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ABEX CORPORATION
AN EVALUATION OF VARIOUS FACTORS INFLUENCING AIRBORNE ASBESTOS CONCENTRATIONS
FRICTION PRODUCTS GROUP - WINCHESTER
SEPTEMBER 30, 1974 - OCTOBER 4, 1974

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PURPOSE

The purpose of this visit was to evaluate some of the factors associated with the manufacturing of various friction products in order to determine the effects of these factors upon the airborne asbestos concentrations associated with the processes.

SUMMARY

For the purposes of this study, the scope of this evaluation was essentially confined to three general locations: the book preformers, the block preformers, and the strip roll machines. Samples were taken in other locations, but the majority of the sampling occurred at these three locations. The variables that were considered during this study were: the type of mix used and the fiber length of the asbestos associated with the specific mix, the height of the employees, the working habits of the employees (clean or dirty), and the effect of additional experimental enclosures upon the airborne concentrations of asbestos.

The results of this study indicate that the type of mix used, and the degree of enclosure significantly effects the airborne asbestos concentrations generated at the various preforming operations. The factors of employee height and the employee working habits were secondary factors, and by themselves did not significantly affect the airborne asbestos concentrations.

Each of the variables investigated during this study will be summarily discussed in the following sections of this report. Various comparative appendices and a sketch are also attached.

DISCUSSION

Mix type: Using the comparative data gathered from the various mix types (see Appendix #2), there are two trends that emerge. First, the wet mixes generate far less airborne asbestos at various preforming operations than the dry mixes. Second, the

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mixes containing more of the longer asbestos fibers in their composition are associated with higher airborne asbestos concentrations. The mixes containing the longer asbestos fibers are generally lighter and fluffier than the mixes containing more of the shorter asbestos fibers. The lightness of the mix adds to the propensity for the airborne distribution of the asbestos fibers.

Regarding wet mixes and the amount of airborne asbestos that they generate, reference is made to Appendix #2, samples #14 & #15 and #20 & #21. These four samples were taken at two similar strip roll machines (#3 & #4). These two machines were sampled in the morning and in the afternoon on the same day. The only variable was that the operators switched machines in the afternoon. Both operators selected were about the same height, and both work very cleanly. The resulting airborne asbestos concentrations were as follows: strip roll machine #3 - (sample #14 0.50 fibers > 5μ/ml), strip roll machine #4 - (sample #15 0.43 fibers > 5μ/ml), strip roll machine #3 - (sample #20 0.29 fibers > 5μ/ml), and strip roll machine #4 - (sample #21 0.18 fibers > 5μ/ml). The average of these four samples is 0.35 fibers > 5μ/ml which is very low especially when there is no local exhaust ventilation provided at these machines. The wet mixes, by binding the asbestos fibers with the other components in the mix, generate very little airborne asbestos in the preforming stages.

The length of the asbestos fibers used in the various mixes is also a significant factor related to airborne asbestos concentrations. Referring to Appendix #2 again, most of the mixes studied contained approximately 50% of the long fibered asbestos and 50% of the short fibered asbestos. The average fiber count computed for these mix types was about 1.5 fibers > 5μ/ml. This average figure can be compared with samples containing only the longer fibered asbestos. Samples #3 and #11 were such samples containing 100% of the longer asbestos fibers. The mix used for these two samples was 80 mix used in the block preform department. The results for these two samples were - (sample #3 4.10 fibers > 5μ/ml) and (sample #11 3.59 fibers > 5μ/ml). These results are approximately 2½ times the average count associated with mixes containing equal amounts of the short and long fibered asbestos.

Another comparative observation made was between the 80 mix results versus results taken at the same machine with the same operator but with another mix (mix 551C8C). This was sample #16 and the resulting concentration was 1.24 fibers

> 5μ/ml almost 3 times less than the airborne concentration that was generated when 80 mix was being used at the machine.

These results strongly indicate that the dry fluffier asbestos mixes containing the longer fibers will generate more airborne asbestos than mixes containing asbestos of shorter fiber length. Perhaps the shorter asbestos fibers are more effectively bound up in the mix than the longer fibers. In any event, substitution of the longer fibered asbestos by the shorter fibered asbestos should be investigated.

Employee Height: Another of the variables studied was the relationship between the height of the employees and the airborne asbestos levels. Attention is called to Appendix #3 which gives comparative data on employee height and Appendix #4 which gives data about the book preform area. For the purposes of determining the effect of the operator height on airborne asbestos concentrations, a total of 4 samples were taken. The two operators selected were 6 ft. tall and 5 ft. 6 in. short, respectively, and they changed positions so that each worked on all four machines for equal periods of the sampling day. All of the other conditions, mix type, etc., remained the same. Samples #1 & #2 and samples #12 & #13 represent this sampling situation.

