUCTED BY:  
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NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH  
Division of Physical Sciences and Engineering  
Engineering Control Technology Branch  
4676 Columbia Parkway  
Cincinnati, Ohio 45226

PURPOSE OF SURVEY: To observe the processes involving adhesives in an athletic shoe plant, with emphasis on the method of application and the associated use of occupational health hazard controls.

DATE OF SURVEY: May 13, 1982

EMPLOYER REPRESENTATIVES  
CONTACTED: Mr. James E. Carter, Safety Director  
Mr. Russell Johnson, Plant Supervisor  
Mr. Jack Curtin, Technical Director

EMPLOYEE REPRESENTATIVES  
CONTACTED: None

STANDARD INDUSTRIAL  
CLASSIFICATION OF PLANT: 3021: Rubber and Plastics Footwear

## Converse Preliminary Report

### Introduction

The emission of solvent vapors into the atmosphere of the plant from using certain adhesives to manufacture shoes may create an exposure hazard for the employees. However, if appropriate controls are employed, the exposures may be kept within acceptable limits.

The Engineering Control Technology Branch of NIOSH is conducting a research study to document and evaluate occupational health hazard 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 in-depth study.

The contacts for this visit were Mr. Jim Carter, Safety Director for Converse; Mr. Russell Johnson, the Plant Supervisor, and Mr. Jack Curtin, the Technical Director.

### Description of Facilities

Converse manufactures two types of shoes in the Lumberton plant: canvas-upper shoes and a leather-upper shoes, both in low-cuts and high-tops. This plant is the largest of Converse's facilities and may be the largest in the U.S. still using the autoclave curing process to manufacture canvas-top shoes. The plant employs approximately 2000 people on two shifts, and over 90% of these are hourly workers.

The manufacturing and associated facilities are housed in a large concrete block and brick building built in 1967. Almost 90% of the 400,000 square feet of floor space is production area, most of this with approximately a 20-foot ceiling height. A small, walled-off portion in the front side of building contains offices, a cafeteria, and dispensary. A diagram of the plant layout is shown in Figure 1.

### Description of Processes

Converse processes the natural rubber stock and blends many of the adhesives used in making their shoes in this plant. Raw materials are received on the west end of the building. The rubber is milled, mixed and calendered. Certain solvent-based adhesives are blended in the cement room. Latex adhesives are prepared in a large vat.

