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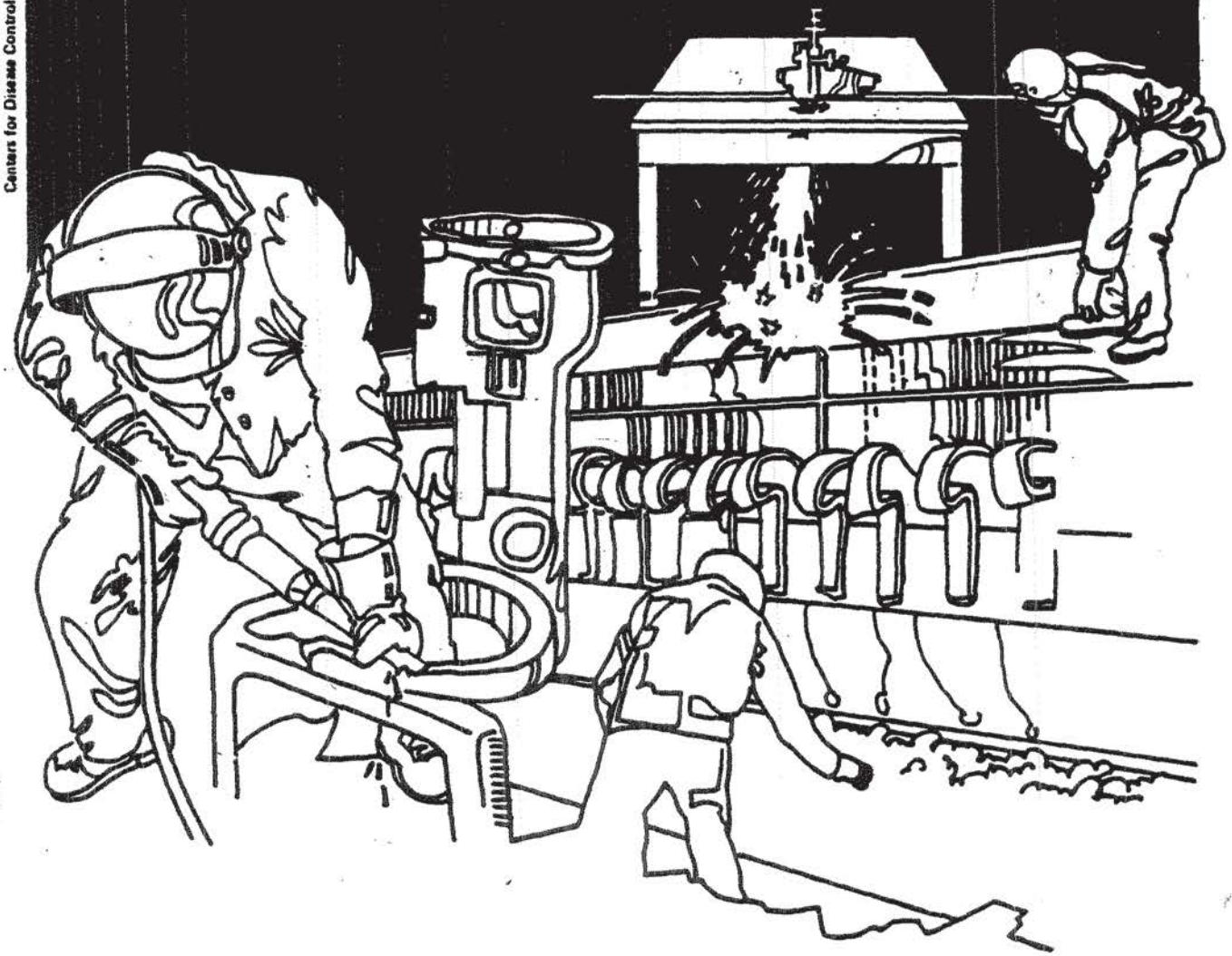

