



Walk-Through Survey Report  
of the  
Steel Manufacturing and Alloying Operations  
at  
ARMCO Middletown Works  
Middletown, Ohio

SURVEY CONDUCTED BY:  
Robert Herrick  
Sanford Leffingwell

DATE OF SURVEY:  
March 15, 1979

REPORT WRITTEN BY:  
Robert Herrick  
Sanford Leffingwell

DATE OF REPORT:  
August 28, 1979

Industrial Hygiene Section  
Industry-wide Studies Branch  
Division of Surveillance, Hazard Evaluations and Field Studies  
National Institute for Occupational Safety and Health  
Cincinnati, Ohio

PURPOSE OF SURVEY:

To conduct a preliminary investigation of steel manufacturing operations as part of the current NIOSH-IWSB study of occupational exposure to manganese.

EMPLOYER REPRESENTATIVES  
CONTACTED:

Howard Shueller, Supervisor  
Safety & Industrial Hygiene

Mike Sullivan  
Industrial Hygiene Engineer

Dave Schwartz  
Assistant Industrial Hygiene Engineer

EMPLOYEE REPRESENTATIVE  
CONTACTED:

Phil Spangler  
ARMCO Employees Independent Federation

STANDARD INDUSTRIAL  
CLASSIFICATION OF PLANT:

3312

## INTRODUCTION

The National Institute for Occupational Safety and Health (NIOSH), is currently conducting an investigation of health effects resulting from occupational exposure to manganese. This study, initiated in the summer of 1978, was prompted in part by a lack of information on health effects of exposure to manganese at low levels and a lack of confidence in the safety margin of present standards, expressed in documentation of the American Conference of Governmental Industrial Hygienists Threshold Limit Values (TLVs) and elsewhere.

Occupational exposure to manganese may occur in a variety of commercial activities, including steel making, chemical processing, dry cell manufacture, and many others.

This survey of the ARMCO Steel Corporation, Middletown Works, in Middletown, Ohio, was conducted as one of a series of initial walk-through surveys in a representative sample of firms manufacturing or using products containing manganese.

## DESCRIPTION OF FACILITY

The ARMCO Steel Corporation, Middletown Works were built in 1901 to 1913, with major renovations in 1965 and 1966. The plant site occupies about 2500 acres, with about 300 acres under roof. The plant is a complete steel making works, specializing in sheet steel and tubing, which contain less than 0.5% manganese.

## DESCRIPTION OF WORKFORCE

The plant employs approximately 6,300 production and maintenance workers, and about 700 supervisory and administrative personnel. Potential for manganese exposure is limited to the furnacemen, helpers, or refractormen making additions to the melt. The melting operations are performed on a 3 shift per day, 4 crew, 7 days per week basis.

## DESCRIPTION OF STEEL PRODUCTION PROCESSES

Steelmaking at ARMCO is accomplished by either basic oxygen furnace or open hearth furnace.

The basic oxygen furnace (BOF) is charged with molten iron from a blast furnace. Oxygen is forced through the melt to reduce carbon content and promote the oxidation of impurities in the bath. Samples are taken for chemical analysis and instructions for additives are sent back to the

furnacemen. Additives, in the form of electrolytic manganese metallic flakes about 3-7 millimeters thick and, typically, 1-10 centimeters in diameter; ferromanganese and silicomanganese as irregular chunks averaging 1-5 centimeters in diameter, with a great deal of course powder admixed; and aluminum pellets are dumped from overhead hoppers into a charging box resting on scales.

The charging box is partially enclosed under a canopy hood, however, the ventilation system was inoperable at the time of the survey. When the furnaceman receives the results of the batch sample analysis, he weighs the necessary quantity of the additives into the charging box (typically 2000 pounds ferromanganese or 500 pounds electrolytic manganese). During this process, a large man-cooling fan is normally operated to blow dust away from the furnaceman. The weighing operation takes 45-60 seconds and is repeated approximately every 50 minutes. The charging box is then moved to a hopper over the ladle, where it is dumped into the melt as the furnace is tapped.