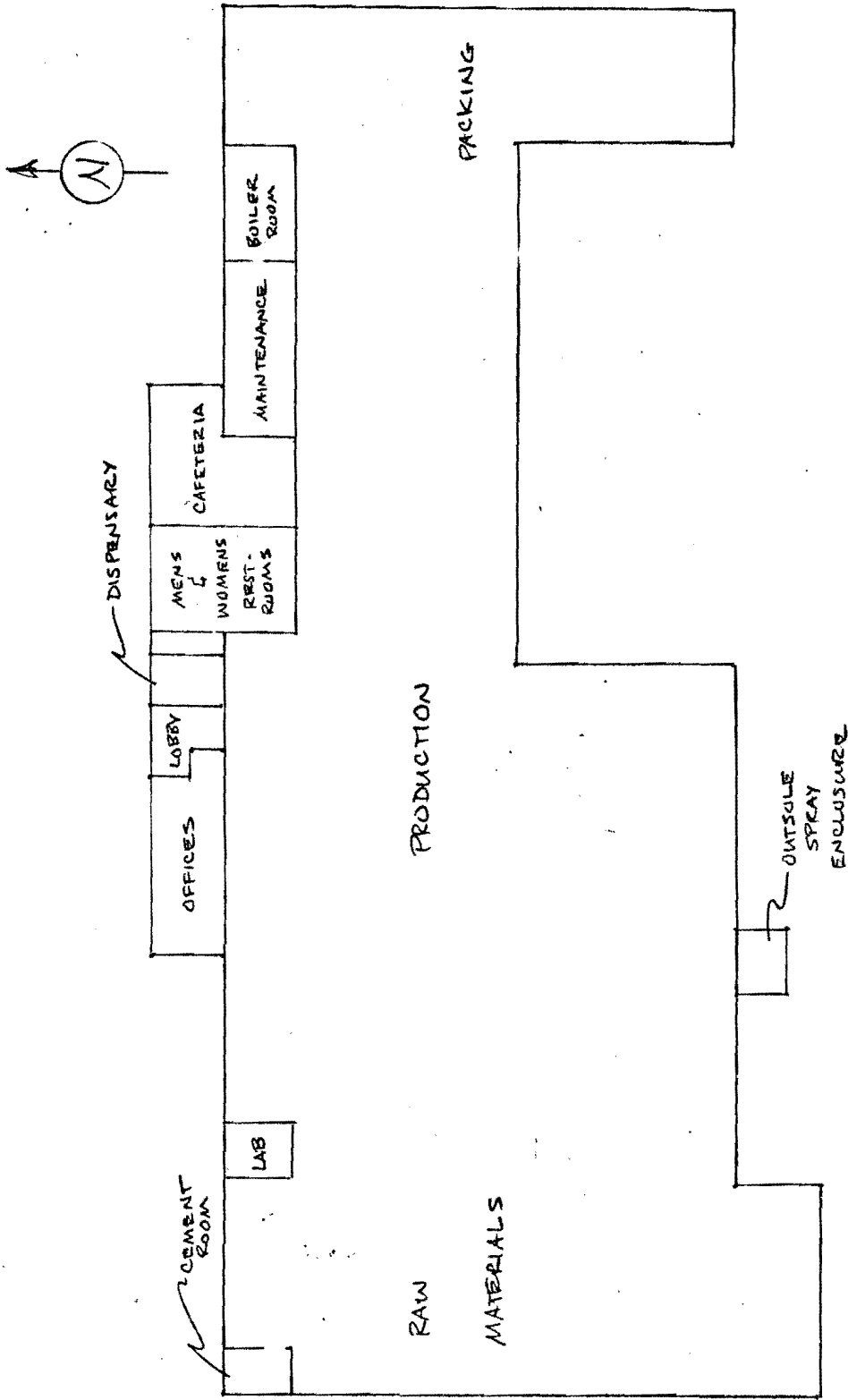


FIGURE 1. LAYOUT OF CONVERSE'S LUMBERTON SHOE PLANT

Rubber stock processing takes place in a high-ceiling (approximately 30 feet) area. Raw materials are raised by an elevator to the top level. Milling and mixing occur as the product works its way down to the ground floor. Long belts of natural rubber, about 2 feet wide, are produced in this manner. The rubber material is coated with zinc stearate to facilitate handling.

The cement room contains four 100-gallon mixing churns. Two solvents, hexane and cement naphtha, are piped into the room from bulk storage tanks. The proper proportions of solvent and pieces of rubber are added to the churn and blended together. The product is mechanically transferred to 55-gallon drums for disposition in the production area. Four counterweighted mixing heads are suspended along one wall for stirring individual 55-gallon drums and small containers.

All shoes are constructed around a solid foot-sized form called a last. All pieces are cut to size and assembled using either stitching or cementing methods. Different adhesives are used depending on the materials being joined, the stresses expected on the bond, and other factors such as drying time, water resistance, expense, and durability.

Some of the material is actually two layers of fabric joined together with a latex adhesive using a machine called a combiner. Other material is precoated with solvent-based adhesive and dried in a spreader machine. There are numerous buffing and smoothing operations to prepare surfaces for a good fit and adhesion.

The adhesive applied to material passing through the spreader is a 50% natural rubber solids adhesive made by Converse using cement naphtha as the solvent. One naphtha product used, special Naphtholit 66/3, is classified as VM&P naphtha which has a time-weighted average (TWA) threshold limit value (TLV) of 300 parts naphtha per million parts of air (ppm), and a short term exposure limit (STEL) of 400 ppm. A STEL is defined as the maximal concentration which a worker can be exposed for up to 15 minutes provided that no more than four excursions per day occur with at least 60 minutes between exposure periods.<sup>1</sup>

Canvas-upper shoes are assembled by a wet-stick lasting process using latex adhesives. Solvent-based adhesives are used for building up and joining the insole and outsole sections. The entire shoe is autoclave cured to vulcanize the rubber and cure the final assembly bonds.

The cements used for insole making and outsole spraying are similar in content, differing in percentage composition. Both are natural rubber base cements with approximately a 50/50 mixture of hexane and naphtha for the solvent. The current TWA-TLV for hexane is 100 ppm. The insole cement, which is roller coated or brushed on, is a 20% solids adhesive. To be sprayable, the outsole adhesive is only 6% solids.