Operator #3C-4418 (6 ft. tall) worked on machines #9 and #13 (sample #1) in the morning and then machines #15 and #16 (sample #12 in the afternoon. His levels of exposure were identical: (sample #1-1.46 fibers > 5μ/ml), (sample #12-1.46 fibers > 5μ/ml). His average exposure was 1.46 fibers > 5μ/ml.

Operator #3C-730 worked on machines #15 and #16 (sample #2) in the morning, and then on machines #9 and #13 (sample #13) in the afternoon. His levels of exposure were: (sample #2-1.75 fibers > 5μ/ml), (sample #13-1.54 fibers > 5μ/ml). His average exposure was 1.64 fibers > 5μ/ml.

These results indicate that the operator height is not an important factor in regards to employee exposure to airborne asbestos.

Employee Working Habits: The type of working habits studied was associated with the degree of care an employee took when working with the mixes and how much dirt was being generated during his normal working activities. Two arbitrary parameters, clean and dirty, were selected. Clean meant that the

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operator did not generate large amounts of dust as he worked and that he kept himself relatively clean for the operation involved. Dirty meant that the operator generated more dust than average and that his person was pretty dirty too. Reference is made to Appendix #3 which compares the operators' working habits.

The average concentration for clean operations was 1.53 fibers >5u/ml (for 12 samples). The average concentration for dirty operations was 1.61 fibers >5u/ml (for 7 samples). During this study the operators would work on the same machines to keep the number of variables to a minimum. The average concentrations for the clean and dirty operators were based on dry mixes containing approximately 50% long and 50% short asbestos fibers. Samples involving 80 mix and wet mixes were not considered because of the effects that those variables had upon the concentrations. The results of these tests indicate that the differences between dirty and clean operators in their exposures were not significant under similar working conditions and with the same mixes.

Experimental Enclosure: Four machines (#9, #13, #12, and #16) in the book preform department were chosen in order to see the effects of additional enclosure upon airborne asbestos concentrations. The attached sketch #1 gives a rough indication as to what the additional enclosure consisted of. Appendix #4, samples #25 & #26 and #27 & #28 give the results of these tests. Samples #25 & #26 were taken at machines #9 & #13 and #12 & #16 respectively, before the additional enclosure was attached. Samples #27 & #28 were taken at the same machines respectively after the additional enclosure was attached.

The sample results are as follows:

a. sample #25 - 1.75 fibers >5u/ml (no additional enclosure).
b. sample #27 - 0.84 fibers >5u/ml (with additional enclosure).
c. sample #26 - 2.31 fibers >5u/ml (no additional enclosure).
d. sample #28 - 1.31 fibers >5u/ml (with additional enclosure).

These test results clearly indicate that the exposure levels were reduced in half as a result of the additional enclosure.

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Conclusions: As a result of this study the following recommendations are made:

1. At the book preform, block preform, disc preform and other areas where high airborne asbestos concentrations have been detected, enclose the operations as much as is practical. Sheet metal enclosures are preferable, but canvas or lead vinyl curtains can be effectively used too.

2. Where practical, substitute wet mixes for dry mixes in the preforming stages.

3. Where practical, substitute mixes containing asbestos fibers of shorter length for mixes containing asbestos fibers of longer length.

During the visit, I received excellent cooperation from Jeff Nicholson, Lloyd Broadstreet, Roger Dillon, Charlie Mallory, and Bob Brown. I thank them all for their assistance and courtesies.

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11/6/74

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FRICTION PRODUCTS GROUP
WINCHESTER, VIRGINIA
APPENDIX #1

FIELD SAMPLE #1

Fiber count>5μ/ml-1.46
Lab No. - 1839
Loc.-Book Preform #13 (new exhaust design) & Book Preform #9 (old exhaust design)
Med. Study #3C-4418
Date - 10-1-74
Time: 8:55am-10:42am
Sampling rate in liters per min. - 1.9591
Air vol.(liters)-209.6
Avge count/field-2.00
Mix used #13-551D-333
Mix used #9-551D-333
Percent long fibers in mix 551D-333 - 55%
Percent short fibers in mix 551D-333 - 45%
Work habits - clean
Worker height - 6 ft.
Ventilation (fpm) #13
a. at weigh scale slot face - 3,500
b. at front hood press face - 600
c. at side hood face-300
Ventilation(fpm) #9
a. at top hood face - 1,200

FIELD SAMPLE #2

Fiber count>5μ/ml-1.75
Lab No. - 1840
Loc.-Book Preform #15 & Book Preform #16 (both are old exhaust design)
Med. Study #3C-730
Date - 10-1-74
Time: 9:00am-10:54am
Sampling rate in liters per min. - 1.9823
Air vol.(liters)-226.0
Avge.count/field-2.58
Mix used #15-133-9
Mix used #16-551D-333
Percent long fibers in mix 133-9 - 26%
Percent short fibers in mix 133-9 - 74%
Percent long fibers in mix 551D-333 - 55%
Percent short fibers in mix 551D-333 - 45%
Work habits - dirty
Worker height - 5'6"
Ventilation (fpm)#15
a. at top hood face 1,300
Ventilation (fpm) #16
a. at top hood face 1,200

FIELD SAMPLE #3

Fiber count>5μ/ml-4.10
Lab No. - 1841
Loc.-Book Preform #5
Med. Study #3C-4059
Date - 10-1-74
Time: 9:21am-10:48am
Sampling rate in liters per min.-1.9591
Air vol.(liters)-170.4
Avge. count/field-4.55
Mix used #5 - 80 mix
Percent long fibers in 80 mix - 100%
Percent short fibers in 80 mix - 0%
Work habits - dirty
Worker height - 6 ft.
Ventilation (fpm) #5
a. at front hood face 1,500 (left)
Double cavity machine

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FIELD SAMPLE #4
Fiber count>5μ/ml - 1.73
Lab No. - 1842
Loc.-Block preform #17
Medical Study #3C-735
Date: 10-1-74
Time: 9:27am-10:45am
Sampling rate in liters per min.-1.9359
Air vol.(liters)-151.0
Avge.count/field-1.71
Mix used #17-551-C
Percent long fibers in mix 551-C - 56%
Percent short fibers in mix 551-C - 44%
Work habits - clean
Worker height-6'1"
Ventilation (fpm)
a. at front hood face-1,600
Single cavity machine

FIELD SAMPLE #5
Fiber count>5μ/ml - 1.20
Lab No. - 1843
Loc. - Disc brake preform #1
Med. Study #3C-424
Date - 10-1-74
Time: 9:34am-11:31am
Sampling rate in liters per min.-1.9823
Air vol.(liters)-232.0
Avge.count/field-1.82
Mix used -672-124
Work habits - clean
Worker height - 5'8"
Ventilation (fpm)
a. left side press area 1,200
b. right side press area 1,200

FIELD SAMPLE #6
Fiber count>5μ/ml-0.00
Lab No. - 1844
Loc. - Blank
Date - 10-1-74

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FIELD SAMPLE #7
Fiber count>5μ/ml-2.99
Lab No. - 1845
Loc.-#2 line Blok O.D. grinder #SKA-442 #3
Med. Study #3C-2095
Date - 10-1-74
Time: 9:39am-11:34am
Sampling rate in liters per min.-1.9591
Air vol.(liters)-225.3
Avge.count/field-4.39
Work habits - clean
Worker height-6'1"
Ventilation (fpm)
a. at wheel hood face 1,800

FIELD SAMPLE #8
Fiber count>5μ/ml-0.60
Lab. No. - 1846
Loc.-Set on a post about 6 ft. from Field Sample #7
Date - 10-1-74
Time: 9:41am-11:37am
Sampling rate in liters per min.-1.9591
Air vol.(liters)-227.3
Avge.count/field-0.90

FIELD SAMPLE #9
Fiber count>5μ/ml-1.11
Lab No. - 1847
Loc.-Mill groove ABB-W-567
Med.Study #3C-727
Date - 10-1-74
Time: 9:43am-11:47am
Sampling rate in liters per min. -1.9823
Air vol.(liters)-245.8
Avge.count/field-1.79
Work habits - clean
Worker height - 6 ft.
Ventilation (fpm)
a. at wheel hood face 1,800

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FIELD SAMPLE #10
Fiber count>5μ/ml-1.68
Lab.No. - 1848
Loc.-Block preform #10
Med. Study #3C-735
Date - 10-1-74
Time: 11:39am-1:55pm
Sampling rate in liters per min.-1.9359
Air vol.(liters)263.3
Avge.count/field-2.89
Mix used - 551D
Percent long fibers in mix 551D-333 - 55%
Percent short fibers in mix 551D-333 - 45%
Work habits - clean
Worker height - 6'1"
Ventilation (fpm)#10
a. at front hood face 1,600
Single cavity machine

FIELD SAMPLE #11
Fiber count>5μ/ml-3.59
Lab. No. - 1849
Loc.-Block preform #5
Med. Study #3C-4059
Date - 10-1-74
Time:11:41am-1:57pm
Sampling rate in liters per. min.-1.9591
Air vol.(liters) 266.4
Avge.count/field-6.30
Mix used - 80 mix
Percent long fibers in 80 mix - 100%
Percent short fibers in 80 mix - 0%
Work habits - dirty
Worker height - 6 ft.
Ventilation (fpm) #5
a. at front hood face 1,500
Double cavity machine

FIELD SAMPLE #12
Fiber count>5μ/ml-1.46
Lab. No. - 1850
Loc.-Book preform #15 & Book preform #16 (both are old exhaust design)
Medical Study #3C-4418
Date - 10-1-74
Time: 11:43am-2:01pm
Sampling rate in liters per min.-1.9591
Air vol.(liters)-270.4
Avge.count/field-2.56
Mix used #15 - 133-9
Mix used #16 - 551D-333
Percent long fibers in mix #133-1 - 26%
Percent short fibers in mix 551D-333 - 74%
Percent long fibers in mix 551D-333 - 55%
Percent short fibers in mix 551D-333 - 45%
Work habits - clean
Worker height - 6 ft.
Ventilation (fpm)#15
a. at top hood face 1,300
Ventilation (fpm) #16
a. at top hood face 1,200

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FIELD SAMPLE #13

Fiber count>5μ/ml - 1.54
Lab No. - 1851
Loc.-Book preform #13 (new exhaust design) & Book preform #9 (old exhaust design)
Med. Study #3C-730
Date - 10-1-74
Time: 11:45am-2:00pm
Sampling rate in liters per min.-1.9591
Air vol.(liters) 264.5
Avge.count/field-2.66
Mix used #13-551D-333
Mix used #9-551D-333
Percent long fibers in mix 551D-333 - 55%
Percent short fibers in mix 551D-333 - 45%
Work habits - dirty
Worker height - 5'6"
Ventilation (fpm) #13
a. at weight scale slot face - 3,500
b. at front hood press face - 600
c. at side hood face-300
Ventilation (fpm) #9
a. at top hood face 1,200

FIELD SAMPLE #14

Fiber count>5μ/ml-0.50
Lab. No. - 1852
Loc. - Roll Machine #3
Med. Study #3C-767
Date - 10-2-74
Time: 7:48am - 11:07am
Sampling rate in liters per min.-1.9823
Air vol.(liters) 394.5
Avge.count/field-1.28
Mix used - 435-7
Wet mix
Work habits-clean
Worker height-5'9"
Ventilation - None

FIELD SAMPLE #15

Fiber count>5μ/ml - 0.43
Lab No. - 1853
Loc.-Roll Machine #4
Med. Study #3C-4473
Date - 10-2-74
Time: 7:52am-11:04am
Sampling rate in liters per min.-1.9591
Air vol(liters) 376.1
Avge.count/field-1.06
Mix used - 734-161
Wet mix
Work habits - clean
Worker height ≏ 5'10"
Ventilation - None

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FIELD SAMPLE #16

Fiber count>5μ/ml-1.24
Lab No. - 1854
Loc.-Block preform #5
Med. Study #3C-4059
Date - 10-2-74
Time: 8:02am-10:54am
Sampling rate in liters per min.-1.9591
Air vol.(liters)-337.0
Avge.count/field 2.76
Mix used - 551CSC
Percent long fibers in mix 551CSC - 56%
Percent short fibers in mix 551CSC - 44%
Work habits - dirty
Worker height - 6 ft.
Ventilation (fpm) #5
a. at front hood face 1,500 (left)
b. at front hood face 600 (right)
Double cavity machine

FIELD SAMPLE #17

Fiber count>5μ/ml-0.97
Lab No. - 1855
Loc.-Block preform #17
Med. Study #3C-735
Date - 10-2-74
Time: 8:06am-10:59am
Sampling rate in liters per min.-1.9823
Air vol.(liters) 342.9
Avge.count/field 2.15
Mix used - 693-555
Percent long fibers in min - 57%
Percent short fibers in mix - 43%
Work habits - clean
Worker height - 6'1"
Ventilation (fpm) #17
a. at front hood face 1,400
Single cavity machine

FIELD SAMPLE #18

Fiber count>5μ/ml-0.74
Lab No. - 1856
Loc.-Block preform #17
Med. Study #3C-4059
Date - 10-2-74
Time: 10:54am-1:08 pm
Sampling rate in liters per min.-1.9591
Air vol.(liters) 262.5
Avge.count/field 1.28
Mix used - 693-555
Percent long fibers in mix - 57%
Percent short fibers in mix - 43%
Work habits - dirty
Worker height - 6 ft.
Ventilation (fpm) #17
a. at front hood face 1,400
Single cavity machine

