PLAINTIFF'S EXHIBIT

K-1998

The Industrial Commission
Of Ohio
Division Of Safety & Hygiene
246 N. High St., Col. O. 43215

October 12, 1984

Ms. Mater
Owens-Corning Fiberglas
32 Case Avenue
Newark, Ohio 43055

Dear Ms. Mater:

On Tuesday, July 3, 1984, an ergonomics survey was conducted at your facility in Newark. This survey concentrated on the insulating pipe building only, with ergonomics surveys of other areas being provided upon request. This report will furnish you with the necessary information to validate some of your accidents and, hence, aid as a proposal toward administrative approval in this area. In addition, the report focuses on analysis of recordable accidents from the OSHA forms 200 for 1983 and 1984; line A4;continuous molded pipe (CMP); the wrapping area; and truck oven area. It will bring to light some alternatives to the present methods and materials used at the particular work stations to reduce the stress and overexertion evident from some of the associated tasks.

If any questions arise about this report or if other ergonomic help is requested at Owens-Corning Fiberglas, please feel free to contact me. I thoroughly enjoyed working with you and the other company representatives on this survey and look forward to another opportunity in the future.

Sincerely,

Ivana Lukac
Industrial Engineer
Ergonomics Program

IL/klp

cc: Jim Wasil
Beth Wetzel

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ERGONOMICS SURVEY

Owens-Corning Fiberglas

Newark, Ohio

July 3, 1984

Prepared by:

Ivana Lukac
Industrial Engineer

ACCIDENT INVESTIGATION STATISTICS

In order to give a better indication of the accident rate and areas of location, which at least statistically, need to be evaluated, an analysis of your OSHA forms 200 for 1983 and 1984 was conducted.

Upon review of these forms, results were recorded on Exhibits 1A, 2A, 3A, 4A, 1B, 2B, 3B and 4B and can be found in Appendix I. These results are summarized by the following:

1983

INJURY	% OF TOTAL DAYS AWAY FROM WORK	% OF TOTAL FREQUENCY OF INJURIES
Strains	43	41
Fractures	21	15
Contusions	14	20
Lacerations	11	10
Sprains	5	5
Burns	3	5
Electric Shock	0	0
Amputations	2	1
Hit by F.O.	1	3

Interestingly, strains accounted for 43% of the total days away from work. Nearly half of the total days away from work are due to strain injuries and 39% of these injuries are to the back. In addition, the rate of occurrence of strain injuries accounted for 41% of the total, with the next most frequent injury being lacerations, approximately 20%.

Exhibit 2A and 3A indicates that the majority of your accidents which resulted in days away from work, over 50%, are for a period of four to ten days. This may be useful in determining monetary losses.

Finally, exhibit 4A indicates that the plant engineering department has the highest incidence of accidents (with respect to days away from work). Other departments which indicate a high frequency of accidents:

1. Wool pack
2. Warehouse and shipping

These departments should be evaluated to obtain specific answers to WHY they departments rank relatively high in injuries.

1984

INJURY	% OF TOTAL DAYS AWAY FROM WORK	% OF TOTAL FREQUENCY OF INJURIES
Strains	38	36
Fractures	11	7
Contusions	14	20
Lacerations	22	20
Sprains	6	3
Avulsions	1	3
Burns	3	5
Tendonitis	4	3
Sliver	1	3

Interpretation of this data indicates that strains, once again, accounted for the majority of days away from work, and the frequency of occurrence being 36%. Lacerations ranked a high second.

Exhibit 2B and 3B indicate that the frequency of injuries was significantly lower in 1984 as opposed to 1983, while the average days away from work remained the same.

Exhibit 4B illustrates the fact that the wool pack area has had the highest incidence of accidents with lost time away from work, with the molded pipe area being second.

