FILE NAME: Johns-Manville (JMA)

DATE: 1973

DOC#: JMA080

DOCUMENT DESCRIPTION: Asbestos-Cement Product Saws - Test Data

86805 D

D. E. Millier November 14, 1973

W. T. Donahue

N. W. Hendry, 3W ✓ A. R. Markus/File
P. L. Earle, R & D ✓ File (2)

A19-9012
DUST CONTROL - SMALL TOOLS
YOUR LETTER, 11/5/73

An extensive survey has been conducted on small tools with regard to dust control as used in the fabrication of the following Asbestos' containing products:

TRANSITE Pipe Products
FLEXBOARD Type Products
MARINITE Products
Asbestos Panels TRANSITOP Type
Ace Panels - Asbestos Cement Extrusions
Dry Wall Joint Cements

Contacts were made with the following companies either through the marketing manager or the sales manager with regard to dust control on their small tools, and in all cases, except one, the only dust control equipment was on their small belt sanders:

Millers Falls Tools
Greenfield, Massachusetts
Mr. Shaw, Tool Gen. Mgr.

Rockwell Manufacturing Company
Pittsburgh, Pennsylvania
Mr. H. Williams, Prod. Mgr.
Mr. Callahan, Sales Manager

Milwaukee Tools
Brookfield, Wisconsin
Mr. Dick Randet, V. P. for Marketing
Mr. Robert Youngquist
Mr. James Bassener

Robert Bosch Corporation
Broadview, Illinois
Mr. E. Cheshire, V. P.
Mr. Don Smith, Nat'l Sales Mgr.

Skil Corporation
Chicago, Illinois
Mr. William Foote, Marketing Mgr.

Black & Decker
Baltimore, Maryland
Mr. Bennett, Sales
Mr. Dick Campbell, Marketing
Mr. Don Ellison, Engineering

Pilot Manufacturing Company
Torrance, California
Mr. J. Rawlins, President

In addition to the above, the following companies in exhaust systems for welding and sand blasting were contacted. These companies make suction systems but none are attached to tools:

Pullman Ind. Vac. Cleaner
Malden, Massachusetts
Mr. Ross

Hobart Manufacturing Company
Troy, Ohio
Mr. Jack Force

Empire Abrasive Equip. Corp.
Philadelphia, Pennsylvania

I, also, have contacted Symons Corporation in Desplaines, Illinois, who make a vacuum grinder for joints in concrete walls, and Kett Manufacturing Company of Cincinnati who have a fiber glass sheet saw with a dust collector but is only usable for material up to about one-half inch thick. The Symons' joint grinder uses a Carbide tool and mills the rough joints in concrete.

Dr. Paul Earle has been working on this project for some time and has some imported equipment from England for dust control on a B & D saw and for a portable drill. In addition, he has put a vacuum pick-up on a large portable "Skil" type saw for test purposes.

Based on his tests to date and the tests conducted by the Asbestos Research Council in England, we find the following:

CUTTING OPERATIONS

Without Exhaust
Using hand, portable power and radial type saws without dust extraction gives dust counts from 20 to 200 fibers per cc, depending on equipment type used and product being cut.

With Exhaust
Using hand, portable power and radial bench saws with efficient dust extraction gives dust contents as low as below 5 fibers per cc, depending on equipment type used and product being cut. This requires a good high-vacuum type exhausting equipment.

With Exhaust and Wet Cutting
Using a good exhaust system and wet cutting, it appears less than 2 fibers per cc fiber count is obtainable. However, wet cutting is banned in California and has possible shock hazards.

DRILLING OPERATIONS

Without Exhaust
Drilling operations generate much less dust without exhausts and probably run mainly less than 5 cc for most operations.

With Exhaust
Drilling with efficient exhaust systems should readily meet the less than 2 fiber per cc count under dry conditions without any water sprays.

SANDING OPERATIONS

Many portable power sanders are available with dust collectors, however, very little sanding is done in the field.

The only operations requiring dry sanding in any volume is in gypsum dry wall applications, mainly in the Eastern U. S., as in the Western U. S. a textured spray finish is popular which requires minimum sanding.

In sanding dry wall joints, the usual sanding is manual, using sand paper and a block, however, the new joint cements which are ready-mixed require much less sanding. In many cases, just a touching off of high spots is required. There is a great labor turnover in this industry so total exposure is probably minimized.

We are continuing to work on this problem and have additional equipment to investigate.

It is highly possible that we might have to recommend parts from various manufacturers and then interest some manufacturer in assembling a complete unit to our specification.

Our survey work is almost complete and we are putting together some of our recommendations on equipment to solve these dust problems generated by use of small tools.

William T. Donahue

0080DI

JM REFRACTORY PRODUCTS

Engineering Information

J-M Products
MARINITE

Industry
ALL

Application
DUST CONTROL FOR PORTABLE TOOLS

J-M Representative
REFRACTORY PRODUCTS DEPT.
INDUSTRIAL PRODUCTS DIVISION

Hand power tools are used extensively in the field to work Marinite sheets. A method has been developed by P.L. Earle's research group to safely collect the dust generated in sawing, drilling, and sanding. The key to the system is high velocity-low volume air movement at the orifice.

Dust collection adaptors have been developed on this principle. The keys to good dust pick up are: (1) small pickup orifice at key locations on each tool; i.e., on saw 5/8" x 5/8" (no larger) with 50 cfm of air, a differential pressure of 4-5" of mercury on suction side and 1½-2" diameter hose no longer than 10 Ft attached from the tool to the dust collector intake.

Rockwell International Co. and Skil Corp. will provide a line of attachments for hand power tools made to J-M specifications. Drawings of units are attached. The user may make his own attachments using aluminum tubing and heavy aluminum tape. These attachments will produce results of less than 2 fibers/cc on all units except the circular saw. A special cutting table that provides suction under the piece being cut must be used with the circular saw to meet the 2 fibers/cc dust requirements. This level is below the 1976 OSHA standard. A drawing of this unit is attached.

A drill attachment is also available from Cape Universal.

Special high-velocity suction units are necessary to provide adequate air velocity to transport dust from the tool. Two units recommended are the Hoffman, Hoffco-Vac 237 and Spencer Model P-190.

Research is continuing study and evaluation on this project. Details will be released as they are developed.

Jim

James E. Neal
Mgr., Engineering and Technical Services

POWER HAND TOOLS THAT HAVE DUST PICK UP CAPABILITIES OF PRODUCING LESS THAN 2 FIBERS/CC

<u>Tools Fitted with J-M Designed Units</u>

Rockwell International

10¼" dia - Circular Saw - Model 310 - 5700 rpm

7¼" dia - Circular Saw - Model 315 - 5800 rpm

*4½" dia - Circular Saw - Trim - 3800 rpm

*No detail sketch as yet

Orbital Sander - Model 505 - 10,000 OSC/min

Most U.S. Manufactured Drills*

1/4 - 3/8" that have bearing boss

1/2" that have chuck diameter less than bearing boss diameter.

*J-M design not implemented as yet. Can use Cape Universal type which is available now.

<u>Tools with Built-In Fitting for Bags</u>

(-Remove bay and attach hose-)

Rockwell Int. Belt Sanders - - Model 500 - 4" x 27"

Rockwell Int. Belt Sanders - Model 503 - Smaller

Stanley Power Tools, Orbital Sander - Model 90-502

DUST COLLECTION SYSTEMS

Hoffco - VAC 237

Hoffman Air Filtration Div. — Guy Cusumano
A Div. of Clarkson Industries, Inc.
103 Fourth Ave. — (212) 677-3600
New York, N. Y. 10003

Spencer Model P-190

Spencer Turbine Co. — Blair Alexander
Hartford, Conn. 06106 — (203) 233-3631

Tool Attachment Producing Companies

Rockwell International Co. — Dennis Huntsmen
Power Tool Division
400 N. Lexington Avenue — (412) 241-8400
Pittsburgh, Pa. 15208

Skil Corp. — William Foote
5000-33 Elstran Avenue
Chicago, Ill. 60630 — (312) 286-2000

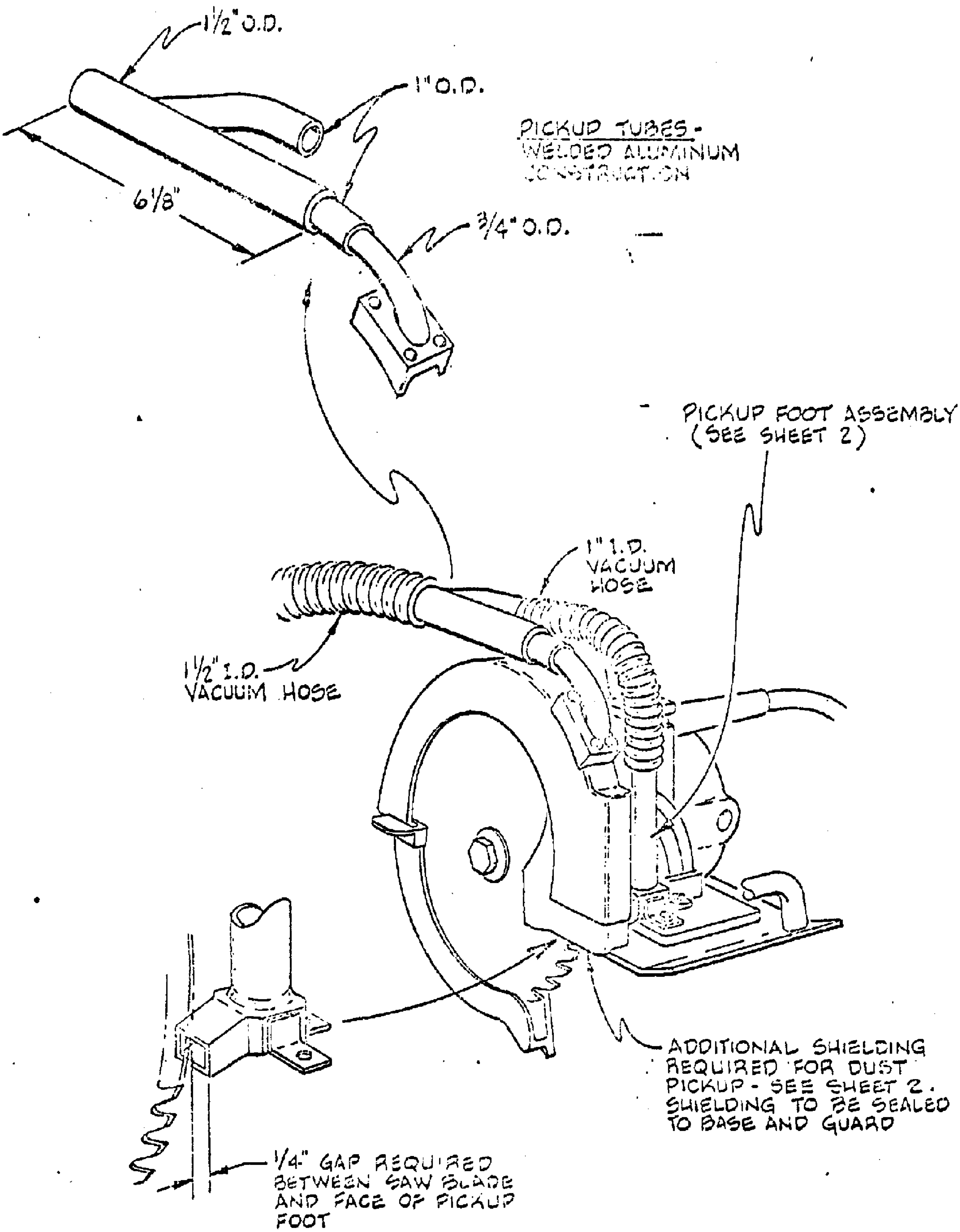
Cape Universal Drill Attachment

Cape Universal Building Products Ltd.
Register Office
P.O. Box 165
Exchange Road
Watford, England

