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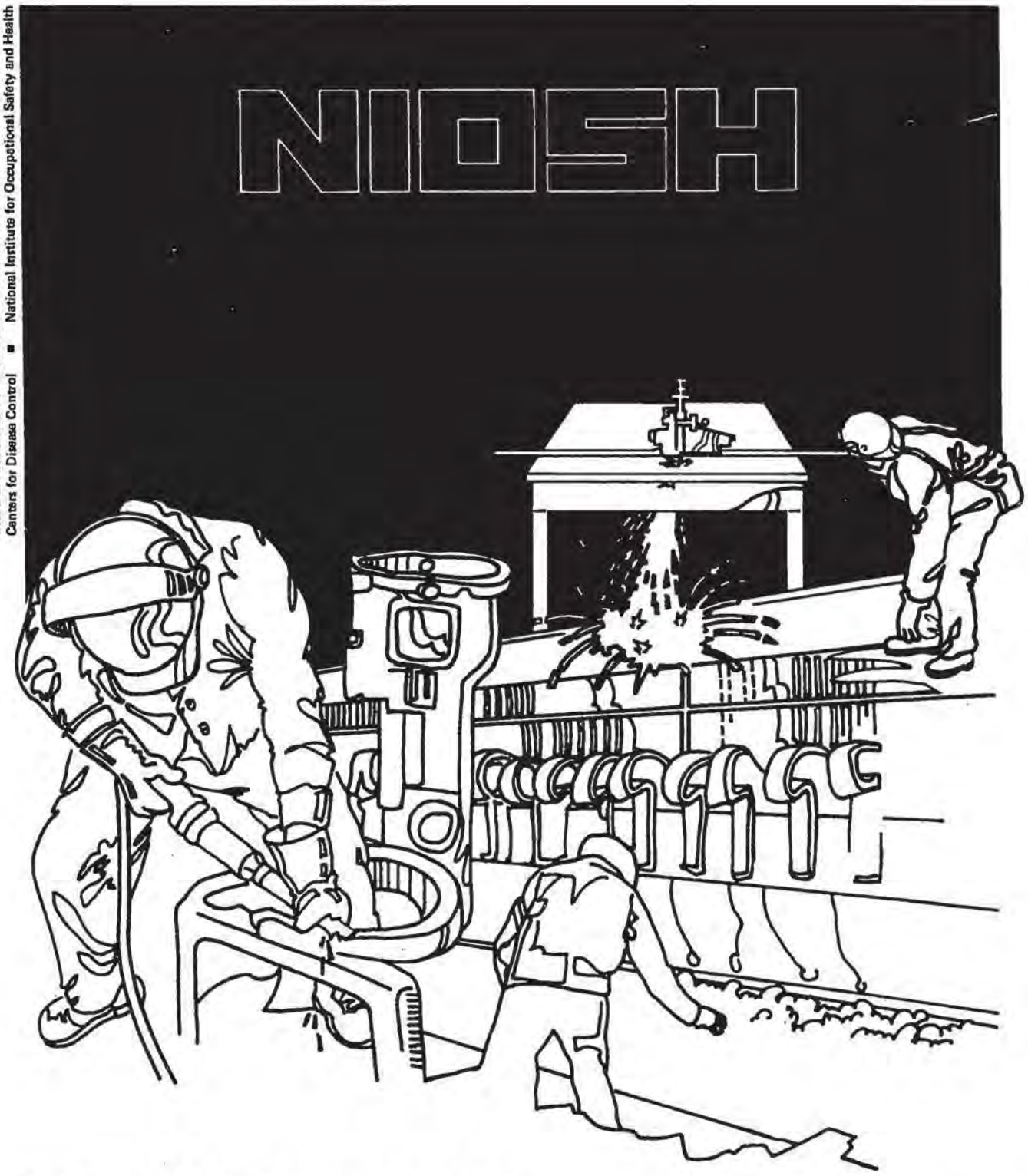


Health Hazard Evaluation Report

HETA 81-177,178-988
UNIVERSITY OF WASHINGTON
SEATTLE, WASHINGTON

PREFACE

The Hazard Evaluations and Technical Assistance Branch of NIOSH conducts field investigations of possible health hazards in the workplace. These investigations are conducted under the authority of Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669(a)(6) which authorizes the Secretary of Health and Human Services, following a written request from any employer or authorized representative of employees, to determine whether any substance normally found in the place of employment has potentially toxic effects in such concentrations as used or found.