In addition to reviewing the OSHA forms 200, several of the Workers' Compensation claims filed were evaluated:

INJURY	FREQUENCY	% OF TOTAL SAMPLE
Slips/Falls	17	37
Strains/Sprains	18	39
Hit by Falling Object	4	9
Miscellaneous	7	15

These results are quite similar to the statistics obtained from the OSHA forms 200; however, additional conclusions can be made. More specifically, the particular areas of wool pack and wool forming appear to have a higher incidence rate of injuries. These areas include:

1. D-6 machine
2. F-5 machine
3. C-4 machine

Hence, ergonomics considerations seem necessary to deal with these manual materials handling injuries.

ANALYSES

A. Line A4

The workers in this area are machine paced, with the speed of the conveyor, at the time of this survey, set at 21.8 ft./min. This process involves the rolling of uncured fiberglass with the operation being continuous in nature (24 hr./day). In addition, the speed of the conveyor can vary anywhere from 13 to 30 ft./min. At higher speeds, two workers are required.

PROCEDURE

1. Lifting of the spindle with the roll of uncured fiber onto a tilt-lift cart. (Note: Some workers do not utilize this cart at times.)

2. Removing the ends (scrap) of fiber and throwing this scrap away.

3. Pushing and pulling of the spindle through the fiber and carrying it back, inserting it into appropriate slots on the machine.

4. Pushing the tilt-lift cart to the storage bin, and utilizing the tilt-lift option of the cart, stacking the bundles for storage, hence, making approximately six-feet columns.

DISCUSSION

These procedures have a potential to cause back injuries. Specific manual materials handling tasks include:

1. Lifting
2. Pulling
3. Pushing
4. Carrying

Ideally, we would like to eliminate all of these potential causes of back injuries; however, often times we can only keep them at a minimum. Hence, if manual materials handling is continued at this operation, several risk factors should be considered. These risk factors include:

1. Horizontal Distance: This is the distance between the center of gravity (COG) of the worker and the COG of the load.

2. Vertical Start Height: The vertical distance at start of the move.

3. Vertical End Height: The vertical distance at end of the move.

4. Frequency: The number of times this operation is performed per minute; can be zero.

5. Duration: This is the length of time (in hours) that this task is repeated.

6. Symmetry: The employee performing this task should be aligned with the object moved.

7. Acceleration: Additional forces build up due to the motion of the worker [Force = (Mass) x (Acceleration)].

8. Weight: How heavy is the load?

9. Handles: Does the load have handles?

All of these risk factors interplay with each other in determining the stress exerted on the back. Some general comments to reduce stress are summarized as follows:

1. The vertical start height should be approximately 30 inches.

2. If the object moved has handles, they should be used. According to research, this has led to a reduction of stress on the back.

3. Acceleration should be minimized as much as possible.

4. Generally, the load should be held as close to the body as possible.

B. Continuous Molded Pipe (CMP)

This area is composed of three lines, 1, 2, and 3. Here the workers are again machine paced, with line 1 taking two rolls of uncured fiberglass, since double layers are required. These rolls are unrolled and through a conveyor system sent to the ovens for curing. It should be noted here that CMP requires about six additional hours of operation of the A4 line to keep up with it. Hence, with A4 running on 21.8 ft./min., it can be concluded that CMP requires about 8000 additional feet of uncured fiber per day.

PROCEDURE

1. Picking up of the uncured bundles (located on the storage bins, which are brought in by means of a fork-lift truck). This procedure involves <u>bending</u>, <u>lifting</u>, <u>lowering</u>, and <u>carrying</u>.

2. A pin is placed through the center of each roll and unrolled one by one, except on line 1.

3. As the last part of uncured fiberglas is unwound, excess or scrap is thrown away, with a new roll being placed.

DISCUSSION

The manual materials handling tasks to consider here involved;

1. Lifting
2. Lowering
3. Carrying

The problem is further enhanced on line '. where two rolls of fiberglass are needed, since two rolls must be unwound simultaneously. Once again, if manual materials handling is necessary, the risk factors discussed previously should be considered, especially on line 1.

