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

#### HEALTH HAZARD EVALUATION DETERMINATION REPORT NO. 79-112-636

#### STEARNS-ROGER FABRICATORS, INC. DENVER, COLORADO

#### DECEMBER 1979

#### I. TOXICITY DETERMINATION

A health hazard evaluation was conducted by the National Institute for Occupational Safety and Health (NIOSH) at Stearns-Roger Fabricators, Inc., Denver, Colorado, on August 15-17 and September 24-25, 1979. At the time of this evaluation 58 breathing zone and general room air samples were taken on workers for manganese (Mn), iron oxide fume (Fe), fluoride (F), nickel (Ni), copper (Cu), chromium (VI) (Cr<sup>+6</sup>), and chrome (metal). Concentrations of manganese, iron oxide, nickel, copper, and chrome (metal) were all well within the most recent evaluation criteria. An overexposure to fluoride existed in one of the five workers monitored for fluoride. Seven Cr<sup>+6</sup> samples were taken in the general area and in the breathing zone of welders welding stainless steel. All levels were below the NIOSH laboratory limits of detection (.005 mg/sample). Since samples were collected for a minimum of six hours, all results illustrate that the samples were below the evaluation criteria of .001 mg/M<sup>3</sup>.

All workers were interviewed pre- and post-shift by a NIOSH medical team. Based on data collected by these interviews, workers did not have medical problems.

Based on industrial hygiene data, the only hazard existing at the time of this survey was one overexposure to fluoride.

#### II. DISTRIBUTION AND AVAILABILITY

Copies of this determination report are currently available upon request from NIOSH, Division of Technical Service, Information Resources and Dissemination Section, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After 90 days the report will be available through the National Technical Information Service (NTIS), Springfield, Virginia. 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. Stearns-Roger Fabricators, Inc..
- 2. U.S. Department of Labor/OSHA Region VIII.
- 3. NIOSH Region VIII.
- 4. Colorado Department of Health.

For the purpose of informing all employees, a copy of this report shall be posted in a prominent place accessible to the employees for a period of 30 calendar days.

#### III. INTRODUCTION

Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669(a)(6), authorizes the Secretary of Health, Education, and Welfare, following a written request by 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.

NIOSH received such a request from the management of Stearns-Roger Fabricators, Inc. to evaluate potential hazards associated with the welding of steel and stainless steel in the production of a variety of products such as steel parts for power plants and chemical and petrochemical plants.

#### IV. HEALTH HAZARD EVALUATION

#### A. Processes Evaluated

Stearns-Roger Fabricators, Inc. performs many different types of welding. This particular plant is certified in over 340 qualified welding procedures. All welders are certified. The types of welding include submerged arc, tungsten inert gas (TIG), and metal inert gas (MIG). Heavy steel is welded using one of the welding processes listed above.

#### B. Environmental Evaluation Design and Methods

There are approximately 50 workers in the specific areas of this request. Most welders were monitored. Only two men were painting, and both of these workers were monitored.

All iron oxide, manganese, fluoride, nickel, copper, chrome (metal), and Cr<sup>+6</sup> samples were collected on 37 millimeter filters using pumps operated at 1.5 liters per minute. The iron oxide, manganese, chrome (metal), nickel, and copper samples were analyzed by atomic absorption spectroscopy using Physical & Chemical Analysis Method (P&CAM) No. 173. Fluoride was analyzed according to P&CAM Method No. 212 using a fluoride electrode. Cr<sup>+6</sup> was analyzed by atomic absorption after being treated with sodium carbonate.

#### C. Medical Evaluation Design and Methods

The medical investigation and walk-thru of Stearns-Roger Fabricators, Inc. was done in August 1979. Pertinent health data was obtained from all available employees by interview using a routine directed guestionnaire.

All potentially exposed workers were interviewed pre-shift and post-shift, which included a total of 20 workers (17 welders, 2 sand blasters, and one pipefitter). Workers' age ranged from 22 to 61 years with a mean age of 40.3 years. The range of employment duration was 2 months to 20 years with a mean of 4.0 years. Twenty percent (4/20) of the workers were smokers.

#### D. Criteria for Assessing Workroom Concentrations of Air Contaminants

Three sources of criteria are generally used to assess workroom concentrations of air contaminants: (1) NIOSH criteria for recommended standards; (2) recommended Threshold Limit Values (TLVs) and their supporting documentation as set forth by the American Conference of Governmental Industrial Hygienists (ACGIH), 1979; (3) Occupational Safety and Health Administration (OSHA) standards (29 CFR 1910.1000), January 1978. NIOSH criteria and ACGIH TLVs represent the most recent and relevant recommendations and are given prominence in this evaluation.

> Permissible Exposures 8-Hour Time-Weighted Exposure Basis (mg/M<sup>3</sup>)

Substance	NIOSH Criteria for Recommended Standard	TLV	Current OSHA Standard
Manganese		5.0"C"	
Iron Oxide		5.0	
Fluoride	2.5	2.5	2.5
Chrome (metal)		0.5	1.0
Copper		0.2	0.1
Nickel	0.015	1.0	1.0
Cr <sup>+6</sup>	0.001	0.05	0.5
Manganese. Iron Oxide. Fluoride. Chrome (metal). Copper. Nickel. Cr <sup>+6</sup> .	2.5  0.015 0.001	5.0"C" 5.0 2.5 0.5 0.2 1.0 0.05	2.5 1.0 0.1 1.0 0.5

mg/M<sup>3</sup> = milligrams of substance per cubic meter of air "C" = ceiling value and should never be exceeded

Occupational health standards are established at levels designed to protect individuals occupationally exposed to toxic substances on an 8-hour per day, 40-hour per week basis over a normal working lifetime.

#### E. Toxicology

<u>Manganese</u> -- Chronic manganese poisoning is a clearly characterized disease which results from the inhalation of fumes or dust of manganese. The central nervous system is the chief site of damage. If cases are removed from exposure, some improvement frequently occurs. However, there may be some residual disturbance in gait and speech. When the disease is well established, the result is permanent disability.

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<u>Iron Oxide</u> -- Iron oxide is relatively non-toxic. Chronic exposures to high concentrations do cause a disease called siderosis. The main complication of this disease is that it prevents getting a good X-ray of the lungs in case another lung disease occurs. Siderosis does not decrease pulmonary function or cause any other metabolic disturbances.

Fluoride -- Chronic exposure to fluoride may cause anorexia, nausea, vomiting, constipation, weight loss, weakness, shortness of breath, and stiffness of joints. It may also produce fluorosis. (Reference 1)

Nickel -- Exposures to nickel are commonly found in welding procedures. The most toxic route of entry is by inhalation. Nickel is an irritant, sensitizer, and carcinogen. Signs and symptoms of nickel overexposures include gingivitis, stomatitis, and metallic taste. Acute symptoms include metal fume fever and nickel itch. Dermatitis with eczema may occur later. Carcinoma of the nasal sinuses and lungs may result from chronic exposure. (Reference 2)

Occupational exposure to nickel should be controlled so that workers are not exposed to concentrations greater than  $15 \text{ ug/M}^3$ . (Reference 3)

<u>Copper</u> -- Copper exposures may occur by ingestion and inhalation. Copper is an irritant to the eyes, nose and respiratory tract. It causes perforation of nasal septum, metal fume fever, and dermatitis. Ingestion may produce nausea, vomiting, and diarrhea. Chronic exposures may produce pigment cirrhosis of the liver. Maintaining a worker's exposure below 0.1 mg/M<sup>3</sup> for an 8-hour time weighted average (TWA) should protect the worker from any of these effects. (Reference 4)

<u>Chromium (VI)</u> --  $CR^{+6}$  is known to produce lung cancer. Dermatitis may result from skin contact with  $Cr^{+6}$ . Ulcerations of wrists and arms is commonly found in overexposed workers. (Reference 5)  $Cr^{+6}$  overexposure documentation of welders welding stainless steel has not been observed. Stainless steel welding without adequate ventilation is a potential source of  $Cr^{+6}$  exposures.

Chrome (metal) -- The most toxic route of entry is by inhalation--followed by percutaneous. Chrome (metal) is very corrosive and is a strong sensitizer. Perforation of nasal septum is seen frequently. Adequate ventilation and frequent monitoring of the work environment is necessary to prevent overexposures. No eating and smoking should be allowed in the work area. Workers sensitized should be removed from the work place. (Reference 6)

#### F. Environmental Results and Discussion

Results of environmental sampling, which included over 50 breathing zone 8-hour TWA samples with over 200 different chemical analyses, showed that workers were not overexposed to manganese, iron oxide, nickel, copper, chrome (metal), and Cr+6. Five welders were monitored for fluoride exposure. One of the workers did receive an overexposure. Fluoride exposures were the highest exposures observed during this evaluation. Chromium (VI) was analyzed on samples taken on welders welding stainless steel. All samples were below NIOSH laboratory limits of detection.

For a detailed description of environmental samples, refer to Tables 1 and 2.

#### G. Medical Results and Discussion

Thirteen (65%) workers reported no symptoms or complaints either pre- or post-shift. Seven workers reported symptoms. Four workers (20%) reported runny or stuffy nose. One of these four workers, however, had a history of hayfever. The other three of these four reported nasal symptoms accompanied by either headache, shortness of breath/heavy chest or stomach pain. The three remaining workers (15%) reported individual complaints of frequency of urination, fatigue, or eye irritation.

Based on the data collected by interviews, symptoms were not prevalent in these workers. Symptoms such as respiratory irritation or possibly metal fume fever might be evident in a significantly exposed worker population. Chronic iron oxide exposure may result in a benigh pneumoconiosis which is detectable by chest X-ray.

#### H. Conclusions

Results of environmental and medical data illustrate that only one worker was overexposed to fluoride. All other environmental samples were well within the most recent evaluation criteria. A follow-up study should be conducted during cold weather when doors and windows are closed, since there is no local or general ventilation present in this facility. One of the reasons for workers not being overexposed was due to the welders' work practices, such as avoiding the welding fume plume, and good hygienic habits. The medical evaluation indicated that workers were not being overexposed.

#### V. RECOMMENDATIONS

- Engineering controls such as local exhaust ventilation and/or electrostatic precipitators as appropriate should be provided to reduce welding fume exposures.
- 2. Eating and smoking should be prohibited in the work area.
- 3. Welders working with flux or welding rod containing fluoride should have adequate ventilation installed.

# VI. REFERENCES

- 1. Plunkett, E.R., Handbook of Industrial Toxicology, Chemical Publishing Company, New York, 1976, pp. 188-190.
- 2. Ibid., pp.287-288.
- 3. NIOSH Criteria for a Recommended Standard....Occupational Exposure to Inorganic Nickel, DHEW (NIOSH) Publication No. 77-164, Cincinnati, Ohio, 1977.
- 4. Plunkett, pp. 114-115.
- NIOSH Criteria for a Recommended Standard....Occupational Exposure to Chromium (VI), DHEW (NIOSH) Publication No. 76-129, Cincinnati, Ohio, 1975.
- 6. Plunkett, pp. 108-109.

# VII. AUTHORSHIP AND ACKNOWLEDGMENTS

Report Prepared By:

Environmental and Medical Evaluation Assistance:

Originating Office:

Report Typed By:

Bobby J. Gunter, Ph.D. Regional Industrial Hygienist NIOSH - Region VIII Denver, Colorado

Arthur S. Watanabe, Pharm.D. Medical Investigator Medical Section, Hazard Evaluation and Technical Assistance Branch (HETAB) NIOSH - Cincinnati, Ohio

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Arvin G. Apol Regional Industrial Hygienist NIOSH - Region X Seattle, Washington

John Harris, M.D. Medical Officer Medical Section, HETAB NIOSH - Cincinnati, Ohio

Jerome P. Flesch, Acting Chief Hazard Evaluation and Technical Assistance Branch NIOSH - Cincinnati, Ohio

Marilyn K. Schulenberg NIOSH - Region VIII Denver, Colorado

# TABLE 1

# Breathing Zone and General Room Air Concentrations of Iron, Manganese, Chrome (Metal), Nickel, and Copper

# Stearns-Roger Fabricators, Inc. Denver, Colorado

### August 15-17, 1979

Cample						mg/M3		
Number	Location	Job Classification	Sampling Time	Fe	Mn	Chrome	Ni	Cu
1	0.67	Wolder	7.02 AM - 2:40 PM	0.61	0.08	*	*	*
1	D-57	Welder	7:03 AM - 2:45 PM	2.20	0.16	0.01	*	0.01
2	L-84	Welder	7:06 AM - 2:18 PM	0.99	0.09	0.01	*	*
3	D-15	Welder	7.07 AM - 2.30 PM	0.80	0.06	*	*	0.01
4	F-55	Welder	7.08 AM - 2.32 PM	0.89	0.06	0.01	*	*
5	B-64	Welder	7.00 AM - 2.32 PM	0.68	0.05	0.01	*	*
6	C-68	Welder	7.10 AM - 2.30 PM	2 7	0.52	0.01	*	0.01
7	D-97	Welder	7.10 AM 2.30 PM	1.4	0.11	*	*	0.01
8	F-53	Welder	7.11 AM 2.20 DM	0.7	0.03	*	*	*
9	F-55	Welder	7:11 AM - 2:24 PM	0.7	0.02	*	*	0.01
10	Tack Welding	welder	7:14 AM - 2:43 PM	0.7	0.02	*	*	*
11	F-58	Welder	7:15 AM - 2:19 PM	21	0.05	0.01	*	0.02
12	C-50	Welder	7:15 AM - 2:30 PM	1 2	0.02	0.01	*	N/A
28	Grit Blast	Blaster	7:11 AM - 3:03 PM	1.2	0.02	0.01	*	N/A
29	Grit Blast	Blaster	7:13 AM - 3:02 PM	1.3	0.02	*	*	N/A
30	Fabrication	Welder	7:12 AM - 2:45 PM	0.9	0.04	*	*	N/A
31	Fabrication	Welder	7:13 AM - 2:48 PM	0.7	0.00	*	*	N/A
34	North End	Welder	7:24 AM - 2:12 PM	0.7	0.05	+	*	
35	C. Steel Automatic	Welder	7:25 AM - 2:52 PM	0.6	0.06	4	*	N/A
36	Central Shop	Welder	7:28 AM - 2:54 PM	0.4	0.05	÷	т о	N/A
37	N. Corner	Welder	7:30 AM - 2:12 PM	0.1	*	~ ~ ~ ~ ~	<u>^</u>	N/A
38	Skid Shop	Welder	7:31 AM - 2:57 PM	1.5	0.33	0.01	*	N/A
39	Middle Positioner	Welding	7:31 AM - 2:50 PM	2.0	0.36	0.01	×	N/A
41	C-84	Welding	7:26 AM - 2:10 PM	1.0	N/A	*	*	N/A
42	C-84	Welding	7:19 AM - 2:10 PM	1.4	N/A	0.01	*	N/A
43	Alloy Room	Welding	7:05 AM - 2:05 PM	1.0	N/A	*	*	N/A

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# TABLE 1 (Continued)

Sample						mg/M3		
Number	Location	Job Classification	Sampling Time	Fe	Mn	Chrome	Ni	Cu
45	Central Shop	Welding	7:11 AM - 1:50 PM	0.4	N/A	*	*	N/A
46	Skid Shop	Welding	7:13 AM - 2:00 PM	0.5	N/A	*	*	N/A
47	General Area	East Side	7:35 AM - 2:10 PM	0.3	N/A	*	*	N/A
48	Allov Room	Welding	7:05 AM - 2:12 PM	1.1	N/A	0.01	*	N/A
49	Fabrication	Welding	7:09 AM - 12:10 PM	0.8	N/A	*	*	N/A
50	Central Shop	Welding	7:10 AM - 2:14 PM	0.6	N/A	*	*	N/A
52	General Area	Skid	7:37 AM - 2:05 PM	0.1	N/A	*	*	N/A
53	Water Base Paint	Painter	9:20 AM - 2:00 PM	0.1	N/A	*	*	N/A
54	General Area	Center	7:36 AM - 2:13 PM	0.2	N/A	*	*	N/A
13	Tack Welding	Welder	7:16 AM - 2:45 PM	0.4	0.04	*	*	*
14	F-59	Welder	7:18 AM - 2:28 PM	0.5	0.01	*	*	0.01
15	F-60	Welder	7:20 AM - 2:28 PM	0.5	0.02	*	*	*
16	F-49	Welder	7:20 AM - 2:30 PM	0.5	0.03	*	*	0.01
17	F-51	Welder	7:20 AM - 2:40 PM	0.4	0.03	0.01	*	*
18	Blasting	Blaster	7:23 AM - 2:28 PM	0.9	0.01	*	*	*
19	Blasting	Blaster	7:24 AM - 2:30 PM	0.8	0.01	*	*	*
21	Alloy Room	Welder	7:00 AM - 2:40 PM	1.6	0.22	0.01	*	*
22	Alloy Room	Welder	7:02 AM - 2:42 PM	2.5	0.23	0.01	*	*
23	Alloy Room	Welder	7:02 AM - 2:46 PM	1.1	0.12	*	*	0.01
24	Alloy Room	Welder	7:04 AM - 2:45 PM	0.9	0.10	*	*	0.01
26	Automatic Welder	Welder	7:08 AM - 2:47 PM	1.0	0.22	*	*	0.01
		EVALUATION CRITERI	A	5.0	1.0	0.025	1.0	1.0
		LABORATORY LIMIT O	F DETECTION mg/sample	0.002	0.002	0.003	0.002	0.002

\* = below laboratory limit of detection N/A = not analyzed

# TABLE 2

# Breathing Zone Air Concentrations of Fluoride

# Stearns-Roger Fabricators, Inc. Denver, Colorado

August 15-17, 1979

Sample Number	Location	Job Classification	Sampling Time	mg/M3 Fluoride	
32	Skid Shop	Welder	7:20 AM - 3:00 PM	0.43	
33	Skid Shop	Welder	7:21 AM - 3:08 PM	2.57	
27	Automatic Welder	Welder	7:10 AM - 2:55 PM	0.07	
44	Automatic Welder	Welder	7:08 AM - 2:05 PM	0.50	
40	Skid Shop	Welder	7:14 AM - 2:12 PM	0.03	

EVALUATION CRITERIA 2.5 LABORATORY LIMIT OF DETECTION mg/sample 0.004