The Hazard Evaluations and Technical Assistance Branch also provides, upon request, medical, nursing, and industrial hygiene technical and consultative assistance (TA) to Federal, state, and local agencies; labor; industry and other groups or individuals to control occupational health hazards and to prevent related trauma and disease.

HETA 81-177,178-988
November 1981
University of Washington
Seattle, Washington

NIOSH INVESTIGATOR:
Arvin G. Apol, I.H.

I. SUMMARY

In February 1981, the National Institute for Occupational Safety and Health (NIOSH) received a request to determine if a potential health hazard existed to employees from exposure to methyl alcohol while operating a spirit duplicator and to the chemical by-products produced when using an electronic stencil maker.

The spirit duplicator is used for periods of time ranging from several minutes to several hours per day. NIOSH conducted an environmental evaluation on April 1, 1981. The average methyl alcohol concentration for a 25 minute period was 1025 ppm. The concentrations for the consecutive 5 minute periods were 1000, 1050, 1100, 950 and 1030 ppm. The NIOSH recommended criteria for methyl alcohol exposures are an 8 hour time weighted average concentration of 200 ppm and/or a 15 minute level of 800 ppm. The 1025 ppm concentration measured exceeded the 15 minute exposure criteria. At the end of the 25 minute period the operator experienced eye irritation.

The stencil cutter was not evaluated at this time. Sampling had recently been conducted by the University of Washington Environmental Health Personnel. The samples collected on Tenex in the exhaust of the cutter and analyzed on a computerized mass spectrophotometer gas chromatograph, showed approximately 28 aliphatic and aromatic hydrocarbon compounds that are indicative of a waxy coating. All identified compounds were present in quantities that were less than 0.1 ppm. Samples, collected in a cold trap, showed traces of carbon dioxide, sulfur dioxide and aliphatic and aromatic hydrocarbons. A recent Health Hazard Evaluation (HHE 81-002) conducted on a stencil cutter of the same manufacturer as the one in this evaluation, showed traces of hydrocarbons C-8 to C-11 and toluene. Analysis of a carbon disulfide extraction of the plastic stencil by gas chromatography (GC) detected only one high boiling component. This component was identified by GC/mass spectroscopy (MS) analysis as a phthalate, probably 2-ethyl-hexyl phthalate (DEHP), a common plasticizer used in vinyl plastics to impart a desired degree of flexibility.

Ozone concentrations, measured with detector tubes, were less than 0.01 ppm. The employees stated that when the stencil cutter is in operation they may experience nose and throat irritation and occasional dizziness.

NIOSH has determined that a health hazard due to excessive exposure to methyl alcohol existed in the operation of a spirit duplicator at the University of Washington. This is based on the methyl alcohol concentrations measured, eye irritation experienced by the operator, and exposure levels similar to those found in a large study involving use of spirit duplicators (TA 80-32 Everett School District) which resulted in operators experiencing such symptoms as blurred vision, headache, nausea and dizziness. The by-products identified from the stencil cutter during operation were present in very low concentrations. Adverse health effects are usually not found with these low exposures. Recommendations to reduce the exposure to methyl alcohol vapors are presented with examples of suggested local exhaust ventilation designs in Section VIII.

KEYWORDS: SIC 7339 (Reproduction Services) methyl alcohol, schools, spirit duplicators, electronic stencil makers.

II INTRODUCTION

In February 1981, NIOSH received a request to determine if a potential health hazard existed to employees (working in room 422 of Miller Hall) from exposure to methyl alcohol while operating a spirit duplicator and to the chemical by-products produced when using an electronic stencil maker. An initial survey was conducted on March 6, and an environmental survey on April 1, 1981. An interim report including environmental results and recommendations was submitted to the University and the requestor on April 13, 1981.

III BACKGROUND

A "spirit duplicator" is a machine that uses methyl alcohol, or spirits, to reproduce printed material. The process consists of taking a master copy with a reverse image printed on it in an alcohol soluble dye and placing it on the drum of the duplicator. The paper to be printed is fed under and in contact with a wick that is saturated with methyl alcohol. A thin layer of alcohol is laid on the paper. As the alcohol-wetted paper comes in contact with the master copy, the alcohol dissolves a small portion of the dye and transfers the image to the finished sheet. Therefore the evaporated methyl alcohol may result in an inhalation exposure to the operator. When the duplicated papers are stacked the methyl alcohol slowly evaporates. Methyl alcohol evaporates at a faster rate when each sheet of paper is exposed to the air, such as during collating and stapling. The operator stands directly in front of the duplicator when it is running. There was no local exhaust ventilation present on the one duplicator used.