Health Hazard Evaluation Report

HETA 83-251-1685
POINT ADAMS PACKING COMPANY
HAMMOND, OREGON

PREFACE

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

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

HETA 83-251-1685
April 1986
POINT ADAMS PACKING COMPANY
HAMMOND, OREGON

NIOSH INVESTIGATORS:
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I. SUMMARY

On June 6 and 7, 1983, the National Institute for Occupational Safety and Health (NIOSH) received a request to evaluate a number of cases of carpal tunnel syndrome and tendonitis among production employees at Points Adams Packing Company (PAPCO), Hammond, Oregon. PAPCO is a commercial fish packing plant owned by Point St. George Fisheries of Santa Rosa, California. At the time of the evaluation 145 production workers (67 males, 81 females) were employed at this facility.

The ergonomic assessment focused on three jobs: filleting, fillet trimming, and sliming (a term used to describe butchering of black cod). These were identified as relatively problematic jobs in terms of the development of repetitive trauma disorders, according to company analysis of lost-time accident records for 1981 and 1982. Based on our observations and review of videotapes and still photographs, we were able to document specific task elements which we believe imposed stressful ergonomic demands on workers in each of these jobs. These demands, observed in one or more of these jobs, included: extensive and repetitive use of the hands, oftentimes in conjunction with wrist deviation and high muscular forces; excessive grip force resulting from using hand tools (primarily knives) with undersized handles; stock locations which required excessive reach; and improper work heights resulting in stress to the shoulders and lower back.

Since an important aspect of the filleting and trimming jobs involved almost constant use of knives, we had tests conducted to determine an optimal knife handle which would be less fatiguing on workers. These tests indicated that a larger handle with dimensions of about 5"(L) X 2"(W) X 0.8"(T) would enable the workers to use less force. With this information we contacted a Finnish knife manufacturer and procured several knives which appeared to meet these handle dimensions, with the intention of conducting a followup survey at the plant if one or more of these knives proved satisfactory. Unfortunately, none of the knives were judged to be acceptable and, as a result, our plans for a followup survey had to be abandoned.

On the basis of the information collected during this evaluation NIOSH investigators identified several potentially hazardous task elements and improper workplace design features which may have contributed to the development of carpal tunnel syndrome, tendonitis, etc., among filleters, trimmers, and slimers. Recommendations for modifying or eliminating these problems are presented in Section VIII of this report.

KEYWORDS: SIC 0912 (Commercial fishing) fish filleting, musculoskeletal disorders, carpal tunnel syndrome, tendonitis, ergonomics, cumulative trauma.

II. INTRODUCTION

In April 1983, the National Institute for Occupational Safety and Health (NIOSH) received a request to conduct a health hazard evaluation at Point Adams Packing Company (PAPCO), a fish filleting plant located in Hammond, Oregon. The request, initiated by PAPCO management with support from representatives of the United Food and Commercial Workers Union Local 143-A, was prompted by concern over the excessive number of cases of carpal tunnel syndrome, tendonitis, and other musculoskeletal disorders suffered by filleters, trimmers, and slimers at the plant. These were identified as relatively high risk jobs in terms of the development of cumulative trauma injury, based on company analysis of lost-time accidents which occurred in 1981 and 1982.

NIOSH investigators conducted an ergonomic evaluation on June 6 and 7, 1983. Along with the NIOSH personnel, an ergonomic consultant with the State of Oregon Worker Compensation department also participated in the evaluation. Interim letter reports summarizing our findings and recommendations were sent to company and union representatives in July 1983 and in January 1984. The State consultant provided the company with a comprehensive report in July 1983.

III. BACKGROUND

A. Workforce

Point Adams Packing Company (PAPCO), Hammond, Oregon is one of 5 fish filleting plants owned by Point St. George Fisheries of Santa Rosa, California. Although fish accounts for the majority of production, PAPCO also processes crab and shrimp. At the time of our evaluation, 145 production workers (64 males, 81 females) were employed at the plant. Fish filleting, trimming, and sliming jobs were among the major job classifications, with a maximum of 44, 20, and 30 workers, respectively, during the peak (summer) season.

