

WALK-THROUGH SURVEY REPORT:

HVLV CONTROL TECHNOLOGY FOR GRAPHITE COMPOSITE TRIMMING AT:

Boeing Commercial Airplane Company  
Fabrication Division  
Auburn, Washington

REPORT WRITTEN 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  
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PLANT SURVEYED: Boeing Commercial Airplane Company  
Fabrication Division  
Box 3707  
Seattle, Washington 98002

SIC CODE: 3729 (Aircraft parts and auxillary  
equipment)

SURVEY DATE: June 9, 1983

SURVEY CONDUCTED BY: Bruce A. Hollett, C.I.H., P.E.

EMPLOYER REPRESENTATIVES CONTACTED: Mr. Dwane Anderson, Administrator  
Division of Safety  
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EMPLOYEE REPRESENTATIVES CONTACTED: No employees contacted

## I. INTRODUCTION

The National Institute for Occupational Safety and Health (NIOSH) is the primary Federal agency engaged in occupational safety and health research. Located in the Department of Health and Human Services (formerly DHEW), it was established by the Occupational Safety and Health Act of 1970. This legislation mandated NIOSH to conduct a number of research and education programs separate from the standard setting and enforcement functions carried out by the Occupational Safety and Health Administration (OSHA) in the Department of Labor. An important area of NIOSH research deals with methods for controlling occupational exposure to potential chemical and physical hazards. The Engineering Control Technology Branch (ECTB) of the Division of Physical Sciences and Engineering has been given the lead within NIOSH to study the engineering aspects of health hazard prevention and control.

Since 1976, ECTB has conducted a number of assessments of health hazard control technology on the basis of industry, common industrial process, or specific control techniques. Examples of these completed studies include the foundry industry; various chemical manufacturing or processing operations; spray painting; and the recirculation of exhaust air. The objective of each of these studies has been to document and evaluate effective control techniques for potential health hazards in the industry or process of interest, and to create a more general awareness of the need for or availability of an effective system of hazard control measures.

These studies involve a number of steps or phases. When the perceived need for research requires further definition, a pilot study is undertaken to assess the need for bench research and or validation of existing capabilities. If it is determined that field studies are needed, a series of walk-through surveys is conducted to select plants or processes with effective and potentially transferable control concepts or techniques. Next, in-depth surveys are conducted to determine both the control parameters and the effectiveness of these controls. The reports from these in-depth surveys are then used as a basis for preparing technical reports and journal articles on effective hazard control measures. Ultimately, the information from these research activities builds the data base of publicly available information on hazard control techniques for use by health professionals who are responsible for preventing occupational illness and injury.

The objective of this pilot study is to determine the state-of-the-art of High Velocity Low Volume (HVLV) technology and to what extent it has been successfully applied in various industries. It will provide an assessment of the need for research and/or validation of existing capabilities and their potential for transfer to other industries. The purpose of this visit was to explore the potential for use of this technology in the graphite composite industry.

## II. PLANT AND PROCESS DESCRIPTION

### Plant Description:

The Boeing Commercial Airplane Company is headquartered in Renton, Washington. The Fabrication Division headquarters is at the Auburn plant, which was constructed in 1966. This division employs about 9000 workers, approximately 5500 at the Auburn plant. The Composite Production Shop (A-3430) in building (17-05) was built in 1968. The composite production activities currently employs 165 workers. The portion of this activity where HVLV hand tools are used is the trim shop, which employs from 10 to 20 per shift on a two-shift schedule.

### Process Description:

The graphite composite trim process was initiated in 1980. The composite consists of layers of glassfiber, Kevlar, and resin impregnated graphite fiber materials. The aircraft composite parts are positioned on benches or platforms for hand tool edging and trimming. This production area was designed to be under negative pressure with respect to the rest of the building and a local exhaust HVLV system was installed with sufficient capacity to meet the needs of anticipated growth.

### Potential Hazards:

The fibrous materials release binder dust and fibers when machined. The glassfibers are primary irritants causing skin and eye irritation. Graphite fibers are a relatively new product which has not demonstrated any new health hazards to date.