The electronic stencil maker produces a stencil copy from the original. The original paper is placed on a drum and is scanned electronically. The stencil is simultaneously burned with an electric arc reproducing the scanned material. The stencil material, such as paper or vinyl, is selected based on the number of copies required. The stencil is then used in the mimeograph copying process.

Since the image is burned in the stencil, the by-products include a variety of hydrocarbons produced from the stencil paper coating and the paper. These by-products are filtered through an activated charcoal and particulate filter and exhausted into the room. The operator starts the unit, leaves the machine and conducts other work in the room until the stencil is made. It takes about 10 minutes to cut a stencil. They cut anywhere from 1 to 30 per day. On most days they cut less than 10 stencils.

IV EVALUATION DESIGN AND METHODS

1. Environmental

Breathing zone samples were collected for methyl alcohol vapors over a 25-minute sampling period. Because the exposure time varies from day to day, a short term sample was collected to indicate the potential exposure while operating the duplicator and to determine if the methyl alcohol concentrations exceeded the NIOSH 15-minute recommended exposure level.

The breathing zone air concentrations were measured using a Wilks Miran 1A infrared gas analyzer with the following settings: Wavelength, 9.5 microns; slit width, 0.5 millimeters; response time, 1 sec; path length, 2.25 meters; absorbance range, 0-1 absorbance units. With these settings the unit had a range of 0-2300 ppm methyl alcohol.

2. Medical

Each employee was interviewed about the health affects experienced during the use of the copying equipment.

V EVALUATION CRITERIA

The environmental evaluation criteria for methyl alcohol are the eight hour time-weighted average (TWA) of 200 ppm (State of Washington standard) and the short term exposure level for any 15-minute period of 800 ppm (NIOSH recommended level).[1]

The two most common routes of occupational exposure to methyl alcohol are inhalation and absorption through the skin. Signs and symptoms of methyl alcohol intoxication include headache; dizziness; nausea; vomiting; weakness; vertigo; chills; shooting pains in the lower extremities; unsteady gait; dermatitis; multiple neuritis characterized by paresthesia, numbness, prickling and shooting pain in the back of the hands and forearms as well as edema of the arms; nervousness; gastric pain; insomnia; blurred vision; general visual disturbances; blindness and acidosis[1] (metabolic disturbance).

Methyl alcohol is not known to be a liver toxin in humans, however, there have been no long-term epidemiologic studies of chronic, low-level occupational exposure[1]. There have been a few older animal studies [2], [3], [4] where autopsy revealed deterioration of basic liver tissue (parenchymatous degeneration) proceeding, in the more severe cases, to focal necrosis (localized areas of tissue death). It is difficult to interpret these reports of liver toxicity in animals which were done in the early 1900's. The data are presented summarily and not in sufficient

detail for careful evaluation. In general, the animal data is inconclusive. It is reported that primates and non-primates metabolize methyl alcohol differently, and the importance of this difference is not well known.

There have been autopsy reports of pancreatic necrosis in humans after acute ingestion of methyl alcohol. As with liver toxicity, the pancreatic pathology in humans is not specific, and chronic ethanol intake is usually an important confounding and likely causative factor.

VI RESULTS AND DISCUSSION

1. Environmental Results

The spirit duplicator operator's exposure to methyl alcohol vapors was measured on April 1, 1981 over a 25 minute period during which time 1025 copies (average 41 copies/minute) were made from 33 master sheets. Two outside windows and the door to the room were open.

The average methyl alcohol concentration for the 25 minute period was 1025 ppm. The concentrations for the consecutive 5 minute periods were 1000, 1050, 1100, 950 and 1030 ppm. This exceeds the recommended criteria of 800 ppm for any 15 minute exposure and the State of Washington standard of 250 ppm for a 15 minute period. At 1050 ppm, the 200 ppm 8 hour Time-Weighted-Average criteria, would be exceeded after 1.5 hours. The operator experienced eye irritation during this sampling period.

Both the breathing zone methyl alcohol concentrations measured and the eye irritation experienced by the operator are consistent with the findings of a large Health Hazard Evaluatin conducted at the Everett Washington School District. In this study 75% of the duplicators tested produced 15 minute concentrations that exceeded 800 ppm (Mean 1285 ppm and median 1185 ppm). In addition 45% of the operators experienced some symptoms such as blurred vision, headache, nausea, dizziness and eye irritation, which are consistent with the toxic effects of methyl alcohol.

