U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
CENTER FOR DISEASE CONTROL
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH
CINCINNATI, OHIO 45226

HAZARD EVALUATION AND TECHNICAL ASSISTANCE
REPORT NO. TA 76-93 IS NOW 760131

EASTMAN KODAK COMPANY
WINDSOR, COLORADO

JANUARY 1977

Study Requested By:
Colorado Occupational Safety and Health

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I. INTRODUCTION

On August 5, 1976, a request came to the National Institute for Occupational Safety and Health (NIOSH) from the Colorado Occupational Safety and Health Program (COSH) to provide technical assistance in evaluating the problem of repetitive motion trauma (Code 26 on the OSHA log) at the Eastman Kodak Plant in Windsor, Colorado. COSH had become involved with this problem in April, 1976, at the request of Kodak employees and public officials who had been contacted by these employees.

NIOSH medical and ergonomics personnel visited the Kodak plant from September 28 to October 1, 1976.

II. BACKGROUND INFORMATION

Kodak's Windsor, Colorado, plant employs about 3,300 persons, making it one of the largest employers in this predominantly-agricultural area north of Denver. The plant was established about five years ago in response to a westward shift in the demand for photographic products. A relatively young workforce, with little previous industrial experience, was recruited locally. Much of the work at this plant involves converting bulk photographic products, produced in other Kodak plants, into consumer-sized units ready for distribution. Most of the Code 26 cases occurred in Departments 530 and 550, which are film and paper packaging operations that require considerable repetitive motion of the hands and arms. No free liquids or gases are used in these departments, and quality control requires a high degree of cleanliness and dust control.

III. METHODS OF EVALUATION:

A. Medical

(1) The OSHA Log listed 85 Code 26 cases from 1972 to 1976. Kodak's medical records on all of these cases were reviewed. Of the 85 cases, 54 are still employed at Kodak. Interviews (Appendix 1) and

physical examinations of the upper extremities were conducted on 36 of these 54 current employees. Only three of the employees who had left Kodak were laid off for Code 26-related disability. Two of these employees were contacted by NIOSH.

(2) In order to determine the frequency of unreported problems, a questionnaire (Appendix 2) was circulated in the two departments (530 and 550) where most of the Code 26 cases had occurred. There was a response from 41 out of 60 employees in area 530, the Motion Picture Recordak section; and there was a response from 84 out of 101 employees in area 550, the Phototypesetting Department.

(3) A literature review was conducted on the relationship of repetitive trauma injuries to the photographic industry, photographic chemicals, and silver toxicity.

B. Ergonomic:

(1) A walk-through of the plant was conducted, including darkroom areas.

(2) Workers were observed as they performed the paper and film packing operations under actual darkroom lighting and under normal white-light illumination.

(3) Motion pictures of packing operations were reviewed. These films, prepared by the Kodak Human Factors Division, demonstrated the modifications of packing techniques already made in response to the Code 26 problem.

IV. RESULTS

A. Medical

1. Case Distribution by Diagnosis

"Code 26" applies to repetitive trauma disorders, as listed on the OSHA industrial health log (Form #100). The OSHA log for the Kodak Windsor plant, from 1972 to 1976, shows the following list of diagnoses under Code 26:

84	Tendonitis
10	Ganglion Cyst of Hand
2	Epicondylitis of Elbow
4	Bursitis
1	Myositis
2	Carpal Tunnel Syndrome
1	Thoracic Outlet Syndrome
104	

These 104 incidents of illness were distributed among 85 employees, fifty-four of whom still work at Kodak.

The questionnaire survey detected another 15 current employees who had experienced some discomfort in their arms that they attributed to the repetitive motions in their jobs. Because these employees had not reported the problem to Kodak, they were not on the OSHA log; however, none of them had felt that the problem was serious enough to require medical attention from any outside source.

The Code 26 problem at Kodak is essentially restricted to the hands, wrists, and forearms. Only two persons complained of leg pain, and only four persons had pain in their arms extending above the elbow.

2. Case Distribution by Department

The areas of the Kodak plant that were most heavily affected were Department 550, with 70 cases of Code 26 illness, and Department 530, with 17 cases. The remaining 17 cases were distributed over the other paper and film packaging areas of the plant.

3. Case Distribution by Time

The frequency of Code 26 illness over time was examined for 1972 to 1976, the period for which an OSHA log has been available. Case frequencies are as follows:

Year	No. Code 26 Cases
1972	15
1973	26
1974	32
1975	21
1976	11

Kodak began to introduce preventive measures in 1973. Case rates are now below the 1972 level, despite an increase to more than double the number of employees in the packaging areas of the plant since 1972.