B. Work Methods Description

Filleting -- About 20 to 30 different species of rock and bottom fish are processed on any given day, depending on the catch. Fish are processed by filleters in basically the same manner. The fish is grasped with a pinch grip with the minor hand and held in position while cutting with a combination of pinch grip and by exerting pressure with the palm of the hand (wrist extension). The dominant (cutting) hand holds the knife with a power grip. The cutting pattern is the same for all fish, an initial cut caudad to the gills, followed by a ventral midline cut towards the tail. The next cut follows the backbone, removing the fillet. The fish is turned over and the process repeated. The cutting process requires

a variety of hand positions, with mild to moderate ulnar deviation, accompanied by more or less continual flexion of the knife hand. Muscle relaxation of the hand flexors occurs during the cutting cycle only while turning the fish.

The company maintains individual production figures on all filleters from which internal production standards were developed. Monitoring of production is accomplished by recording, for each filleter, the total weight of whole fish processed and the resulting total poundage of fillets and carcasses, from which percent recovery is determined. Since filleters are paid and, more importantly, recalled to daily work on the basis of the total poundage filleted, both speed and precision are required if a worker is to ensure him/herself a place on the daily recall list. This recall system placed emphasis on high productivity whereby workers tended to ignore or tolerate repetitive motion-type injuries.

Trimming - After being cut from the fish and skinned in a skinning machine, excess fins, scales and/or skin are removed by the trimmers. Cutting varies from one fillet to another and depends on the extent to which these anatomical parts remain. Consequently, trimming is not as structured or physically demanding as the filleting job.

Sliming - This term applies to the preparation of black cod or sable fish. Three workers, each having different responsibilities, are assigned to this job. The cod, delivered to PAPCO in large crates, is dumped incrementally onto a stainless steel work table. The lead worker called the 'butcher' removes the head, then cuts the belly along the ventral midline. A second worker, positioned further down the table disembowels the fish, then scrapes the blood canal along the spine using a homemade tool. The tool consisted of a rounded hollow brass-handled spoon with a water hose positioned inside the handle so that the nozzle was directly above the spoon blade. This design allowed the worker to simutaneously scrape and clean the visceral cavity. The third worker weighed and packaged the fish into shipping containers.

Unlike the filleting and trimming jobs, sliming is not performed on a daily basis. Furthermore, the work crew is staffed on the basis of seniority, not production. Consequently, relatively less mental and physical stress appeared to be associated with this job as compared to the filleting and trimming jobs.

C. Company records analysis

According to information provided to NIOSH by PAPCO, musculoskeletal disorders of the upper limb (primarily diagnosed as

tendonitis and carpal tunnel syndrome) were a major problem at this plant, with repetitive action jobs accounting for about 20% of the OSHA reportable accidents in 1982, representing 80% of all lost work days. Company analysis of lost time accidents that were attributable to repetitive actions jobs revealed that of the 38 cases reported in 1981 and 1982, 26 or 68% were represented by 3 job categories (with the number of cases in parenthesis): filleters (19), trimmers (3), and slimers (4). About half of the injuries to filleters occurred while they were trainees within the first two months of starting this job. Most injuries were reported during the summer months when a 6 day work week and overtime was common.

IV. EVALUATION PROCEDURES

During the site visit on June 6 and 7, 1983, a walk through tour of the facility was made with representatives of the company, union, and the State of Oregon ergonomics consultant. The purpose of this tour was to become familiar with plant operations and those 'high risk' jobs which were identified by the company in the request, i.e., filleting, trimming, and sliming. To aid in the evaluation of these jobs, photographs and videotapes were taken for subsequent analysis. In addition, workers were informally questioned regarding perceived task difficulties and suggestions for job modifications which might make tasks less difficult.

After reviewing the videotapes, we felt that an important factor in reducing trauma to the filleters and trimmers was a better designed knife handle. Consequently, in January 1984, we initiated a search for: (1) criteria of a knife handle shape that would reduce the required amount of grip strength, and (2) knives commercially available that would meet this criteria. We advised the company that if such a knife were available we would conduct a follow up study at the plant to determine its acceptability.