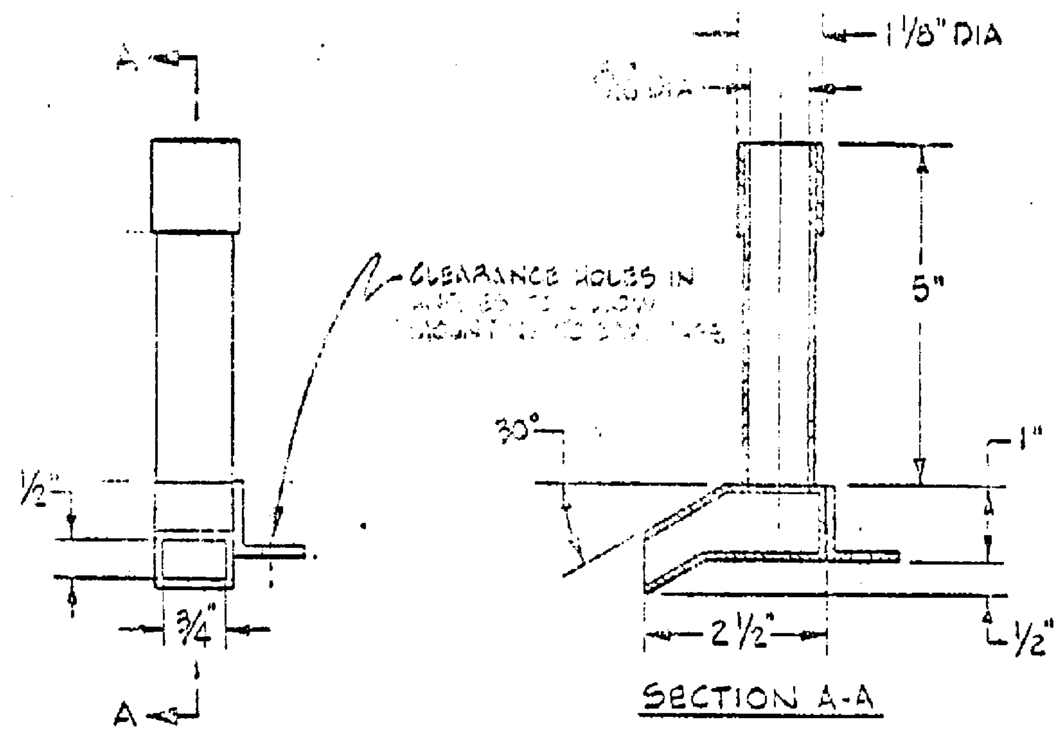
Telephone: WATFORD 34551

Telex: 262744

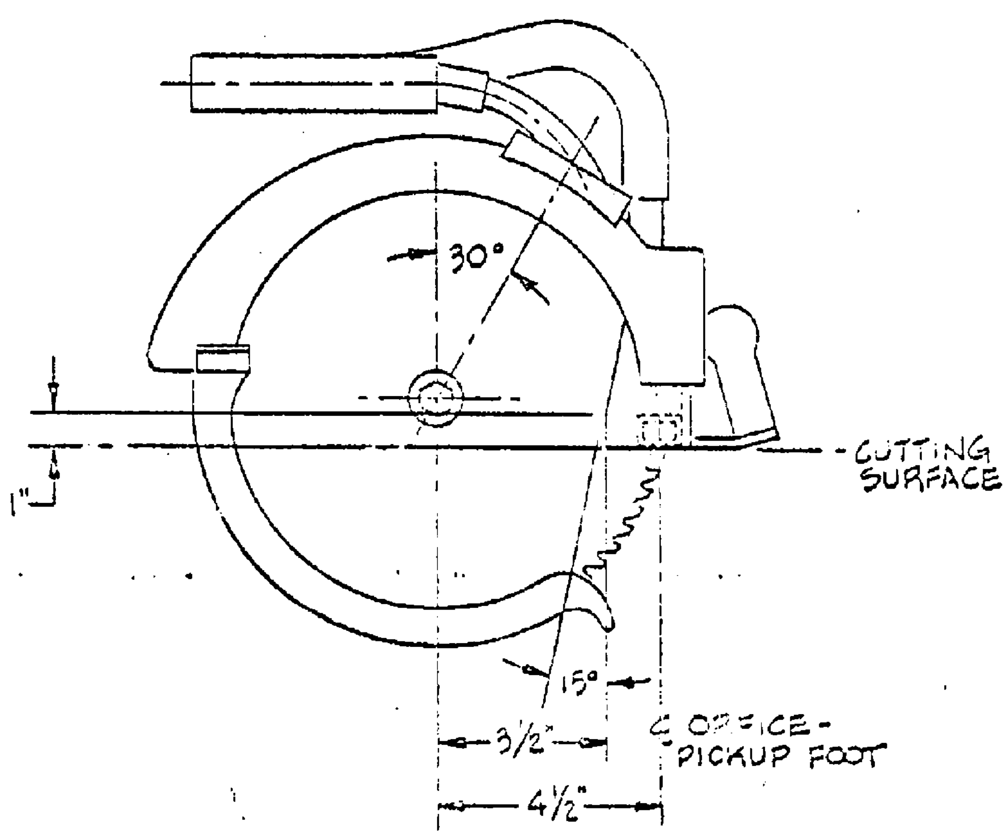
FIG. 1



DUST EXTRACTOR - PORTABLE SAW - 10¼" DIA. BLADE

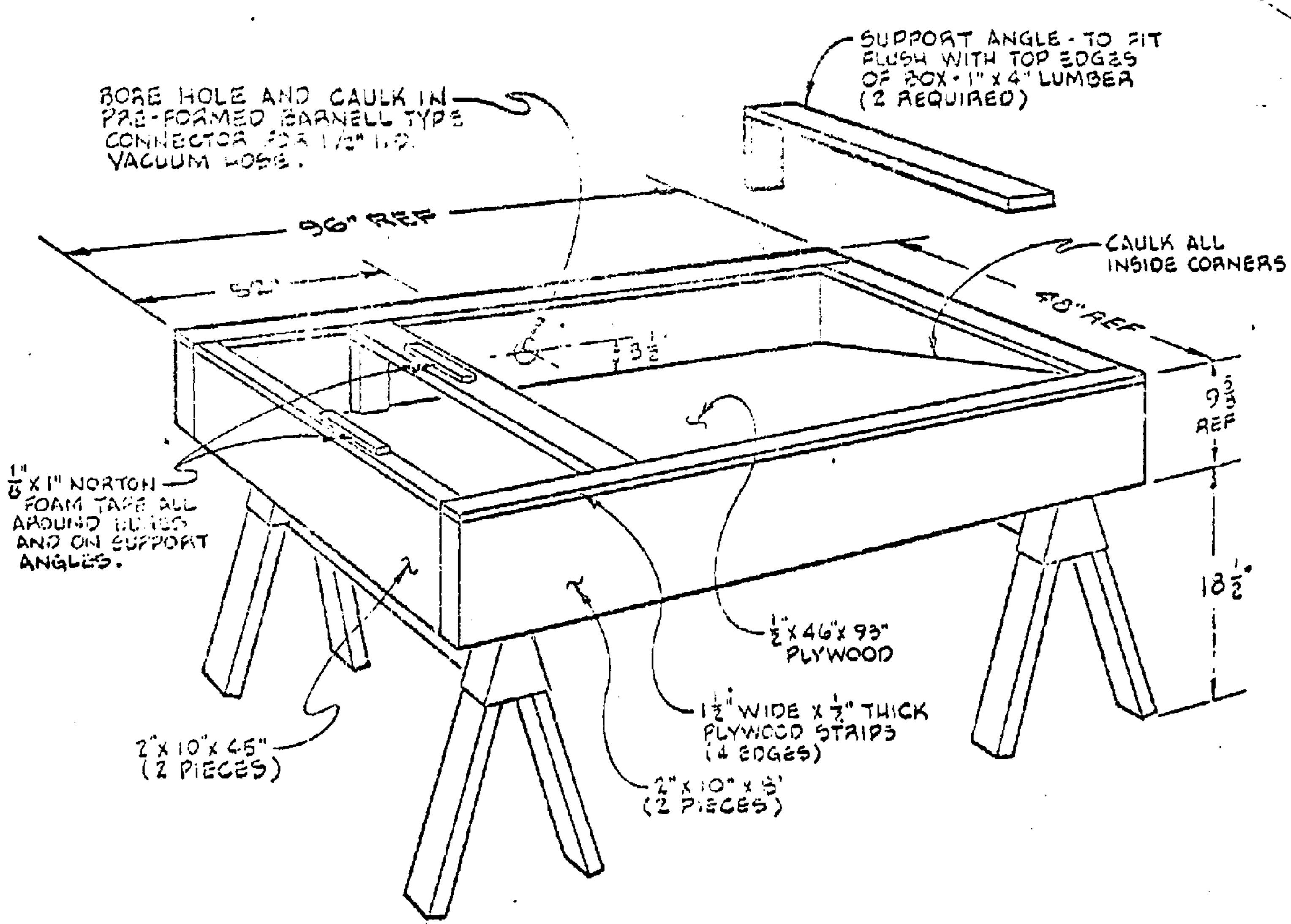


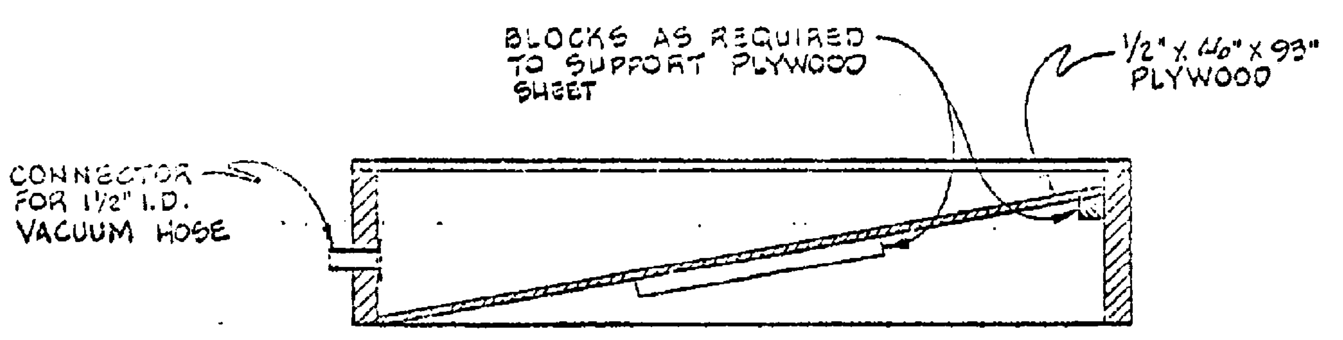
PICKUP FOOT - WELDED ALUMINUM CONSTRUCTION



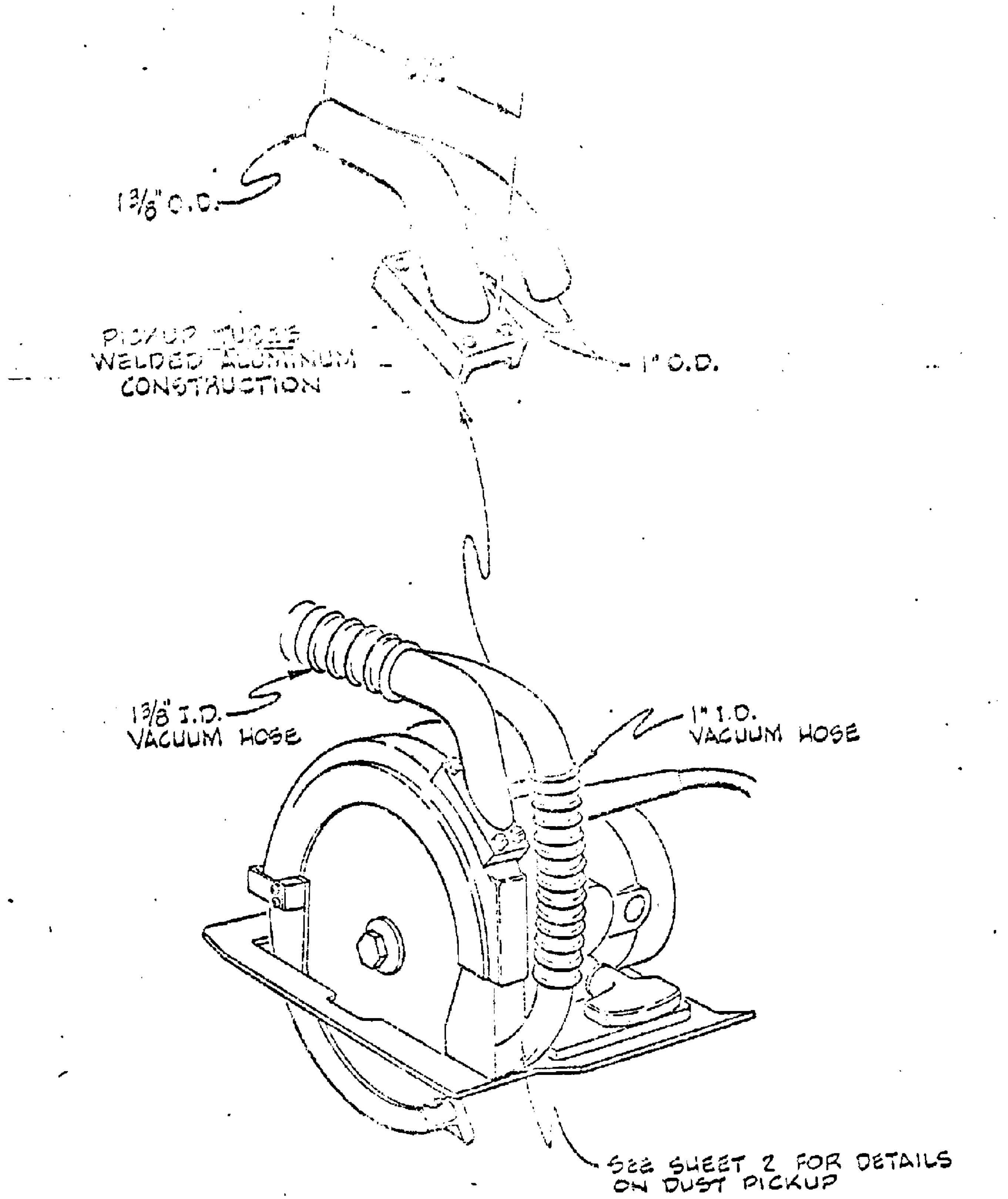
DUST EXTRACTOR - PORTABLE SAW - 10¼" DIA BLADE.

CUTTING BOX -

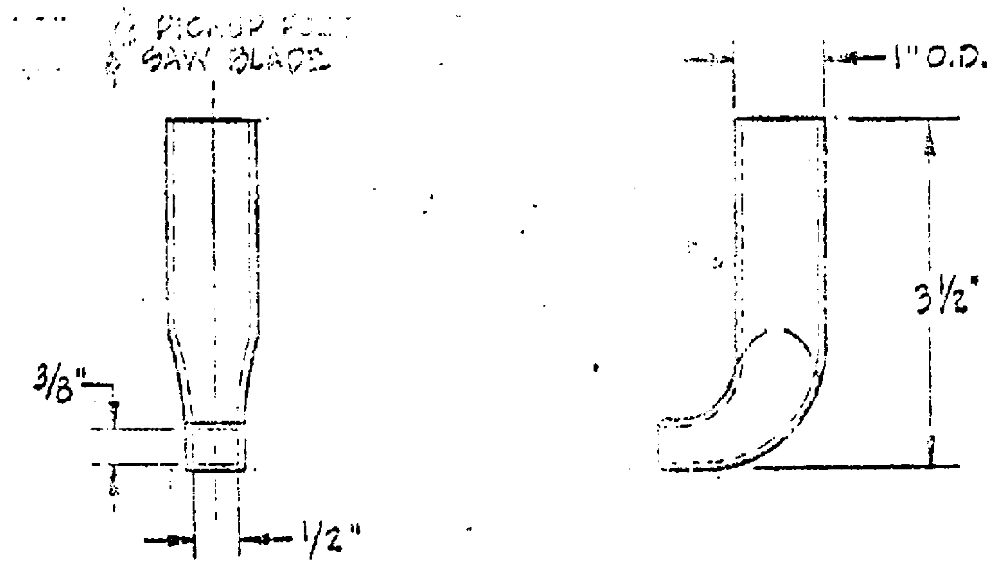




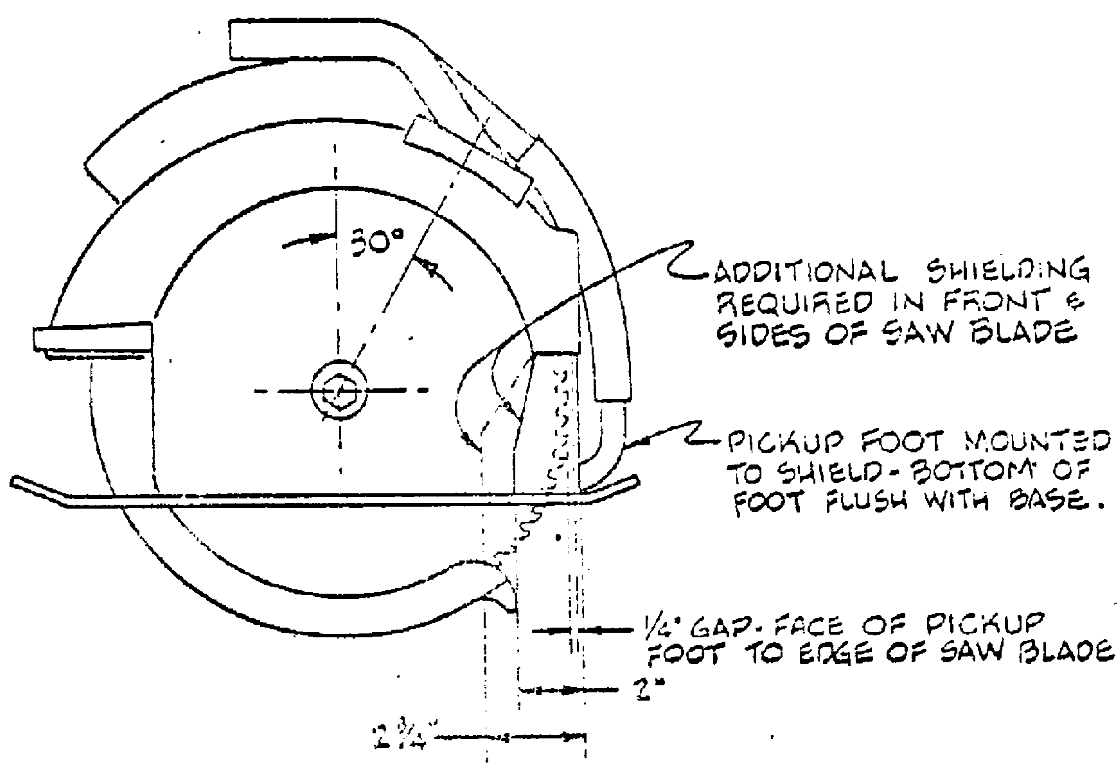
SECTION



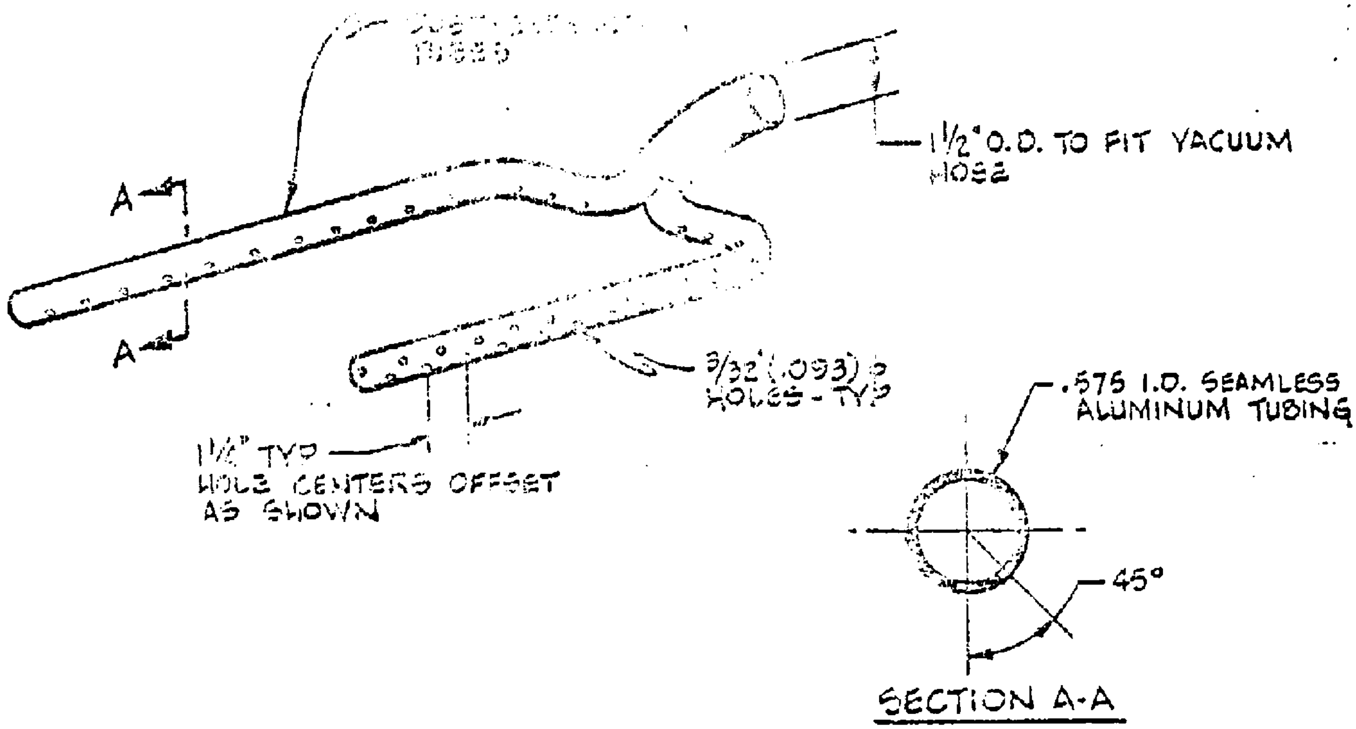
DUST EXTRACTOR - PORTABLE SAW - 7 1/4" DIA BLADE