The stencil cutter was not evaluated at this time. Sampling had recently been conducted by the University of Washington Environmental Health Personnel. The samples collected on Tenex in the exhaust of the cutter and analyzed on a computerized mass spectrophotometer gas chromatograph, showed approximately 28 aliphitic and aromatic hydrocarbon compounds, that are indicative of a waxy coating. All identified compounds were present in quantities that were less than 0.1 ppm. Samples, collected in a cold trap, showed traces of carbon dioxide, sulfur dioxide and aliphatic and aromatic hydrocarbons. A recent Health Hazard Evaluation (HHE 81-002) conducted on a stencil

cutter of the same manufacturer as the one in this evaluation, showed traces of hydrocarbons C-8 to C-11 and toluene. Analysis of a carbon disulfide extraction of the plastic stencil by gas chromatography (GC) detected only one high boiling component. This component was identified by GC/mass spectroscopy (MS) analysis as a phthalate, probably 2-ethyl-hexyl phthalate (DEHP), a common plasticizer used in vinyl plastics to impart a desired degree of flexibility.

Ozone concentrations, measured with detector tubes, were less than 0.01 ppm. The employees stated that when the stencil cutter is in operation that they may experience nose and throat irritation and occasional dizziness.

VII CONCLUSION

NIOSH has determined that a health hazard due to excessive exposure to methyl alcohol existed in the operation of a spirit duplicator at the University of Washington. This is based on the methyl alcohol concentrations measured, eye irritation experienced by the operator, and equivalent exposure levels as those found in a large study involving use of spirit duplicators (TA 80-32 Everett School District) which resulted in operators experiencing such symptoms as blurred vision, headache, nausea and dizziness. Recommendations to reduce the exposure to methyl alcohol vapors are listed in Section VIII. Examples of the suggested local exhaust ventilation designs are found in Figures 1, 2 and 3.

The by-products identified from the stencil cutter during operation were present in very low concentrations. Adverse health effects are usually not found with these low exposures, however, they may occur through synergistic reactions. This process should be studied in-depth due to the fact that many workers use this process, however this would be difficult since there is usually only one stencil cutter in any location, the number of workers exposed at each location is minimal, and the time of use varies greatly.

VIII RECOMMENDATIONS

1. Limit the operation of the spirit duplicator by any one person to 5 minute runs with a minimum waiting period between runs of 10 minutes.

2. Consider substituting Type 1 duplicator fluid (95% ethyl alcohol, 5% cellosolve) for methanol. The occupational health standard for ethyl alcohol is 1000 ppm and for cellosolve it is 200 ppm. (The American Conference of Industrial Hygienists currently recommends 50 ppm for cellosolve.) Ethyl alcohol costs more per gallon. It will produce good copies if a hard wick is used in the duplicator. If too much ethyl alcohol is transferred to paper, bleed through may occur and the ink will run.

3. Install local exhaust ventilation similar to the attached drawings. Since the exhaust ventilation system used for the spirit duplicator in room 122 appears to be tied into the bathroom exhaust system, it might be possible to tie into the bathroom exhaust system on the 4th floor, which is only several feet away. If this is done the total exhaust rate for the bathroom system may have to be increased. Another way would be to move the exhaust system, that is not currently used, from room 222 to 422.

4. If local exhaust is used as the control method an additional ventilated enclosure could be constructed for the stencil maker. If sized to just accommodate this machine the amount of exhaust air would only be 100 to 150 cfm. If this is done it would eliminate any present concern of the employees to unknown exposures as a result of making stencils.

5. Run all copies that require the use of a spirit duplicator on the duplicator located in room 122. If this system is used, the exhaustventilation grill should be lowered to a point just above and close behind the duplicator. Additional capture of the vapors can be made by constructing an enclosure for the duplicator. See attached drawings. (Note if ribboned side curtains are not desired, the enclosure can be widened with only a slight reduction in the capture efficiency.)

6. The charcoal filter on the electronic stencil machine should be changed whenever odors are detected. The purpose of this charcoal filter is to absorb vapors. The more the machine is used, the more often the filter will need replacing.

IX REFERENCES

1. Criteria for a Recommended Standard...Occupational Exposure to Methyl Alcohol, U. S. Department of Health, Education, and Welfare, PHS, CDC, NIOSH, March 1976, Publication Number 76-48.

2. Tyson H. H., Schoenberg M. J., J. Am Med Association 63: 915, 1914.

3. Scott E., Helz MM, McCord, CP; Am J. Clin Pathol 3:311. 1933.

4. Patty F.A. ed., Industrial Hygiene and Toxicology, Second Edition,, Interscience Publishers, New York, p. 1415, 1962.

5. HE 80-32. Everett School District.

X DISTRIBUTION AND AVAILABILITY

Copies of this report are currently available upon request from NIOSH, Division of Standards Development and Technology Transfer, Publications Dissemination Section, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After ninety (90) days the report will be available through the National Technical Information Service (NTIS), Springfield, Virginia 22161. Information regarding its availability through NTIS can be obtained from the NIOSH Publica- tions Office at the Cincinnati, Ohio address.