C. Wrapping Area

In evaluating the wrapping area, it was brought to my attention the extensive repetitive hand motions involved with wrappers of cured pipes. This particular procedure involves the opening of the cured pipe and the "rolling" motion associated in wrapping the pipe, which produces a bending of the wrists. These types of procedures have been known to lead to cumulative trauma disorders. It must be pointed out that the work practices on the date of this survey and the degree of their applicability to any long-term situation can only be determined by a professional well versed in the practice of industrial hygiene and/or occupational medicine. Use of these data in an effort to establish or eliminate cause-and-effect relationships with regard to disease or illness must be done with extreme caution, and then only by an individual who fully understands the many inherent variables.

Therefore, in addition to redesigning your manual materials handling tasks, redesign in the area is also suggested.

PROCEDURE

1. Worker reaches and picks up box off inclined overhead that is located approximately six feet off the floor which excludes box height.

2. The box is placed on a tilt-lift stand.

3. Pipes are automatically fed into the wrap area from one end with wrap paper coming in through the other. The worker must open up the piece of pipe and wrap the paper around it in addition to securing it with a customized taping process.

4. Finished products are placed into the box.

5. Filled boxes are either lifted by

   a. utilizing the tilt-lift stand
   b. manually lifting of the box, bypassing the tilt-lift option.

   and are placed on a conveyor system which sends them to an automatic sealer.

DISCUSSION

Although majority of the observed procedure centers around the potential for cumulative trauma disorders, some manual materials handling considerations are also necessary to prevent possible back injuries. This would involve the redesign of the present workplace area. Presently, the worker must twist every time he/she places the wrapped roll of uncured fiberglass into the designated box. It is suggested that this procedure be eliminated with a more efficient and effective workplace design be implemented.

In addition, the angle at which the tilt-lift stand rests needs to be smaller. It is felt that an angle < 45 degrees would provide a better position for filling and lifting operations. Also, the legs of the stand dig into the floor, thus providing less than optimal use of the stand and resulting in more energy utilization to lift it, hence, one worker chose to bypass it altogether.

D. Truck Oven Area

This area is involved with special orders that require different diameter specifications of pipe than normally produced by the CMP lines. However, while the CMP lines are automated, the truck oven area involves the majority of its operations around extensive manual materials handling.

PROCEDURE

1. Uncured fiberglass is routed through the machine and spun on a spindle by two workers to the desired thickness.
2. Once the specified diameter is reached, each worker picks up a metal rod and strikes the fiberglass, breaking through the fiber and paper underneath.
3. The rolled fiberglass with the spindle is transported, lifted manually or by the aid of a hoist to place into the mold which is later rolled into the oven for curing.

DISCUSSION

While special order pipes involve manual materials handling, there are several limitations in implementing a positive redesign. The majority of the problem focuses on the manual breaking of fiberglass and paper. Although this procedure seems inefficient, trying to find an effective alternative is extremely difficult, however, one that is needed. The problem seems to be that the fiberglass must be "chopped," hence providing ragged edges which blend into the rest of the fiberglass roll, once inside of the mold, and upon completion of the curing process, there is only an invisible seam. However, if the edge were straight, a definite seam would be evident after the curing process on the pipe.

Therefore, the problem is to obtain some type of blade or other device that would produce a serrated edge.

The only other observation in this area dealt with the hoist. Although the hoist is available for the lifting and carrying of the fiberglass rolls, it was not utilized on the day of this survey.

PREVENTIVE ALTERNATIVES

A. Line A4 and CMP

1. Presently, the uncured fiberglass, which has been placed on the storage bin, is temporarily stored for approximately six hours. Later, usually the same day, it is brought into the continuous molded pipe (CMP) area, which is adjacent to the A4 line. This stacking and unstacking of bundles involves extra manual materials handling. It is strongly suggested that these procedures be eliminated. This could be accomplished by making the material flow much more continuous by connecting the A4 line with CMP. It is believed that by increasing the speed of the A4 line

to keep up with CMP, and by purchasing a conveyor system, with some additional features, this alternative would indeed be feasible.

