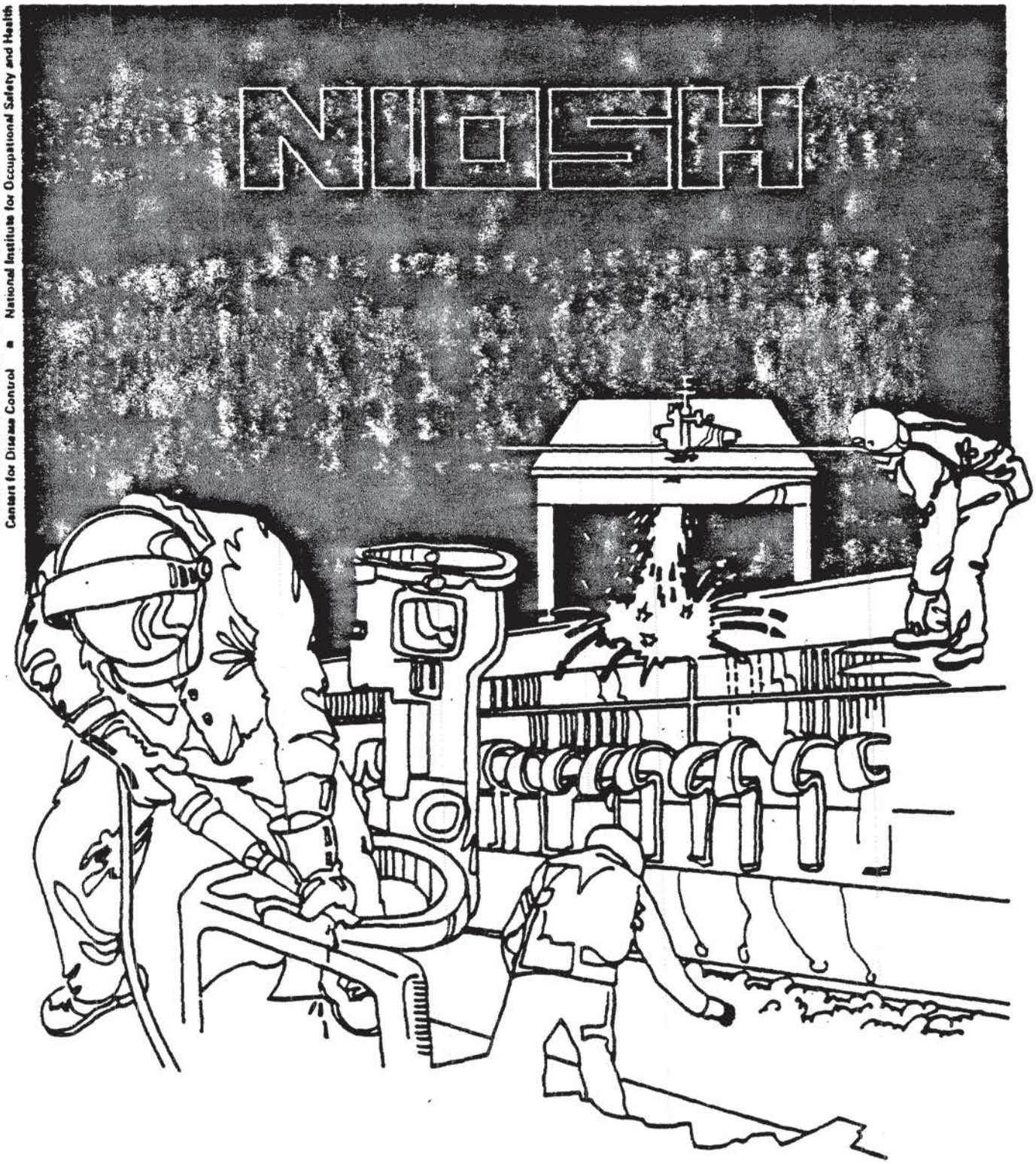
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES • Public Health Service
Centers for Disease Control • National Institute for Occupational Safety and Health




# Health Hazard Evaluation Report

GHETA 83-309-1405
CHRYSLER CORPORATION FOUNDRY
INDIANAPOLIS, INDIANA

## 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.

GHETA 83-309 -1405
January 1984
Chrysler Corporation Foundry
Indianapolis, Indiana

NIOSH Investigator:
A. Patil, M.D.