Copies of this report have been sent to:

a) The Requestor
b) University of Washington, Seattle, Washington
c) Washington Industrial Safety and Health Agency, Olympia, Washington
d) U.S. Dept. of Labor, OSHA, Region X
e) NIOSH, Region X

For the purpose of informing the exposed employees, the employer will promptly "post" this report for a period of thirty (30) calendar days in a prominent place(s) near where the affected employees work.

XI ACKNOWLEDGEMENTS

Report Prepared and Survey Conducted By:

Arvin G. Apol
Regional Industrial Hygienist
NIOSH/Region X
Seattle, Washington

Originating Office:

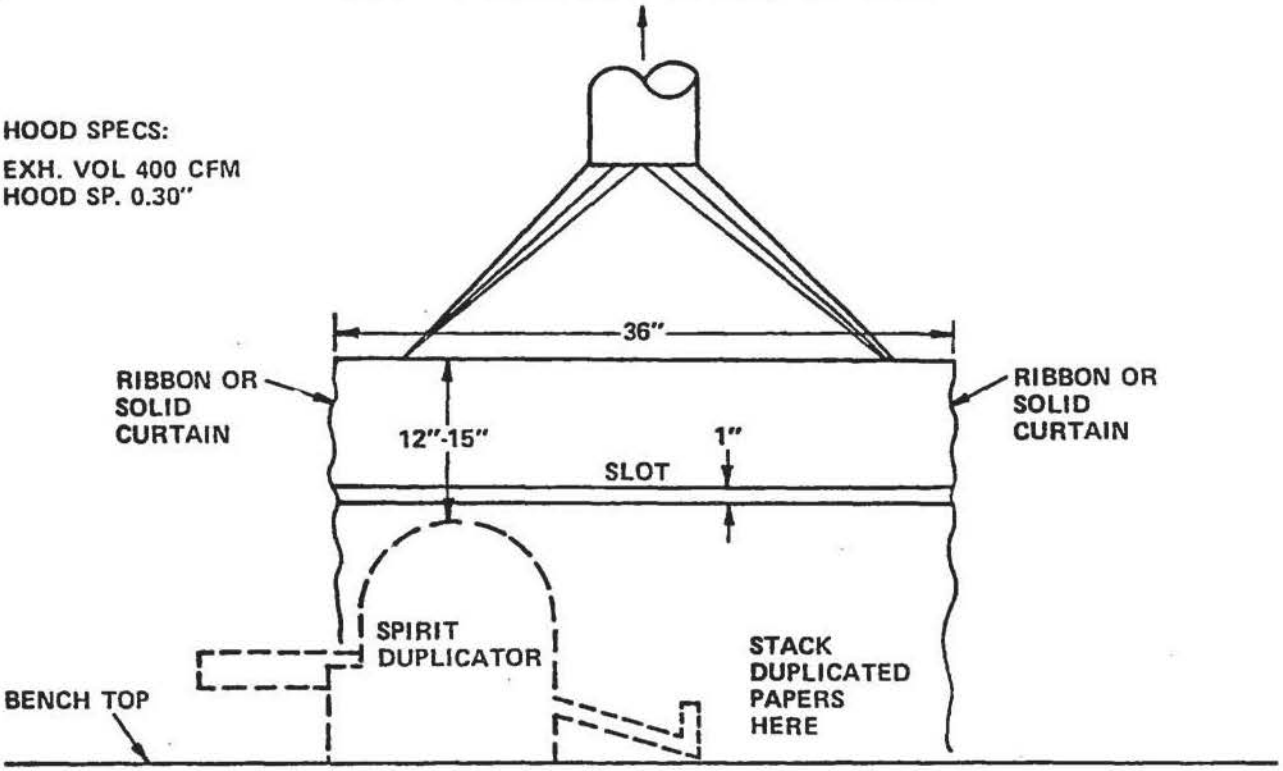
Hazard Evaluation and Technical Assistance Branch
DSHEFS/NIOSH

"DUPLICATING MACHINE EXHAUST"

–PREFERRED METHOD–
GOOD ENCLOSURE WITH SLOT EXHAUST

HOOD SPECS:

EXH. VOL 400 CFM
HOOD SP. 0.30"