The conveyor system should be closed loop with walk-through gates being provided. An inclided plane should be placed in front of the A4 machine so that the spindle with uncured fiber can be slid (rolled) onto the conveyor system, thus eliminating the carrying procedure. Positioned right in front of the inclide should be a scale, preferably underneath the conveyor system, providing the weighing option. Once the fiber is weighed, it will be distributed between the three CMP operators by means of a belt conveyor system. If it is not picked up on the first run-through, it will simply be recycled through. Hence, by providing such a system, a much more continuous material flow will be evident and a substantial reduction in manual materials handling. This reduction will also be observed by the CMP operators, who now no longer need to overexert themselves in the unloading of the storage bins.

If line A4 and CMP cannot be connected, other alternatives should be considered:

Presently, the weight of the spindle on line A4 is approximately 15.5 pounds, with the small bundles weighing totally 26 pounds and the large ones 32 pounds. Hence, a reduction in the weight factor should be considered. One suggestion is decreasing the weight of the spindle.

The material composition of the spindle should be made of the lightest material possible, but yet being able to support the weight of all dimensions of rolls of uncured fiber. Suggestions other than aluminum include:

a. magnesium
b. plastics

In addition to reducing the weight of the spindle by its material composition, another alternative may also prove effective. It is suggested that a ribbed spindle be purchased for this purpose; this design feature would have less surface area than the present. To minimize this surface area even more, a perforated pattern is recommended.

By providing a lighter spindle, less pressure would be exerted on the back, decreasing the potential for a back injury.

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2. The use of the tilt-lift cart should be emphasized. Presently, some workers bypass the use of the cart altogether.

3. In the CMP area, workers should be provided with pallet lift tables, so each level of uncured fiber can be positioned at an optimal working height. To maximize on savings, workers on line 2 and 3 should share a pallet lift table.

B. WRAPPING AREA

1. Here the primary concern is to evaluate the present procedure for pipe wrapping and determine the trade-offs between the end result and the potential for causing a cumulative trauma disorder. This issue was discussed with Mr. Dean, operations supervisor, who informed me that you presently are looking into a different alternative in this area. The present suggestion is to wrap the molded pipe automatically, before it goes through the cutting machine. It is believed that this alternative would yield profitable results and should be further investigated.

2. To deal with the possibility of inducing a cumulative trauma disorder, other preventive alternatives can be considered:

   a. If possible, rotation of employees.

   b. Reduce the frequency, duration, and force exerted during hand work.

      The frequency of wrapping can be decreased by having a temporary storage area. Such a storage area is already in existence with the present work area layout.

      Duration of exposure can be reduced by rotating workers and/or making a different shift schedule involving additional workers.

      To reduce the forces on the hand to hold the pipes, a power grip posture (posture used to hold a tennis racket) is preferred over a pinch posture. According to research, a power grip posture reduces the forces on the hand by four to five times over the pinch posture. In addition, the main objective in reducing the forces exerted by the hand is to keep the wrist straight whenever possible. This may involve tilting the work surface, or providing a curved fixture, that when the worker "rolls" the pipe and paper, would allow the wrist to remain straignt.

c. A comprehensive exercise program may prove helpful in implementing--along with other preventive measures--"The rationale behind the recommendation is that since the exercises do increase the flexibility and strength of an operator's hands, arms and fingers in areas directly related to the task that must be performed, the risk of incurring an injury from repetitive trauma is decreased."[1] In addition, this exercise program has been suggested to be voluntary in nature; however, response has generally been positive.

For best results, a combination of these is suggested.