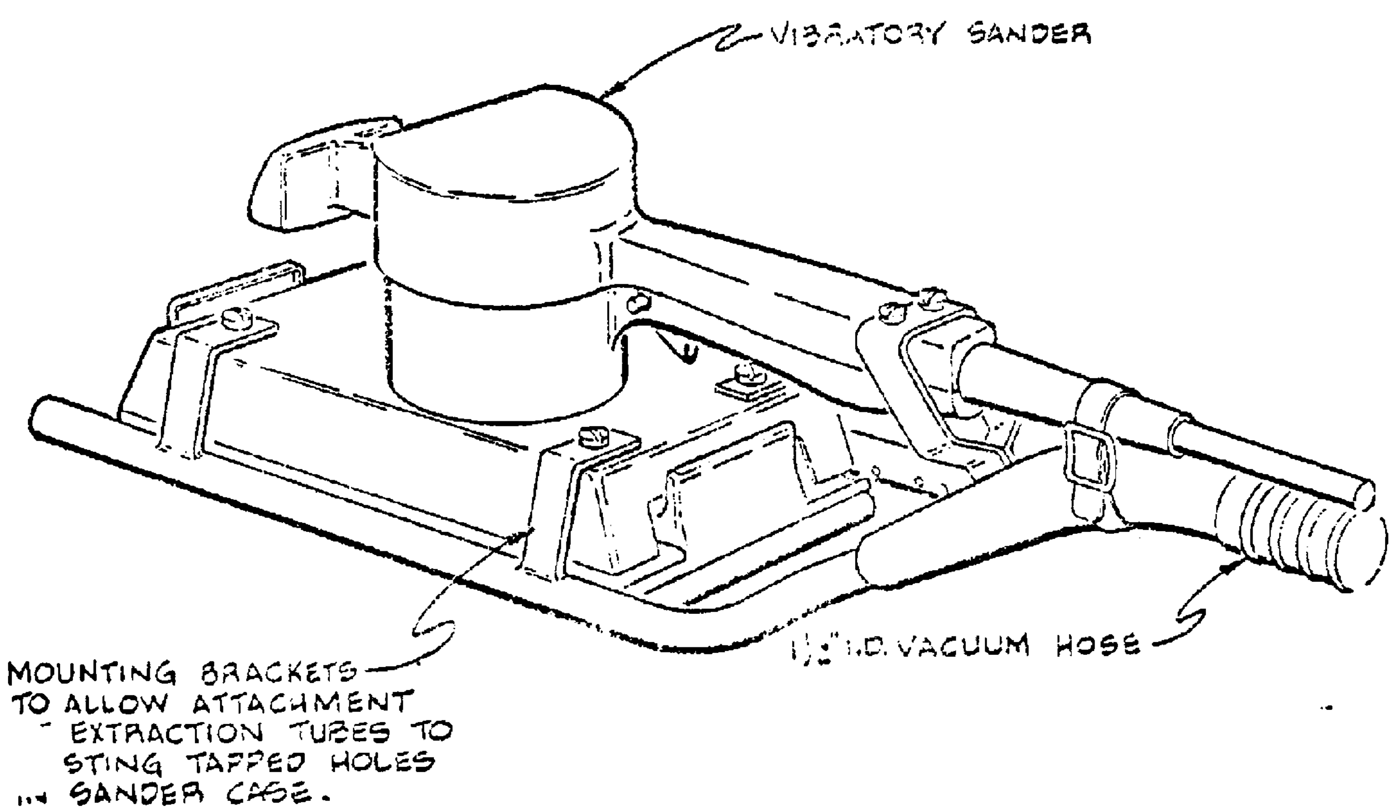


PICKUP FOOT - WELDED TO SHIELDING

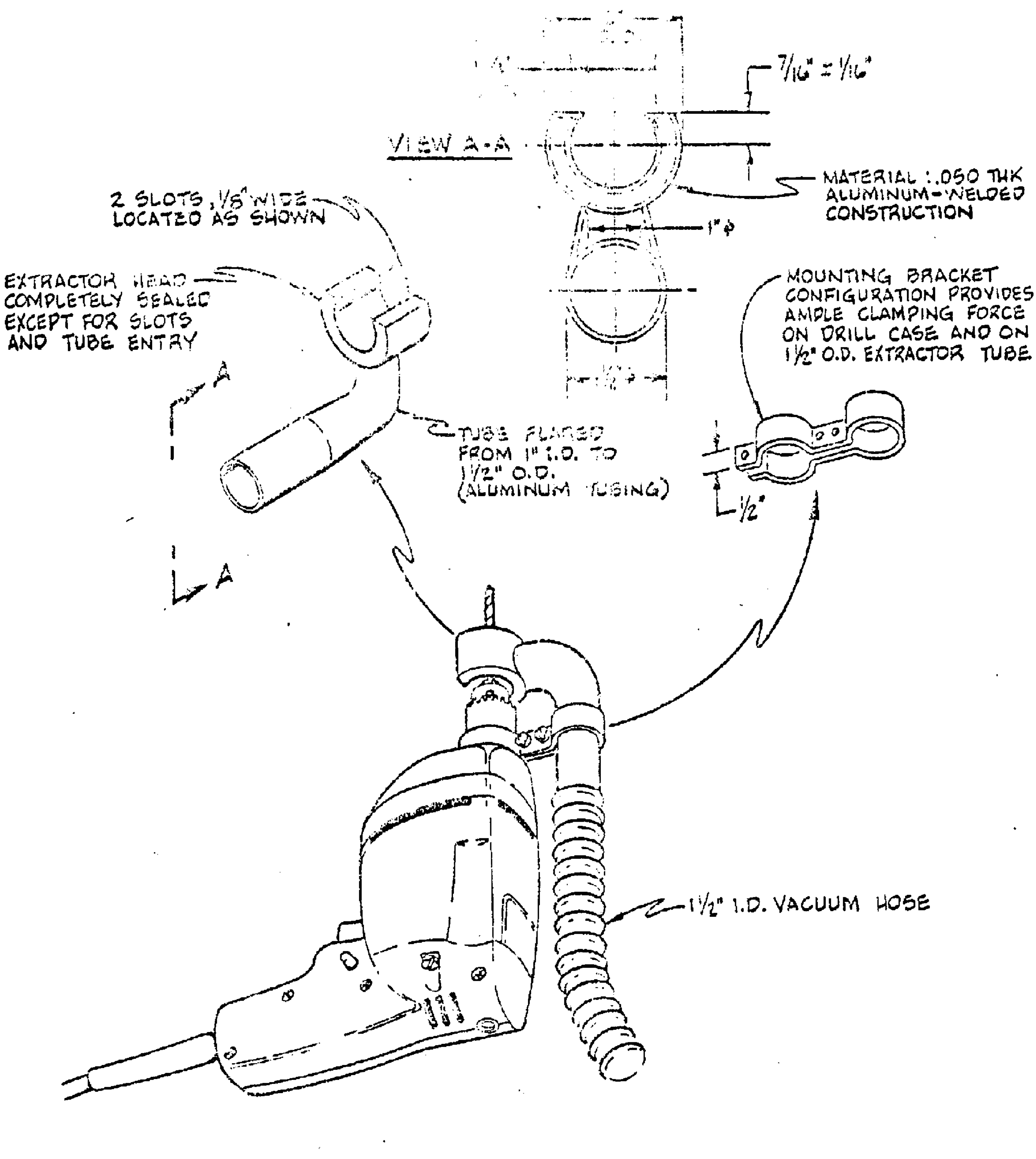


DUST EXTRACTOR - PORTABLE SAW - 7 1/4" DIA BLADE

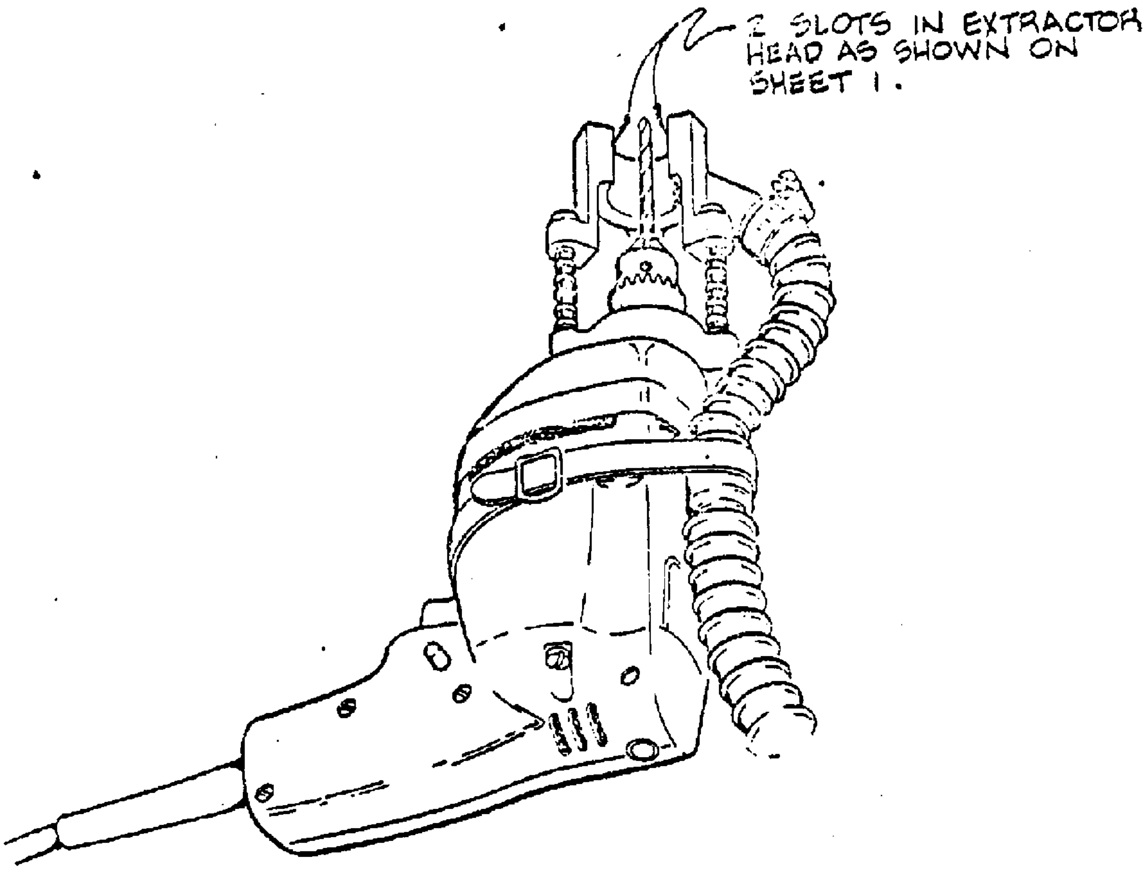




DUST EXTRACTOR - VIBRATORY SANDER

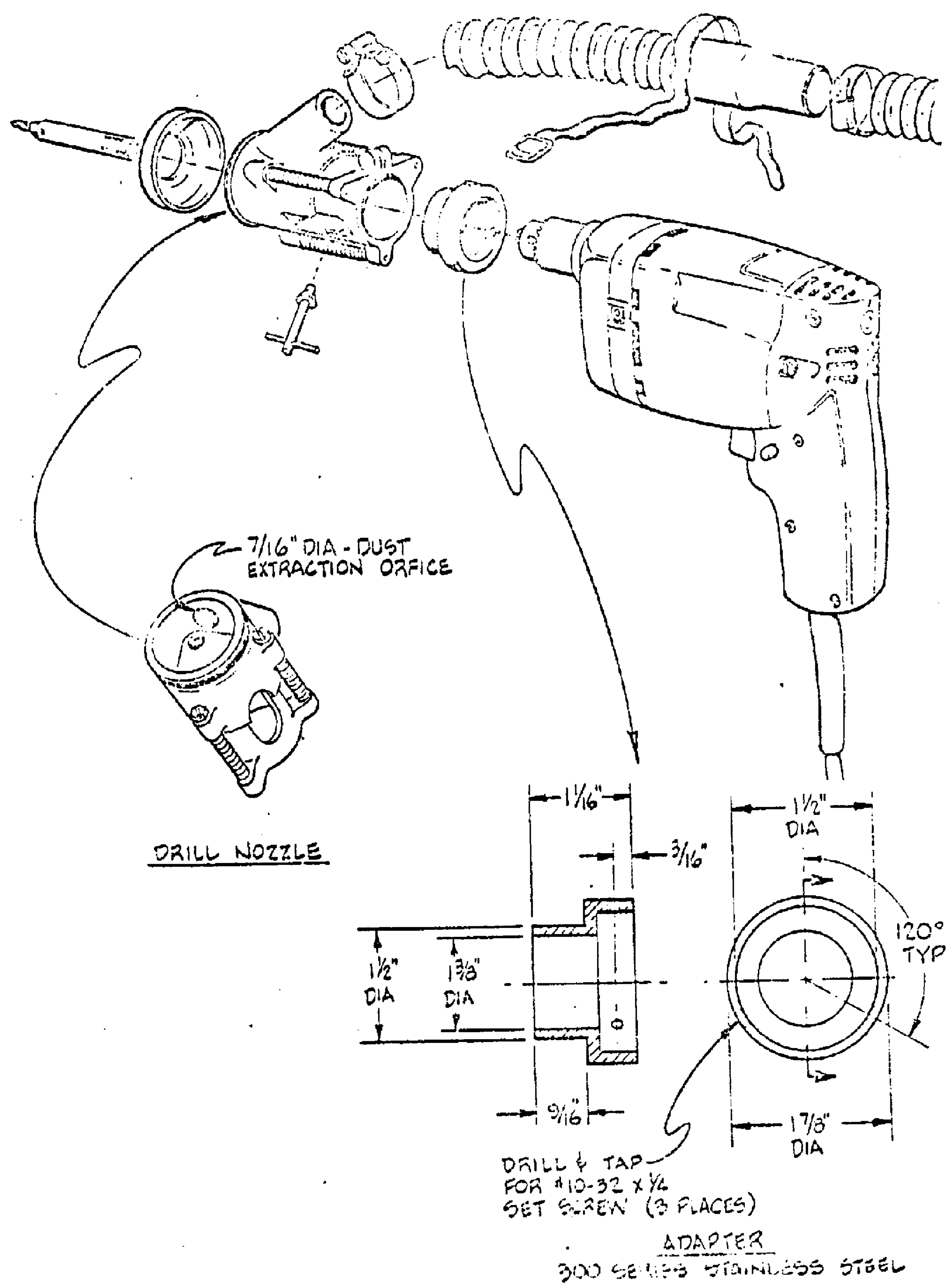


DUST EXTRACTOR - DRILL



DUST EXTRACTOR - SPRING LOADED

EXTRACTOR HEAD FOLLOWS DRILL ENTRY INTO MATERIAL



DUST EXTRACTOR - DRILL - CAPE UNIVERSAL TYPE

Power Tool Division
Rockwell International

400 North Lexington Avenue
Pittsburgh, Pennsylvania, U S A 15208
(412) 241-8400
Telex 866241 Cable ROMCO

25 April 1974

Mr. Milt Trosper, Research Engineer
Johns-Manville
Research & Development Center
Greenwood Plaza
Denver, CO 80217

Dear Milt:

Enclosed for your reference is a copy of the report on the Model 315 saw that you modified. The report is from one of our field sales personnel. As I said on the phone, the information herein is not as complete as would be desirable, but will have to do for the present. The area blocked off on the report covers a completely different topic and need not concern you.

I am looking forward to a cooperative and mutually beneficial relationship between our organizations.

Very truly yours,

Donald R. Wazenegger

D. R. Wazenegger
Development Engineer
Advance Development

DRW:lrm

Attachment

cc: D. A. Maniero/FILE 3556-02

DP 00 DN

Rockwell
MANUFACTURING COMPANY

LOCATION	DEPARTMENT	NAME	DATE
[illegible]	ADV. [illegible]	[illegible]	3-16-74

SUBJECT: "DRYWALL SAW" - (315 WITH DUST ATTACHMENT)

cc: D. C. Huntsman, Pittsburgh
B. [illegible] Dollar, Atlanta

Dear Dan:

Although I gave you an oral report and evaluation on the "Drywall Saw," I am forwarding a more specific report in writing for all concerned.

1. American Drywall, Raleigh, N. C. is a rather small operation. Wilbur Matthews needs a saw with a vacuum to do a particular job in order to compete with the company with whom he once worked - and who has a modified version of a "Drywall Saw." Matthews liked the saw, we used it in conjunction with a Spartan Vacuum and in my judgement, it picked up 85% to 90% of the dust. This was under ideal conditions. He is cutting 2½" thick Gypsum, a sample of which I sent you with the return of the test saw. Mr. Matthews states his needs for this saw is immediate and he will "need one for the present."

2. Not being satisfied with this test and report, I contacted a very large Drywall company in Raleigh, Partitions, Inc. and talked to a Mr. Jack Webb who has been around the business many years. I also wanted a peek at what they were using. They are using a Skil model 825 with an attachment made by Vaughn Wall, Inc., Los Angeles, Calif. I understand the attachment ispatented. The attachment is nothing more than a piece of round aluminum disc the size of the blade housing with a round hole in the middle at the blade arbor for a vacuum attachment. In order to use this attachment, they must take the entire Skil blade housing off, cut two 3/4" pieces of plywood in an oval as the upper bladehousing and screw them together, then they attach the aluminum disc to the plywood and side of the saw and plug in the vacuum. It's a rather crude arrangement, to say the least. Mr. Webb used our saw and feels a. we should have an 8¼" saw instead of 7¼" for the capacity - b. Vacuum port hole should be from the side of the saw and b. attachment should cover the side of the saw completely down to the base and including the rear portion from base to blade housing as we lost a lot of dust in this area. Jack Webb was not concerned with the trouble that would be encountered in changing the blade if we had a complete blade cover. It would be better than what they now have.

For my evaluation, a "Drywall Saw" as I have dubbed it, would not be practical as such. However, I do believe a "Drywall Saw Attachment" as an accessory would be avery practical idea. The proper contact for future test and evaluations would be Jack [illegible] of Partitions, Inc., Raleigh, N. C. rather than Wilbur Matthews of American Drywall.

REPORT NO..404-122
DUST CONTROL FOR FIELD
FABRICATION TO MEET OSHA
STANDARDS (7/11/74)

P.L. EARLE & M.R. TROOPER

JOHNS-MANVILLE RESEARCH
AND ENGINEERING CENTER

Report No. 404-132

Date July 11, 1974

Title DUST CONTROL FOR FIELD FABRICATION TO MEET OSHA STANDARDS

SUMMARY

This report makes no attempt to rewrite the accepted practice of dust control but rather to broaden and bring light to a neglected facet of dust control: low volume/high velocity exhaust principles.

In general, there are at present three types of hoods used for dust control: machine hoods, top or canopy hoods and booths or enclosures. Each controls dust emissions sufficiently for certain applications and in general cannot be extended into each others applications. By the same token low volume/high velocity pick up designs are primarily designed to be used with hand operated power tools utilized for field fabrication of asbestos containing materials.

Until recently, hand operated power tools have been overlooked with respect to dust control. A survey taken in November, 1973, (see Appendix I) showed that in general the only dust control presently installed on small power tools was on small belt sanders. Stateside, only Hoffman Air Systems Division of Clarkson Industries, Inc., with their rudimentary design have given any time to small power tool dust control. Cape Asbestos of Norris Industries Rushen Limited of England (see Appendix II) and Black and Decker of Germany (see Appendix II) are developing dust control devices for small power tools; however, all of these are either of limited application or in the early design stages. With these developments clearly lacking, an accelerated program was initiated in July of 1973 to develop a system of dust control which would be OSHA accepted for field fabrication of asbestos containing materials.

Contents: Summary, Introduction, Theory, Pick-Up Design, Development Program, Special Techniques, Future Work, Recommendations, Appendices.

Reported by P. L. Earle

Trosper

jes
jmw

See Distribution on Reverse Side

INTRODUCTION

Asbestos "FLEXBOARD" 4' x 8', 10' x 12'	1/8" to [illegible]	[illegible] sq ft ([illegible])	Varies from 5% to 30% of the sheets
Asbestos "MARINITE" For Shipbuilding 4' x 8'	1/2" to 2"	3,600,000 sq ft (1" basis)	90% of the sheets
Asbestos Cement Pipe "TRANSITE" Type	2" to 36" dia. 1/4" to 2" wall	120,000,000 lin. ft (about 10,000,000 pipe)	1% Field Cut about 100,000 cuts
Asbestos Cement Extrusions "ACE" Type	1" to 3 1/4"	1,500,000 lin. ft (2" basis)	5% Field Cuts

The above considers the U.S. market only. It is easily seen that a tremendous mount of asbestos related field cuts are made each year.

Research in Industrial Hygiene has shown that some respiratory difficulties are caused and aggravated by exposure of the lung to asbestos containing dust within the respirable size range. The respirable size range is generally accepted to be above 0.05 microns in aerodynamic diameter to a maximum of 10 microns in aerodynamic diameter. Particles greater than 10 microns in aerodynamic diameter are generally screened by a number of biological defenses prior to the bronchi.

The fibrous structure, asbestos, at first appeared to be an exception to the above standard for airborne materials. However, particles having a fibrous form with a length in excess of 5 microns are generally used as the standard for asbestos containing dust. The purpose of this standard was to classify those particle sizes which have an excessively long half life in the human lung. It is these particles exhibiting characteristics of longevity in the lung which are of interest to the design of an asbestos dust control system.