## I. SUMMARY

In June 1983, the Chrysler Corporation and the United Auto Workers (UAW) National Joint Committee on Health and Safety requested the National Institute for Occupational Safety and Health (NIOSH) to review chest radiographs from the medical surveillance program at the Chrysler Corporation Foundry in Indianapolis, Indiana.

This request was precipitated by employee concerns regarding the medical surveillance program, particularly some disagreement on the radiographic diagnosis of pneumoconiosis. The company: 1) does not use the International Labor Office (ILO) International Classification of Radiographs of Pneumoconioses; 2) does not use NIOSH-certified "B" readers for interpreting radiographs; and 3) does not use at least two independent readers for interpretation of all radiographs.

A set of 78 systematically sampled postero-anterior (PA) chest radiographs from the surveillance system files were independently interpreted by three NIOSH-certified "B" readers. These interpretations were then compared to the company interpretations and also for inter-reader variability. Using the median "B" reading, none of the radiographs were considered technically unacceptable, but 35% were classified as having poor technical quality. Only one radiograph had a median "B" reading of $\geq$ 1/1 profusion of small opacities, and the company had interpreted this film as "positive." The company interpreted as "negative" the three films with a median "B" reading of 1/0 for small opacities. Two films with a negative median "B" reading were interpreted by the company as "positive." Despite these differences, there were no statistically significant differences between the proportion of films interpreted as positive by the median "B" reading and the company reading, and agreement on individual films was as good between the company reading and the median "B" reading as it was between any two "B" readings.

The surveillance program at the Chrysler Corporation Foundry in Indianapolis, Indiana uses non-standard methods for radiographic surveillance. Despite this, the company readings were generally consistent with "B" reading obtained by NIOSH. However, to avoid concerns about the surveillance program, NIOSH recommends that the company utilize standard radiographic equipment and technique, NIOSH-certified "B" readers, and the current ILO International Classification of Radiographs of Pneumoconioses.

Key Words: (SIC 3321) Chest radiograph, medical surveillance, ILO classification, "B" reading, pneumoconiosis.

## II. BACKGROUND

In past years workers have been exposed to silica dust in several operations at the Chrysler Corporation Foundry in Indianapolis, Indiana. Chrysler operates a medial surveillance program which includes pre-placement and periodic chest radiography. Eighteen workers from the active payroll (which excludes retirees) have been identified as having radiographic abnormalities indicating pneumoconiosis. However, there has been some disagreement between the UAW union and and the Chrysler medical department on the interpretation of some of these radiographs.

The company readers are not NIOSH-certified "B" readers and they do not use the ILO classification. ("B" readers are physicians who have passed a proficiency examination in interpreting chest radiographs using the International Labor Office (ILO) Classification of Radiographs of Pneumoconioses[1].) The company uses its plant physician for the initial reading of the radiographs, and if he suspects the presence of pneumoconiosis on a radiograph, he refers that radiograph to a contracted radiologist who is an "A" reader. (To qualify as an "A" reader, the physician had to either participate in one of the two-day seminars conducted periodically for NIOSH by the American College of Radiology (ACR) or submit to NIOSH six radiographs interpreted properly according to the ILO classification.) The company interpretations of radiographs for pneumoconiosis were limited to "positive" or "negative," with additional information on other abnormalities (if present).

In June 1983, the Chrysler Corporation and the United Auto Workers National Joint Committee on Health and Safety requested NIOSH to review radiographs of certain individuals working at the foundry.

## III. EVALUATION DESIGN AND METHODS

A set of 78 postero-anterior (PA) chest radiographs from the company's medical surveillance program were reviewed by three NIOSH-certified "B" readers. They had been systematically selected from a set of approximately 550 radiographs. Every seventh radiograph was selected from the set, which was arranged in alphabetical order by last name. This method of sampling had been agreed upon by both the company and union and was acceptable to NIOSH. Three "B" readers, two of whom are members of the American College of Radiology (ACR) Task Force on Pneumoconiosis[2], interpreted the radiographs independently. Their readings were compared to that of the company. The interpretations of the three "B" readers were also compared to assess inter-reader variability for pneumoconioses.

In a separate analysis the proportion of radiographs with a profusion $\geq$ 1/1 by median "B" reading was compared with the proportion read as positive by the company. This was done to estimate how much of the difference between the company and "B" reading could be contributed to a single step in the 12-point ILO classification scale.

## IV. EVALUATION CRITERIA

All chest radiographs were independently interpreted by three NIOSH-certified "B" readers using the 1980 International Classification of

Radiographs of Pneumoconioses of the International Labor Office(ILO)[1]. A "B" reading of rounded or irregular or combined opacities (i.e. any pneumoconiosis) of $\geq$ 1/0 profusion was considered positive. If two or all three of the "B" readers called the film positive, it was considered positive, i.e., a median "B" reading was used.

Technical quality of each radiograph was assessed using the following grades from 1980 ILO Classification[1]:

Good
Acceptable, with no technical defect likely to impair classification of the radiographs for pneumoconiosis.
Poor, with some technical defect but still acceptable for classification purposes.
Unacceptable

## V. RESULTS

Table 1 displays the technical quality assessments of the 78 radiographs. Only one "B" reader found any radiographs unacceptable, but the median "B" reading classified 35% (n=27) as poor in quality. Of these 27 films, "overexposure" was the most common defect, followed by "poor contrast" and "improper positioning".

Table 2 compares the median "B" positive reading ($\geq$ 1/0 profusion) with the company reading for pneumoconiosis. Four radiographs were positive by the median "B" reading compared to three considered "positive" by the company. Although there was no statistically significant difference between the proportions of films "positive" by the median "B" reading and the company reading, only one film was considered positive by both.

Table 3 presents the comparison between the median "B" reading and the company reading if the median "B" reading cutoff is increased to $\geq$ 1/1 profusion. Only one radiograph had a median "B" reading profusion $\geq$ 1/1, and the company reading was also "positive" on this film. (All three "B" readers had reached a consensus on this radiograph with a median "B" reading profusion of 1/2.) Two additional films were "positive" by the company reading, but were not $\geq$ 1/1 profusion by the median "B" reading.

Inter-reader variability for pneumoconiosis ($\geq$ 1/0 profusion) among the three "B" readers is shown in Table 4. No statistically significant differences in the proportions of radiographs interpreted as positive were observed among the three "B" readers.

Tables 5 summarizes the three "B" readings and company reading for the 10 films considered "positive" by either any one "B" reading ($\geq$ 1/0 profusion) or the company reading. Consensus among all four readings was reached on only one of these 10 positive radiographs. Nine (12%) radiographs had $\geq$ 1/0 profusion by at least one "B" reader, but only 4 films had a median "B" reading of  Three radiographs were interpreted as "positive" for pneumoconiosis by the company reading. For 2 of these 3, at least one "B" reading was $\geq$ 1/0 profusion. One radiograph considered "positive" by the company was read as negative by all three "B" readers. No large opacities were observed. Small opacities included both rounded (q) and irregular (s,t) shapes.

Agreement on the proportion of "positive" films does not necessarily mean agreement on each individual film's reading. Thus the agreement on individual radiographs was calculated for the company reader versus the median "B" reading and for the individual "B" readers. For each pairing, the percentage agreement was calculated as the number of radiographs called positive by both readers plus the number of radiographs both called negative, divided by the total number of radiographs read by both, and multiplied by 100. In all comparisons reading agreement was between 91% and 95%. (Table 6)

## VI. DISCUSSION

No formal check was made of the radiographic equipment used in the Chrysler surveillance system. Thus, we can not say whether the equipment would comply with NIOSH recommendations or if the radiographs were taken by a trained technician. None of the radiographs were classified by the "B" readers as unacceptable due to technical quality. (A 5% maximum rate for technically unacceptable films is allowed by NIOSH in a mandated surveillance program for coal miners. [3]) However, 35% of the radiographs were classified as having "poor" technical quality by the median "B" reading, mainly due to overexposure, poor contrast and improper positioning, which are among the most frequent causes of poor quality in chest radiography [2]. Recognition of technical defects is a prerequisite to correction of the problem to minimize the chances of its recurrence in the future.

The company readings were based on clinical readings and not on the standard ILO classification of pneumoconiosis. The ILO classification avoids the use of terms implying pathological processes such as "fibrosis" or "honey combing," and simply categorizes a radiograph according to the size, shape, and profusion of small opacities and size of large opacities. In individual cases the full pathological significance attached to these opacities may be unknown, but this classification does provide a standard basis for epidemiological and physiological studies, as well as for pneumoconiosis surveillance among workers.[4]

Previous studies have indicated a great inter-reader variability in the radiographic diagnosis of pneumoconiosis which has led to the use of the standardized ILO classification, use of NIOSH-certified "B" readers, and the use of more than one reader.[4] Generally the greatest difficulty in classifying radiographs exists when profusion levels are near the division of 0/1 or 1/0. A given reader will never exhibit complete consistency in his classification of profusion, even when he reevaluates an identical series of radiographs on multiple occasions. Even more variability may arise when a number of readers independently evaluate a series of radiographs. Such inconsistencies are unavoidable, and indeed characteristic of all clinical testing in which human judgement is a factor.

## VII. CONCLUSIONS

1. The company does not use NIOSH-certified "B" readers or the standard ILO International Classification of Radiographs of Pneumoconioses, and in some cases only one reader is used.

2. Although none in the current sample of radiographs was considered to be of unacceptable technical quality by any "B" reader, 35% were considered to be of poor quality by at least two "B" readers.

3. Disagreement on the interpretation of individual films between the median "B" reading and the company reading was no greater than disagreement among "B" readers, themselves.

4. Only one film had a median "B" reading of $\geq$ 1/1 profusion, and the company surveillance program properly interpreted that film as "positive."

## VIII. RECOMMENDATIONS

In order to avoid concerns about the surveillance program, the company should utilize standard radiographic equipment and technique, a NIOSH-certified "B" reader, and the current ILO International Classification of Radiographs of Pneumoconioses. Because of inherent variability in the interpretation of chest radiographs, all chest radiographs should be interpreted independently by at least two readers, both using the ILO classification system and at least one of whom should be a "B" reader.

## IX. REFERENCES

1. Guidelines for the use of ILO International Classification of Radiographs of Pneumoconioses. Revised edition. International Labor Office, Geneva, 1980.

2. Technique for chest radiography for pneumoconiosis. Editor: E.N. Sargent, American College of Radiology, Chicago, 1982.

3. Specification for medical examination of underground coal miners. Chest radiographic examinations, Federal Register, Vol. 43, No. 148, 1978.

4. Occupational Lung Diseases. Editors: W.K.C. Morgan and A. Seaton. W.B. Saunders Company, 1975.

## X. AUTHORSHIP AND ACKNOWLEDGEMENTS


| | |
|---|---|
| Report Prepared By: | Ashok Patil, M.D.<br>Clinical Investigations Branch |
| Assisted By: | Thomas K. Hodous, M.D.<br>Clinical Investigations Branch |
| Statistics Consultant | Martin R. Petersen, M.S.<br>Epidemiology Investigations Branch |
| Originating Office | Division of Respiratory Disease Studies<br>National Institute for Occupational Safety and Health<br>Morgantown, West Virginia |


## XI. DISTRIBUTION AND AVAILABILITY OF REPORT

Copies of this report are currently available upon request from NIOSH Division of Standards Development and Technology Transfer, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After 90 days, the report will be available through the National Technical Information Service (NTIS), 5285 Port Royal, Springfield, Virginia 22161. Information regarding its availability through NTIS can be obtained from NIOSH Publications Office at the Cincinnati address. Copies of this report have been sent to:

1. Chrysler Corporation
2. NIOSH Regional Office VI
3. OSHA
4. United Auto Workers

For the purpose of informing affected employees, copies of this report shall be posed by the employer in a prominent place accessible to the employees for a period of 30 calendar days.

TABLE 1

A. Assessment of Technical Quality of Radiographs by Three "B" Readers (n=78 films)

| Quality Grading | Reader 1 (%) | Reader 2 (%) | Reader 3 (%) | Median Reading (%) |
|---|---|---|---|---|
| Good | 19% | 9% | 80% | 19% |
| Acceptable | 46% | 45% | 9% | 45% |
| Poor | 35% | 46% | 5% | 35% |
| Unacceptable | 0% | 0% | 6% | 0% |

B. Frequency of Technical Defects Observed In "Poor" Quality Radiographs

| Technical Defect | Median Reading n (%) |
|---|---|
| Overexposure | 10 (37) |
| Lack of Sharp Details | 1 ( 4) |
| Artifact | 1 ( 4) |
| Improper Position | 7 (26) |
| Poor Contrast | 8 (29) |
| TOTAL | 27 (100) |

TABLE 2
Median "B" Reading (≥ 1/0 Profusion) Vs Company Reading

| | | Median "B" Reading + | Median "B" Reading − | Total |
|---|---|---|---|---|
| Company Reading | + | 1 | 2 | 3 |
| | − | 3 | 72 | 75 |
| Total | | 4 | 74 | 78 |

McNemar's Exact Test p = 1

TABLE 3
Median "B" Reading (≥ 1/1 Profusion) Vs Company Reading

| | | Median "B" Reading + | Median "B" Reading − | Total |
|---|---|---|---|---|
| Company Reading | + | 1 | 2 | 3 |
| | − | 0 | 75 | 75 |
| Total | | 1 | 77 | 78 |

McNemar's Exact Test p = 0.50

TABLE 4
Comparison Between Individual "B" Readers
Pneumoconiosis (≥ 1/0 Profusion)

| | | Reader 1 + | Reader 1 − | Total |
|---|---|---|---|---|
| Reader 2 | + | 6 | 0 | 6 |
| | − | 0 | 72 | 72 |
| Total | | 6 | 72 | 78 |

McNemar's Exact Test p = 1

| | | Reader 1 + | Reader 1 − | Total |
|---|---|---|---|---|
| Reader 3 | + | 2 | 0 | 2 |
| | − | 4 | 72 | 76 |
| Total | | 6 | 72 | 78 |

McNemar's Exact Test p = 0.10

| | | Reader 2 + | Reader 2 − | Total |
|---|---|---|---|---|
| Reader 3 | + | 2 | 0 | 2 |
| | − | 4 | 72 | 76 |
| Total | | 6 | 72 | 78 |

McNemar's Exact Test p = 0.10

TABLE 5
SUMMARY OF CHEST RADIOGRAPHS
POSITIVE BY ANY "B" READING (≥ 1/0 Profusion) OR BY COMPANY READING

| Obs. No. | "B" Reader 1 | "B" Reader 2 | "B" Reader 3 | Median | Company |
|---|---|---|---|---|---|
| 1 | -- | -- | -- | - | + |
| 2 | 1/0 t/t | -- | 1/1 t/t | + | - |
| 3 | -- | 1/0 t/s | -- | - | - |
| 4 | -- | 1/0 t/q | -- | - | - |
| 5 | 1/0 t/t | -- | -- | - | - |
| 6 | 1/0 t/t | 1/0 q/q | -- | + | - |
| 7 | 1/0 q/t | -- | -- | - | - |
| 8 | -- | 1/0 q/t | -- | - | + |
| 9 | 1/0 t/q | 1/1 q/q | -- | + | - |
| 10 | 2/1 q/q | 1/2 q/q | 1/1 q/t | + | + |

q: Small rounded opacities of diameter exceeding about 1.5 mm and up to about 3 mm.

s: Small irregular opacities of width up to 1.5 mm.

t: Small irregular opacities of width exceeding 1.5 mm and up to about 3 mm.

TABLE 6

Agreement Between "B" Readings (> 1/0 Profusion) and Company Reading For Pneumoconiosis

Company Vs. Median "B" Reading

| Company | Median "B" | No. of Radiographs |
|---|---|---|
| + | + | 1 |
| - | - | 72 |
| + | - | 2 |
| - | + | 3 |

Agreement Between Company Reading and Median "B" Reading

[(1 + 72) / (1 + 72 + 2 + 3)] X 100 = 94 % agreement

Agreement Among "B" Readers

| | |
|---|---|
| Reader 1 vs. Reader 2 | 92% |
| Reader 2 vs. Reader 3 | 92% |
| Reader 1 vs. Reader 3 | 95% |

Agreement Between Company and Individual "B" Readers

| | |
|---|---|
| Company vs. Reader 1 | 91% |
| Company vs. Reader 2 | 94% |
| Company vs. Reader 3 | 95% |