There is a tendency for Code 26 problems to occur soon after starting work in the packaging areas. (see Figure 1). Susceptible workers usually develop their problem within a few months of beginning work in the packaging areas.

4. Case Distribution by Age and Sex

Persons with Code 26 problems did not differ significantly in age from the general workforce. The median age was 23 years for persons on the Code 26 list and 24 years for the workers in Departments 530 and 550 who reported no Code 26-type symptoms on the questionnaire survey.

Females composed a disproportionately large fraction of the affected individuals. Women comprise 49% of Departments 530 and 550, but they comprise 73% of Code 26 cases. All three of the workers laid off for Code 26 problems were women.

5. Medical Evaluation and Treatment of Cases

The medical workup of Code 26 cases by the Kodak Medical Department included physical exams on all 85 cases, X-Ray studies on 66 of the 85, blood studies for arthritis (uric acid, rheumatoid factor, ASLO, ANA, sedimentation rate) on 69 of the 85, and referral to outside specialists in 32 of the 85 cases. Six of the X-Rays taken by Kodak were reported as slightly abnormal. Abnormalities included one diagnosis of degenerative joint disease, one widening of the acromioclavicular junction, three cases of benign bone cysts, and one case of mild osteoporosis with possible calcific tendonitis. Three of the blood tests showed possible abnormality, including two borderline elevations in ASLO titer and one borderline elevation in rheumatoid factor.

Almost all of the Code 26 cases resolved with conservative therapy, consisting of immobilization, support, heat, and anti-inflammatory medication. Nine persons required casting of the affected arm for adequate immobilization. Eight persons required surgery: four for ganglion cyst removal and four for tenosynovitis. Three of the four who were operated on for tenosynovitis were eventually laid off because their symptoms could not be sufficiently reduced to allow them to continue working. Sixteen persons with tendonitis of the hands or forearms had one or more recurrences of tendonitis in the same or opposite arm. Of the 36 Code 26 cases interviewed by the NIOSH medical officer, nineteen reported some continuing discomfort in their hands or arms when doing certain repetitive jobs. Only four of these nineteen, however, had any tenderness in their arms on physical examination.

The disability associated with the Code 26 problem at Kodak has generally been transient. A mean of 12.6 days off work was required to manage 11 of the more serious cases. A mean of 21.9 days doing lighter work was required to manage 99 of the reported Code 26 cases. Kodak records indicate that only three persons have been laid off for Code 26-related problems. There were, however, 19 persons who transferred jobs within the company because of Code 26 illness.

B. Ergonomic

(1) Area 550: The high-risk job in this department involves wrapping and packing of a photochemical paper roll cassette ("Spec. 175") by a standing worker under reduced illumination. Usually using their left hands, workers pick up a paper roll that varies from 2 to 8 inches in length, measures about 2.5 inches in diameter, and weighs from 1 to 2.5 lbs. This roll is lifted and moved about 10 to 20 inches and placed on a stand, where the packing operation is completed by inserting a spacer, covering the roll with a black plastic bag, placing the covered roll in a cardboard box, sealing the box with tape, and trimming the excess paper with scissors.

While no quotas are enforced, workers are expected to complete from 250 to 400 packages daily, which necessitates almost continuous motion of both hands. Of the 36 persons from the Code 26 log interviewed by the NIOSH medical officer, 20 reported that they felt pressured by the unofficial quota system. Several others reported competitive pressures within the peer group. Many of the Code 26 cases reported that their problem began during the training period as they pushed to meet the quota, but were not yet smooth in performing the required hand motions.

Several persons reported that they have adapted to their job by finding a balance between an acceptable minimum level of production and the wrist discomfort caused by excessive repetitive motion.

Since 1973 there have been several changes aimed at reducing the tendonitis problem. Workers undergo a 240-hour training period prior to permanent assignment to a job. Those who cannot tolerate the arm motions required, or who cannot attain the quota with minimal wastage of the product, are transferred to other jobs. This training period now stresses efficient hand motions, and special training personnel have been designated. Workers now receive some warning about the dangers of repetitive motion, and are encouraged to report any problems promptly.

One important change has been the development of "job modules", or groups of workers who rotate specific jobs in order to vary their exposures to repetitive motion. During the NIOSH interviews, workers reported that job rotation has probably been the most helpful change made so far, and they would like to see this approach used for more jobs.