THEORY

For a dust control system to be successful in capturing the respirable dust associated with asbestos fabrication, it must accomplish one of the following four objectives:

1. The work area must be air swept with large volumes of air with sufficient velocity to prevent normal drafts from carrying respirable particles away from the work area. The operator, tool, and work piece must be allowed for and the volume of air handled must compensate for these obstructions. Clearly, this situation can only operate effectively in a closed environment such as a fabrication shop or industrial plant.

2. On a smaller scale, it is possible to enclose the tool and air sweep the tool and the cutting area. This is not generally acceptable due to the settling rate of many of the larger particles which coat the work area and will be distributed locally by the movement of the tool across the surface of the work piece. In addition, separate protection from dust emitted from below the work piece must be incorporated into the design.

3. A third recourse is totally shrouding that part of the tool which is generating the dust and evacuating this shroud with a high volume/low vacuum exhaust system. (Appendix II, i.e., Cape Universal) Total shrouding has several disadvantages such as operator visibility of the work site. Here again separate consideration must be given to protection from dust emitted below the work piece. In addition, a significant amount of operator technique must be employed to achieve low dust counts.

4. Finally, in close proximity to the point of dust generation, a pick up producing a jet of exhaust air with a velocity in excess of the generated dust can be introduced.

This low volume/high velocity exhaust system is the unique application of exhaust which uses small volumes of air at relatively high velocities to control dust emitted from portable hand tools. The control is effected by exhausting the air directly at the point of dust generation. The use of close-fitting custom made hoods is necessary to direct the pattern of the generated dust toward the orifice. Capture velocities are relatively high but the exhaust volume is low due to the small distance required, i.e., usually less than one inch. This method allows the application of local exhaust ventilation to portable tools which otherwise would require relatively large volumes of air and enormous duct work when controlled in the conventional exhaust methods.

When designing a low volume/high velocity dust control system, it is necessary to consider some of the characteristics of typical small dust particles. A particle of 0.5 microns in diameter has a terminal velocity of 0.001 cm per second in still air while a particle of 10 microns in diameter has a terminal velocity of 0.3 cm per second (the velocity is directly proportional to the momentum vector of the particle). A one to two mile per hour breeze represents a velocity substantially in excess of 25 cm per second. It can thus be seen that the small respirable particles, if not immediately captured, will be spread by normal air currents throughout the work area and will remain suspended in the air for extended periods.

However, when considering asbestos particles of 20 microns in length and under, the Stokes Law consideration begins to have a noticeable effect. Spherical particles having an aerodynamic equivalent diameter of 10 microns will reach their terminal velocity without any really significant variations irrespective of their initial velocity or density. The linear asbestos particles slow much quicker due to rotational energy being used rather than kinetic energy. This rapid attainment of terminal velocity explains several phenomena. For example, when a belt sander is observed, we would expect that the particles moving at between 4000 and 5000 feet per minute would immediately leave the work at the last contact point between the belt and the sander. Instead it can be readily observed that a very substantial proportion of reasonably good sized dust particles are carried around on the belt and thrown off not only at the first pulley of the belt but indeed some of the particles are carried fully 360° around past the second pulley and ground back into the work by the belt. In a similar fashion, when observing the typical abrasive saw in operation it can be seen that large quantities of the dust which is generated comes off the top of the saw in and around various portions of the guard. Here again, the obvious and still incorrect thought would be that all of the material would fly out tangentially from the contact point between the blade and the work piece, especially in view of the fact that some high speed abrasive saws are generating particles with an initial velocity substantially in excess of 12,000 ft per minute.

(Paraphrased from Hoffman Air Systems pamphlet and modified to asbestos considerations.)

This consideration would be true only for a low pressure atmosphere. Normally an envelope of air is formed by the friction of the rotating blade against the atmosphere. This envelope, in addition to the Stokes Law considerations, makes the problem one of limiting the dust exposure time from generation of the dust to pick up of the dust.

The phenomena of dust generation can be observed in essentially all fabricating tools used in industry. The dust seen when observing this phenomenon represents a substantial proportion of the respirable factor which is the dust that constitutes a health problem. The capture of this portion of the dust directly at or as close as possible to the point of generation before the machine and air currents have had a chance to spread the dust around the entire work area is the principal purpose of a dust control system.

The design calculations for low volume/high velocity exhaust systems are largely empirical. In normal ventilation practice, air is considered to be incompressible since static pressures vary only slightly from atmospheric pressure. However, in low volume/high velocity systems the extreme pressures required introduce problems of air density, compressibility and viscosity which are not easily solved. In addition, pressure drop data for small diameter pipe, especially flexible tubing, are not commonly available. For practical purposes, the exhauster should be selected for the capacity to maintain at least a 2.5 to 3.0 inches of mercury pressure differential across a 0.5625 square inch orifice at the end of a 10 foot hose of 1 1/2 to 2 inch diameter. Further discussion can be found in the appendix under vacuum systems. Resistance in the pipe should be kept as low as possible; flexible tubing of less than 1 inch to 1 1/2 inch diameter should be limited to 10 feet or less. The main consideration in piping for such systems is to provide smooth internal configuration so as to reduce pressure loss at the high velocities involved, and to minimize abrasion. Ordinary screwed-fitting piping is to be avoided because the lip of the pipe or male fitting, being of smaller diameter than the female thread, presents a discontinuity which increases pressure loss and may be a point of rapid abrasion.

It must be emphasized that although data are empirical, these systems require the same careful design as the more conventional ones. Abrupt changes of direction, expansions and contractions must be avoided and care must be taken to minimize pressure losses.

PICK UP DESIGN

Basic consideration must be given to the tool being fabricated with a dust pick up. In normal operations, where is dust being generated? Refer to Appendix III. After consideration of these basic rules and once the particle vectors (see Appendix III) are noted, it is possible to fit the tool for dust control.

Hood design is the most important single aspect to good dust control. A badly designed and installed hood cannot be adequately corrected by tripling of the vacuum source. Hood design must entail all of the following:

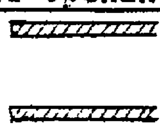
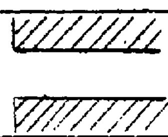
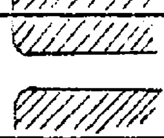
Orifice size
Flanging of the orifice
Hood structure
Operator acceptance
Tubing structure
Fabricating material
Exhaust vacuum system

Orifice size must be given special attention since the velocity of the air stream is closely related to the size of the opening. Referring to Appendix III it can be seen that the volume of air displaced is drastically altered by the opening.

The development work was done using a P-190 manufactured by Spencer Vacuum Co. (see Appendix IV) which has a surge point at approximately 40-50 percent maximum volume. It is desirable to design the pick up orifice area to lie within this surge point at a given vacuum pressure.

This will give a greater pressure differential at the orifice when opposed to designing at or near maximum volume displacement. Please note the table in Appendix III which shows different orifice velocities as measured by a VTP flowmeter (see Appendix V).

Flanging or the type of opening is of importance since the coefficient of entry C_e as well as the loss, fraction of velocity head are affected. As seen below a plain duct end gives $C_e = 0.72$ and $F = 0.93$ while a well rounded entry gives $C_e = 0.98$ and $F = 0.04$. This type of entry is desired and recommended for all pick up design. When this type is not possible, use of a flanged duct entry is recommended.

Type of Opening	Description	Coefficient of Entry C_e	Loss, Fraction of velocity head F
	Plain duct entry	0.72	0.93
	Flanged duct entry	0.82	0.49
	Well Rounded entry	0.98	0.04

(The above from page 26 ANSI Z9.2-1971)

Hood structure could be likened to a piece of modern sculpture in that it must be smooth, graceful and non-constricting. Again, a proper hood must be fabricated for each tool considered, and it must match smoothly with the inherent flow pattern of the tool being fabricated. Also, it must meet operator acceptance from the aspects of weight, visability of work area and mobility. The tooling site must be clearly visible for the operator to work efficiently. The hose should leave the tool adjacent to the power cord and weight should be kept to a minimum. Tubing constrictions can be optimized by die cast techniques and the use of smooth connections which could be worked out between tool manufacturer and exhaust manufacturer. Several such connections are commercially available (see Appendix V).

The material being fabricated will dictate greatly the particular type of lower seal used as prescribed under SPECIAL TECHNIQUES. In general, with all sheet materials, some sort of lower seal must be provided when cutting with a circular saw. The thickness and hardness will have to be considered. If the material is hollow, consideration must be given to evacuation of the hollow. Greater detail to special problems will be found under SPECIAL TECHNIQUES.

The final consideration but not the least important is the exhaust vacuum system. Much detailed research has been devoted to securement of a portable system suitable for shop or field fabrication. At present, two manufacturers produce units capable of producing the necessary pressure differential; Spencer Vacuum Company and Hoffman Air Division of Clarkson. Units similar to the Spencer P-190 will produce sufficient vacuum to undertake any of the included designs found under DEVELOPMENT PROGRAM and SPECIAL TECHNIQUES. All shop-type vacuums tested at present cannot maintain a sufficient velocity with the orifice sizes needed. Two double-headed shop-type vacuums have been found to produce the necessary velocity. However, filtration considerations are incomplete (see FUTURE WORK).

DEVELOPMENT PROGRAM

The use of small volumes of air at high velocities makes it possible to convey the dust-laden air away from the source using small diameter lightweight flexible hoses generally 2-inch diameter. The operator thus has freedom of movement within the area required for field fabrication. The control is achieved by exhausting relatively small volumes of air directly from the point of dust generation by using custom-made hoods (shrouds) mounted directly on the operator's tool. Capture velocities from 2500 to 10,000 ft/min are used. Exhaust volumes are, however, quite low, permitting the use of very small lightweight hoods which do not encumber the operator any more than normal safety guards (see photos). This method has permitted the effective control of asbestos dust from stationary or portable tools while utilizing only a small fraction of the volume of air required by low pressure high volume methods. This eliminating make up air and the additional heat required in fabrication shops.

With the low volume/high velocity system, it has been found that to meet a proposed reduction in acceptable standard from 5.0 fibers/cc to 2 fibers/cc, exhaust hoses with a minimum diameter of 1 1/2 inch and preferably 2 inch diameter are necessary to maintain the needed pressure differential. Guy Cusumano in his pamphlet by Hoffman Air Systems Division of Clarkson Industries, Inc. states, "It should be noted that these minimum theoretical air volumes are based upon relatively low speed tools used in a very limited manner on relatively speaking precision work. Plastic hose sizes shown are assumed to be for operations where the hose does not have to exceed 8 feet in length. In cases where high production operations are involved, the hose size may have to be increased and the air volumes upgarded by as much as 100 percent."

When using only a low volume/high velocity orifice, Guy is quite correct. However, with the addition of a properly installed hood to direct the particles into or by the orifice it is possible to reduce the necessary exhaust vacuum pressures significantly. In general, a set of two orifices 5/8 inch, to 3/4 inch in diameter with a 10 to 20 foot 1 1/2 inch diameter hose were used on the circular saw pick ups designed. The mercury lift at the end of the 20 foot hose was 4 to 4.5 inches with one orifice and 3.3 to 3.6 inches with two orifice openings as found on a typical saw pick up.

Initially, we purchased a Rockwell Model 510, 10 inch masonry saw equipped with a Hoffman Air Systems designed high velocity/low volume pick up attachment. Upon initial test, dust escaped from both the front and the side of the saw hood. Dust counts were 10 to 15 fibers/cc. In order to meet a 5.0 fiber/cc, the saw hood was extended both vertically and horizontally with respect to the blade diameter as seen in photographs 9-1 through 12-3, Appendix VI. The larger particles had a tendency to tangentially continue their path below the saw hood. The hood was lowered to meet the guide plate and a seal was formed which contained the larger particles. See Drawing No. 13, Appendix VI.

Those particles continuing in the air stream adjacent to the blade are removed by a second orifice located approximately 30° forward of vertical on the blade guard. On the original model this orifice was aerodynamically smoothed and enlarged to achieve the necessary pressure drop. See Drawings 13 and 14, Appendix VI. The Rockwell 510 as supplied from Hoffman Air Systems had an additional third vacuum port on the rear of the saw shroud. This particular port was not found to be necessary (see Photograph 12-3, Appendix VI).

Tests were again run on 1 1/2 inch CORSPAN (R) with a piece of 3/4 inch plywood as a lower seal. See Drawings 5 and 6, Appendix VI. Results were favorable as dust counts were 5 to 6 fibers per cc. Dust emissions were noted at the end of the panel being cut. It appeared that the blade was acting like a fan and blowing dust out of the cores much like a "naked" cut. (See Photograph 1 and 2, Appendix VI) To overcome this difficulty, an end cap shown in Photographs 4 through 7 with vacuum attached was designed. Photo 8-a shows the masking tape seal on the opposite end of the hollow panel. This formed an orifice of the cut being made in the CORSPAN and allowed dust counts below 1.0 fiber/cc. Further discussions of this technique will be found under SPECIAL TECHNIQUES. The vacuum system used was a Spencer Air System Model P-190. Specifications and details of this particular vacuum system are contained in AppendiX IV.

A complete shroud was obtained from Cape Universal. See Appendix II. This shroud had been developed for use on a 9 1/4 inch Super Saw Cat HD 1215 manufactured overseas by Black and Decker. This saw is available in the U.S. market. This shroud can be ordered from Cape Universal in Watford, England. For further information see Appendix II. Test results of this particular shroud (see Drawings 15 and 16, Appendix VI) led to acceptable dust levels below 5.0 fibers per cc. The total shroud concept has several disadvantages. The first objection would be operator acceptance due to the totally limited visibility of the enclosed blade. Abrasive blades may twist in cutting and the operator who cannot see the blade will have trouble cutting a straight line. A second disadvantage lies in the fact that in making the initial entry into a sheet material the vacuum ports, or orifices, are located in such a way that the actual orifice is really 3 or 4 square inches in area. This reduces the velocity down to the point where there is very little actual dust control. It is only when the saw is at least 3/4 of the blade into any particular product that the velocity capable of capturing the emitted particles is developed. It should be noted that the vacuum system used on the Cape Universal attachment is of the low velocity/high volume type. Considerable operator technique will allow dust counts near 2.0 fibers/cc. (See SPECIAL TECHNIQUES)

In an effort to improve the pick up of the Cape Universal total shroud, a high velocity/low volume vacuum source was added. In cutting CORSPAN (R) the sides of the shroud were sucked in against the abrasive blade ripping a hole in the side. Reinforcement of the shroud allowed the recorded dust counts. See Appendix VII. The vacuum system recommended by Cape Universal is the Model 743 Mark II dust unit as produced by Universal Industrial Appliances Division. In Appendix II, further discussion of this system may be found with several American vacuum systems which will substitute.

The second Rockwell saw tested was a Model 315, 7-1/4 inch masonary saw. A similar pick-up was developed with less frictional loss due to constriction within the pick-up design. See Photographs and Drawings 19 through 25, Appendix VI. By eliminating most of the right angles inherent in the initial Hoffman Air Systems decisn, it was possible to produce a higher velocity at the orifice. The higher the velocity, the greater the pick-up of the particles generated by the saw. On the Model 315, it was determined that changing depth of the blade for different material thickness changed the relative position of the orifice when side mounted as by Hoffman with respect to the blade. In order to compensate for this difficulty, the pick-up was mounted in front of the blade rather than beside the blade. This procedure allowed the pick-up to continually remain relative to the dust generation point and directly in the path of the generated particles. This position also reduced the siren effect present with some carbide toothed blades.

Initial recorded results of tests of the Rockwell 315 indicated that by decreasing both orifice openings slightly, it would be possible to achieve a greater pressure differential across the orifice, thereby increasing the velocity of the air. The orifices were reduced in size by approximately 10 percent of the diameter. Asbestos counts below 2.0 fibers/cc were recorded as shown in Appendix VII. The final dimensions of the orifices can be seen in Drawings 24 and 25 of Appendix VI.

Until a commercial grade "Skil" type saw could be located, the development work was confined to the vertically adjusting Rockwell type saws. The Rockwell saws are typical of heavy-duty industrial grade saws which adjust verrically while the commercial grade Skil type saws adjust depth by tilting forward at a pivot point. This small difference is significant when considering the addition of a dust control pick-up. More detail will be found under SPECIAL TECHNIQUES.

Using a 7-1/4 inch heavy-duty ball-bearing saw manufactured by Skil Corporation, an initial design based on a flexible shroud was tested. The results were favorable (below 2.0 fibers/cc) as seen in Appendix VII. Photograph 26 (Appendix VI) shows the Skil attachment. Again, when cutting any material, a lower seal (plywood) must be employed.

Cored materials require an addition vacuum attachment to evacuate the hollows of the material. Further development of the Skil-type saw was deferred until additional saws could be secured. (See FUTURE WORK)

A Rockwell Model 728 was received from Rockwell International. This saw had been mocked up by Rockwell per our recommendations and although crude in design (i.e., welded from 1/8 and 1/16 inch metal) the dust counts were under 2.0 fibers per cc. This saw demonstrates the capacity for field designed and built shrouds until production of a commercial shroud begins.

A Rockwell Model 314, 4 1/4 inch portable trim saw was supplied by Rockwell International for test and mock-up. In order to use this saw to the greatest advantage, it was necessary to design the ability of an angle cut into the shroud design. A combination of the front mount pickup used on the other Rockwell saws and the flexible shroud used on the Skil 7 1/4 inch saw was employed. Initial tests revealed that a windage effect from the rotor vanes of the saw was deforming the needed air envelope. Partial blockage of these vanes by closing the desired slots allowed successful asbestos counts below 2.0 fibers/cc with full flexibility of the saw.

Attachment of all the above mentioned shrouds can be facilitated through existing and/or added attachment points. Again, all orifices must be aerodynamically smooth and smooth lines of flow are recommended.

Field fabrication also includes drilling in addition to cutting. Cape Universal supplied a drill shroud which fits a large number of American drills (see Appendix II). This shroud (see Drawings and Photographs 27-29, Appendix VI) was tested on a Skil 3/8 inch drill. Results were favorable drilling 1 1/2 inch CORSPAN (R) with 0.8 fibers/cc personal exposure. MARINITE was slightly higher with 2.5 fibers/cc. Results recorded come from one hour of continuous drilling. In addition to the Cape Universal shroud, a pick up has been designed which will be spring loaded as can be seen in Drawing 31, Appendix VI. The pick up shown in drawing 30 has been tested and a combination of the Cape Universal spring loaded total shroud with the partial high velocity/low volume shroud of Drawing 30 results in the optimum design shown in Drawing 31. This design allows operator visibility while following the bit during penetration into the material.