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FIELD SAMPLE #19

Fiber count>5μ/ml-1.15
Lab No. - 1857
Loc.-Block preform #5
Med.Study #3C-735
Date - 10-2-74
Time: 11:02am-1:10pm
Sampling rate in liters per min.-1.9823
Air vol.(liters)-253.7
Avge.count/field-1.91
Mix used - 551CSC
Percent long fibers in mix 551CSC - 56%
Percent short fibers in mix 551CSC - 44%
Work habits - clean
Worker height - 6'1"
Ventilation (fpm) #5
a. at front hood face 1,500 (left
b. at front hood face 600 (right)
Double cavity machine

FIELD SAMPLE #20

Fiber count>5μ/ml-0.29
Lab. No. - 1858
Loc.-Roll machine #3
Med. Study #3C-4473
Date - 10-2-74
Time: 11:06am-1:13pm
Sampling rate in liters per min.-1.9823
Air vol.(liters)-251.8
Avge.count/field-0.48
Mix used - Wet mix 435-7
Percent long fibers in mix 435-7 - 0% (?)
Percent short fibers in mix 435-7 - 100% (?)
Worker habits - clean
Worker height - 5'10"
Ventilation - None

FIELD SAMPLE #21

Fiber count>5u/ml-0.18
Lab No. - 1859
Loc.-Roll machine #4
Med. Study #3c-767
Date - 10-2-74
Time: 11:08am-1:12pm
sampling rate in liters per min.-1.9591
Air vol.(liters)-242.9
Avge.count/field-0.28
Mix used - Wet mix 734-1(
Percent long fibers in mix 734-161 - 0%
Percent short fibers in mix 734-161 - 100%
Worker habits - clean
Worker height - 5'9"
Ventilation - None

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FIELD SAMPLE #22

Fiber count>5μ/ml-0.00
Lab No. - 1860
Loc. - Blank
Date - 10-2-74

FIELD SAMPLE #23

Fiber count>5μ/ml-2.02
Lab No. - 1861
Loc.-Discpreform #3
Med. Study #3C-014
Date - 10-3-74
Time: 8:28am-10:50am
Sampling rate in liters per min.-1.9823
Air vol.(liters)-281.5
Avge.count/field-3.75
Mix used - 238
Worker habits - clean
Worker height - 5'10"
Ventilation (fpm) #3

a. lower left side small hood at face, 2,700
b. middle left side small hood at face 2,800
c. upper left side hopper exhaust at face - 600
d. lower right side small hood at face 2,800
e. middle right side small hood at face 2,500
f. upper right side hopper exhaust at face - 500

FIELD SAMPLE #24

Fiber count>5μ/ml-2.38
Lab. No. - 1862
Loc.-Block preform #11
Med. Study #3C-168
Date - 10-3-74
Time: 8:38am-10:48am
Sampling rate in liters per min. - 1.9591
Air vol.(liters)-254.7
Avge.count/field-3.96
Mix used - 551-DSC
Percent long fibers in mix 551-DSC - 55%
Percent short fibers in mix 551-DSC - 45%
Work habits - dirty
Worker height - 6 ft.
Double cavity machine

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FIELD SAMPLE #25

Fiber count>5μ/ml-1.75
Lab No. - 1863
Loc.-Book preform #13 (new exhaust design) & Book preform #9 (old exhaust design)
Med. Study #3C-4418
Date - 10-3-74
Time: 9:02am-10:52am
Sampling rate in liters per min. - 1.9823
Air vol.(liters)-218.1
Avge.count/field-2.50
Mix used #13-551D-333
Mix used #9 - 551D-333
Percent long fibers in mix 551D-333 - 55%
Percent short fibers in mix 551D-333 - 45%
Work habits - clean
Worker height - 6 ft.
Ventilation (fpm) #13
a. at weigh scale slot face - 4,000
b. at front hood press face - 600
c. at side hood face - 300
d. at rear hood face- 600
Ventilation (fpm) #9
a. at weigh scale slot face - 4,000
b. at top front hood face - 2,100
Sample taken without experimental enclosure in position.

FIELD SAMPLE #26

Fiber count>5μ/ml-2.31
Lab No. - 1864
Loc.-Book preform #12 & Book preform #16 (both are old exhaust designs)
Med. Study #3C-730
Date - 10-3-74
Time: 9:06am-10:53am
Sampling rate in liters per min.-1.9591
Air vol.(liters)-209.6
Avge.count/field-3.16
Mix used #12-551D-333
Mix used #16-47E
Percent long fibers in mix 551D-333 - 55%
Percent short fibers in mix 551D-333 - 45%
Percent long fibers in mix 47E - 100% (?)
Percent short fibers in mix 47E - 0% (?)
Work habits - dirty
Worker height - 5'6"
Ventilation (fpm) #12
a. at weigh scale 5,300
b. at top hood face 2,200
Ventilation (fpm) #16
a. at weigh scale 4,200
b. at top hood face - 2,300
Sample taken without experimental enclosure in position.