To ascertain what constituted a 'good' handle design, we reviewed our observations with Dr. Suzanne Rodgers, Adjunct Professor, Department of Industrial Engineering, State University of New York at Buffalo. We contracted with her to conduct some preliminary experiments to determine handle designs which would minimize grip strength (or force) requirements of the hand and would also prove to be acceptable to workers, based on comfort criteria (or 'feel'). Once the optimal handle dimensions were developed, we contacted the Marttiini Knife Company in Finland to discuss a prototype knife which appeared to meet these handle design requirements. This knife company furnished several models which were sent to Dr. Rodgers for evaluation. Unfortunately, none of the knives proved satisfactory. Consequently plans for a field trial had to be abandoned.

V. EVALUATION CRITERIA

Since complaints dealt with hand and wrist problems, we focused our videotape analysis upon tasks which resulted in excessive wrist extension and flexion, ulnar and radial deviation, and pinching motions, because repetitive use of these postures, particularly in conjunction with high muscular forces, have been linked to common cumulative trauma disorders such as carpal tunnel syndrome, tenosynovitis, and tendonitis.[1,2] Few quantitative criteria exist which delineate hazards associated with this type of work. Rather, generally accepted ergonomic principles concerning use of well-designed hand tools, work station design, etc., are utilized, which involve application of professional judgement. Our recommendations focused on use of ergonomically designed hand tools and equipment modification, with the goal of eliminating stressful hand and wrist postures and motions, and muscular forces.

VI. RESULTS AND DISCUSSION

Based on our observations and review of videotapes and still photographs we were able to identify certain aspects of the filleting, trimming, and sliming jobs we feel were particularly stressful to the musculoskeletal system. These include:

1. Filleting - As mentioned earlier, filleting was the most physically demanding job at the plant. During season peaks when catches are good, filleters work long hours. There are no shifts, per se; the workforce stays until the entire catch is processed. (Probably no food crop requires more speed in processing than fish.) Workers are paid for the total poundage filleted, based upon species. While the workpace is critical, so is recovery of marketable flesh hence both speed and precision are required.

   From an ergonomic point of view the filleting operation is complex. The different cuts required many different hand and wrist positions. Particularly apparent in the major (cutting) hand is wrist hyperflexion associated with maximum ulnar deviation. The knife is held continuously with a power grip which contributes to hand and forearm fatigue. The other hand holds the fish; ulnar deviation, pinch grip, and wrist extension are commonly required. Prolonged static contractions of the forearm finger flexors were observed.

   Since the fish were kept on ice until processing the flesh was partially frozen at the time of filleting. Passing the knife through the tissues appeared to require considerable force, which increased grip strength requirements.

The room temperature was kept cool, but more important, the hands were continuously chilled from handling the iced fish. Almost all filleters work bare handed (fish hand). Much of the time, a glove was worn on the minor (fish holding) hand. The most commonly used glove was made of heavy nylon with a wire mesh liner to protect against accidental cuts. The gloves appeared to be awkward, and probably required considerable grip force to maintain a secure hand hold on the fish. In some instances we observed that the gloves were too large for the worker's hand.

Many of the filleters, particularly those of short stature, worked with elevated shoulders and elbows away from their side either by choice, or because the fixed-height work table was too high. From the standpoint of muscle fatigue (and perhaps impaired blood flow to the hands), this appeared to be a very stressful position to maintain. In addition, we observed workers using full arm extension (reach distances of about 25 to 30 inches) when procuring or disposing trays of fish from the conveyor line. This task appeared to place considerable stress on the shoulder muscles and possibly the lower back as well.

Most of the filleters used Dexter-Russell or Chicago Cutlery knives. The handles of both knives were made of molded plastics with similar dimensions of about 4 to 4.4" long X 1.4" wide X 0.8" thick. Criteria for handle design were lacking; they appeared to be based largely on 'feel'. Maintaining a sharp knife blade via steeling was done to facilitate cutting. However, this maintainance activity was primarily undertaken by the experienced filleters.