3. If the present methods cannot be modified, current workplace considerations should be evaluated.

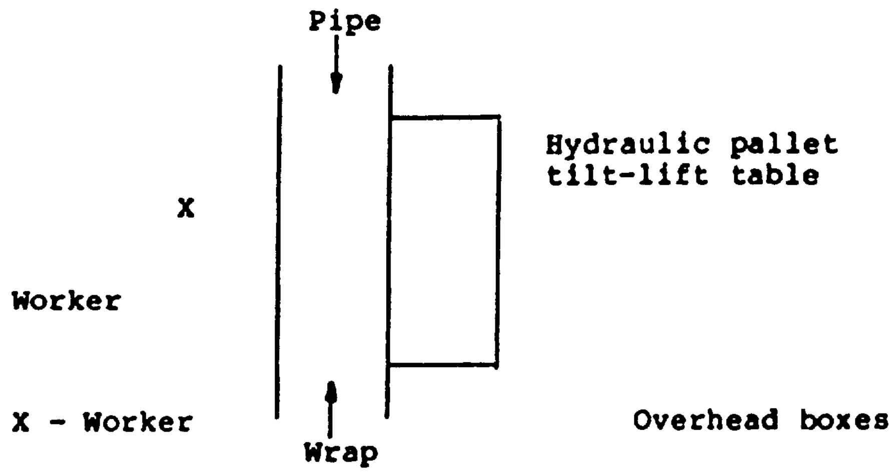
   a. The angle of the tilt-lift stand should be decreased to less than 45 degrees.

   b. The floor should be fixed so that the legs of the stand will not dig into it. To further assist the worker with this procedure, it is suggested that a hydraulic tilt-lift table be purchased per worker--estimated cost being approximately $2,500.

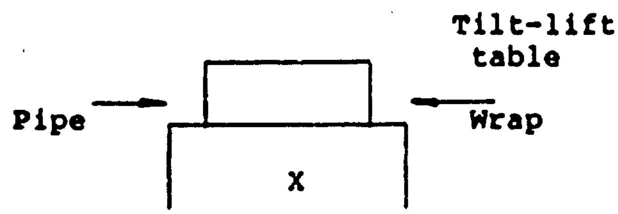
   To eliminate the twisting involved in filling the boxes with pipes, in addition to reducing other manual materials handling risk factors associated with the job, the following redesign is suggested.

   Utilization of a hydraulic tilt-lift table with the proposed workplace layout:

TOP VIEW



FRONT VIEW



This suggestion would eliminate the twisting, bending, lifting, and carrying tasks related with the present job description.

Upon filling one layer, the employee should lower the hydraulic tilt-lift table, allowing for an optimal working height at all times. Once the box is filled, it can be tilted to the adjacent conveyor system and be sealed, etc.

C. TRUCK OVEN AREA

1. Design of a blade or other device that would produce the necessary serrated edge on the fiberglass roll.

2. The use of the provided hoist should be emphasized to the employees. Even though the same task might be performed more quickly if the workers carry the roll themselves, they are at the same time increasing their susceptibility to a back injury. By reducing the risk factors of this manual materials handling job the liklihood for a back injury will also be reduced.

"Many aspects of the physical act of manually lifting a load have been identified as potentially hazardous to a person's musculoskeletal system. Among those cited in a review of the literature by Herrin, et al., (1974) are:

1. Weight - force required.

2. Location/Site - position of the load center of gravity with respect to the worker.

3. Frequency/Duration/Pace - tempered aspects of the task in terms of repetitiveness of handling.

4. Stability - consistency in location of load center of gravity as in handling bulky or liquid materials.

5. Coupling - texture, handle size and location, shape, color, etc.

6. Workplace Geometry - spatial aspects of the task in terms of movement distance, direction, obstacles, postural constraints, etc.

7. Environment - factors such as temperature, humidity, illumination, noise, vibration, frictional stability of the foot, etc."[2]

A training program in this area is suggested, to make the worker aware of <u>all</u> of the risk factors specifically associated with the job.

REFERENCES

[1]Cumulative Trauma Disorders and Ergonomics Teleconference presented by the National Safety Council on May 16, 1984. Analysis of the exercise progam in manufacturing at the Somerville plant. Ethicon, Inc. p. 112

[2]Work Practices Guide for Manual Lifting, U.S. Department of Health and Human Services, Public Health Service, Center for Disease Control, National Institute for Occupational Safety and Health, Cincinnati, Ohio March 1981, p. 15.