### III. CONTROLS

#### PRINCIPLES OF CONTROL

Occupational exposures can be controlled by the application of a number of well-known principles, including engineering measures, work practices, personal protection, and monitoring. These principles may be applied at or near the hazard source, to the general workplace environment, or at the point of occupational exposure to individuals. Controls applied at the source of the hazard, including engineering measures (material substitution, process/equipment modification, isolation or automation, local ventilation) and work practices, are generally the preferred and most effective means of control both in terms of occupational and environmental concerns. Controls which may be applied to hazards that have escaped into the workplace environment include dilution ventilation, dust suppression, and housekeeping. Control measures may also be applied near individual workers, including the use of remote control rooms, isolation booths, supplied-air cabs, work practices, and personal protective equipment.

In general, a system comprised of the above control measures is required to provide worker protection under normal operating conditions as well as under conditions of process upset, failure, and/or maintenance. Process and workplace monitoring devices, personal exposure monitoring, and medical monitoring are important mechanisms for providing feedback concerning effectiveness of the controls in use. Ongoing monitoring and maintenance of controls to ensure proper use and operating conditions, and the education and commitment of both workers and management to occupational health are also important ingredients of a complete, effective, and durable control system.

These principles of control apply to all situations, but their optimum application varies from case-to-case. The application of these principles in the graphite composite process is discussed below.

#### Engineering Controls:

The trim room HVLV exhaust system has 39 ceiling drops providing convenient access from any work station. The system is powered by a Lamson 300 Hp blower, which draws 6000 CFM at 11" of Mercury. There are normally 10-15 drops attached at one time and only 5-10 in operation at once. This results in an exhaust rate of approximately 3000 to 4000 CFM from the trim room. Replacement air is drawn through the doors from the rest of the shop area. Three drops are larger 3" ducts while the remainder are 1 1/2". The Micro Pul dust collector has an automatic air blast bag shaker. They replaced the original butterfly cleanout valve with a gate valve to avoid damage from debris getting caught in the valve. The only maintenance problem with this 3-year-old system was a bearing failure.

Boeing had designed their own shroud for a router edging tool. It positioned the collection hood (a length of large diameter elastomer pipe) around the body of the tool and channeled the exhaust air through a flexhose which encompassed the air supply line for the first 8' immediately preceding the tool. This integrated concentric design approach had the advantage of making

the tool much more convenient to hold and maneuver than the typical side-add on hood and hose.

Boeing is anticipating use of some smaller portable HVLV vacuum systems in remote parts of the plant.

**Work Practices:**

Many tools were used with the exhaust hose positioned adjacent to the work piece near the working surface or held by the worker in his other hand adjacent to the cutting tool. This is the typical operating method where shroud designs have not been suitable for the task or tool.

**Monitoring:**

Environmental monitoring is accomplished when a new process is started up or process changes are made. Repeat monitoring is done to follow up problems and when the data is outdated. Monitoring results in the trim shop were reportedly well below the nuisance dust criteria of 10 mg/m<sup>3</sup>.

Medical monitoring is provided through preplacement and termination physical examinations. Periodic examinations are available based on the requirements of the occupational exposure. Trim shop workers are not required to take any periodic exams.

**Personal Protection:**

Safety glasses and foot protection are required, while hearing protectors and respirators are available on request but not required in the trimming facility.

**Other Unique Practices:**

Fixed machines were placarded with safety do's and don't's. The safety office provides video taped training for the monthly programs.

**Other Observations:**

From discussions with Mr. Anderson and Mr. Chandler, it would appear that there are likely to be a number of facilities utilizing HVLV systems in the various Boeing activities. Due to the size and diversity of these several companies, it would be advisable to coordinate any further studies in Boeing plants well in advance to ensure that each level is properly contacted. Coordination with the Corporate Industrial Hygiene program does not ensure awareness of the Health and Safety elements at various sites under consideration.

**Conclusions and Recommendations:**

This Boeing and the Kenworth Truck Company edging router hood designs each had very interesting elements. The combination of the two approaches might yield a more convenient tool with a more efficient collection enclosure. The

possibility of such a collaboration between Boeing and Kenworth was discussed with the Boeing representatives. The Boeing representatives concurred full integration of HVLV with trim tools is feasible, and stated manufacturers of pneumatic tools ought to market trim tools with integral hoods for use with HVLV systems.

Boeing has reportedly established full control of composites dust in this facility. However, the extent of integration of HVLV with trim tools is not sufficient for an in-depth NIOSH study of HVLV.