A larger spacer was also introduced in 1973 to help reduce the number of hand motions needed to hold a roll in place during packaging. A more stable stand for holding the larger size paper rolls is now used. Additional improvements have been made in the cardboard boxes used to package the paper rolls, including better dies to pre-stamp the boxes to reduce the effort needed for their assembly.

Other improvements are in planning stages by Kodak. These include (1) engineering efforts to reduce total hand motion, (2) plans for a better roll-holding stand that is adjustable to each worker's height and reach, (3) plans to reduce the hand effort required to lift the larger rolls, (4) changes to reduce the awkward degree of ulnar deviation required to operate the scissors in the final trimming operation, (5) use of mirrors to reduce the degree of manual handling needed for product inspection, and (6) job rotation beginning as early as the training period. Because of the variety of product sizes required by consumers, automation of this packaging operation would be difficult. Efforts are underway, however, to induce consumers to accept a more standardized product that would be easier to automate.

(2) Area 530: The high-risk job in this department involves rewinding film from a large reel onto smaller take-up reels, followed by packing of these small reels into light-tight plastic boxes. Light levels are very low in this area, and workers stand before workbenches of fixed height. The plastic film boxes are inserted into a holder, opened with a sharp supination motion of the wrist, filled with a film spool, and sealed by a strong finger flexion that usually requires both hands. This whole operation is repeated from 1000 to 1200 times per shift. Improvements in training have been made in this department, but no system of job rotation has yet been introduced here. Engineering improvements planned by Kodak in this department include adjustable bench heights, pre-opened film boxes, a mechanized box-closer, and eventual mechanization of most of the operation.

V. CONCLUSIONS

The problem of Code 26 illness at the Kodak plant in Windsor, Colorado, seems to the NIOSH investigators to be clearly ergonomic in nature. A literature search[1] revealed that repetitive trauma disorders are common in industry, but the photographic industry has not had unusually large numbers of cases. The significant findings from this investigation are as follows:

(1) Most of the cases involve tendonitis or ganglion cysts of the hands, wrists, and forearms. Workers generally know which motions cause pain, and many have learned to limit their output to a level which will not cause pain.

(2) Most cases have been mild, responding well to conservative management. The recurrence rate is significant, however, when workers are sent back to the same jobs.

(3) Kodak has done medical workup of the problem, including X-ray and laboratory studies on most cases, and referral to outside specialists on several cases. No significant or consistent abnormalities were found to indicate that the problem is anything other than ergonomic (mechanical) in nature.

(4) Affected workers do not differ significantly in age from unaffected workers. The work force at the plant is generally young and without much industrial experience. There are few persons with a past history of musculo-skeletal disorders.

(5) Women comprise a disproportionate fraction of the Code 26 cases. The women complained especially about the amount of hand effort required to package the larger, heavier rolls of paper. They also had more complaints about the non-adjustable proportions of the workbench areas.

(6) Many of the Code 26 cases reported feeling pressured and rushed in their work, either by the unofficial quota system or by competitive pressures from other workers. This seems to be particularly true during the training period, which may account for the higher incidence of Code 26 problems in the first few months of employment.

(7) Although the Code 26 problem is decreasing, it still exists. The frequency of Code 26 cases has dropped off sharply since 1974, presumably because of the preventive measures introduced by Kodak and because of the removal of susceptible persons from the high-risk departments. Many workers, including persons on the Code 26 list as well as persons who never sought medical attention, still report discomfort when doing certain jobs. They report that job rotation has probably helped more than anything else in reducing the problem, and they would like to see the job rotation program expanded.

(8) The question of silver toxicity, or other chemical toxicity from the photographic products, was raised in the initial request for an investigation of the Code 26 problem at Kodak. NIOSH investigators have seen no evidence to indicate that there is a toxic problem involved. A literature search did not reveal any known association of silver poisoning with tendonitis. The areas of the plant involved in this investigation handle only dry products; no free gases or liquids are used. Quality control requires careful dust control, and Kodak air sampling data (done by standard methods) showed the air inside the plant to be about as clean as the ambient air outside the plant. Kodak also did leaching studies on photographic products (also done by standard methods, using simulated saliva and sweat); they found only negligible levels of silver and hydroquinone extraction.

One of the more seriously affected persons on the Code 26 list has never had a perfectly clear diagnosis or a satisfactory response to treatment, despite visits to a number of specialists and several attempts at surgical correction. This case is not typical of the vast majority of cases on the Code 26 list, most of which are straight-forward cases of tenosynovitis and ganglion cysts. This case is also not typical of silver toxicity, however.