Causes and Prevention of Repetitive Trauma Disorders, W. Monroe Keyserling, Assistant Professor of Occupational Safety, Department of Environmental Health Sciences, Harvard School of Public Health, presented at the National Training Institute seminar held August 21-24, 1984.

Cumulative Trauma Disorders and Ergonomics Teleconference presented by the National Safety Council on May 16, 1984.

Jim Wasil, Industrial Hygienist, Division of Safety and Hygiene, Industrial Commission of Ohio, Ergonomics Program.

APPENDIX I

	STRAIN	FRACTURES	CONTUSIONS	LACERATIONS	SPRAINS	BURNS	ELECTRIC SHOCK	AMPUTATIONS	HIT BY FOREIGN OBJECT	TOTAL
BACK	347		181							528
ARM/SHOULDER	254	30		30						314
HAND	68	320	48	211	9	37				693
KNEE	188		10							198
GROIN	11									11
ANKLE	21	45			97	10	3	45		221
THIGH	7									7
CHEST AREA	4									4
RIBCAGE		44	6							50
LEG			5							5
FOOT			28							28
EYE AREA						10			11	21
HEAD			28							28
TOTAL	900	439	306	241	106	57	3	45	11	210[illegible]

EXHIBIT 1A
1983 NUMBER OF DAYS AWAY
FROM WORK (TYPE OF INJURY
RELATED TO PART OF BODY)

	STRAIN	FRACTURES	CONTUSIONS	LACERATIONS	SPRAINS	BURNS	ELECTRIC SHOCK	AMPUTATIONS	HIT BY FOREIGN OBJECT	TOTAL
BACK	17		4							21
ARM/SHOULDER	7	1	1	1						10
HAND	5	8	5	8	1	3		1		31
KNEE	3	1								4
GROIN	1									1
ANKLE	3	2			4		1			10
THIGH	1									1
CHEST AREA	1									1
RIBCAGE		2	1							3
LEG			1							1
FOOT			4							4
EYE AREA						1			3	4
HEAD			2							2
TOTAL	38	14	18	9	5	4	1	1	3	93