Additions to melts from open hearth furnaces are performed in a similar manner. Additives (including ferromanganese and electrolytic manganese) are weighed into charging boxes approximately 4 feet by 3 feet in dimension and dumped by forklift truck into the ladles of molten metal immediately after tapping. The No. 2 open hearth contains 6 furnaces, of which 5 are usually in operation. These furnaces produce 300-ton batches of steel every 12 to 13 hours.

#### DESCRIPTION OF MEDICAL, INDUSTRIAL HYGIENE AND SAFETY PROGRAMS

ARMCO has a large, well equipped Employee Health Clinic employing 2 physicians and 20 nurses. There are employees with first aid training throughout the plant and a limited number of Emergency Medical Technicians. Pre-employment physical exams are performed on all employees; periodic examinations are done at varying frequency by job category. The physicians have seen no cases of manganism in the several years they have been there.

There is a formal safety and industrial hygiene program, with a supervisor, four safety engineers, two industrial hygienists, and two industrial hygiene technicians at the plant level. There is active union participation in the program.

#### DESCRIPTION OF SURVEY METHODS

The major portion of the survey was devoted to the collection of general area samples near the point of manganese additions at BOF No. 15. A diagram showing the location of the area samplers is attached as Appendix I. Area samples were collected to determine airborne concentrations of

total and respirable dust and manganese dust. Samples for airborne respirable dust and respirable manganese dust were collected at a flow rate of 1.7 liters per minute (lpm) on 37mm diameter matched weight Millipore Type MCE (mixed cellulose ester) filters preceded by a 10mm MSA nylon cyclone. Total dust and manganese samples were collected at 2.0 lpm on closed face 37mm diameter matched weight Millipore type MCE filters. All samples were collected over a period of approximately 2 hours, during which time 3 batches of manganese - containing additives were weighed out and added to the ladles.

Total and respirable dust concentrations were determined gravimetrically. Total and respirable manganese levels were determined by atomic absorption as specified in the NIOSH Atomic Absorption Method P&CAM 173.<sup>1</sup>

## RESULTS AND DISCUSSION

Attached as Appendix II is a Table of the airborne dust and manganese concentrations observed during three additive charging cycles at BOF No. 15. All observed manganese levels were well below the American Conference of Governmental Industrial Hygienist (ACGIH)<sup>2</sup> and Occupational Safety and Health Administration (OSHA)<sup>3</sup> standard of 5 mg/m<sup>3</sup>, a 15-minute ceiling value. It is anticipated that typical airborne concentrations of dust and manganese would be lower than those observed, since workers reported that they normally activate a large man-cooling fan to blow dust away when they weigh out the manganese - containing additions. During the period of sampling, this fan was not operated, creating a worst-case operating condition.