The outsoles of cold-process shoes are precoated with a urethane cement. This adhesive is about 20% solids dissolved in a solvent blend consisting of 45% methyl ethyl ketone (MEK), 22% toluene, 13% acetone, and 2% isopropanol. The Material Safety Data Sheet recommends a TLV of approximately 190 ppm for this adhesive.

Some solvent-based adhesives are brushed on. Others are either sprayed or rolled on by machine; however, most automated applications are followed by a worker inspecting and spreading the adhesive with a hand-held brush to assure that an uniform layer completely covers the piece. Some of the latex adhesives are applied by dipping the parts to be coated to the desired depth in a bath of adhesive. The hot melt adhesives are injected onto the part from a moving applicator head while the shoe is clamped in a fixed position.

#### Description of Controls

There is extensive ventilation in the rubber processing area. The stations where bags of pigment are emptied have outwardly inclined, slotted hoods. Smoke-tube analysis showed capture velocities are adequate in the absence of cross drafts. All mixing and milling equipment is ventilated, as is the sheet stock forming equipment.

The cement room has general ventilation at floor level. The churns are closed except for charging and emptying. No odor of solvent vapor was noticeable. The room itself is separated from the rest of the building by a concrete block wall. The threshold of the doorway is raised to contain a spill. The roof is designed to vent the overpressure from an explosion. Explosion and fire prevention measures have been employed, and a sprinkler system has been installed for fire suppression. The solvents for making the adhesives are stored in underground tanks outside the building. The 55-gallon drums are lined with disposable plastic "bags" to allow the use of previously used drums and circumvent cleaning the drums both before and after use as an adhesive container.

Both the spreader and the combiner are ventilated. The drying section of the spreader is fully enclosed with two updraft ventilation hoods. The combiner is covered with a canopy hood primarily to control the odor of ammonia from the latex adhesive. All leather buffing and shaving operations are ventilated to control the dust. Exhaust ventilation is installed above the bottom forming presses and tempered air is blown down in front of these presses. The outsole spray area is enclosed in a separate room constructed outside the main building. The spray section of the tunnel is to be enclosed and ventilated. The room is covered with an explosion-venting roof.

The drying tunnel on the insole making line is ventilated. The adhesive is applied to the various pieces along an unventilated section of the conveyor belt. Most of the adhesive applications are machine aided.

The outsole prep line is enclosed and ventilated. The application section has a partial plexiglass enclosure with open areas to allow working access. The drying chamber for this process is also ventilated.

Other than the raw materials processing area, the entire building is air conditioned. The exhaust ventilation, both local and general, is balanced by the replacement air supplied by the comfort ventilation system.

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## Other Factors Relating to Occupational Health and Safety

Converse has a full-time safety director employed at this plant. He meets with the production supervisors and performs monthly safety inspections. Management strongly supports the safety program. A safety committee, which includes the managers of Personnel, Engineering, and Maintenance, meets monthly to discuss possible problems and their solutions. Job Safety Analysis has been performed on some equipment operating procedures.

Industrial hygiene assistance and sample analyses are provided on request by their workers compensation carrier, Employers Insurance of Wausau. Allied Chemical provided these services when they owned Converse. Most of the local exhaust ventilation was installed during that association.

A nurse is on duty in the plant during every shift. A number of workers have been trained in first aid at the local technical college under a program in which Converse pays the instruction fee. Injuries requiring emergency medical care would be treated at the emergency room of the hospital in Lumberton.

Each employee is covered by a medical/hospitalization plan. Physical examinations are given prior to employment, and some routine tests, such as audiometric screening and blood pressure monitoring, are administered periodically. Personal protective equipment is available on request but no item is required to be worn by every employee.

## Conclusions and Recommendations

Although hot melt and latex adhesives are now successfully used for some permanent bonds, solvent-based adhesives are still needed by the shoe industry. Properly designed local exhaust ventilation can adequately and economically control vapor emission into the workplace air.

Converse has installed ventilation in a number of areas to control workplace concentrations of potentially hazardous vapors and, in some cases, objectionable odors. Moving the outsole spraying process outside the main building is a commendable application of process isolation.

If the footwear industry is selected for further study, Converse would be a prime candidate for an in-depth survey. The solvent spreader, insole making, outsole spraying, and cold process bottoming areas would be studied.

1. TLVs<sup>R</sup> Threshold Limit Values for Chemical Substances and Physical Agents in the Workroom Environment, Adopted by the American Conference of Governmental Industrial Hygienists, 1981.