Field fabrication can also include the use of a gasoline powered cut-off saw such as the Quickie Target 12 inch saw supplied by Evans Saw Company (see Appendix II). The Target 12 inch was tested cutting 1 1/2 inch CORSPAN (R) and found to be in excess of 200 fibers/cc without dust control. However highly satisfactory results were obtained (see Appendix VII) with the wet cutting kit supplied by Evans Saw Co. (see Appendix II). The water supplied is introduced into the air envelope surrounding the saw blade through the shroud. The blade mists the water wherein the dust produced becomes encapsulated by the water and falls harmlessly to the ground. This technique is similar to that used on wet diamond blade saws (see Photographs 32-33, Appendix VI). Collection of the generated water-dust can be effected by a "sink" arrangement which allows the water-dust to collect in a barrel. Addition of a precipitating agent to the barrel will allow the dust to settle in the bottom (see SPECIAL TECHNIQUES). Removal of the water can be accomplished using the same water pump attached to the Target 12 inch wet kit. If the material is collected in a plastic bag it can be sealed and disposed of properly. The addition of a small amount of Portland Type I cement will form an encapsulated block which can be used for fill at the site. It should be noted that based on a 1/4 inch wide cut, very seldom can eight pounds of dust be generated in a single day by one operator. The volume of this amount of dust is seldom in excess of 0.5 cubic feet. It can readily be seen that with frequent precipitation of the material, a weeks work could be collected before removal would be necessary.

Attempts at the adaption of a dry pick up attachment to a gasoline cut-off saw has been unsuccessful. The rotation of the blade is reversed when compared to the hand power saws and thus emits most of the dust below the material being cut. This direction of rotation does, however, eliminate much of the "bucking" or surging of the saw which would be encountered if rotation was reversed. Therefore, to attach a vacuum-type pick up, the following would have to be done: 1) reverse the direction of the saw blade to allow a top-mounted pick up on the front of the present shroud; 2) develop a skid or base plate to a) help stabilize the saw and counter the surging and b) control the penetration of the blade such that a lower seal could be used as with the Rockwell-type saws.

Communication with Evans Saw Company indicates that reversal is possible and this will be investigated (see FUTURE WORK). Dust count results will be found in Appendix VII.

Fine finishing will occasionally be done using either a rotating belt or vibratory sander. As indicated by an investigation of dust pick ups (see Appendix I) attached to hand tools; only the rotating belt sanders are presently manufactured with dust pick ups. Due to the small amount of dust produced when compared to saws, it was found that by attaching any vacuum source (i.e., 1.5 inches of mercury or above with the orifice open) to the manufactured pick up, successful dust counts of below 2.0 fibers/cc could be made.

The vibrating sanders such as the Rockwell 505 shown in Drawing 37, Appendix VI, can be adapted using a "U" tube with holes spaced 3/4 inch apart with a 45° angle separation. With this pick up attached, personal samples of 0.8 fibers/cc were recorded while sanding MARINITE 36. This type of pick up is highly acceptable for any vibrating sander due to the very fine particulate matter generated. (See Hoffman Air Division, pamphlet, Appendix IV).

Fabrication of low density (i.e., below 100 lb/cu ft) materials such as MARINITE calls for the use of a jig or sabre saw. Rockwell supplied a jig saw shown in Photographs and Drawings 34-36 of Appendix VI. The jig saw when adapted with a pick up and used in conjuction with a vacuum table (see SPECIAL TECHNIQUES) gives asbestos dust counts below 2.0 fibers/cc. Attachment can be made using existing screws. A modification of the blower is necessary since the air envelope must be continuous and uniform. This was done using aluminum tape. Premeasurement of the needed modification will allow safe fabrication of the MARINITE products over a vacuum table or trough.

SPECIAL TECHNIQUES

Vacuum Cutting

All materials when cut with a rotating blade will allow particles to escape below the cutting surface unless a special provision is made to control the available path of escape. Referring to Appendix II, it will be noted that Cape Universal recommends a lower seal upon which the board being cut is placed. This seal can be any material readily cut by the saw being used; i.e., plywood. For all board-like, solid materials such a seal is necessary. The mechanism invoked is simply the elimination of the lower escape path such that the air envelope can move the generated particles up into the area of the high velocity/low volume orifice supplied on the saw. This technique will work on thin (i.e., less than 1/2 inch) low and high density materials (i.e., concrete, asbestos solid panels).

for low density thick solid panels (i.e., MARINITE) an additional vacuum source must be used to form an orifice of the cut being made in the panel. Referring to Photographs and Drawings 38-1 through 39, Appendix VI; the vacuum table design can be noted. Basically the vacuum table consists of a wedge-shaped chamber with a foam seal (Norton V770 closed cell pressure sensitive tape 3/4 inch x 1/2 inch) and a vacuum connection. When a vacuum is drawn on the vacuum table, the material will seal to the foam tape. The disposable firing strips below the tape allow numerous cuts to be made after which these strips are replaced along with a new foam tape border. Movable supports should also be fabricated to support the material and eliminate bowing of the sheet under vacuum forces.

Cored products such as CORSPAN (R) will allow dust to escape due to the fan effect of the blade. Two modifications can be made to eliminate this problem. First, seal one end (fartherest from the cut site) with masking tape or a similar method. (See Photograph 8-a, Appendix VI). Attach an "end cap" (Photographs 4-7, Appendix VI) with a vacuum attachment. Always keep the exhaust connection on the opposite side of the panel with respect to the initial entry. This is necessary since the effective vacuum moves across the panel core by core seeking the shortest path of least resistance with respect to the advancing cut.

Some consideration should be given to the type of blade used for panel fabrication. Abrasive blades such as the silicon carbide type manufactured by New England and Tuck Point types manufactured by Bullard are excellent for asbestos cement products. Carbide tipped blades will ease cutting MARINITE-type products and others such as Upson Naples Millboard. The Carbide blade will also produce larger particles and less "exposed" asbestos. Entrance and exit techniques can be influenced by the type of blade used and time should be taken in the field to develop the proper entry and exit style.

Wet Cutting

In addition to the wet kit supplied by Evans Saw Company, two other wet cutting attachments were tested. First a SKIL water feed attachment (see Appendix II) was tested successfully on the SKIL 7 1/4 inch circular saw. It should be noted that proper precautions shall be taken when the SKIL water feed attachment is used in conjunction with an electric tool. The asbestos counts will be below 2.0 fibers/cc and the same techniques for disposal used for the Quickie Target 12 inches should be employed. Secondly, the "TRICO-MIST" coolant system, designed to spray coolant on the surface of working surfaces was investigated. However, due to the small volume of water produced by the mist system it is ineffective in controlling the emitted particles (see Appendix II) from a sawing operation. Low emission milling and grinding operations could be controlled by the "TRICO-MIST".

Tests were also run on the Stone Machinery Co. saw at Manville. When used in conjunction with the wet kit, asbestos counts below 5.0 f/cc were recorded. With additional shrouding counts below 2.0 f/cc on expected.

Wet cutting includes disposal of the produced water-dust. In addition to the forementioned techniques, some discussion can be given to the types of precipitating agents used and various filtration techniques.

Precipitating agents such as the "MR" solution, an anionic surface active compound discussed in Appendix I under Witco Chemical can be used to drop the suspended solids from solution after their collection. The physical properties and mixing ratio will be found in Appendix I.

A second method of collection, filtration is also possible through the use of either pressure or gravity flow GAF filter bags. Long used in industry, these filter systems have been proven to be reliable and easily maintained. Capture meshes of 1, 3, 5, 10, 25, 50 and 100 microns are commonly available. It is suggested that the 5 micron nylon or polypropylene bags be used to effectively retain the asbestos fibers. Refer to Appendix V for further details on the GAF filter system. This system also opens up the possibility of recycling the supply water if the job site will allow such a facility.

Vertical vs. Pivot Adjustment

Circular saws adjust in depth by one of two methods: vertical carriage or pivot-tilt about a hinge mounted at the front of the base. Vertical adjustment lends to the attachment of a dust shroud with little modification, the exception being that of angle cutting. The pivot adjustment, however, has a forward movement of the saw shroud (guard) in addition to the vertical movement. This arching movement makes necessary a different type of shroud which must be flexible in two planes of movement; three if angle cuts are to be made. Mockups are being made on SKIL supplied tools and each plane is being attacked in the laboratory. A supplemental report will detail the necessary shroud. However, significant modifications of the existing saw guard is expected in order to achieve three planes of movement. It should also be noted that such forward movement changes the relative position of the secondary orifice on said circular saws. This can lead to design problems and should be considered when designing a pick up attachment. In general, with the saw set at the most commonly used depth, the secondary orifice should be placed approximately 30° forward of the vertical-bisecting plane.

Vacuum Units

Large centrifugal fans have been successfully tested. These units are manufactured by Hoffman and Spencer vacuum companies. The main criterion being the ability of the vacuum unit to maintain 2.5 to 3.0 inches of mercury vacuum with a 0.75 square inch orifice at the end of a 10 foot hose. Many barrel mount and floor model vacuum systems have been tested and found lacking (see Appendix IV). Unfortunately these units were designed to move large volumes of air at low pressures. Just the opposite of the low volume/high vacuum system described herein. However, additional small units are presently being tested or mocked up for test and these show promise. The Advance Floor Machine Co. produces a twin motor, 230 volt barrel vacuum which should deliver sufficient velocity at the orifice. Also, a Clarke external final filter system has been rated with respect to air velocity and found to be successful in achieving the required vacuum. Additional tests must now be run to verify the filtration characteristics of the unit with respect to asbestos dust.

FUTURE WORK

Spencer Vacuum will supply a Model P 138 vacuum which lists for less than $1,000 to be tested with the pick ups designed. This unit is expected to supply the necessary vacuum for 1-2 tools. The Model P 190 used for the development program could supply 3-4 tools. (See Photograph 41, Appendix VI). Interest has now been generated in the vacuum manufacturers companies to possibly manufacture units designed specifically to produce the high velocity needed. Once the pick ups are placed into use and a market established, several manufacturers will either design a new unit or modify existing units to the needed characteristics.

An Advance DriVac has been purchased. This unit mounts on top of any 55 gallon drum. Two triple stage bypass vacuum motors will maintain at least 2 inches of mercury through a 20 foot hose. The dust collection unit consists of 44 individual candle-shaped filters equal to 30 square feet of filter area. (See Appendix IV).

Clark Vacuum Company has supplied a drum vacuum which is powered by two, one-horse power motors. This unit is supplied with external final filters. Successful velocity measurements have been taken and dust counts will be ran at the time the Advance unit is prepared for test.

Bits and Pieces

Mockups are being made on SKIL supplied circular saws, flat disc and rotary grinders, and routers. These will be returned to Skil Corporation as models for production shrouds. Communication will continue with Evans Saw Company with respect to reversing the direction of a cut-off gasoline saw. Preliminary contacts have been made with the major suppliers of the gasoline engines used in the cutt-off saws. Since these units are simply modified chain saws, all of the engines are tooled to operate in one direction. However, no difficulty is foreseen in reversing any given engine once retooling is completed. Stanley Tool Company manufactures a vibratory sander with a built-in dust collector which will be tested. Routers and lathes will be evaluated with respect to asbestos fabrication and modified as needed.

RECOMMENDATIONS

Completion of the above work and development of the cut-off saw for TRANSITE pipe will continue. Vacuum sources are listed in Appendix IV. Also shown are partial lists of the various manufacturers and/or suppliers contacted during the program. Continued work should be carried out to maintain the momentum presently being experienced. The design of new vacuum sources should be monitored and recommendations from J-M would be advised.

As OSHA continues to tighten contracts, development programs such as this will become more common. The solution to a problem is always easier if the answer is totally or at least partially known before the question is asked. Therefore, continued monitoring of "Hot Spots" in industry should be done as a common practice.

APPENDIX I

Corporate Project Assignment

State of the Art 1973-74

Survey of Small Tools

Survey of Field Cuts

Marinite Engineering Information Report

Power Tool Institute

Mafell Saw (Black and Decker of Germany)

Witco Chemical (Anionic Surface Active Compound)

Rockwell International (Field Evaluation)

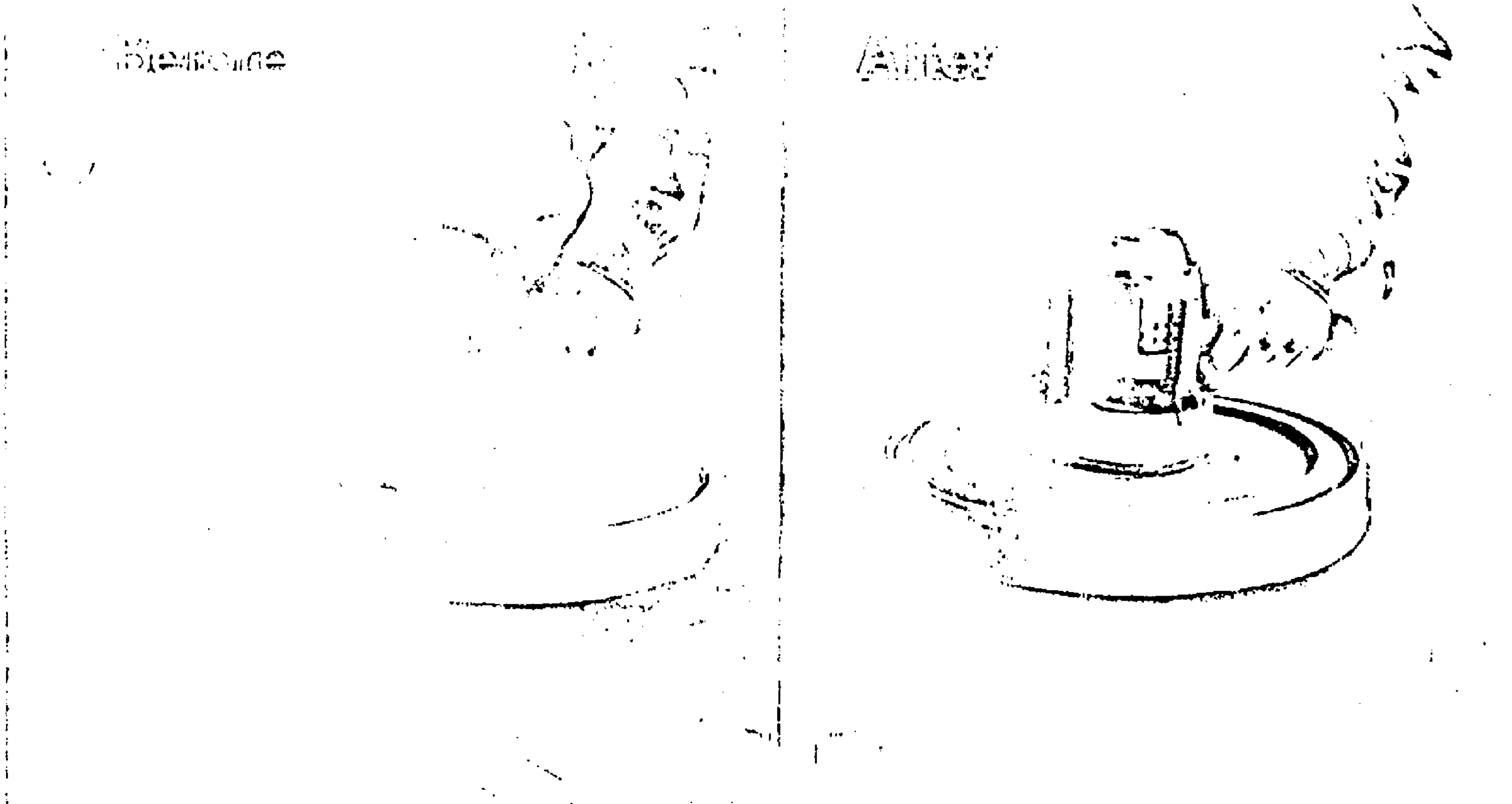
Black and Decker Comment on Dust Control

Letter, Donahue to SKIL Corp, their equipment

STATE OF THE ART, 1973-74

Company	COMMENTS
Rockwell International	No pickups, agreed to work with Johns-Manville R & D to develop a system
SKIL Corp.	No pickups, agreed to send saws for mockup early 1974
Robert G. Evans Saw Co.	Has wet kit for gasoline cut-off saw
Black and Decker	Dust pickups being designed in Germany. A review of their material shows a development very similar to Cape Universal of England.
Kett Tool Co.	Samples of material (asbestos containing) sent for their test with Kett vacuum pickup
Bosch Corp.	Will furnish tools for test when development program is completed
Stanley Power Tools	Offered to furnish tools for test
Power Tools Division Desa Industries	Interested in pickups, agreed to offer as an accessary when development completed
Geneva Power Tools McGraw Edison Co.	Interested, No commitment

8680EF



2

DUSTUCTOR®

Low Volume High Velocity Dust Control Systems

HOFFMAN
AIR APPLIANCE

Dustuctor® systems offer immediate, effective control over the hazardous and costly problems of dust created by portable grinders, pneumatic chisels, wire brushes, sanders and other tools — even ultra high speed air driven tools used to work heavy metals such as uranium. By the use of patented nozzles and hoods fitted to individual tools, Dustuctor equipment traps breathing zone dust in the dangerous under 10 micron range at the source, and conveys it through small diameter tubing to a high efficiency separator. The small sized, lightweight extraction heads and integrated system design make Dustuctor highly flexible and maneuverable — it becomes, essentially, a part of the tool itself.

All this means decided advantages in terms of installation and operation costs. Unlike high-volume low vacuum systems, Dustuctor does not require massive ductwork or provisions for large amounts of make-up air. The system removes only the dust — it does not draw out substantial volumes of conditioned air in the summer, or heated air in winter. The problem of negative pressure is eliminated. You don't need special grinding rooms. And reduced costs plus effective production means more profit.