2. Trimming - This job is much less demanding in terms of the use of power grip and forceful cuts as compared to the filleting job. Observations of this job revealed that many of the underlying factors associated with the filleting job, except for reduced cutting force requirements, also apply to this job as well.

3. Sliming - The major problem associated with this job is the almost constant use of a power grip on an undersize-handled tool. The uninsulated metal handle and constant exposure to cold water, resulting in reduced blood flow to the extremeties probably, exacerbated the problem. We also observed that the butcher used considerable force to decapitate the fish with the knife.

VII. CONCLUSIONS

For each of the three jobs we evaluated, a combination of factors appeared to have contributed to the excessive number of musculoskeletal injuries afflicting PAPCO workers. These included: workrate, awkward

hand and wrist deviations, use of gloves that compromise grip strength, cold temperature, use of high muscular forces for prolonged periods, excessive workplace reaches and heights that stress shoulder muscles, and improper tool handle design.

NIOSH sponsored research work conducted by Dr. Rodgers provided dimensions for an optimal knife handle, based on force reduction criteria. However, we were unsuccessful in our attempts to procure a filleting knife with such a handle from a major knife manufacturer.

Recommendations provided in the next section focus on workplace modification, tool redesign, and training with the ultimate goal of reducing or eliminating biomechanical hazards associated with the development of cumulative trauma disorders.

VIII. RECOMMENDATIONS

The recommendations provided in this report incorporate those provided to the company in Interim Report #2 (January 1984), and are in general agreement with those provided to the company by the State of Oregon ergonomics consultant.

Since many aspects of the filleting and trimming jobs were similar, recommendations for these two jobs will be presented together.

Filleting and Trimming Jobs

1. Although our search for a filleting knife with a ergonomically acceptable handle design was unsuccessful, we were able to identify (via contract work performed by Dr. Rodgers) optimum handle dimensions which would minimize grip strength requirements. These handle dimensions were approximately 5"(L) x 2"(W) x 0.8"(T), about twice the size of the knife handles used by the workers. Since knives with handles of these dimensions apparently were not commercially available, we suggest that the company investigate the possibility of retrofitting existing knives, if feasible.

2. Modification in the work station should be made to alleviate biomechanical stress to the shoulder muscles and lower back. The cutting table should be lowered (or the worker raised) so that the work height is at 32 to 34 inches above the floor or platform for the smaller workers and about 36 to 38 inches high for the taller workers. Proper work height may also allow the worker to use less awkward wrist positions when filleting or trimming. To further reduce shoulder muscle and lower back strain, reduction of reach distances associated with movement of trays to and from the conveyor should be made. The reach should be within 20 inches of the front edge of the cutting table (3).

3. The surface of the cutting table should be rippled or textured to increase friction in order to reduce the force needed to hold the fish or fillet by the minor hand during the cutting operation. This modification should also reduce the need for a pinch grip.

4. The use of gloves on the minor hand by filleters compromises grip strength to some extent. However, we feel that, despite this shortcoming, it is probably more important to minimize cooling of the hands through continued use of the gloves. One way to improve grip strength would be to provide better fitting gloves to the workers.

5. Since repetitive trauma injuries afflicted trainees more so than experienced filleters and trimmers, all new hires in these job classifications should be made familiar with and appreciate the type of movements and postures that precipitate cumulative trauma disorders. Trainees should be initially assigned to experienced filleters who can demonstrate (1) how to maintain a proper knife angle during the cut which would minimize force requirements needed to push the knife through the tissue and (2) the art of steeling a knife, which if properly done, should also minimize force requirements. Finally, during the training period emphasis on speed should be minimized.

Sliming Job

1. Since the tool used to slime black cod suffers from the same problem (small handle) as the filleting knives we recommend that a design like the one in Figure 1 be used. This design, which incorporates the same handle dimension as recommended above for the filleting and trimming knife, would permit the slimer to use less grip force and provide better protection from the cold.