FIELD SAMPLE #27

Fiber count>5μ/ml-0.84
Lab. No. - 1865
Loc.-Book preform #13 (new exhaust design) & Book preform #9 (old exhaust design)
Med. Study #3C-4418
Date - 10-3-74
Time: 12:12pm-2:02pm
Sampling rate in liters per min.-1.9591
Air vol.(liters)-213.5
Avge.count/field-1.16
Mix used #13-551D-333
Mix used #9 - 551D-333
Percent long fibers in mix 551D-333 - 55%
Percent short fibers in mix 551D-333 - 45%
Work habits - clean
Worker height - 6 ft.
Ventilation (fpm) #13
a. at weigh scale slot face - 4,000
b. at front hood press face - 600
c. at side hood face - 3
d. at rear hood face - 6
Ventilation (fpm) #9
a. at weigh scale slot face - 4,000
b. at top front hood face - 2,100
Sample taken with the experimental enclosure in position.

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FIELD SAMPLE #28

Fiber count>5μ/ml-1.31
Lab No. - 1866
Loc.-Book preform #2 & Book preform #16 (both are old exhaust designs)
Med. Study #3C-730
Date - 10-3-74
Time: 12:14pm-2:03pm
Sampling rate in liters per min.-1.9359
Air Vol.(liters)-211.0
Average count/field-1.79
Mix used #12-551D-333
Mix used #16 - 47E
Percent long fibers in mix 551D-333 - 55%
Percent short fibers in mix 551D-333 - 45%
Percent long fibers in mix 47E - 100% (?)
Percent short fibers in mix 47E-0% (?)
Work habits - Dirty
Worker height - 5'6"
Ventilation (fpm) #12
a. at weigh scale 5,300
b. at top hood face 2,200
Ventilation (fpm) #16
a. at weigh scale 4,200
b. at top hood face - 2,300
Sample taken with the experimental enclosure in position.

FIELD SAMPLE #29

Fiber count>5μ/ml-0.00
Lab No. - 1867
Loc. - Blank
Date - 10-3-74

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APPENDIX #2

Sample No. Field	Lab.	Mix Used	% Long Fibers in Mix		% Short Fibers in Mix		Fiber Count >5u/ml
1	1839	#551D-333	55%		45%		1.46
2	1840	#133-9	26%)	40% Avge.	74%)	60% Avge.	
		#551D-333	55%)		45%)		1.75
3	1841	#80 mix	100%		0%		4.10
4	1842	#551C	56%		44%		1.73
5	1843	#672-124	-		-		1.20
6	1844	Blank	-		-		0.00
7	1845	-	-		-		2.99
8	1846	-	-		-		0.60
9	1847	-	-		-		1.11
10	1848	#551D-333	55%		45%		1.68
11	1849	#80 mix	100%		0%		3.59
12	1850	#133-9	26%)	40% Avge.	74%)	60% Avge.	
		#551D-333	55%)		45%		1.46
13	1851	#551D-333	55%		45%		1.54
14	1852	#435-7	Wet mix		Wet mix		0.50
15	1853	#734-161	Wet mix		Wet mix		0.43
16	1854	#551CSC	56%		44%		1.24
17	1855	#693-555	57%		43%		0.97
18	1856	#693-555	57%		43%		0.74
19	1857	#551CSC	56%		44%		1.15
20	1858	#435-7	Wet mix		Wet mix		0.29
21	1859	#734-161	Wet mix		Wet mix		0.18
22	1860	Blank	-		-		0.00
23	1861	#238	-		-		2.02
24	1862	#551DSC	55%		45%		2.38
25	1863	#551D-333	55%		45%		1.75
26	1864	#47E	-		-		2.31
27	1865	#551D-333	55%		45%		0.84
28	1866	#551D-333	55%		45%		
		#47E	-		-		1.31
29	1867	Blank	-		-		0.00