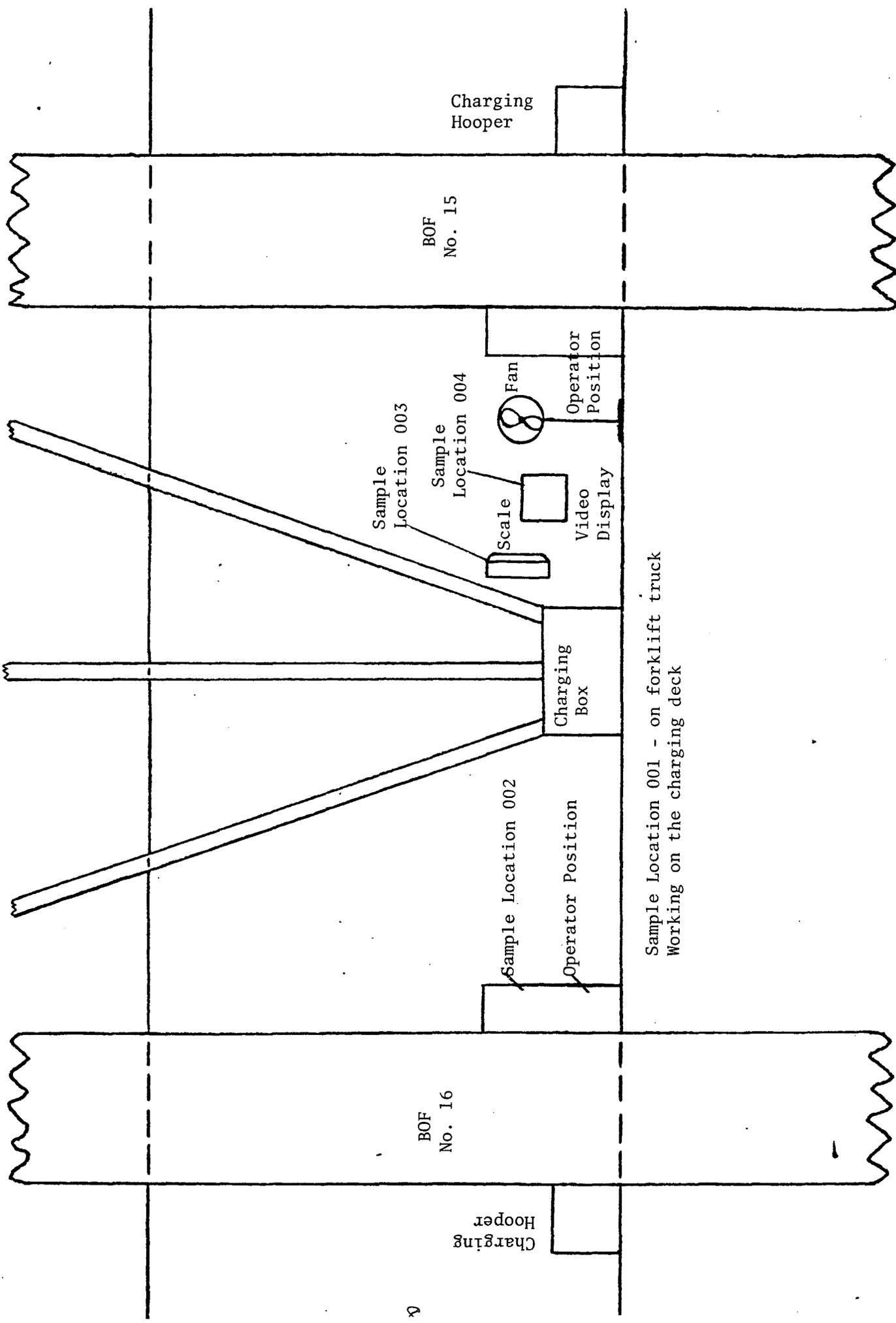
## CONCLUSIONS

Airborne manganese levels on the charging floor of BOF No. 15 were substantially below permissible exposure limits, despite the fact that the man-cooling fan was not operated during the sampling period. Observation of work practices indicated that workers spend very little time in the dustier areas of the charging floor, consequently, personal exposure levels would be well below the concentrations observed during the sampling period. Based on the low levels of airborne manganese observed, and the small number of workers exposed, it is expected that the ARMCO Middletown Works will not be included in the NIOSH study of occupational exposure to manganese.

## REFERENCES

1. National Institute for Occupational Safety and Health, April 1977, NIOSH Manual of Analytical Methods, Second Edition, Method Number P&CAM 173, DHEW (NIOSH) Publication Number 77-157-A.
2. American Conference of Governmental Industrial Hygienists, Threshold Limit Values for 1978, ACGIH, 1978.
3. 29 CFR Paragraph 1910.1000.

APPENDIX I



Charging Hooper

BOF No. 15

Sample Location 003

Sample Location 004

Fan

Operator Position

Scale

Video Display

Charging Box

Sample Location 002

Operator Position

Sample Location 001 - on forklift truck Working on the charging deck

BOF No. 16

Charging Hooper

APPENDIX II

### Sample Results

Area Samples from Charging Deck, BOF No. 15  
ARMCO Steel, Middletown Works

Sample Number <sup>2</sup>	Total (mg/m <sup>3</sup> ) <sup>1</sup>		Respirable (mg/m <sup>3</sup> ) <sup>1</sup>	
	Particulate	Manganese	Particulate	Manganese
001	2.46	0.607	0.51	0.190
002	0.66	0.034	0.18	0.005
003	3.24	0.828	1.79	0.001
004	6.64	2.453	0.51	0.347

<sup>1</sup> Concentrations reported reflect only the sampling period (approximately 2 hours) and are not time-weighted over the 8 hour workday.

<sup>2</sup> Sample locations are shown in Appendix I.