2. Because manual decapitation required considerable force, we recommend that a mechanical guillotine-type device be used.

IX. REFERENCES

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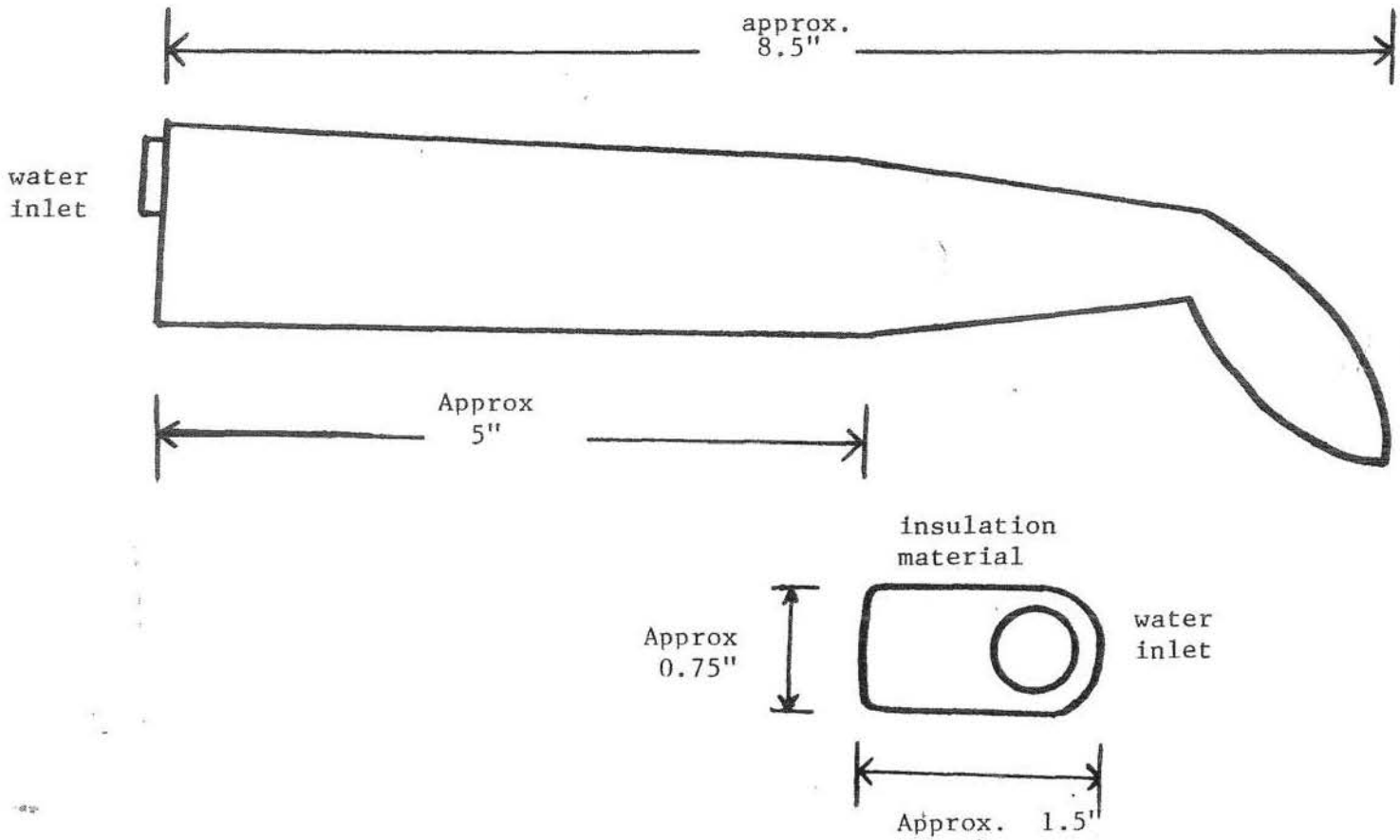

Figure 1. Proposed Slimming Tool

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