FRICTION PRODUCTS GROUP
WINCHESTER, VIRGINIA
APPENDIX #3

Sample No. Field	Sample No. Lab.	Medical Study No.	Work Habits	Worker Height	Fiber Count >5u/ml	
1	1839	3C-4418	Clean	6 ft.	1.46	
2	1840	3C-730	Dirty	5'6"	1.75	
3	1841	3C-4059	Dirty	6 ft.	4.10	(80 mix)
4	1842	3C-735	Clean	6'1"	1.73	
5	1843	3C-424	Clean	5'8"	1.20	
6	1844	-	Blank	-	0.00	
7	1845	3C-2095	Clean	6'1"	2.99	
8	1846	Post	-	-	0.60	
9	1847	3C-727	Clean	6 ft.	1.11	
10	1848	3C-735	Clean	6'1"	1.68	
11	1849	3C-4059	Dirty	6 ft.	3.59	(80 mix)
12	1850	3C-4418	Clean	6 ft.	1.46	
13	1851	3C-730	Dirty	5'6"	1.54	
14	1852	3C-767	Clean	5'9"	0.50	(wet mix)
15	1853	3C-4473	Clean	5'10"	0.43	(wet mix)
16	1854	3C-4059	Dirty	6 ft.	1.24	
17	1855	3C-735	Clean	6'1"	0.97	
18	1856	3C-4059	Dirty	6 ft.	0.74	
19	1857	3C-735	Clean	6'1"	1.15	
20	1858	3C-4473	Clean	5'10"	0.29	(wet mix)
21	1859	3C-767	Clean	5'9"	0.18	(wet mix)
22	1860	-	Blank	-	0.00	
23	1861	3C-014	Clean	5'10"	2.02	
24	1862	3C-168	Dirty	6 ft.	2.38	
25	1863	3C-4418	Clean	6 ft.	1.75	
26	1864	3C-730	Dirty	5'6"	2.31	
27	1865	3C-4418	Clean	6 ft.	0.84	
28	1866	3C-730	Dirty	5'6"	1.31	
29	1867	-	Blank	-	0.00	

FRICTION PRODUCTS GROUP
WINCHESTER, VIRGINIA
APPENDIX #4

Sample No. Field	Lab.	Date	Medical Study No.	Location	Fiber Count >5μ/ml
1	1839	10-1-74	3C-4418	Book preform #13(new exhaust design)	1.46
1	1839	"	"	Book preform #9(old exhaust design)	
2	1840	10-1-74	3C-730	Book preform #15(old exhaust design)	1.75
2	1840	"	"	Book preform #16(old exhaust design)	
12	1850	10-1-74	3C-4418	Book preform #15(old exhaust design)	1.46
12	1850	"	"	Book preform #16(old exhaust design)	
13	1851	10-1-74	3C-730	Book preform #13(new exhaust design)	1.54
13	1851	"	"	Book preform #9(old exhaust design)	
25	1863	10-3-74	3C-4418	Book preform #13(new exhaust design)	1.75
25	1863	"	"	Book preform #9(old exhaust design) Sample taken without experimental enclosure	
26	1864	10-3-74	3C-730	Book preform #12(old exhaust design)	2.31
26	1864	"	"	Book preform #16(old exhaust design) Sample taken without experimental enclosure	
27	1865	10-3-74	3C-4418	Book preform #13(new exhaust design)	0.84
27	1865	"	"	Book preform #9(old exhaust design) Sample taken with experimental enclosure	
28	1866	10-3-74	3C-730	Book preform #12(old exhaust design)	1.31
28	1866	"	"	Book preform #16(old exhaust design) Sample taken with experimental enclosure	

FRICTION PRODUCTS GROUP
WINCHESTER, VIRGINIA
APPENDIX #5

Sample No. Field	Lab.	Date	Medical Study No.	Location	Fiber Count >5μ/ml
3	1841	10-1-74	3C-4059	Block preform #5 (80 mix) double cavity	4.10
4	1842	10-1-74	3C-735	Block preform #17 (551C mix) single cavity	1.73
10	1848	10-1-74	3C-735	Block preform #10 (551D mix) single cavity	1.68
11	1849	10-1-74	3C-4059	Block preform #5 (80 mix) double cavity	3.59
16	1854	10-2-74	3C-4059	Block preform #5 (551CSC mix) double cavity	1.24
7	1855	10-2-74	3C-735	Block preform #17 (555 mix) single cavity	0.97
18	1856	10-2-74	3C-4059	Block preform #17 (555 mix) single cavity	0.74
19	1857	10-2-74	3C-735	Block preform #5 (551CSC mix) double cavity	1.15

FRICTION PRODUCTS GROUP
WINCHESTER, VIRGINIA
APPENDIX #6

Sample No. Field	Lab.	Date	Medical Study No.	Location	Fiber Count >5μ/ml
14	1852	10-2-74	3C-767	Roll Machine #3 (435-7 mix) wet mix No local exhaust ventilation	0.50
15	1853	10-2-74	3C-4473	Roll machine #4 (734-161 mix) wet mix No local exhaust ventilation	0.43
20	1858	10-2-74	3C-4473	Roll machine #3 (435-7 mix) wet mix No local exhaust ventilation	0.29
21	1859	10-2-74	3C-767	Roll machine #4 (734-161 mix) wet mix No local exhaust ventilation	0.18

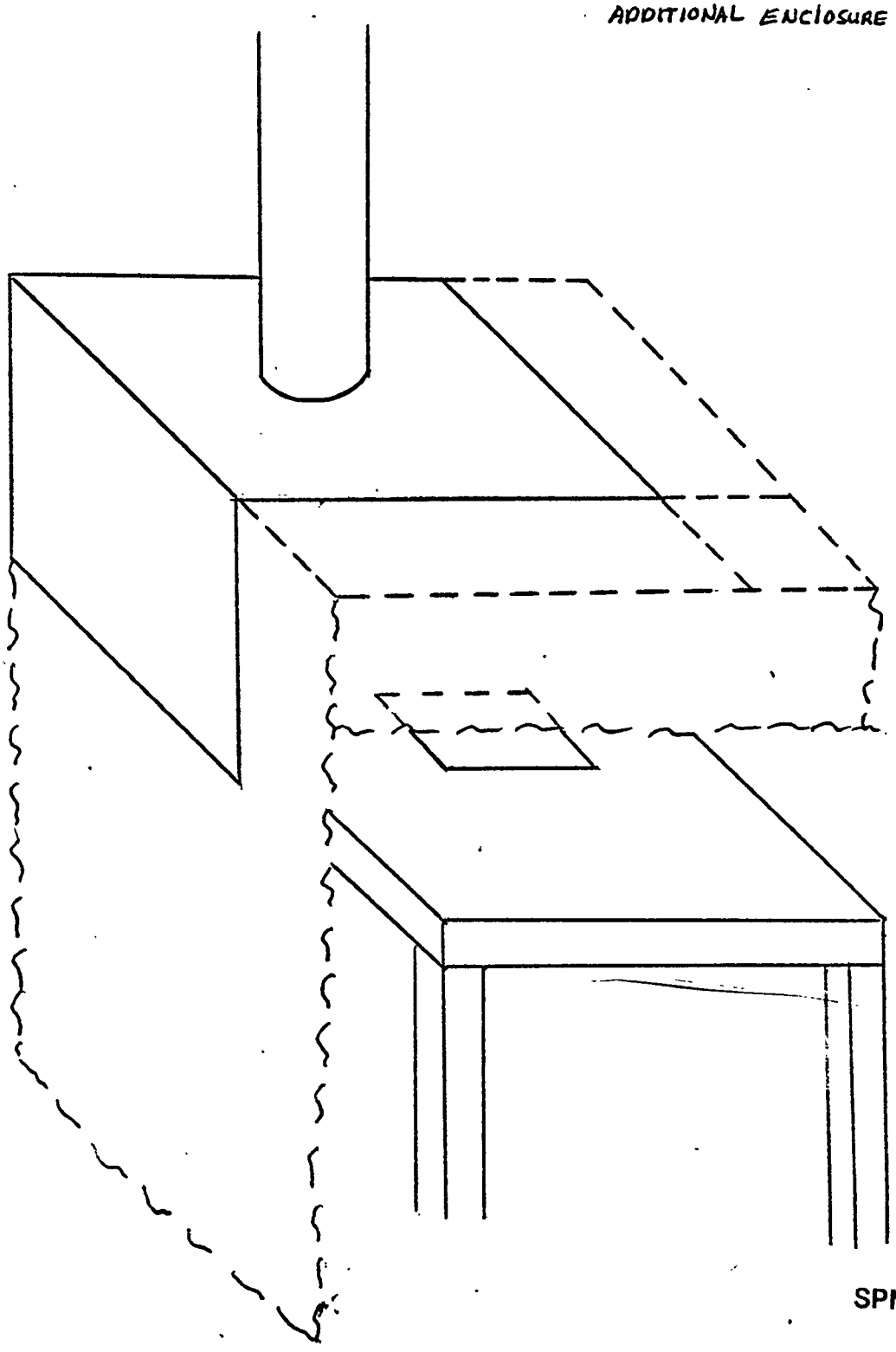
SKETCH #1

BOOK PREFORM

PRESENT ENCLOSURE = ——

ADDITIONAL ENCLOSURE (WOOD) = — —

ADDITIONAL ENCLOSURE (plastic) = ~~



SPNY 003304

NOT DRAWN TO SCALE

ETS 10-25-74

WINCHESTER, VIRGINIA

EMPLOYEE NAME MEDICAL STUDY NUMBER REFERENCE

NAME	MEDICAL STUDY NO.
James Morris	3C-4418
Loring McDaniel	3C-730
Richard Kesner	3C-4059
T. L. Smeltzer	3C-735
Robert Dove	3C-724
Edward Woods	3C-2095
Richard Carpenter	3C-727
Gordon Miller	3C-767
Dennis Voit	3C-4473
Douglas Clark	3C-014
Thomas Kane	3C-168