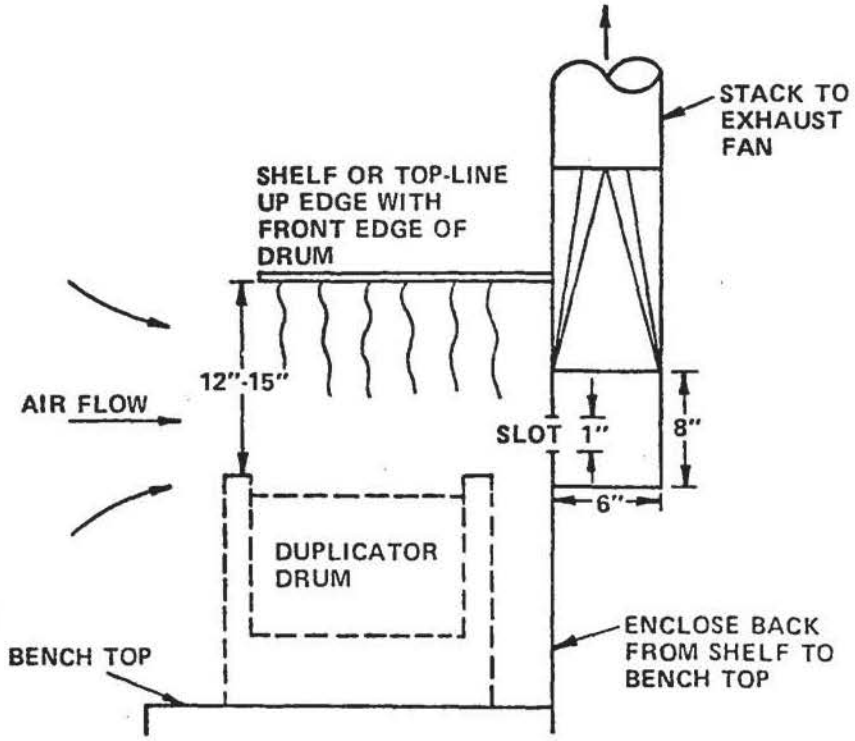
FRONT VIEW

NOTE:

–ADD HOOD SP. TO SYSTEM SP. FOR FAN SIZE EXH. TAKE OFF CAN BE DOWN

–PROVIDE FOR MAKE-UP AIR EG. VENT IN DOOR

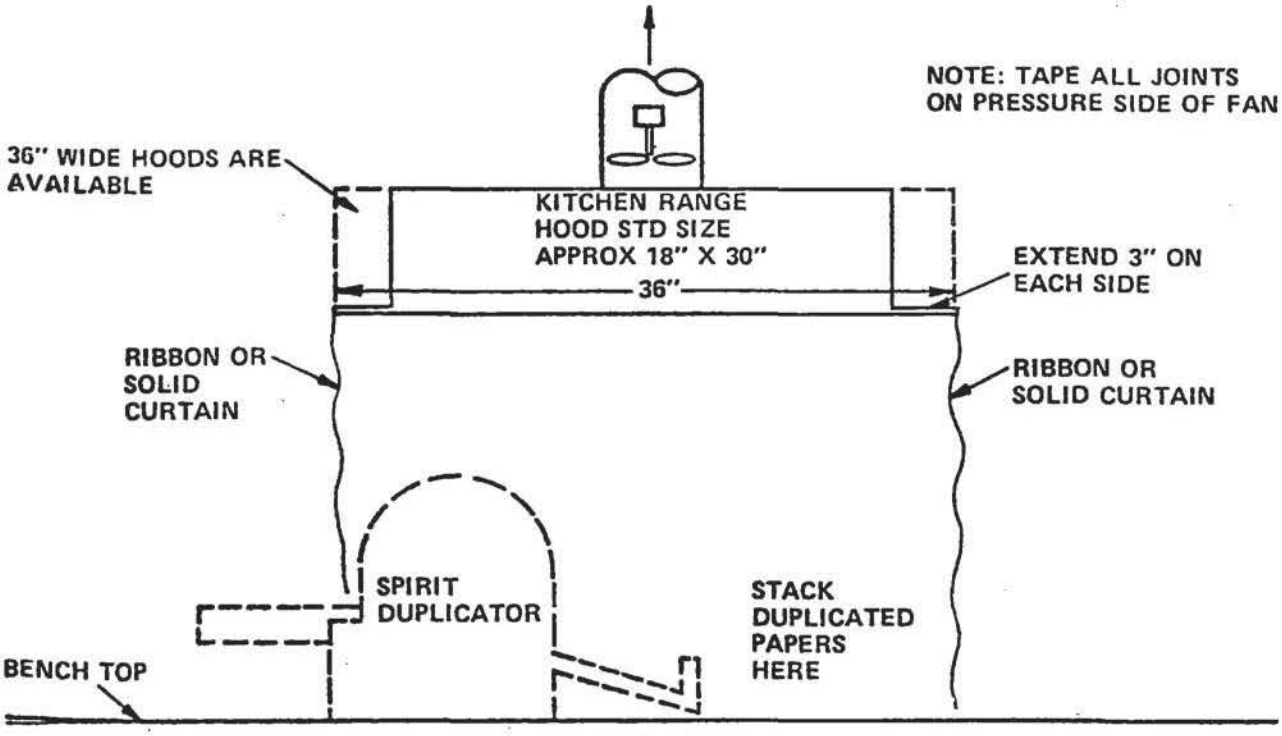
–LOCAL CODES MAY PROHIBIT EXHAUSTING THROUGH WINDOW PANES



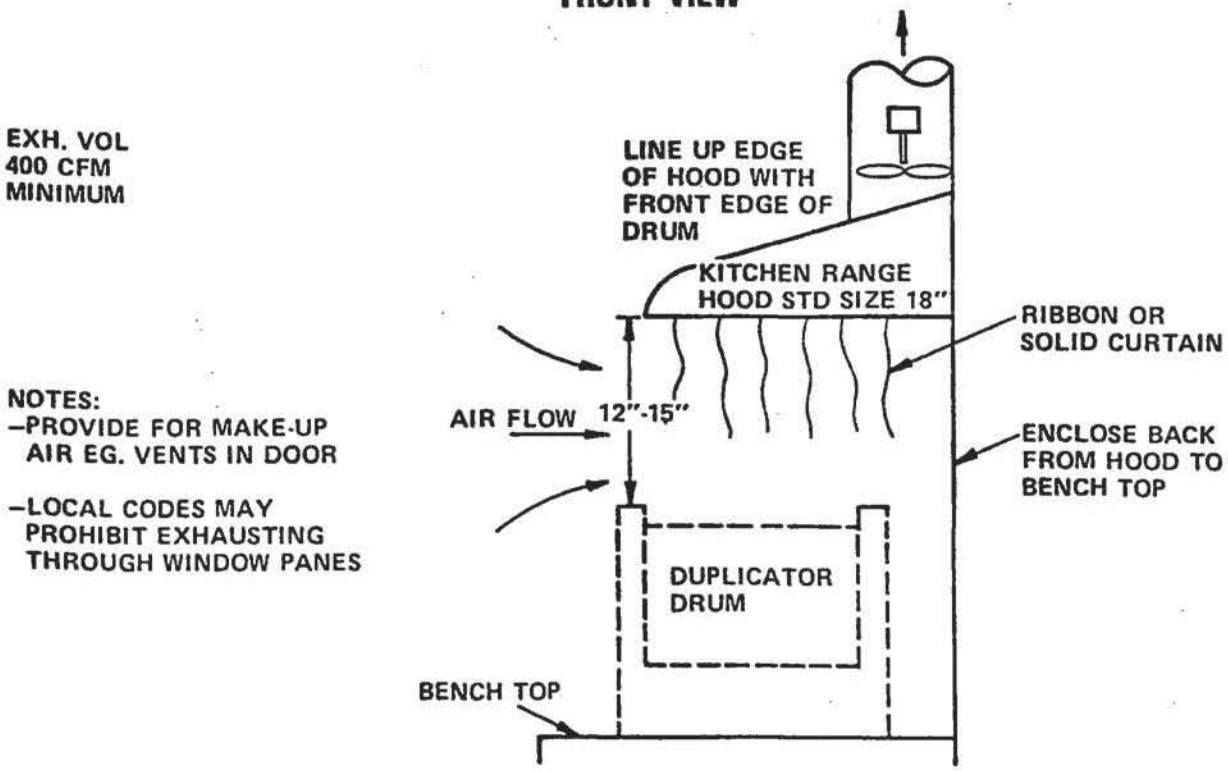
END VIEW

"DUPLICATING MACHINE EXHAUST"