EXHIBIT 2A
1983 FREQUENCY OF INJURIES
BASED ON ACCIDENTS WHICH RESULTED
IN DAYS AWAY FROM WORK

EXHIBIT 3A

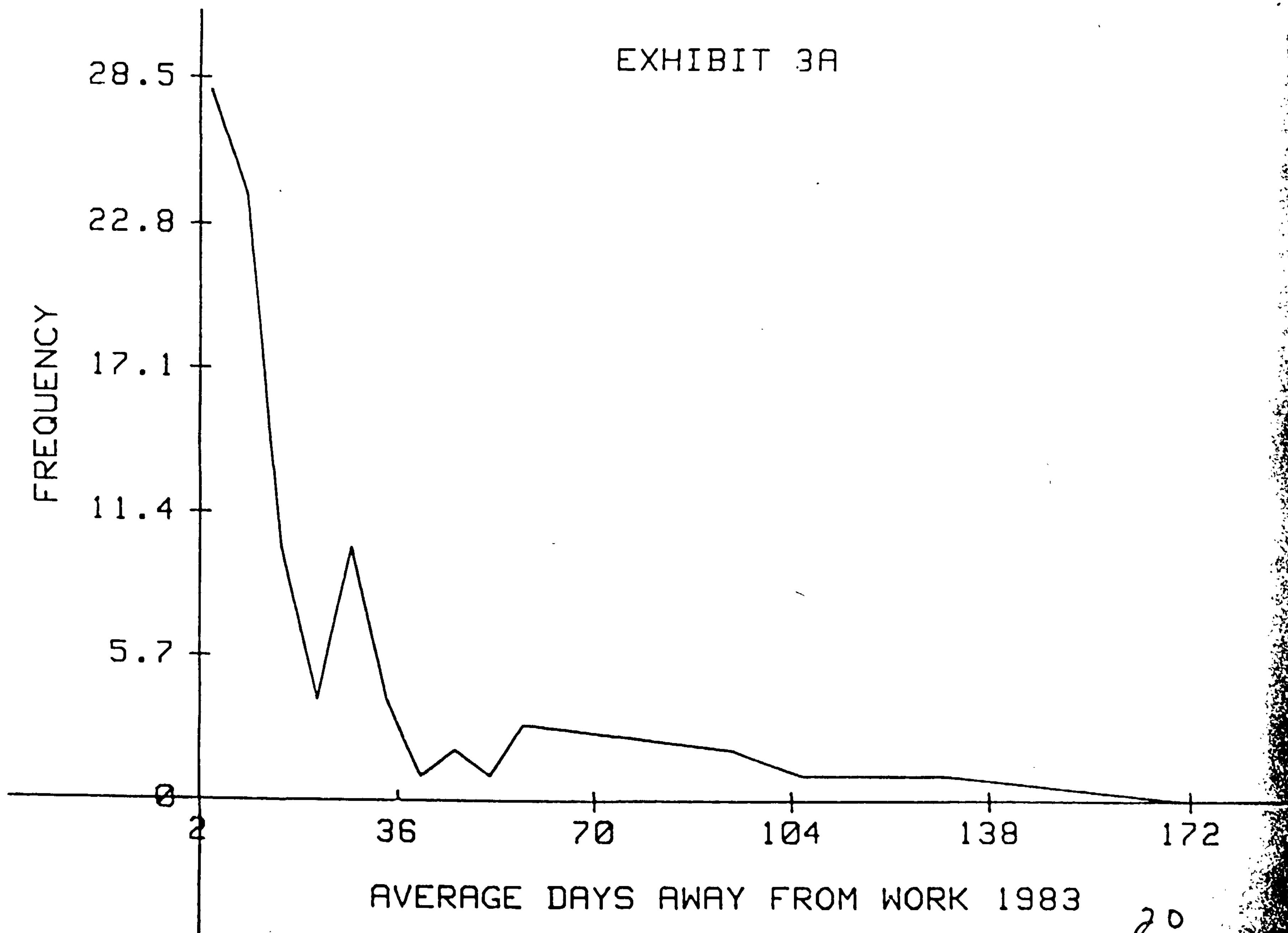


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EXHIBIT 4A

1983

Department	Frequency of accidents with days away from work
Aerocor	4
Plant Engineering	20
Wool Pack	17
Molded Pipe	10
Warehouse and Shipping	12
Wool Form	8
Aeroflex	7
Repack	9
Pipefitter	1
Interior Products	1
MPMS (Manufactured Parts Machine Shop)	2
Purchasing	1
Utility	1
TOTAL	93

	STRAIN	FRACTURES	CONTUSIONS	LACERATIONS	SPRAINS	AVULSIONS	BURNS	TENDONITIS	SLIVER	TOTAL
BACK	47									47
ARM/SHOULDER	38		6							44
HAND/WRIST	61	14	41	131		20	20	26	6	299
KNEE	64									64
REPRODUCTIVE ORGANS	4		17							21
ANKLE		21			36	8				65
CHEST AREA	11									11
FOOT		29	5							34
LEG			13							13
TOTAL	225	64	82	131	36	8	20	26	6	598

EXHIBIT 1B
1984 NUMBER OF DAYS AWAY FROM WORK (TYPE OF INJURY RELATED TO PART OF BODY)