VI. RECOMMENDATIONS

Kodak has made, or is already planning to make, many of the modifications in procedures that the NIOSH investigators suggested. The solution to the problem of repetitive trauma injury lies in engineering out as much excess motion as possible, automating as many other repetitive motions as possible, and making the workplace as adaptable as possible to the physical strength and dimensions of each individual worker.

Specific recommendations include:

(1) The sharp ulnar deviation required when using scissors in the paper-trimming operation in Department 550 should be modified, possibly by tool redesign or developing a rotating holder for the boxes of film.

(2) Much of the problem, especially for female workers, has been with the heavier rolls of paper. These rolls should be placed so that less lifting is required, and so that both hands, or at least alternating hands, may be used to lift the rolls. Alternatively, stronger workers could be assigned to pack the 8-inch rolls.

(3) Workbenches or footstands that are adjustable to the height and reach of each person may be of help.

(4) Mechanical devices to eliminate the movements needed to open and close the light-tight boxes in Department 530 would be helpful.

(5) Training should emphasize the need to develop speed gradually, and to report any arm discomfort early. Workers should be observed carefully during the training period as well as occasionally following permanent assignment, to eliminate awkward or unnecessary limb motions.

(6) Job rotation should be expanded to give workers some relief from those jobs requiring the most repetitive wrist motion.

(7) Workers should be reassured that they are not expected to push themselves beyond reasonable limits in order to meet a quota. Competition between workers to achieve exceptionally high levels of production should not be encouraged. Kodak should clarify its policy on minimum production requirements, as many employees in the packing area are unsure whether or not a definite quota system exists.

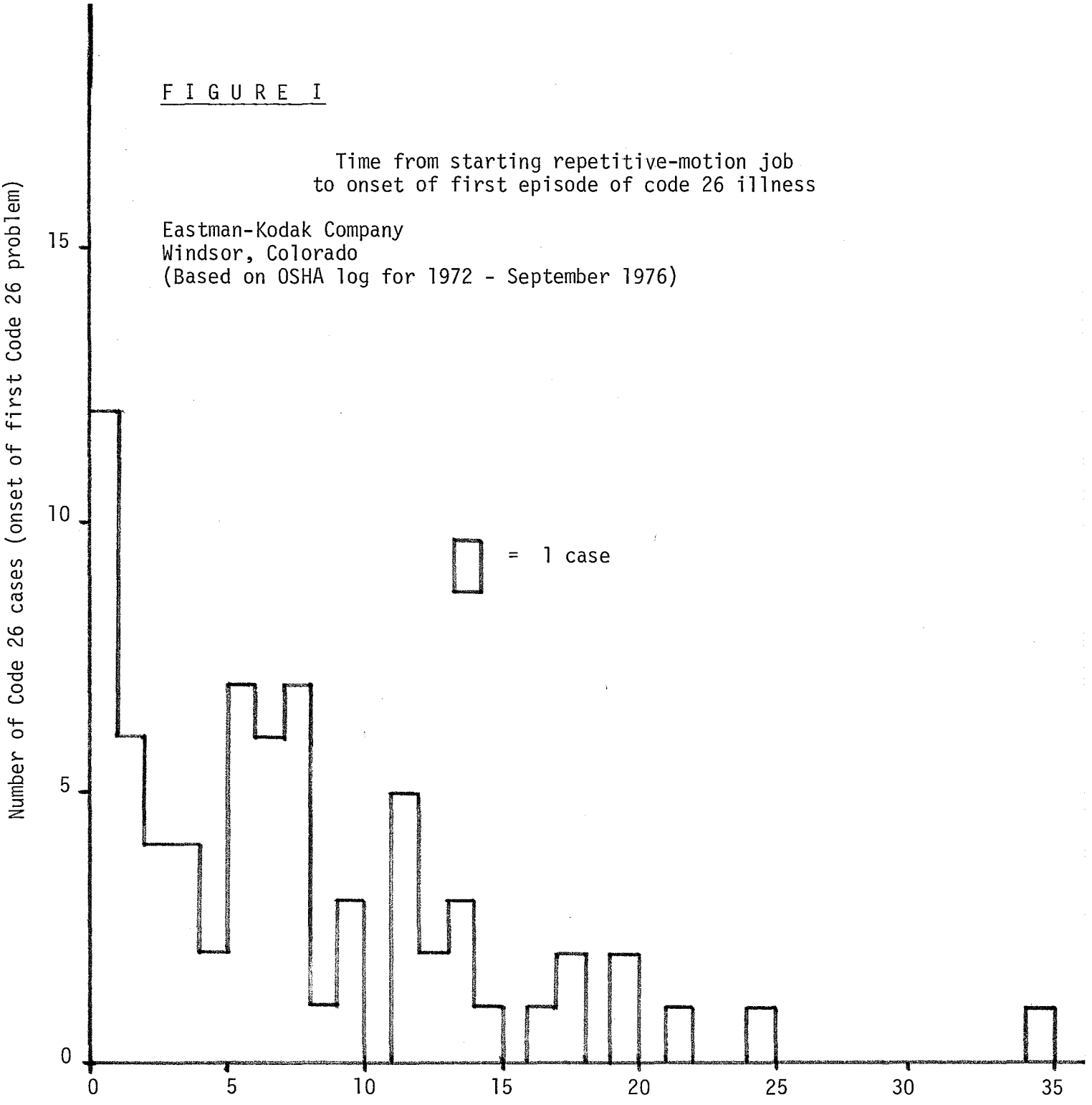
REFERENCES:

1. Wells, Margaret J. - Industrial Incidence of Soft Tissue Syndromes. - Physical Therapy Review. 41:512, July 1961.

F I G U R E I

Time from starting repetitive-motion job
to onset of first episode of code 26 illness

Eastman-Kodak Company
Windsor, Colorado
(Based on OSHA log for 1972 - September 1976)



The National Institute for Occupational Safety and Health has been asked to help evaluate the problem of tendonitis in the packing area of the Kodak Windsor plant. We would like as many persons as possible in the packing area to participate in this study to make the results as accurate as possible.

Voluntary Agreement Form: Please read and sign the following statements if you agree to participate in this study.

"I understand that this investigation is being conducted by the National Institutes of Occupational Safety and Health for the purpose of evaluating the problem of tendonitis in the packing area of the Kodak Windsor plant.
I understand that my participation is voluntary, and that any information provided will be treated confidentially.
I understand that the study will consist of completing a questionnaire, and in some cases a brief physical examination of affected areas of the hands and arms."

Date_____ Signature_____

Kodak Windsor Plant

Name_____

Age_____ Sex _____

Work History:

	Months	Years
1. How long have you worked at Kodak?	_____	_____
2. How long have you been doing your present job?	_____	_____
3. What job did you do before your present job?		
_____		
How long did you do that job?	_____	_____

Current Medical History:

1. Have you had any problems with persistent or bothersome pain or swelling in your hands or arms while working at Kodak? Yes_____ No_____

   If Yes: a)Describe area of body affected._____

   _____

   b)When did this problem start?_____

   c)Was there any unusual pressure for working very rapidly at that time? Yes_____ No_____

   d)Has the problem affected your ability to work or to do your customary household chores? Yes_____ No_____

   e)Have you changed work areas because of this problem? Yes_____ No_____

   If Yes: Has this changed helped? Yes_____No_____

   f)Have you seen a doctor for this problem? Yes_____ No_____

   If Yes: What treatment was given?_____

   _____

   Did this treatment help? Yes_____NO_____

   e)Have any changes in work practices in your area helped your problem? Yes_____No_____

   If Yes: Describe what work changes helped you.

   _____

   _____

2. Do you feel that pressures to work rapidly cause you to be tense and nervous on the job? Yes_____ No_____

   If Yes: Have these pressures gotten any better recently? Yes_____No_____

3. Do you find your job difficult to do at the speed at which you customarily need to work? Yes_____No_____

Past Medical History:

1. Did you have any persistent or bothersome problems with arthritis, tendonitis, or joint pains before coming to Kodak? Yes____No____

   If Yes, Describe:_____

2. Do you regularly take any medications? Yes_____ No_____

   If Yes,List_____

   _____

QUESTIONNAIRE

1. Insurance Number_____

2. Age_____ 3. Sex_____

4. Work History: Department Number_____

   a. Exact Job Description_____

   b. How long have you worked at Kodak? Months_____ Years_____

   c. How long have you been doing your present job? Months_____ Years_____

   d. What job did you do before your present job?_____

   e. How long did you do the job in d above? Months_____ Years_____

5. Current Medical History

   a. Have you had any problems with persistent or bothersome pain or swelling in your hands or arms during the time you have been at Kodak?

   YES_____ NO_____

   If YES: 1. Describe the area of body affected.

   _____

   2. When did the problem start?

   _____

   3. Do you believe that this problem may have started as a result of working at Kodak?

   YES_____ NO_____

   If YES, describe:

   _____

   4. Did you report the problem to the Kodak Medical Department?

   YES_____ NO_____

   5. Did you see an outside physician for the problem?

   YES_____ NO_____

Comments: