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CENTER FOR DISEASE CONTROL
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH
CINCINNATI, OHIO 45226

HEALTH HAZARD EVALUATION DETERMINATION
REPORT NO. 79-30-669

CF&I STEEL CORPORATION
PUEBLO, COLORADO

FEBRUARY 1980

I. SUMMARY

In January 1979 the National Institute for Occupational Safety and Health (NIOSH) received a request to evaluate employee exposures to lead, solvents, and crystalline silica in the galvanizing department, fence post shop, and the casting foundry at CF&I Steel Corporation, Pueblo, Colorado. In order to evaluate these three areas, an extensive medical and industrial hygiene evaluation was performed. Breathing zone air samples were taken on workers for determination of exposures to quartz and cristobalite, total respirable dust, lead, zinc, iron, chromium, total hydrocarbons, and m-xylene. Medical evaluation consisted of a comprehensive medical questionnaire and physical examination of 96 workers. Specific tests included blood lead levels, free erythrocyte protoporphyrin (FEP), zinc protoporphyrin (ZPP), hemoglobin, and a chemistry profile (SMA-20). The 38 casting foundry workers received PA chest radiographs for the evaluation of pneumoconiosis.

Thirty-nine percent (39%) of the breathing zone air samples taken for crystalline silica exceeded the NIOSH recommended standard of 0.05 mg/M^3. Twenty-six percent (26%) of the breathing zone air samples taken for total respirable dust exceeded the 1979 Threshold Limit Value (TLV) of 5 mg//M^3. Twenty-seven percent (27%) of the lead samples taken in the galvanizing department exceeded the Occupational Safety and Health Administration (OSHA) standard of 0.05 mg/M^3.

Increased lead absorption was found in 14 workers (blood lead greater than 40 ug/100 ml) with four having a blood lead greater than 60 ug/100 ml. Evidence of increased body burden of lead (FEP greater than 870) was noted in ten of these 14 workers. The mean blood lead level of workers in the galvanizing department (58 workers, mean = 27.34) was twice that in the casting foundry (38 workers, mean = 14.21). Nineteen percent (19%) of the casting foundry workers had radiographic abnormalities. Three chest radiographs were classified as simple pneumoconiosis; other abnormalities included pleural changes (4), cardiac enlargement (3), granuloma (1), and miscellaneous (3).

On the basis of these environmental and medical data, NIOSH concluded that a health hazard existed from overexposure to lead and crystalline silica at CF&I Steel Corporation.. Recommendations on ventilation, work practices, and medical surveillance procedures necessary to control these hazards are included on page 7.

II. INTRODUCTION

NIOSH received a request from United Steelworkers of America Local No. 2102 in Pueblo, Colorado, to determine if there was a health hazard in the galvanizing department, fence post shop, and casting foundry at the CF&I Steel Corportation, Pueblo, Colorado.[1] NIOSH was refused entry in January 1979. Therefore, in cooperation with the Union, a large percent of the workers from these three departments were given physical examinations including extensive biological monitoring at the Local Union Hall on January 25-26, 1979. Results of this medical survey were included in an application for a warrant. A warrant was issued for NIOSH to conduct a health hazard evaluation. This in-plant environmental evaluation was completed October 8-12, 1979.

III. BACKGROUND

The galvanizing department produces galvanized wire by passing steel wire through molten lead below the vaporization temperature (approximately 600 degrees F). This gives the wire tensile strength. The wire is then passed through molten zinc which completes the galvanizing process. In the galvanizing department all workers were monitored eight hours for lead and zinc exposures. Ventilation measurements were taken over all lead and zinc pots. Adequate capture ventilation velocities were present on most pots. However, the skirting should be lowered and maintained in order to better balance the ventilation on all pots.

Metal fence posts consisting of two sides with an approximate 35 degree angle are manufactured in this department. These posts are dip painted. Adequate ventilation existed in this department and was verified by the low exposures found on all breathing zone samples. A majority of the workers were monitored for eight hours for exposure to total hydrocarbons, m-xylene, lead, chromium, and iron.

The casting foundry produces parts that are used almost totally by the steel mill. It is a typical foundry using molding sands that contain crystalline silica. The furnace is adequately ventilated. A majority of the workers were monitored eight hours for crystalline silica and total dust.

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[1]Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 19 U.S.C. 669(a)(6), authorizes the Secretary of Health, Education, and Welfare, following a written request by any employer or authorized representative to employees, to determine whether any substance normally found in the place of employment has potentially toxic effects in such concentrations as used or found.

IV. METHODS

A. Environmental Methods

Crystalline silica samples were collected on 37 mm FWS-B filters and analyzed according to NIOSH Method P&CAM No. 109 using x-ray diffraction. Total dust samples were collected on 37 mm filters and calculated by weight difference. Lead, chromium, iron and zinc samples were collected on 37 mm AA filters and analyzed by NIOSH Method P&CAM No. 173. M-xylene and total hydrocarbons were collected on organic solvent charcoal tubes and analyzed according to NIOSH Method P&CAM No. 127.

B. Medical Methods

A medical questionnaire was completed which obtained data on occupational history, respiratory symptoms, past medical history, and symptoms of lead poisoning.

A limited physical examination included vital signs, as well as emphasis on objective findings of lead toxicity.

The following laboratory tests were completed on 96 workers:

1. Blood lead values were determined using the Delves' Cup Method.

2. Free erythrocyte protoporphyrins (FEP) were determined according to the method of Chisholm and Brown. (Reference 1)

3. Zinc protoporphyrins (ZPP) were measured on site using a portable analyzer.

4. Hemoglobin was measured by standard laboratory techniques.

5. A chemistry profile (SMA-20) was also performed. BUN, creatinine, and uric acid were the specific tests of interest.

6. All foundry workers were given PA chest radiographs for the evaluation of pneumoconiosis and other chest abnormalities.

V. EVALUATION CRITERIA

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), January 1978.

	Permissible Exposures 8-Hour Time-Weighted Exposure Basis (mg/M^3)
Lead	0.05 (OSHA)
Zinc	5.0 (TLV)
Iron	5.0 (TLV)
Chromium	0.5 (TLV)
m-Xylene	435.0 (TLV)
Total Hydrocarbrons	*
Total Dust.(respirable)	5.0 (TLV)
Crystalline Silica	0.05 (NIOSH)

* no evaluation criteria available.

mg/M^3 = milligrams of substance per cubic meter of air

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.

Lead -- Although capable of causing acute toxicity when absorbed in large amounts, lead exposure is usually associated with chronic toxicity due to absorption of lesser amounts over prolonged periods of time. The major route of entry of lead into the body is the lung, although slight amounts may be ingested.

The early effects of lead toxicity are non-specific, and except for laboratory determination of lead in the blood, are difficult to distinquish from the symptoms of minor seasonal illness. The symptoms are decreased physical fitness, fatigue, sleep disturbance, headache, aching bones and muscles, digestive system symptoms (particularly constipation), abdominal pains and decreased appetite. These symptoms are reversible, and complete recovery is usually possible on removal from exposure.

The three organ systems most commonly affected by lead are the bone marrow (producer of red blood cells), the nervous system, and the kidneys.

Because of more efficient material handling methods and biological monitoring, serious cases of lead poisoning are rare in industry today.

Inorganic lead has been shown to be mutagenic and teratogenic. It can cross the placental barrier and can affect embryological and fetal development. Lead is eliminated from the body via urine and feces. NIOSH recommends that a blood lead value of 60 micrograms per 100 grams whole blood (60 ug Pb/100 g blood) be the maximum occupational blood lead level. When this value is exceeded, the employee should be removed from the lead exposure to allow his body to reduce its lead burden.

Lead is a highly toxic metal, but long experience in industry has shown that good engineering controls in the workplace and good personal hygiene among employees can make lead a safe material with which to work.

The OSHA lead standard (29 CFR 1910.1025) states: The employer shall make available medical examinations for all workers that are exposed to inorganic lead at levels exceeding 30 ug/M^3 over an 8-hour work period. This level (30 ug/M^3) is called the action level. Each worker at or above 40 ug/100 grams shall also have an annual physical examination according to OSHA 1910.1025.

Zinc -- Overexposures to zinc may produce fever and chills (metal fume fever) which subsides within twelve hours but may leave a metallic taste.

Iron -- Overexposures to iron over a prolonged period may produce a benign condition called siderosis which may be described as iron coating of the lungs.

Chromium -- The most toxic route of entry is by inhalation--followed by percutaneous. Chromium is very corrosive and is a strong sensitizer. Perforation of the 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 2)

m-Xylene -- This solvent may cause irritation of the respiratory tract, fatigue, headaches, dizziness, narcosis, and anemia. Maintaining a worker's exposure below 435 mg/M^3 should protect the worker from these symptoms. (Reference 3)

Total Hydrocarbons -- A more specific analysis would have been performed. However, CF&I Steel officials prohibited NIOSH investigators from securing bulk samples of this compound which limited the laboratory in its analyses. In order to be safe one would have to assume that any exposure to total hydrocarbons would be hazardous. The OSHA Form 20 was given for this substance. There was not sufficient data on this form for adequate evaluation.

Total Dust -- Overexposures to any dust may produce damage to the total respiratory system especially if the dust contains disease producing substances.

Crystalline Silica -- Exposures at levels above the recommended criteria can produce a fibrotic condition of the lungs (silicosis). This is a disabling disease that can lead to permanent disability and death. Maintaining a worker's exposure below 0.05 mg/M^3 should prevent any occupational disease.

VI. RESULTS

A. Environmental Results

Twenty-seven percent (27%) of the lead samples taken in the galvanizing shop exceeded the evaluation criteria. None of the zinc samples exceeded the evaluation criteria. The results may be reviewed in Table 1.

Thirty-nine percent (39%) of the breathing zone samples taken in the casting foundry exceeded evaluation criteria. Twenty-six percent (26%) of the breathing zone samples for total dust exceeded the evaluation criteria. See Table 2 for results.

Chromium, iron, and m-xylene breathing zone samples did not exceed evaluation criteria. Results may be reviewed in Tables 3 and 4.

B. Medical Results and Discussion

96 workers (all male) participated in the study. This included 38 foundry workers and 58 workers associated with the galvanization process. Although the galvanization group and the foundry workers showed no difference in mean age or length of employment, the average blood lead level in the galvanization group was twice that in the foundry workers. (Table 5). There was also more reported nausea (22%) and insomnia (36%) in the galvanization group (Table 6). 36% of the workers in the galvanizing group reported wearing respirators compared to 63% of the foundry group. However, only 5 of the 14 workers with blood lead levels greater than 40 ug/100 ml did not report wearing a respirator.

The results of the physical examinations are shown in Table 7. Hypertension (diastalic blood pressure greater than 90 mmHg) was found in 29% of the workers examined. In those with blood lead levels greater than 40 ug/100 ml, 43% had an elevated blood pressure. Neurological signs (weakness, sensory changes, reflex changes) were infrequent, and did not differ between the galvanizers and the foundry workers. One worker had clinical evidence of a presenile dementia. Although he had worked in a lead exposure area for more than 30 years, his blood lead and FEP were normal.

Fourteen galvanizers had blood lead levels greater than 40 ug/100 ml. Their mean age and length of exposure were not different from all the galvanizers or foundry workers. The highest blood lead level was 66 ug/100 ml. The measures of kidney function (BUN, creatinine) were normal, and no one had anemia. Ten of the fourteen had FEP's greater than 870 which is consistent with an increased body burden of lead.

The results of the comparison of the group with blood leads greater than 40ug/100 ml with the overall galvanization group by job classification is shown in Figure 1. This graph demonstrates that increased lead absorption is mainly confined to the wire shop, specifically to the job classifications of blocker, lead pan operator, patent furnace operator, and reeler. Historically, respirators were consistently worn around the lead pan operation, but otherwise were used only for "high" dust exposures.

In comparing the groups for respiratory complaints, the foundry group had a higher reported prevalence of dyspnea on exertion (shortness of breath when walking) and past history of pulmonary disease (Table 8). Smoking histories

did not significantly differ between the two groups. 3 of the 36 foundry workers having chest X-rays done had evidence of silicosis on these X-rays when read using the ILO-UC 1971 classification system. No complicated or advanced disease was found on X-ray. The remainder of the abnormal radiographs included pleural changes (4), cardiac enlargement (3) and granuloma (1).

Conclusions:

1. A health hazard due to lead exposure was found at this facility. Both over exposure to lead (from the environmental samples) and increased absorption of lead (from the medical testing) were demonstrated. This hazard due to lead exposure was confined to the galvanizing area. The medical data indicate that the increased lead absorption is mainly confined to the wire shop.

2. A health hazard due to overexposure to crystalline silica and total respirable dust was found in the foundry. Evidence of silicosis was found in 3 of the 36 foundry workers having chest X-rays done. An increased prevalence of respiratory symptoms was also found in the foundry workers.

VII. RECOMMENDATIONS

1. Workers with blood lead level greater than 40 ug/100 ml should be retested, and if still elevated, measures need to be taken to reduce their exposure. The new OSHA lead standard and its present implementation status should also be consulted.

2. All casting foundry workers should regularly receive chest radiographs, pulmonary function testing, and respiratory symptom questionnaires to screen for silicosis.

3. The ventilation system should be balanced in the galvanizing shop.

4. Adequate changing rooms and clean clothing should be provided for all galvanizing department workers.

5. The entire walls and ceilings of the galvanizing shop should be cleaned and vacuumed.

6. No eating, drinking, smoking, or snuff usage should be allowed in the galvanizing department, fence post shop, or casting foundry.

7. The respirator program should be enforced.

8. Local ventilation should be installed at the shakeout, and general ventilation should be installed throughout the casting foundry.

9. A hypertension screening and detection program would appear useful.

VIII. REFERENCES

1. Chrisholm JJ, Brown DH: Micro-scale photofluorometric determination of "free erythrocyte porphyrin (protoporphyrin IX). Clinical Chemistry 21(11):1669-1682, 1975.

2. Plunkett, E.R., Handbook of Industrial Toxicology, Chemical Publishing Company, New York, 1976, pp. 108-109.

3. Ibid., p. 438.

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X. 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. CF&I Steel Corporation.
2. U.S. Steelworkers of America Local 2101.
3. U.S. Department of Labor/OSHA - Region VIII.
4. NIOSH - Region VIII.

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.

TABLE 1

Atmospheric Breathing Zone Concentrations of
Lead (Pb) and Zinc (Zn)

CF&I Steel Corporation
Pueblo, Colorado

October 10, 1979

Sample Number	Job Classification	Location	Sampling Time	mg/M3 Pb	mg/M3 Zn
109	Wiper Line	Galvanizing	6:05 AM - 1:57 PM	0.01	0.04
114	Blocker Pan	Galvanizing	6:15 AM - 1:50 PM	0.01	0.04
108	Reeler Pan	Galvanizing	6:20 AM - 2:02 PM	0.13	0.04
113	Operator Pan	Galvanizing	6:26 AM - 1:58 PM	0.03	0.03
107	Laborer	Galvanizing	6:31 AM - 2:00 PM	0.02	0.05
112	Operator	Galvanizing	6:31 AM - 1:59 PM	0.02	0.04
102	Gas Tender	Galvanizing	6:31 AM - 1:59 PM	0.01	0.04
111	Laborer	Galvanizing	6:32 AM - 2:00 PM	0.05	0.03
103	Wiper	Galvanizing	6:33 AM - 2:02 PM	0.01	0.10
106	Operator	Galvanizing	6:35 AM - 2:05 PM	0.08	0.24
110	Reeler	Galvanizing	6:43 AM - 1:54 PM	22.0 *	0.31
		EVALUATION CRITERIA		0.05	5.0
		LABORATORY LIMITS OF DETECTION		0.005	0.002

* = This sample was eliminated in statistical analyses of this data.

TABLE 2

Atmospheric Breathing Zone Concentrations of
Respirable Crystalline Silica (Quartz)(Cristobalite) and Total Respirable Dust

CF&I Steel Corporation
Pueblo, Colorado

October 9-11, 1979

Sample Number	Job Classification	Location	Sampling Time	mg/M^3 Quartz	Cristobalite	Respirable Dust
4098	Craneman	Foundry	2:43 PM - 9:40 PM	0.07	*	0.52
4102	Crane Helper	Foundry	2:45 PM - 9:40 PM	0.09	*	0.55
4113	Craneman	Foundry	2:47 PM - 9:40 PM	0.04	*	0.40
4117	Helper	Foundry	2:47 PM - 9:40 PM	0.04	*	0.30
4110	Helper	Foundry	2:48 PM - 9:40 PM	0.13	*	0.76
4119	Pourer	Foundry	2:52 PM - 9:30 PM	0.10	*	0.71
4106	Helper	Foundry	2:54 PM - 9:40 PM	0.12	*	0.51
4099	Helper	Foundry	2:58 PM - 9:38 PM	0.21	*	1.16
4116	Foreman	Foundry	3:00 PM - 9:40 PM	0.04	*	0.34
4103	Molder	Foundry	5:26 AM - 2:11 PM	0.09	*	2.49
4108	Craneman	Foundry	6:30 AM - 1:08 PM	0.28	*	1.29
4097	Sand Slinger	Foundry	6:25 AM - 1:03 PM	0.13	*	0.75
4111	Craneman	Foundry	5:26 AM - 1:05 PM	*	*	0.17
4109	Ingot Molder	Foundry	6:20 AM - 11:32 AM	*	*	6.70
4104	Sand Mixer	Foundry	6:19 AM - 1:03 PM	*	*	5.30
4114	Core Maker	Foundry	6:10 AM - 11:50 AM	*	*	1.70
4105	Molder	Foundry	6:32 AM - 1:53 PM	*	*	7.20
4101	Chipper	Foundry	6:58 AM - 2:20 PM	*	*	6.84
4096	Molder	Foundry	6:10 AM - 2:01 PM	*	*	2.30
4100	Iron Pourer	Foundry	5:41 AM - 2:06 PM	*	*	7.96
4112	Sand Blaster	Foundry	6:00 AM - 2:25 PM	*	*	5.24
4118	Craneman	Foundry	6:05 AM - 2:04 PM	*	*	0.48
4107	Foreman	Foundry	6:17 AM - 1:17 PM	*	*	2.27
			EVALUATION CRITERIA	0.05	0.05	5.0
			LABORATORY LIMIT OF DETECTION	0.03	0.03	0.03

* = below laboratory limit of detection

TABLE 3

Atmospheric Breathing Zone Concentrations of
Lead (Pb), Chromium (Cr), and Iron (Fe)

CF&I Steel Corporation
Pueblo, Colorado

October 11, 1979

Sample Number	Job Classification	Location	Sampling Time	mg/M3 Pb	Cr	Fe
78	Shearer Helper	Post Dept.	6:48 AM - 1:56 PM	*	*	0.2
91	Riviter	Post Dept.	6:42 AM - 2:05 PM	*	*	1.3
92	Shearer	Post Dept.	6:40 AM - 1:28 PM	0.01	*	1.1
76	Paint Man	Post Dept.	6:37 AM - 2:05 PM	0.01	*	0.8
77	Chipper	Foundry	6:32 AM - 2:20 PM	*	*	0.8
104	Furnace Helper	Foundry	4:02 AM - 11:33 AM	0.01	*	0.3
100	Furnace Operator	Foundry	4:05 AM - 11:32 AM	0.01	*	0.2
90	Skimmer Pourer	Foundry	5:28 AM - 1:25 PM	*	*	0.1
		EVALUATION CRITERIA		0.05	0.5	5.0
		LABORATORY LIMIT OF DETECTION		0.005	0.003	0.005

* = below laboratory limit of detection

TABLE 4

Atmospheric Breathing Zone Concentrations of
Total Hydrocarbons and m-Xylene in the
Fence Post Department

CF&I Steel Corporation
Pueblo, Colorado

October 11, 1979

Sample Number	Job Classification	Location	Sampling Time	mg/M^3 Total Hydrocarbons	mg/M^3 m-Xylene
1	Bundler	A-Line	6:32 AM - 1:58 PM	17	1.5
2	Bundler	A-Line	6:34 AM - 1:52 PM	17	0.8
3	Bundler	B-Line	6:36 AM - 1:48 PM	13	0.7
4	Plateman	Post Dept.	6:38 AM - 1:55 PM	16	0.6
5	Bundler	B-Line	6:44 AM - 2:00 PM	15	0.6
6	Riviter	A-Line	6:46 AM - 1:55 PM	41	2.0
7	Shearer Helper	A-Line	6:46 AM - 1:55 PM	19	2.0
8	Bundler	A-Line	6:55 AM - 1:55 PM	*	3.0
9	Bundler	A-Line	6:55 AM - 1:55 PM	10	0.5
10	Riviter	A-Line	6:50 AM - 2:02 PM	52	2.0
11	Bundler	A-Line	7:09 AM - 1:50 PM	19	2.0
12	Millwright	B-Line	9:21 AM - 1:54 PM	23	1.0
		EVALUATION CRITERIA		*	435.0
		LABORATORY LIMIT OF DETECTION mg/sample		0.1	0.01

* = no standard exists--unable to analyze for specific chemical since CF&I Steel Corporation prohibited NIOSH from securing a bulk sample.

The OSHA Form 20 stated petroleum distillate 41% (mineral spirits) TLV 500 mg/M^3. However, neither petroleum distillate nor mineral spirits are in 1979 TLV's.

Table 5

Demographic Characteristics of the Survey Population

CF&I Steel Corporation
Pueblo, Colorado

Characteristics	Galvanizers with Blood Lead >40µg/100ml (N=14)	All Galvanizers (N=58)	All Foundry Workers (N=38)
Age			
Mean	43.29	45.36	44.47
Standard Deviation	10.21	10.41	14.35
Range	22-53	22-59	21-64
Duration of Employment at CF & I Steel Corporation			
Mean	20.21	23.26	22.24
Standard Deviation	11.00	11.12	13.15
Range	<1-36	<1-50	2-43
Blood Leads			
Mean	53.07	27.34	14.21
Standard Deviation	7.99	17.47	6.07
Range	43-66	<6-66	7-37

Table 6

Historical Data for Lead Exposure
CF&I Steel Corporation - Pueblo, Colorado

History and Symptoms	Galvanizers with Blood Lead >40µg/100ml				All Galvanizers				All Foundry Workers			
	Smoker (N=8)		Nonsmoker (N=6)		Smoker (N=41)		Nonsmoker (N=17)		Smoker (N=26)		Nonsmoker (N=12)	
	N	%	N	%	N	%	N	%	N	%	N	%
Lead History												
Wearing clothes home, at least once a week	0	0	0	0	2	5	3	18	5	19	4	33
Do not usually shower before going home	3	38	3	50	23	56	14	24	10	38	6	50
Do not use respirator in dusty areas	4	50	1	17	27	66	10	59	10	38	4	33
History of metal fume fever	0	0	0	0	7	17	2	12	2	8	0	0
History of lead toxicity	1	13	0	0	2	5	0	0	0	0	0	0
Symptoms												
Poor appetite	2	25	0	0	5	12	1	6	0	0	0	0
Constipation	0	0	0	0	4	10	1	6	1	4	1	8
Nausea more than 2 times per week	0	0	2	33	8	20	5	29	2	8	1	8
Crampy abdominal pain	1	13	1	17	5	12	3	18	1	4	0	0
Metallic taste in mouth	2	25	0	0	11	27	4	24	6	23	2	17
Sweet taste in mouth	1	13	1	17	7	17	4	24	1	4	1	8
Tires easily	2	25	1	17	12	29	5	29	5	19	3	25
Difficulty falling asleep	2	25	1	17	15	37	6	35	2	8	2	17

Table 7

Physical Examination
CF&I Steel Corporation - Pueblo, Colorado

Physical Signs	Galvanizers with Blood Lead >40µg/100ml				All Galvanizers				All Foundry Workers			
	Smoker (N=8)		Nonsmoker (N=6)		Smoker (N=41)		Nonsmoker (N=17)		Smoker (N=26)		Nonsmoker (N=12)	
	N	%	N	%	N	%	N	%	N	%	N	%
Hypertension	3	38	3	50	6	15	8	47	4	19	4	33
Lead line	0	0	0	0	0	0	0	0	0	0	0	0
Chest	1	13	0	0	2	5	0	0	0	0	0	0
Abdomen	0	0	0	0	2	5	0	0	1	4	2	17
Neurology	1	13	2	33	4	10	6	35	4	15	4	33

Table 8

Historical Data of Respiratory Symptoms and Past Medical History
CF&I Steel Corporation - Pueblo, Colorado

Medical History	Galvanizers with Blood Lead >40µg/100ml				All Galvanizers				All Foundry Workers			
	Smoker (N=8)		Nonsmoker (N=6)		Smoker (N=41)		Nonsmoker (N=17)		Smoker (N=26)		Nonsmoker (N=12)	
	N	%	N	%	N	%	N	%	N	%	N	%
Respiratory Symptoms												
Chronic bronchitis	4	50	1	17	11	27	3	18	4	15	2	17
Dyspnea on exertion	1	13	1	17	10	24	5	29	11	42	2	17
History of asthma	0	0	0	0	8	20	2	12	5	19	2	17
Hemoptysis	0	0	1	17	3	7	3	18	3	12	1	8
Past Medical History												
History of hospitalization	8	100	3	50	33	80	13	76	17	65	7	58
History of serious accidents	3	38	0	0	11	27	3	18	4	15	2	17
History of pulmonary disease	0	0	1	17	8	20	4	24	9	35	4	33
History of dermatological disease	0	0	0	0	8	20	4	24	1	4	0	0
History of neurological disease	1	13	0	0	12	29	0	0	5	19	0	0
History of cancer	0	0	0	0	2	5	0	0	1	4	0	0

Figure 1

Comparison of Job Classifications of galvanizers with Blood Lead Values >40µg/100ml to Total Galvanization Group
CF&I Steel Corporation - Pueblo, Colorado