Dustuctor system performance is highly efficient. Silicosis, asbestosis, and beryiliosis threats are significantly reduced. Various other nuisance dusts which cause seemingly inert pneumoconioses are also brought largely under control with Dustuctor systems. **A short technical description of Dustuctor is provided under the heading "Low Volume — High Velocity Exhaust Systems" in "Industrial Ventilation, A Manual of Recommended Practice" published by the American Conference of Governmental Industrial Hygienists.**

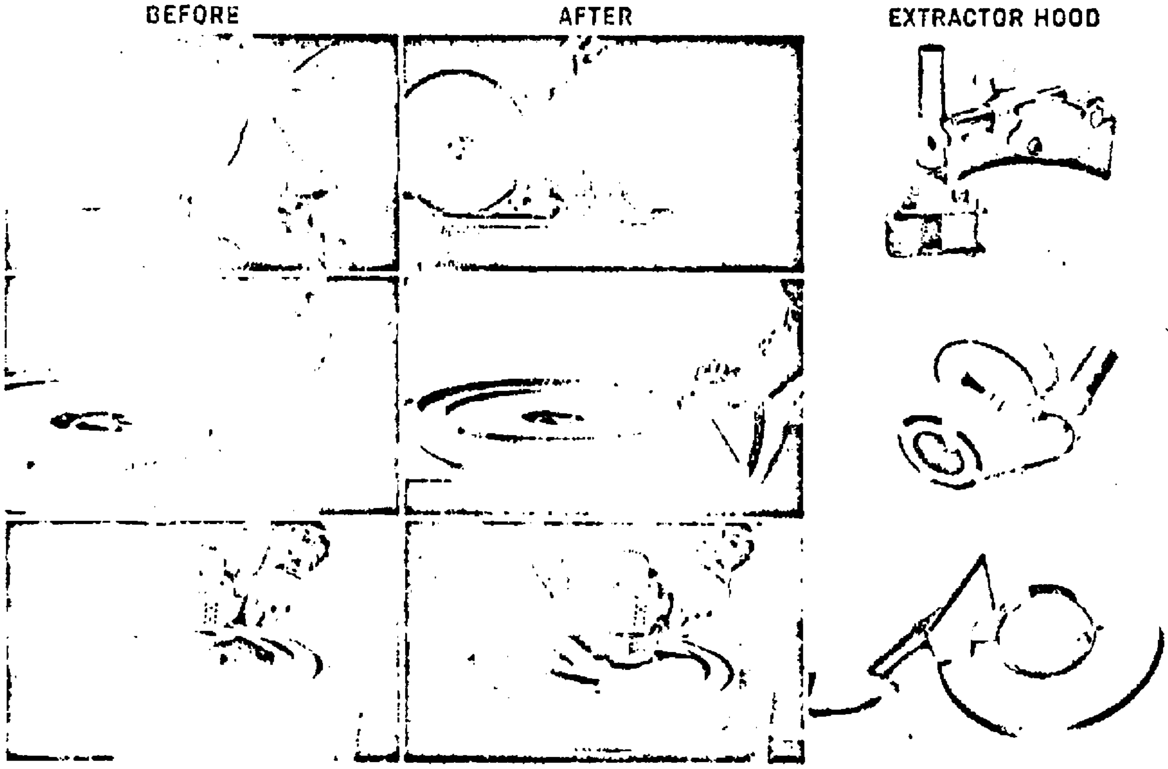
Dustuctor offers the additional advantage of service as a heavy duty vacuum cleaning system. Shake-out sand spills, blasting grit or welding flux recovery, ore dust spillage from conveyors, batch conveying, and many other in-plant problems can be handled. These miscellaneous duties can usually be accomplished by a simple change of accessories on the piping system.

Several hundred world-wide installations have proven the effectiveness of our Low Volume High Velocity dust control system. Let a Hoffman representative show you how you can reduce costs, cut down on operational hazards, and increase productivity, with the unique Dustuctor system.

Low volume high velocity dust collection systems for portable hand-held tools

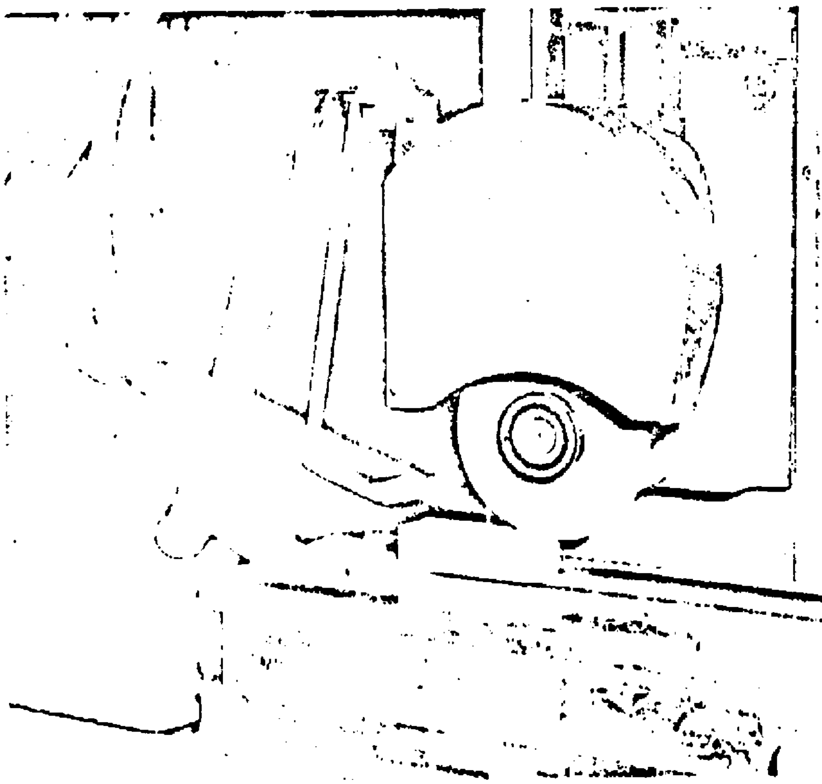
DUSTUCTOR AT WORK

BEFORE | AFTER | EXTRACTOR HOOD



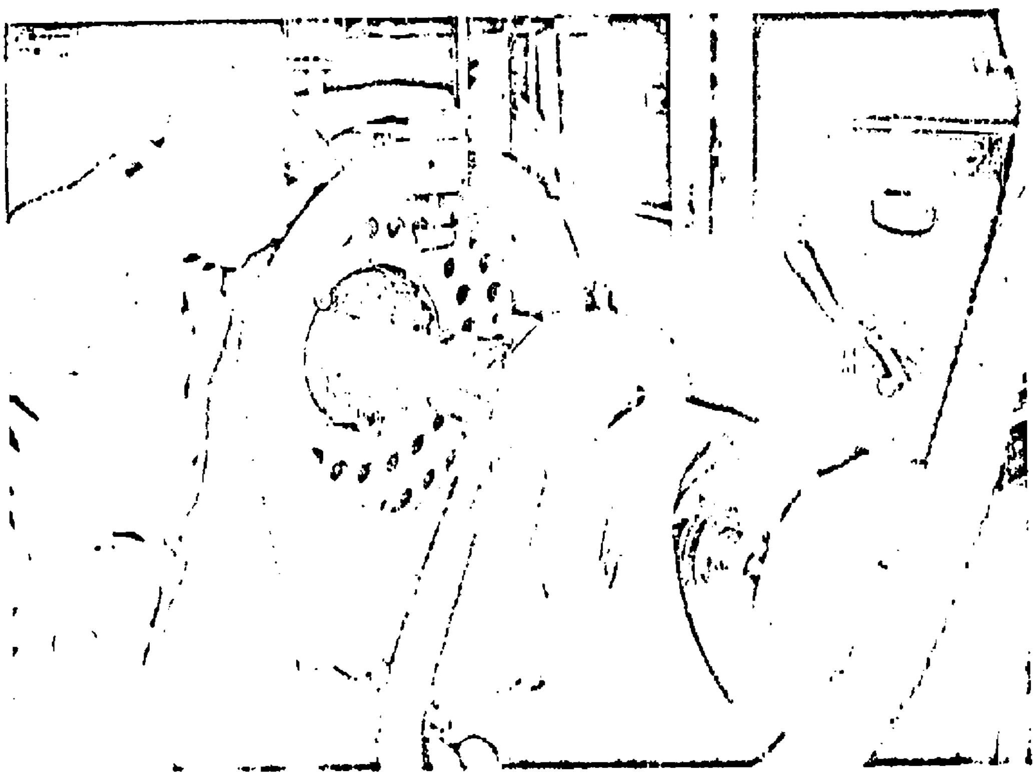
A S & R • BOEING • CANADA IRON FOUNDRIES • CATERPILLAR • DENVER POST • GM • GE • B. F. GOODRICH • HONEYWEL KROGER CO. • LEVER BRO. • MARTIN CO. • MERGENTHALER LINOTYPE • PEERLESS POTTERY, INC. • CHARLES PFIZER • RAYTHEO. REMINGTON ARMS • S.N.S.O. ROYAL ORDNANCE FACTORY • STAUFFER • UNION CARBIDE • VICKERS-ARMSTRONG, LTD. • WATERTOWN ARSENAL • WESTINGHOUSE

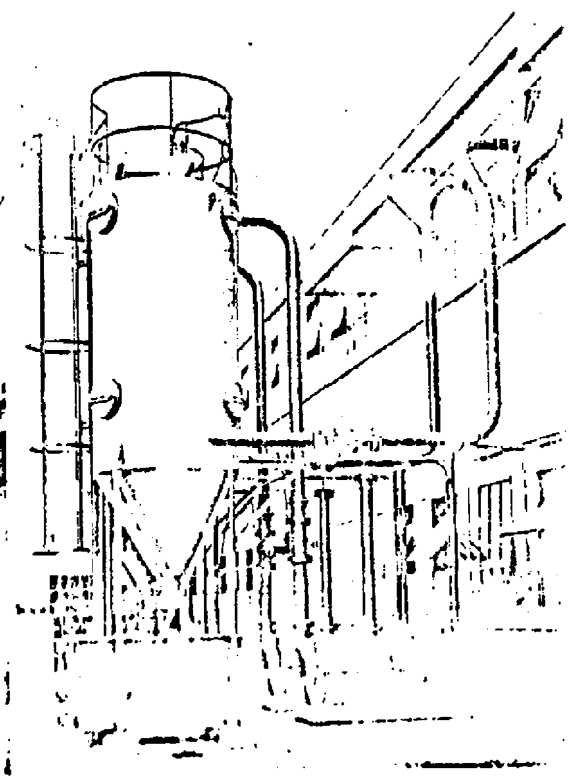
ALUMINUM CHIPS • ASPIRIN DUST • BERYLLIUM DUST • BRASS CHIPS • CARBON DUST • CEMENT CHIPS • CERAMIC DUST • CIRCUIT BOARD DUST • COPPER CHIPS • DETERGENT DUST • EXPLOSIVES • FIBER GLASS DU: GRAPHITE BEARING DUST • OIL VAPOR • PAPER DUST • PHARMACEUTICAL TABLETING DUST • PLASTIC CHIPS • PORCELAIN FRIT • SILICA DUST • DRINK MIX • TUNGSTEN CARBIDE DUST • URANIUM CHIPS & DUST



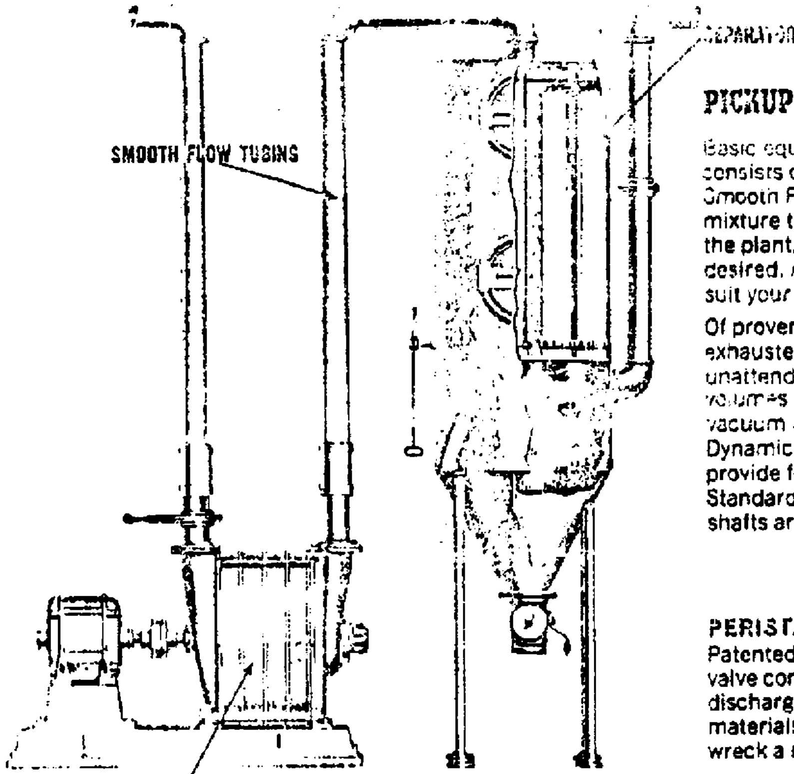
Tungsten Carbide Pick up

Rocket Propellant Pick up





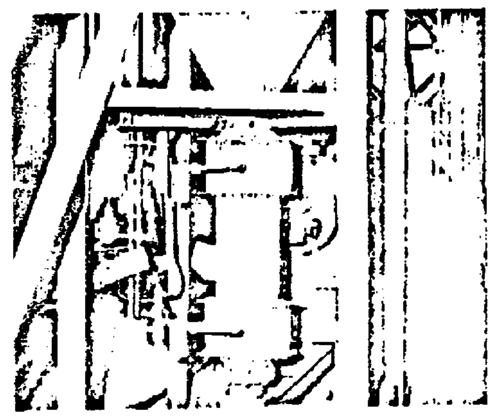
Typical System Installation



PICKUP POWER TO 12" HG

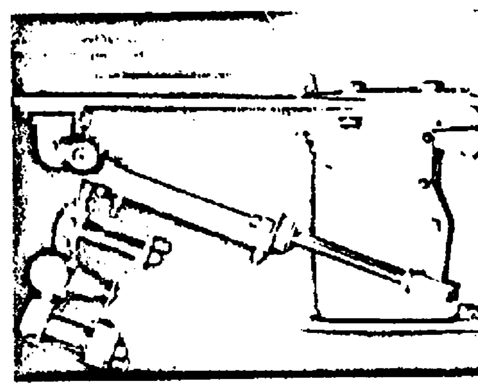
Basic equipment for a typical vacuum cleaning system consists of a centrifugal exhauster connected to a separator. Smooth Flow tubing or steel pipe carries the dust/air mixture to the separator. The tubing extends throughout the plant, with inlet valves at locations where collection is desired. A large selection of hose and tools is available to suit your application.

Of proven cast-iron, four-bearing heavy-duty design, Hoffman exhausters permit continuous unattended operation at volumes up to 13,000 Cfm, vacuum to 12" hg. Dynamically balanced rotors provide for smooth running. Standard motors and drive shafts are used.



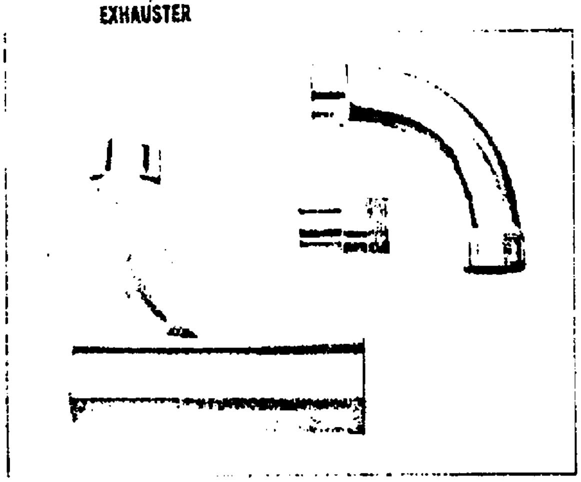
PERISTALTIC VALVE

Patented Rubber diaphragm valve continuously discharges abrasive materials which would wreck a rotary feeder.



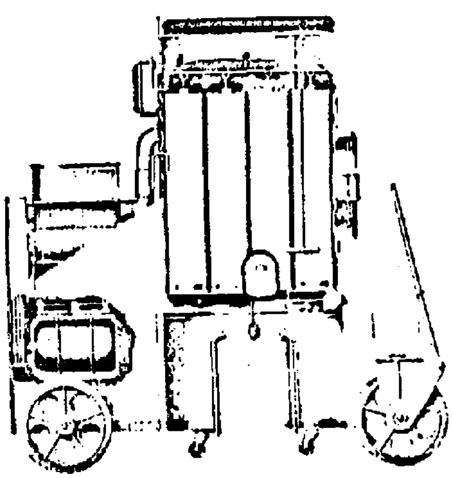
HINGE VALVE

Unique valve for batch discharge. Flap is a cast iron spherical section with linkage arranged to be self-compensating for wear. Seals against a rubber gasket placed out of the normal flow of material. Available in manually operated version, or air operated, as shown.



SMOOTH-FLOW®

Smooth-Flow pneumatic tubing and fittings have slip-fit joints . . . no threads. They are easily installed by non-technical personnel, with every joint fastened airtight with an adhesive or tape on the bell and tube fitting. Hoffman Smooth-Flow piping assures you of full suction power from the vacuum machine to the point of work.



HEAVY-DUTY INDUSTRIAL PORTABLE VACUUM UNITS

Hoffman heavy-duty portable vacuum cleaners through 15 HP. Mobility and flexibility enable the operator to do a thorough job of dust collecting or vacuum cleaning. Typical of the Hoffman portable units is the 10 HP Hoffco-Vac 100 developing 8.5" hg suction. Filtering area is 63 sq. ft. Removable dust bucket has a capacity of 7.5 cu. ft.

ENGINEERING SERVICE

Hoffman Application Engineers are located in every major city in the United States and, through subsidiary and affiliated companies, in Canada, Latin America and Europe. These men are specialists. They will focus Hoffman's 50 years of experience on your individual needs — and can save you time and money. You will find their names in Thomas Register and the Yellow Pages of your phone directory, or you may contact us for the engineer serving you. There is no charge, no obligation, for their service.

HOFFMAN

DIVISION OF CLARKSON INDUSTRIES, INC.

USA/Air Appliance Department
Hoffman Industries
103 Fourth Avenue
New York, New York 10003
TEL: 212-677-3600

CANADA/Hoffman Industries of Canada Limited
58 Bertal Road, Toronto 15, Ontario
TEL: 416-763-3528

ENGLAND/Hoffman Air & Filtration Systems Ltd
Howard House — Lloyd Street
Altrincham, Cheshire/TEL: 061-928-7402

OFFICES/PLANTS: UNITED STATES, CANADA, ENGLAND, GERMANY, FRANCE, SWITZERLAND, ITALY, MEXICO

Dustuctor (R)

Low Volume/High Velocity Dust Control Systems

Johns-Manville

Research & Development Center

Denver, Colorado 80217
(303) 770-1000

April 12, 1974

Dr. Franz Alfeis
The Upson Company
Lockport, New York 14094

Dear Franz:

We have completed our cutting tests with asbestos fiber count on the asbestos laminated paperboard products you supplied. One of these had a plain asbestos on the paperboard, but the other had a printed vinyl overlay on the asbestos.

In our first test, we used a band saw with all ventilation off and we collected dust samples in the immediate area and also on a personal sampler worn by the person doing the cutting. The filter on these collectors was then examined microscopically according to OSHA standards and the number of asbestos fibers counted and converted to an 8-hour weighted average:

Test Board	Test Type	Test Time	Fibers/ml (8 hr avg)
Plain Laminate	Personal	30 min.	5.2
Plain Laminate	Area	30 min.	3.1
PVC Laminate	Personal	60 min.	11.2
PVC Laminate	Area	60 min.	4.0

As you can see, both personal measurements were above the 5 fiber/ml limit established by OSHA and all measurements are above the 2 fiber/ml limit which Johns-Manville has imposed on itself.

Subsequent to the above tests, we made another test using a portable Skil saw with a dust control attachment. This test was run for thirty minutes, but only on the PVC laminated board, since this gave the poorest results in the first test for some unknown reason. The test with the Skil saw with dust control gave fiber counts on an 8-hour weight average of 0.7 and 0.5 fibers/ml for the personal and area samplers respectively. These are well within the limits of OSHA and also the more stringent limits set within Johns-Manville.

These data show that it is necessary to provide dust control when asbestos laminated paperboard is cut with a saw or other unit of that type. We do not believe dust control will be necessary for shear or rotary knife cutting within a plant, but this should be checked at the appropriate time.

As mentioned to you, we hope to have brochures on self-contained portable cutting units with dust control attachments within about three weeks now. As soon as they are available, we will send you a couple. This type of cutter apparently will be available from Skil and North American Rockwell.

This should give you the information you need for the present.

Sincerely,

John

John W. Axelson

kjm

cc:
R. J. Hattersly - Boston

bcc:
W. C. Streib - R&D
N. W. Hendry - 2 South
J. E. Connor - 2 South
J. F. Reis - 2 South
F. L. Jackson - R&D
W. J. Plichta - R&D
P. L. Earle - R&D

To: P. L. Earle - R&D Center Date: May 28, 1974

From: D. R. Christensen - R&D Center

Copies: D. E. Hillier/G. L. Swallow - 4 North
M. F. Trosper - R&D Center

Subject: SAWING OF MARINITE 23, ONE INCH THICK USING A ROCKWELL PORTABLE JIGSAW MODEL 648 - R&D CENTER - SPECIAL REQUEST

Special samples were done May 23 and 24, 1974 for airborne asbestos fibers generated during the sawing of MARINITE 23, one inch thick. Ventilation varied but the baghouse used was the same. The results follow.

Location	Description	Ventilation		TLV	Results
ACE Area of Product Development Building	Rockwell portable jigsaw Model 648	Spencer portable baghouse using 2 hoses one to saw and the other to the vacuum table	P P	2.0 2.0	0.8 F/cc 0.5 F/cc
		Spencer portable baghouse ventilated saw only	P A	2.0 2.0	4.9 F/cc 2.3 F/cc

A - Area Sample
P - Personal Sample

Prepared by T. F. Antonson

D. R. Christensen

D. R. Christensen

jes

AL 102121310

...ould be expressed as a percentage of the total material pulverized by the tool, an additional measure of dust collection efficiency. By this method, the amount of work done by a tool (linear in. cut, and weight of material pulverized per unit time) was measured for more accurate test-to-test comparisons.

Tools Tested

With the aid of Dennis Kelleher, a number of tools from Europe were procured for evaluation. The results of tests with these and other tools, under various conditions, are detailed in Tables 1 and 2. The tools are described in Table 3. Test results of each tool will be discussed separately. It should be noted that a great deal of work was done during each test, i.e., 4 holes drilled/minute, 18 linear in. cut/minute etc. This rate of fabrication is probably higher than would be encountered in the field, and thus, represents a most severe test condition. In addition, the dust in the chamber was concentrated in a small volume of air and the air flow carried it directly past the sampler, giving higher readings than were encountered in an open area.

Drill - A 1/4 in. Black and Decker drill with a 3/8 in. chuck was used to drill 1/4 in. holes in 1/4 in. flexboard with a common masonry bit. The board was held vertically, parallel to the flow of air through the chamber. The drill was held horizontally, and operated at full speed. With no dust collecting shroud, dust counts were a low 0.9 f/cc. With the shroud marketed by Cape Universal Building Products Ltd., the dust count was reduced to 0.2 f/cc. When operated with the shroud in an open room, the dust count (personal sampler) was less than 0.1 f/cc.

Morcem "Nibbler" - (Dan Klip No. 80847) - This unit was mounted on a 1/4 in. Black and Decker drill with a J-M fabricated adaptor, and operated at approximately 40 percent of full drill speed. With no dust collection, the tool gave a dust count of 1.0 f/cc in the dust chamber and less than 0.1 f/cc in an open room. The cut was rather rough, but the tool operated well and should be satisfactory for use with asbestos-cement up to 3/8 in. thick where a smooth finished cut is not required. This tool is also recommended for cutting corrugated asbestos cement. It was noted that coarse material accumulates on the floor with use of this tool.

Norcem Handsaw - (Eternit Sag No. 80810) - This simple handsaw is laborious to operate. With no dust collection system, the dust count was 0.3 f/cc in the dust chamber and 0.1 f/cc in an open room. It was noted, however, that a considerable amount of dust fell to the floor during use which could pose a cleanup problem.

Norcem Handclippers - (Eternit Saks No. 80805) - This hand tool, usable for asbestos-cement up to 3/16 in. thick, produced a dust count of 0.3 f/cc (personal sampler) in an open room, with no dust collecting. As with the "nibbler", above, coarse material accumulates on the floor when this tool is used.

Norcem Scoring Knife - (Eternit RisseKniv No. 80800) - A personal sampler dust count of 0.8 f/cc was recorded in an open room when using this "score and snap" hand tool. It can be used for cutting asbestos-cement up to about 1/4 in. thickness.

Cape Power Saw Shroud - (Mounted on Rockwell Saw) - Cape Universal Building Products Ltd. markets a saw shroud made of light, flexible plastic which fits over the saw guard above the board being cut. Tests were run with the shroud on a Rockwell saw, using 3/4 in. wood backing under the board being cut to prevent the escape of dust from the lower part of the saw. A dust count of 1.2 f/cc was achieved. However, three problems with this shroud were noted. The wood backing is needed, a somewhat bothersome requirement to which workers in the field may not adhere. Secondly, the rather flimsy plastic was pulled into contact with the blade by the vacuum assuring quick destruction of the shroud. Lastly, a quantity of dust was not picked up by the vacuum system, but was left as a trail on the board after cutting, posing a cleanup problem. For these reasons, the use of this shroud is not recommended despite the acceptable dust count achieved.

unsatisfactory

Open Type Shroud - Rockwell Power Saw - This is an open type dust collection shroud, designed to capture dust particles in their flight path, as opposed to a totally enclosed design which is simply evacuated with a vacuum source. A number of attempts were made to improve the performance of the tool, including the following: the use of wood backing, or a vacuum box, under the board being cut; thin blades (diamond) which create less dust simply because they pulverize less material; enlarged discharge ports leading from the shroud; adding baffles inside the shroud to direct the flight of the dust particles toward the vacuum ports; added shielding at key points around the blade; elimination of all fittings (tees) in the vacuum hose; and attachment of the 2 in. hose from the vacuum cleaner directly to the shroud, thus eliminating all 1 in. hose. The best dust count achieved with any of the above attempts was 21.0 f/cc.

unsatisfactory

A saw with an enclosed-type shroud was then received, the "Festo" from Germany, and as testing with it began, [illegible] advantages became evident.

Festo Power Saw and Shroud - (Germany) - This tool came equipped
ith a diamond blade and shroud designed to enclose most of the
blade and cutting area, this enclosed volume then to be evacuated
by vacuum. Tested in the chamber without any vacuum pickup, the
dust count was 20.5 f/cc. With the vacuum cleaner operating, and
the shroud and saw exactly as received from the manufacturer, the
dust count was 4.5 f/cc, a great improvement but still substantially
dustier than the OSHA standard of 2.0 f/cc. The shroud was then
modified by adding two rubber "skirts" on the bottom part of the
shroud, which sealed the apertures between the shroud and the bottom
of the board. This change resulted in a further decrease in dustiness
to 0.8 f/cc in tests in both the chamber and an open room. It should
be stressed that the saw, as received from the manufacturer, was
unsatisfactory, and shroud modifications were necessary to meet the
OSHA standard. Also, the power source for the saw must be 220 V.,
50 hertz.

J-M Shroud - Rockwell Power Saw - With the success of the modified
"Festo-type" shroud, a similar attachment was made to fit the
Rockwell saw. The initial version resulted in a fiber count of
2.5 f/cc. Additional changes were made by tape mockup, and tested
at 0.0 f/cc. Reproduction in metal gave zero f/cc in both the dust
chamber and in an open room. These figures compare to 21.0 f/cc
for the saw as received from the manufacturer. It should be noted
that these final tests were made with a common masonry blade. An
expensive diamond blade is not required.

The major difference between this dust shroud and the Festo model
is that efforts were made to keep the volume of the J-M model rel-
atively small, although it can be reduced still further, and to
minimize openings from the shroud through which dust and debris
could escape and air could enter and reduce the vacuum available
for dust collection. To this end, the following major changes were
made from the Festo design.

1. The vertical adjustment bracket is outside the shroud, allowing
the shroud to be smaller and giving easier access for adjustment
for cutting boards of different thicknesses.

2. Rubber skirts on the bottom half of the shroud seal the opening
between the shroud and the board being cut without binding on
the board.

3 Openings in the saw table, on each side of the blade, were closed.

4. Cooling air from the motor is excluded from the shroud, and
instead exhausts into the room air. The Festo draws air through
the motorinto the shroud, thus decreasing vacuum available for
dust collection.

This dust collection shroud gives every indication of allowing the cutting of flat asbestos-cement sheets in an acceptably dust free manner when used with the Nilfisk GA-73 vacuum cleaner, with no other special precautions or procedures.

Vacuum Cleaner

The Nilfisk model GA-73 has a three stage filter system and reportedly retains 100 percent of dust particles down to 1.0 micrometer in size and 99.9 percent of particles 0.3 micrometers in size. This unit is recommended for use with asbestos by E. M. Fenner, and is therefore the only one recommended for use with tools for the fabrication of asbestos-containing materials.

Several tests were run in the dust chamber to better determine the suction required to adequately operate the Rockwell saw equipped with the J-M design shroud. The results, detailed in Table 1, are summarized as follows.

No. of Vacuum Cleaner Motors Operating	Air Velocity Pressure (inches mercury)	Dust Count (f/cc)
3	3.0	0.0
2	2.5	0.4
1	1.0	2.8

The dependence of dust collection efficiency on the vacuum source is evident. These data indicate the possibility that a vacuum cleaner smaller and less expensive than the Nilfisk GA-73 might be usable with the J-M power saw shroud and still give fiber counts under 2.0 f/cc. The use of a smaller vacuum source cannot be recommended however, until after acquisition and testing of such a unit.

Saw Blades

It is worth mentioning a few words about power saw blades. Our tests have shown that, with the J-M saw shroud, common masonry blades are satisfactory both for the quality of the cut and for the fact that the dust generated by their use can be controlled by the shroud. This type of blade is inexpensive and locally available in all parts of the country.

Diamond blades have one distinct advantage over the masonry blades. That is, they are thinner, on the order of 0.06 to 0.10 in. thick, compared to 0.125 in. thickness for the masonry blades. The thinner blades obviously create less dust because they pulverize a smaller volume of material. Diamond blades, however, have two drawbacks. They are expensive, over $100 each and, unless they are ventilated (have holes, slots, etc. in the blade) they can burn out in a very short time when used with asbestos-cement. An unventilated diamond blade burned to an unusable condition after cutting less than 18 in. of 1/4 in. asbestos-cement in a test at Research.

Masonry blades are recommended for use with the J-M shroud for cutting asbestos-cement. If, however, one wishes to use a diamond blade, the Jadem blade, ventilated for dry cutting, is recommended. It is available from Geo. Pfaff Inc., Amityville, New York.

CONCLUSIONS

A suite of tools has been evaluated for cutting and drilling asbestos-cement, which gives dust counts below 2.0 f/cc, and which, therefore, should be satisfactory for use under the OSHA standard. In addition, an apparatus and method has been developed for testing the dust generation of a variety of tools and materials without exposing the operators to dust, and is available for use in the future.

It is anticipated that E. M. Fenner will direct the assembly of the information contained in this report for dissemination to interested parties in the asbestos-cement industry.

APPENDIX E

TABLE 1. RESULTS OF DUST TESTS CONDUCTED IN DUST TEST CHAMBER(1)

Tool Description	Test Conditions	Test Duration (min)	Material Pulverized by Tool: No. Holes, No. In., etc.	Holes or In./min	Material Pulverized: Total Gm	Gm/Min	Percent Pulverized Material Captured(2)	Dust Conc. (f/cc)	Remarks
Drill-Black and Decker, 3/8 in. bit	No shroud, no dust pickup (vertical board)	40	163 holes	4.08 holes	33	0.83	15	0.7	Visible dust
Drill-Black and Decker, 3/8 in. bit	Cage Shroud, Milwaukee vacuum (vertical board)	40	163 holes	4.08 holes	27	0.68	90	0.8	No visible dust
Porter "Rabbit" - (Ops Reg No. [illegible])	No shroud, no dust pickup (mounted on drill)	40	450 in.	11.25 in.	(3)	(3)	—	1.0	
Marvin Sander (Catalog No. [illegible])	No shroud, no dust pickup	[illegible]	53.3 in.	3.55 in.	34	2.3	6	0.3	Laboratory. Coarse dust fell to bottom of chamber, a potential cleanup problem.
Cage Shroud									
Rockwell Saw - Jasco diamond blade	Used Cage shroud over [illegible] and Rockwell housing. Used Milwaukee vacuum with 2 in. hose connected directly to shroud - 3/4 in. wood backing.	15	370 in.	25.0 in.	248	16.5	90	2.4	Much dust left on board after cutting was completed.
Rockwell Saw - Masonry blade	Cage shroud fitted over normal guard - Used [illegible] with 1 in. hose from cage shroud to 2 in. hose - 3/4 in. wood backing.	15	370 in.	25.0 in.	243	16.2	90	1.3	Much dust left on board after cutting was completed.

(1) Test conditions: Vacuum chamber air velocity pressure = 1.0 to 1.2 in. Hg. Air velocity pressure through chamber (measured in [illegible]) = 0.8" wgh.

(2) Amount captured by vacuum pickup (output) or baghouse (intake) as a percent of material pulverized by tool.

(3) Not measurable. Tool shredded strip being cut off.

NOTE: Material being fabricated is flat asbestos-cement sheet, 1/8 in. thick

APPENDIX B

TABLE [illegible]. [illegible] (Cont.)

Test Description	Test Conditions	Test Duration (min)	[illegible]	[illegible]	Material Pulverized Total	[illegible]	Percent Pulverized Material [illegible] (2)	Dust Count (f/cc)	Remarks
[illegible]									
[illegible]	[illegible]	[illegible]	[illegible] in.	[illegible] in.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible] in.	[illegible] in.	[illegible]	[illegible]	[illegible]	[illegible]	Slight amount visible dust
[illegible]	[illegible]	[illegible]	[illegible] in.	10.0 in.	[illegible]	[illegible]	[illegible]	[illegible]	No visible dust
[illegible]									
[illegible]	[illegible]	[illegible]	[illegible] in.	[illegible] in.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible] in.	10.0 in.	[illegible]	[illegible]	[illegible]	[illegible]	Slight amount visible dust
[illegible]	[illegible]	[illegible]	[illegible] in.	10.0 in.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible] in.	[illegible] in.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible] in.	[illegible] in.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible] in.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

(1) [illegible]
(2) [illegible]

APPENDIX [illegible]

TABLE 1. RESULTS OF DUST TESTS CONDUCTED IN DUST TEST CHAMBER[1] (Cont.)

Tool Description	Test Conditions	Test Duration (min)	Material Pulverized by Tool: No. Holes, Sq. In., Etc.	Holes or In./min	Material Pulverized: Total Wt.	Material Pulverized: [illegible]	Percent Pulverized Material Captured[2]	Dust Count (f/cc)	Remarks
Open-Type Shroud									
Rockwell Saw - Carbide tipped blade	Dust-type shroud in place, 3/4 in. wood backing, no vacuum pickup	15	360 in.	17.0 in.	3[illegible]5	[illegible]	[illegible]	[illegible]	Much visible dust
Rockwell Saw - Carbide tipped blade	[illegible]	15	[illegible] in.	17.[illegible] in.	[illegible]	[illegible]	[illegible]	[illegible]	Much visible dust
Rockwell Saw - Carbide tipped blade	[illegible]	15	[illegible] in.	17.[illegible] in.	[illegible]	[illegible]	[illegible]	[illegible]	Visible dust
Rockwell Saw - Masonry blade	[illegible] 3/4 in. wood backing [illegible]	15	[illegible] in.	[illegible] in.	[illegible]	[illegible]	[illegible]	[illegible]	Some visible dust
Rockwell Saw - Masonry blade	[illegible]	15	[illegible] in.	[illegible] in.	[illegible]	[illegible]	[illegible]	[illegible]	Slight visible dust
Rockwell Saw - [illegible] blade	[illegible] 3/4 in. wood backing [illegible]	15	[illegible] in.	[illegible] in.	[illegible]	[illegible]	[illegible]	[illegible]	Slight visible dust - some dust left on board after cutting completed.

(1) Test conditions - Vacuum cleaner air velocity pressure = 1.0 to 1.5 in. Hg. Air velocity pressure through chamber (measured in downstream duct) = 0.[illegible] Hg.
(2) [illegible] as a percent of material pulverized by tool.