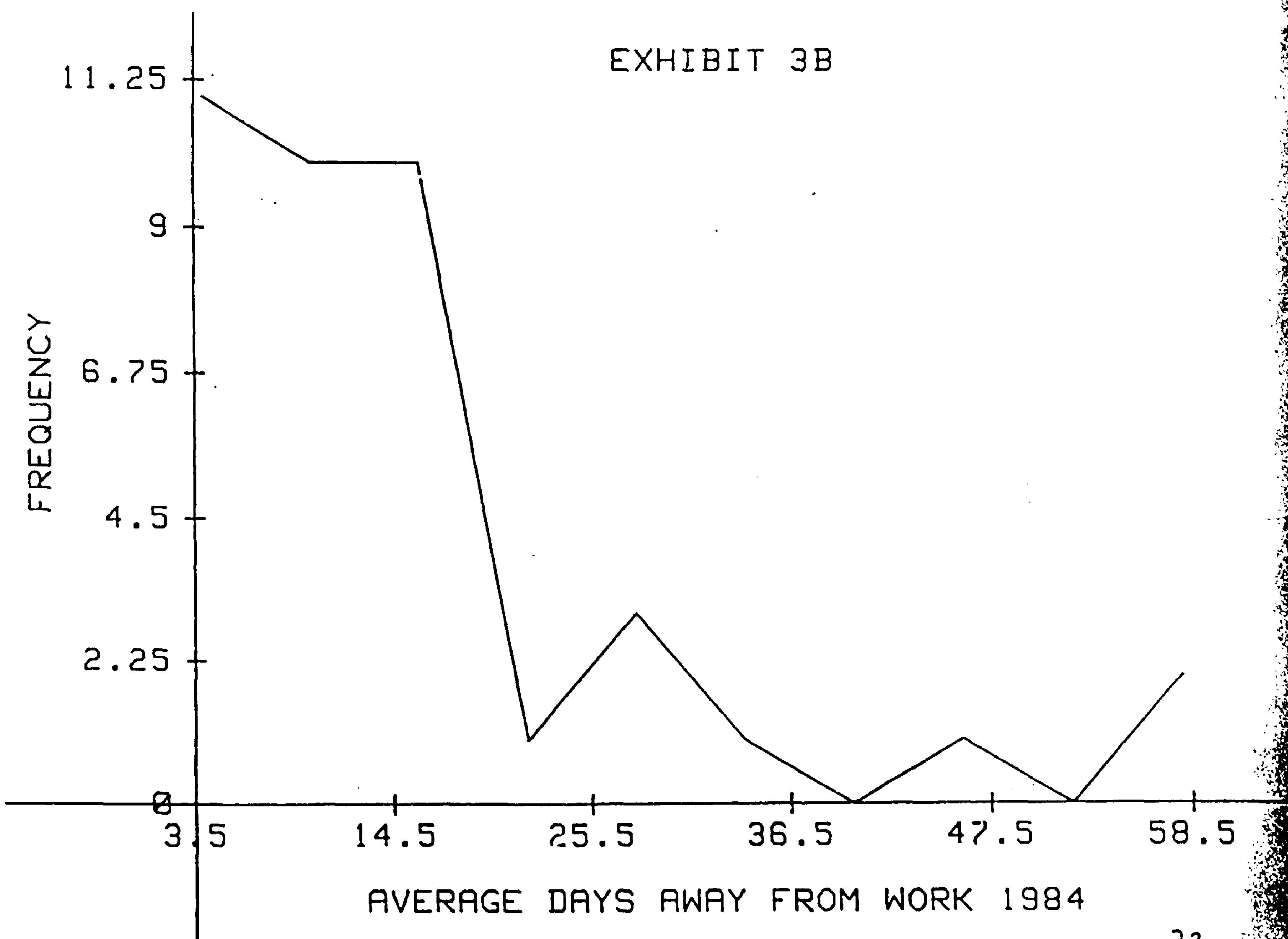
EXHIBIT 3B
FREQUENCY
11.25
9
6.75
4.5
2.25
0
3.5
14.5
25.5
36.5
47.5
58.5
AVERAGE DAYS AWAY FROM WORK 1984

EXHIBIT 4B

1984

Department	Frequency of accidents with days away from work
Plant Engineering	5
Wool Pack	11
Aerocor	2
Molded Pipe	9
Warehouse and Shipping	6
Interior Products	2
Repack	1
MPMS (Manufactured Parts Machine Shop)	2
Aeroflex	1
TOTAL	39

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