–ALTERNATE METHOD–
KITCHEN RANGE TYPE HOOD
WITH GOOD ENCLOSURE



FRONT VIEW



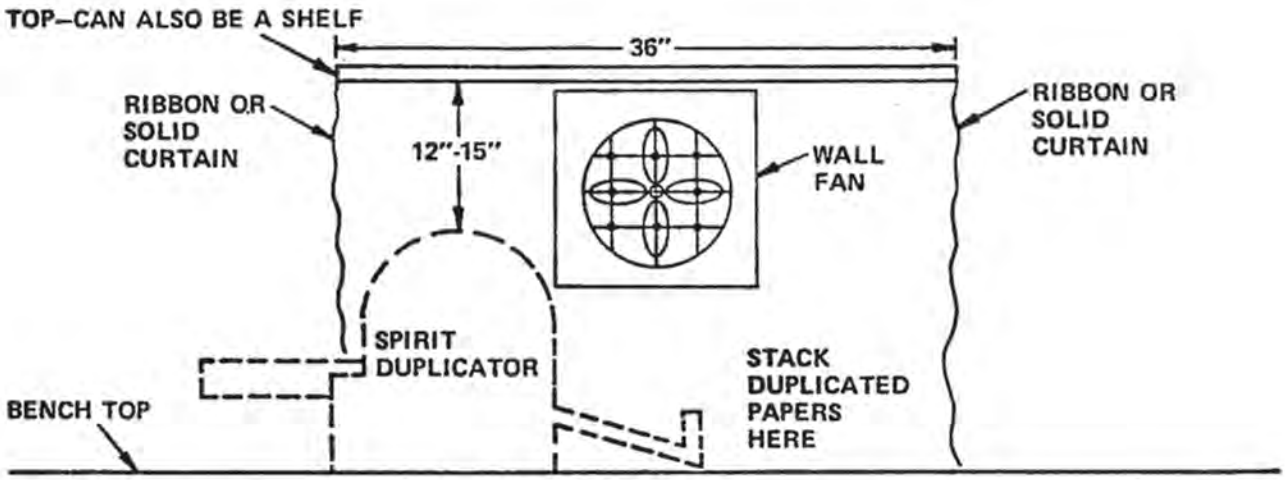
NOTES:
–PROVIDE FOR MAKE-UP AIR EG. VENTS IN DOOR

–LOCAL CODES MAY PROHIBIT EXHAUSTING THROUGH WINDOW PANES

END VIEW

"DUPLICATING MACHINE EXHAUST"

–ALTERNATE METHOD–
WALL FAN WITH GOOD ENCLOSURE



FRONT VIEW

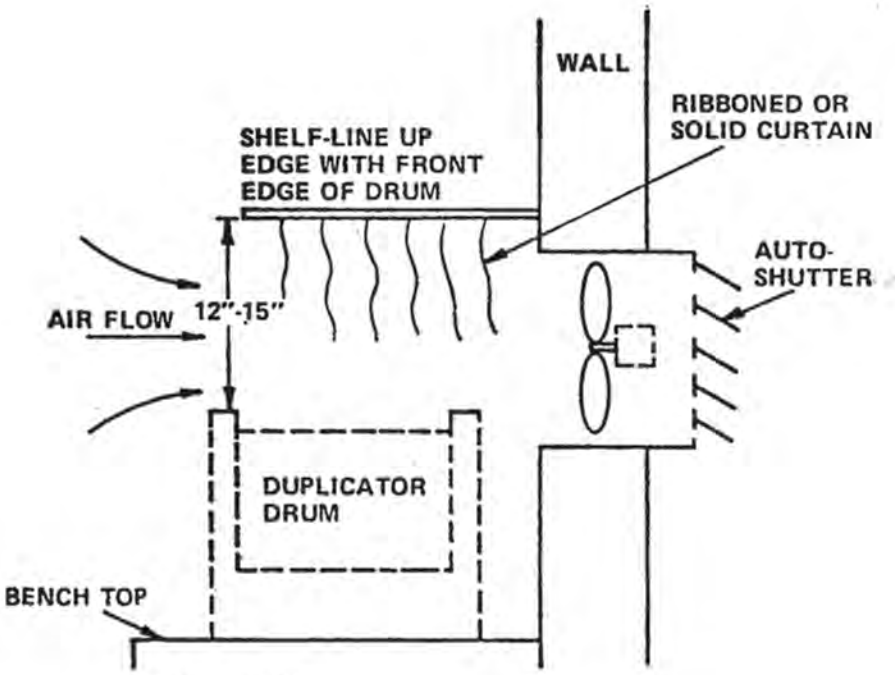
EXH FAN:

WALL TYPE WITH AUTO-SHUTTER 400 CFM MINIMUM

NOTE:

–LOCAL CODES MAY PROHIBIT WINDOW MOUNT

–PROVIDE FOR MAKE-UP AIR EG. VENTS IN DOOR



END VIEW

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