APPENDIX [illegible]

TABLE 3. RESULTS OF DUST TESTS CONDUCTED IN OPEN ROOM

Tool Description	Test Conditions	Test Duration (min)	Material Fabricated: Type	Material Fabricated: Quantity	Material Fabricated: Quantity per Min	Dust Counts (fibers/cc): Area	Dust Counts (fibers/cc): Personal	Remarks
Drill - Black and Decker, with Cape dust pickup shroud	1/4 in. masonry bit, operated at full speed. Drilled downward through horizontal board. Used Nilfisk GA-73 vacuum (3.0 in. Hg air velocity pressure).	60	1/4 in. flat A/C	553 holes	9.00 holes	0.0	<0.1	
Porter "Nibbler" - [illegible] No. [illegible], powered on Black and Decker drill	No dust collection.	40	1/8 in. flat A/C	450 in.	11.25 in.	0.0	<0.1	Slight amount of coarse material fell to floor.
Porter Bandsaw (Porter Cable No. [illegible])	Blade No. [illegible]. No dust collection.	15	1/8 in. flat A/C	53.8 in.	3.57 in.	none taken	0.1	Much coarse material fell to floor, a potential cleanup problem.
Porter Hand Clippers (Porter Cable No. [illegible])	No dust collection.	15	1/8 in. flat A/C	270 in.	18.0 in.	0.2	0.3	Some coarse material fell to floor.
Porter Scoring Knife ([illegible] No. [illegible])	No dust collection.	15	1/8 in. flat A/C	273 in.	18.4 in.	none taken	0.0	
[illegible] power saw (diamond blade)	[illegible] diamond blade [illegible], with Nilfisk GA-73 vacuum (3.2 in. Hg air velocity pressure) (rubber skirt on bottom part of shroud).	15	1/4 in. flat A/C	170 in.	1[illegible].0 in.	0.5	0.0	
Rockwell power saw, [illegible] dust pickup shroud, (masonry blade)	Totally enclosed shroud made by J-M, with Nilfisk GA-73 vacuum (3.0 in. Hg air velocity pressure).	40	1/4 in. flat A/C	720 in.	18.0 in.	none taken	0.0	

APPENDIX I

TABLE 3. DESCRIPTION OF TOOLS EVALUATED AND FOUND TO BE SATISFACTORY (Cont.)

Drill (Cont.)

Hose adaptor - (2 in. to 1 in.) - Use 2 in. x 1 in. x 1 in. "Y" fabricated by J-M for saw. When used for drill, tape shut one 1 in. leg of the "Y".

Fabricated by J-M.

Power Saw

Rockwell International Co. - 8-1/4 in. model 680.

Locally available in most areas.

Dust pickup shroud for saw.

Fabricated by J-M.

Diamond Blade - 8 in. Jadem ventilated diamond blade, No. 7624046C. Common masonry blades are satisfactory, but if it is desired to use a diamond blade, this type is highly recommended.

Geo. Pfaff Inc.
16 South Ketcham Avenue
Amityville, New York 11701

Masonry Blade - Research tests were made with a "New England" 8 in. silicon carbide blade. Equivalent blades should be satisfactory.

Locally available.

Hose adaptor - 2 in. x 1 in. x 1 in.

Fabricated by J-M.

APPENDIX I

TABLE 1. DESCRIPTION OF TOOLS EVALUATED
AND FOUND TO BE SATISFACTORY

Vacuum Source

Nilfisk model GA-73 vacuum cleaner, equipped with three filter systems and 2 in. hose.

Nilfisk of America, Inc.
701 King Manor Drive
King of Prussia
Penna. 19406

Telephone (215) 277-3900

Drill

1/4 in. Black and Decker Model 1046, equipped with 3/8 in. chuck No. 92555.

Locally available in most areas.

Dust pickup shroud for drill, "Portable Drill Nozzle Kit - Pat. App. 59350".

Cape Universal Building Products Ltd.
Register Office
P.O. Box 165
Exchange Road
Watford
England

Telex - 262744
Telephone - WATFORD 34551

Masonry Bit - Research tests were made using a 1/4 in. carbide tipped "Regular helix" No. 5463 (FDS) bit, manufactured by Super Tool Division of Gulf and Western. Any similar masonry bit should be satisfactory.

Locally available.

APPENDIX I

TABLE 3. DESCRIPTION OF TOOLS EVALUATED AND FOUND TO BE SATISFACTORY (Cont.)

The following tools are available from:

Norcem
3470 Slemmestad
Oslo,
Norway

Telephone: (02) 78-03-60

Nibbler*

Norcem Den Klip No. 80847, for use with Black and Decker drill described above. For cutting asbestos-cement up to approximately 3/8 in. thickness.

Adaptor, required for mounting on drill, is fabricated by J-M.

Handsaw

Norcem (Eternit) Eclipse saw ("Eternit Sag" No. 80810).

Sawblade ("Ekstra Sagblad" No. 80811), Type 56-10.

This tool is recommended for use only in situations where a limited amount of cutting is required.

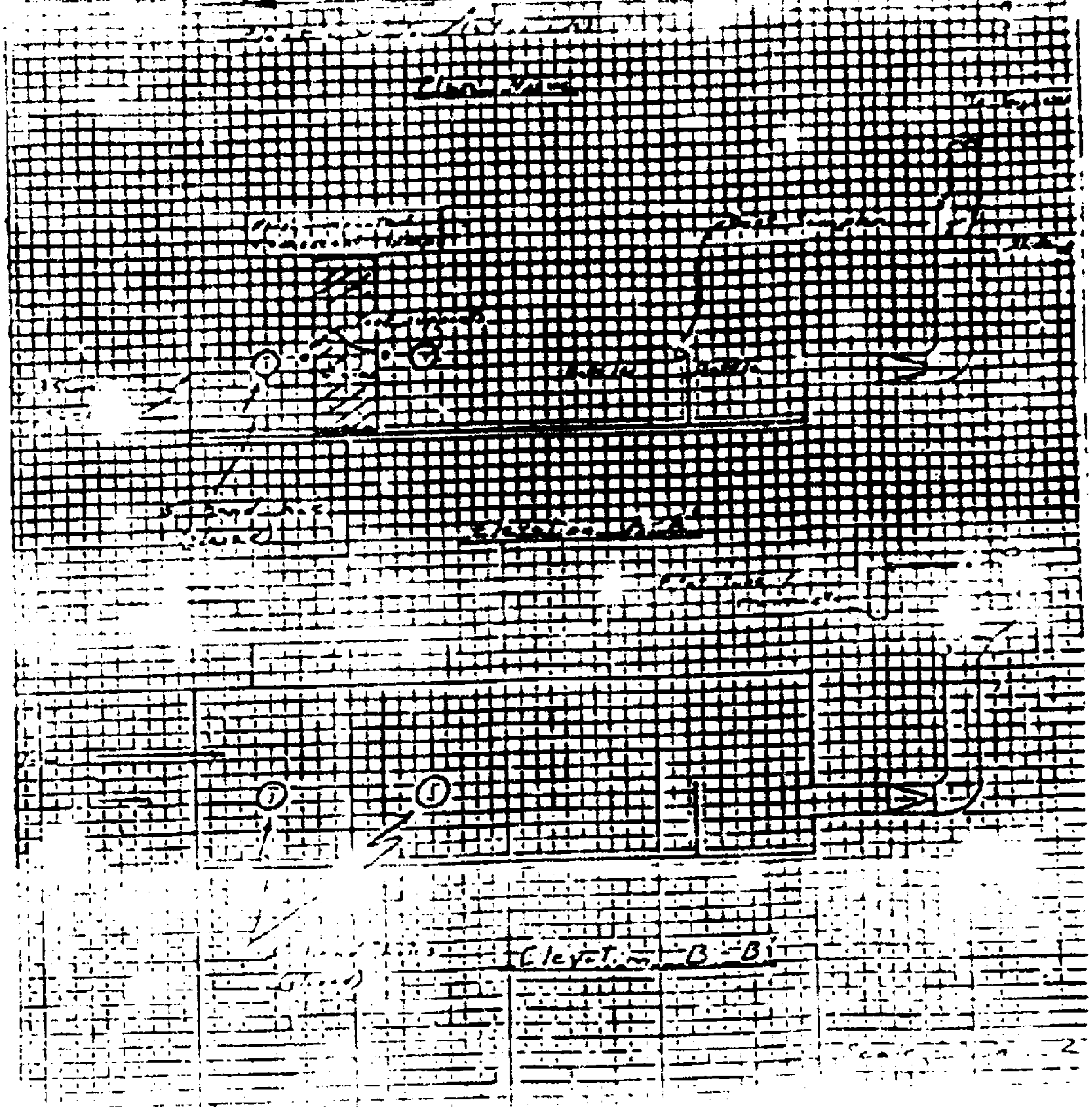
Scoring Knife

(Norcem) "Eternit Risseknive" No. 80800. This tool is usable for cutting asbestos-cement up to approximately 1/4 in. thick.

Hand Clippers

(Norcem) "Eternit Saks" No. 80805. The use of this tool is limited to asbestos-cement with a maximum thickness of approximately 3/16 in. and recommended only for cutting relatively small quantities of material.

Johns-Manville
Research and Development Center



Johns-Manville
search and Development Center

Report No 8811-1050-63
Date August 16, 1978

EVALUATION OF TOOLS FOR THE DUST-FREE FABRICATION OF ASBESTOS-CEMENT

SUMMARY

All tools required for common job-site fabrication of flat A/C sheets have been tested with the exception of a bayonet (sabre) saw, and a hand rasp. The saw is used for making cutouts for electrical fixtures, piping, etc., and the rasp for dressing or beveling rough edges of the sheets. Neither of these tools would be used continuously on a job, but their use is required for "detail work".

A Rockwell Model 548 (heavy duty) bayonet saw, with 67-22396
carbide blades was purchased for our experimental work. A
shroud was designed which fits tightly to the saw housing,
and completely encloses the blade and cutting area above the
board. All particles emitted above the board are captured
using a Nilfisk GA73 vacuum cleaner. Air enters the shroud
only through the slot cut in the board by the blade. This air
stream carries fine dust particles from below the board up
through the slot into the shroud, and only a minor amount of
coarse, sand-like material escapes. One advantage of this design
is that there is no shroud below the sheet, and the saw can
therefore be used for entry in the middle of a board. This
factor should add immeasurably to workmen's acceptance of the
tool. Dust counts (Table 1) with this saw were zero in the dust
test chamber using a pla ic prototype of the shroud. An
aluminum shroud resulted in 0.6 f/cc in the test chamber, and
0.1 f/cc in an open room. This shrouded tool, illustrated
in the Appendix, is considered satisfactory for the intermittent
service for which it is intended.

The hand rasp gave dust counts of 0.8 and 0.1 f/cc in the test chamber and open room, respectively. Its use should be very limited, however, because it creates fine debris which cumulatively could result in excessively high dust counts.

Contents: Summary, Appendix

Reported by F. Bodycote
Asbestos & Mineral Technology

Reported by G. Bauman
Asbestos & Mineral Technology

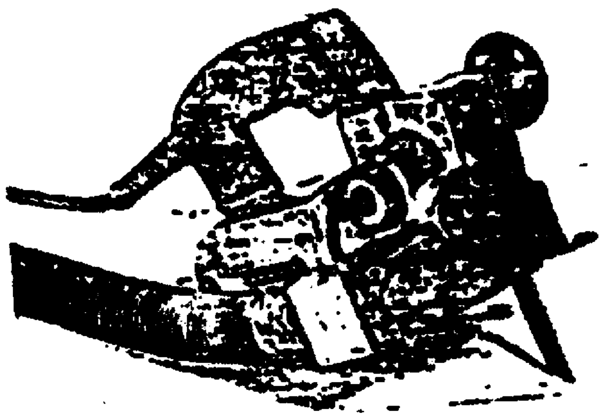
APPENDIX

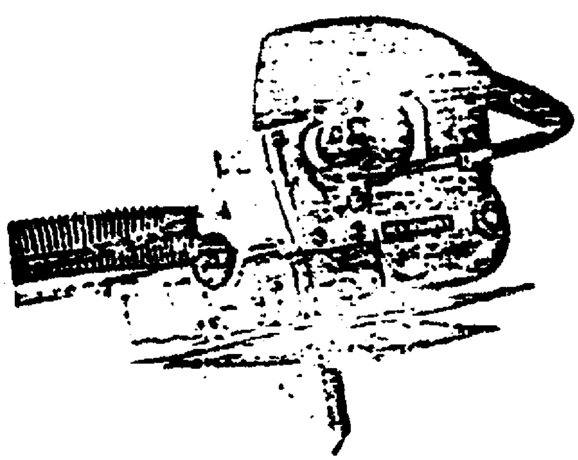
TABLE 1 - RESULTS OF DUST TESTS

[illegible] Description/Test Conditions	Test Duration (min)	Material Pulverized: [illegible] / Strokes/min [illegible]	Material Pulverized: Total Mat'l Pulv. (gm)	Material Pulverized: % Pulv. Mat'l Captured	Dust Counts (f/cc): [illegible]	Dust Counts (f/cc): [illegible]	Remarks
[illegible] Saber Saw (Dust Chamber)							
[illegible] Shroud-flow as rec'd from mfg'r	15	12-inch	48	16	7.0	—	Very dusty.
[illegible] prototype shroud (Plexiglas)	15	12-inch	13	93	0.9	—	Small amount of coarse mat'l fell to floor.
[illegible] aluminum shroud	15	12-inch	89	91	0.5	—	Some material fell to floor.
[illegible] Saber Saw (Open Room)							
[illegible] aluminum shroud	40	12-inch	—	—	0.4	0.3	
[illegible] Rasp (Dust Chamber)	15	15 strokes	17	18	0.8	—	Considerable amount of dust and debris on floor.
[illegible] Rasp (Open Room)	40	33 strokes	—	—	0.5	0.1	Considerable amount of dust and debris on floor.

[illegible] Refer to Report No. [illegible] 1050 for description of "dust test chamber" and conditions of operation. Vacuum [illegible] to the saw shroud was [illegible]. Material being fabricated was 1/4-inch flat [illegible].

[illegible] of material captured [illegible] baghouse and vacuum cleaner, expressed as a percent of total material pulverized by tool.





SHROUDED SABRE SAW

AL 102 14 1176 A-C Product Saws - Test Data

Johns-Manville
Sales Corporation

[illegible]

Leonard M. [illegible]
Vice President
Director Environmental Services
Health Safety & Environment Department

March [illegible]

Commander Joseph [illegible] Bellanca, [illegible]
Bureau of Medicine & Surgery Code [illegible]
Navy Department
Washington, DC [illegible]

Dear Dr. Bellanca:

In accordance with our telephone conversation of this morning, I enclose the following information.

I. Asbestos-Cement Pipe

A. A copy of the work practice booklet prepared by the Asbestos-Cement Pipe Producers Association entitled, "Recommended Work Practices for A/C Pipe."

B. [illegible] of the summary and conclusions from the report prepared by Equitable Environmental Health Inc. of Berkeley, California which includes monitoring data from field operations utilizing the recommended work practices.

II. Asbestos-Cement Sheet

A. A copy of Johns-Manville's Research and Development Center report no. [illegible] entitled "Tool Demonstration for [illegible] Navy Seabees"

[illegible] photographs showing the [illegible] asbestos-cement [illegible] document [illegible] prepared.

[illegible]

[illegible]

Comdr. Joseph J. Bellanca
Page 2
March 19, 1979

Monitoring data for spray application of asbestos reinforced asphaltic coatings has been developed by the Flintkote Company. They have informed me that the fiber levels in all cases are below the OSHA mandated limits. I would anticipate that brush application of similar products would generate even less airborne fibers.

Special tooling and work practices are not required when applying asbestos roofing felt or asbestos reinforced asphaltic coatings. The fibers are so firmly bound by the asphalt that the standard work practices are sufficient.

Fabrication of asbestos-cement products using portable power tools can generate airborne fibers in excess of OSHA limits. This occurs because these fabricating operations apply sufficient mechanical energy to the pipe or board to literally tear the fibers loose. In the case of A/C pipe, this problem has been overcome by the use of single point tooling and the recommendation that portable power saws not be used. In the case of A/C sheet, the problem is being solved by the use of special hand tools and the installation of dust control equipment on portable power tools.

I hope this information is sufficient for your needs. Please contact me if additional information is required.

Very truly yours,

Edmund M Fenner

EMF:jh
Encl.
cc R. P. Carter - Johns-Manville

AL10212/298

Johns-Manville

-search and Development Center

Report No. [illegible]

Date April [illegible] 1978

-ALUATION OF TOOLS FOR THE DUST FREE FABRICATION OF ASBESTOS-CEMENT

SUMMARY

The objective of this project was to find or develop tools for the field fabrication of asbestos-cement in an acceptably dust free manner, i.e., with dust counts under the OHSA standard of 2.0 fibers/cc.

An apparatus and procedure was first devised with which the dust generation of a variety of tools and materials may be evaluated without exposing personnel to the dust evolved. This test chamber is expected to be useful for such testing in the future.

Tools for the job-site cutting and drilling of asbestos-cement have been evaluated which give fiber counts of less than 2.0 fibers/cc. Included are both hand and power tools. Of special interest is a portable power saw and shroud, to be used with a Nilfisk vacuum cleaner. With no awkward or special procedures or precautions, the tool operates with dust counts on the order of zero fibers/cc. These implements should be adequate for the common "on-the-job" fabricating requirements.

It is anticipated that E. M. Fenner will direct the assembly of a "work practices manual" for asbestos-cement users, utilizing the information from this project.

Contents: Summary, Introduction, Discussion, Conclusions and Appendices.

Reported by F. M. Bodycomb

F. Bodycomb
Asbestos and Mineral Technology

-ported by [illegible]

F. Bauman
Asbestos and Mineral Technology

INTRODUCTION

The objective of this project was to locate or devise tools that would allow the fabrication of asbestos-cement in the field in an acceptably dust-free manner. The information on the tools will be included in a "work practices manual" to be prepared under the direction of E. M. Fenner.

Special recognition is due Milt Trosper for the voluminous background information he supplied; Stella Gaburo for providing membrane filter test services; and Les Monard for his innovative mechanical skills.

DISCUSSION

This project actually involved two phases. Before evaluating any tools, a chamber was designed and built in which personnel could operate the tools being tested without exposure to the dust generated during the procedure. This "dust chamber" is illustrated in Figure 1, and photographs are also included in the Appendix. The chamber is a glove box approximately 30 in. high, 30 in. wide, and 8 ft long. Air is drawn into one end of the chamber, through the area in which the cutting is taking place, and exits at the other end of the chamber carrying light dusts to the baghouse. Baffles inside the chamber direct the dust-laden air past a dust sampler (open face membrane filter) so that the dust generated during the fabricating operation is monitored. Gloves are mounted on both sides of the box so that two operators can attend the operation simultaneously, for safety's sake.

The following procedure was used to evaluate tools in the chamber. The board to be fabricated was weighed and clamped to the "tool rest". Air velocity pressure from the vacuum cleaner was checked to ascertain that it was between 3.0 and 3.2 in. of mercury at a point 1/2 in. behind a 5/8 in. orifice at the end of a 20 ft long, 2 in. hose. The side of the chamber was bolted in place and the air flow through the chamber adjusted to an air velocity pressure of 0.6 in. of water, measured in a 6 in. duct downstream from the chamber. A measured quantity of material (linear in.) was cut in a given time period during which dust counts by the membrane filter method were taken. The board was cleaned and reweighed and debris remaining in the bottom of the chamber was collected and weighed. From these weights, the amount collected by the vacuum cleaner or going to the baghouse (baghouse material was usually very small)