



Welding Exposures in Construction - 30 Years of OSHA Data

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PO 136 Construction

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Acknowledgements

- Co-author: Pam Susi, MSPH, CIH - Center for Construction Research and Training (CPWR)
- Funded in part by cooperative agreement OH009762 from National Institute for Occupational Safety and Health (NIOSH)
- Thanks to OSHA for providing the data set



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Objectives

- Use OSHA data to characterize 8hr-TWA exposures to airborne contaminants associated with welding in the construction industry, with a focus on Mn.
- Explore mixed exposures with additive effects especially Mn and Pb
- Test for any exposure trends in time over the 30 year period



OSHA DATA SET

- Data set obtained in 2008; over 100,000 measurements; ~30,000 welders in a wide variety of industries, from 1978-2008.
- A subset for the Construction Industry was extracted based on SICs (15xx, 16xx and 17xx) (N~2500).



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Types of Data in the OSHA File **that** **were used in this analysis**

Exposure Type	Inspection Type	Sample Type
Ceiling	Complaint	Personal
Peak	Follow-up	Bulk
TWA	Referral	Wipe
Dose	Other	Blood
ND	Fatality	Urine
Not analyzed	Monitoring	Area
Short Term Exposure Limit	Variance	
Not Valid	Unprogrammed	
	Programmed	

Agents Ranked by Sample Size

Substance	Count (N)	Zeros (<LOD)
Pb	455	239
Fe	418	14
Zn	293	36
Cu	238	41
Cr	238	92
Ni (ins)	201	115
Mn	182	27
Cd	149	115
Total	112	7
CrVI	6	1

Select Exposures: Mean/OEL > 0.5

	Mean	PEL	TLV	REL	Mean/ PEL	Mean/ TLV	Mean/ REL
Mn	0.10	5.0	0.1	1.0	0.02	1.0	0.1
Cu	0.12	0.1	0.2	0.1	1.2	0.6	1.2
Pb	0.22	0.05	0.05	0.05	4.5	4.5	4.4
Ni ins	0.045	1.0	0.2	0.015	0.05	0.2	3
CrVI	0.006	0.005	0.01	0.001	1.2	0.6	6
Cd	0.013	0.005	0.01	Ca	2.5	1.3	NA
Zn	2.67	5.0	NA	5.0	0.5	NA	0.5



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2 digit SIC codes



Ironworkers rehabilitating a steel bridge (could fall under 16XX or 17XX steel erection)

SIC CODE	DESCRIPTION	EXAMPLES
15xx	Building General Contractors	Includes residential, commercial, industrial buildings
16xx	Heavy Construction	Includes roads, bridges, tunnels, water, sewer, power & communication lines
17xx	Special Trade Contractors	Includes sub specialties – e.g. steel erection, plumbing, HVAC, & sheet metal work

Welding Crafts in Construction



Boilermakers work on boiler tubes during power plant rehab/maintenance



Pipe-fitter/welder working on HVAC piping during new construction of a university building



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Manganese by 2 digit SIC

Mn	15xx	16xx	17xx
Mean	0.08	0.19	0.07
Median	0.04	0.06	0.03
Std. Dev.	0.10	0.35	0.10
Maximum	0.34	1.66	0.58
Count	19	52	111
Fraction > TLV*	0.32	0.37	0.25

*Inhalable Mn TLV = 0.1 mg/m³ 2013



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Lead by 2 digit SIC

Pb	15xx	16xx	17xx
Mean	0.06	0.48	0.14
Median	0.00004	0.007	0.00004
Std. Dev.	0.14	2.75	1.16
Maximum	0.70	28	19.06
Count	44	123	288
Fraction > TLV*	0.18	0.29	0.17

*Pb TLV = 0.05 mg/m³ 2013



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Descriptions of some 4 digit SIC

SIC CODE	DESCRIPTION	EXAMPLES
1629	Heavy Construction not elsewhere classified	Petrochemical plant; power plant; pile driving , boilermakers
1791	Structural Steel Erection	Iron work, structural-contractors; Storage tanks,
1799	Special Trade Contractors, NOC	Welding contractors, operating at site of construction: Lead burning contractors

Manganese by 4 digit SIC

Mn	1629	1791	1799
Mean	0.22	0.17	0.05
Median	0.05	0.13	0.01
Std. Dev.	0.40	0.16	0.10
Maximum	1.66	0.58	0.35
Count	29	16	17
Fraction > TLV*	0.41	0.75	0.18

*Inhalable Mn TLV = 0.1 mg/m³ 2013



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Lead by 4 digit SIC

Pb	1629	1791	1799
Mean	0.58	0.10	0.13
Median	0.00004	0.03	0.00004
Std. Dev.	3.63	0.23	0.49
Maximum	28	1.45	2.9
Count	61	51	56
Fraction > TLV*	0.11	0.33	0.20

*Lead TLV = 0.05 mg/m³ 2013



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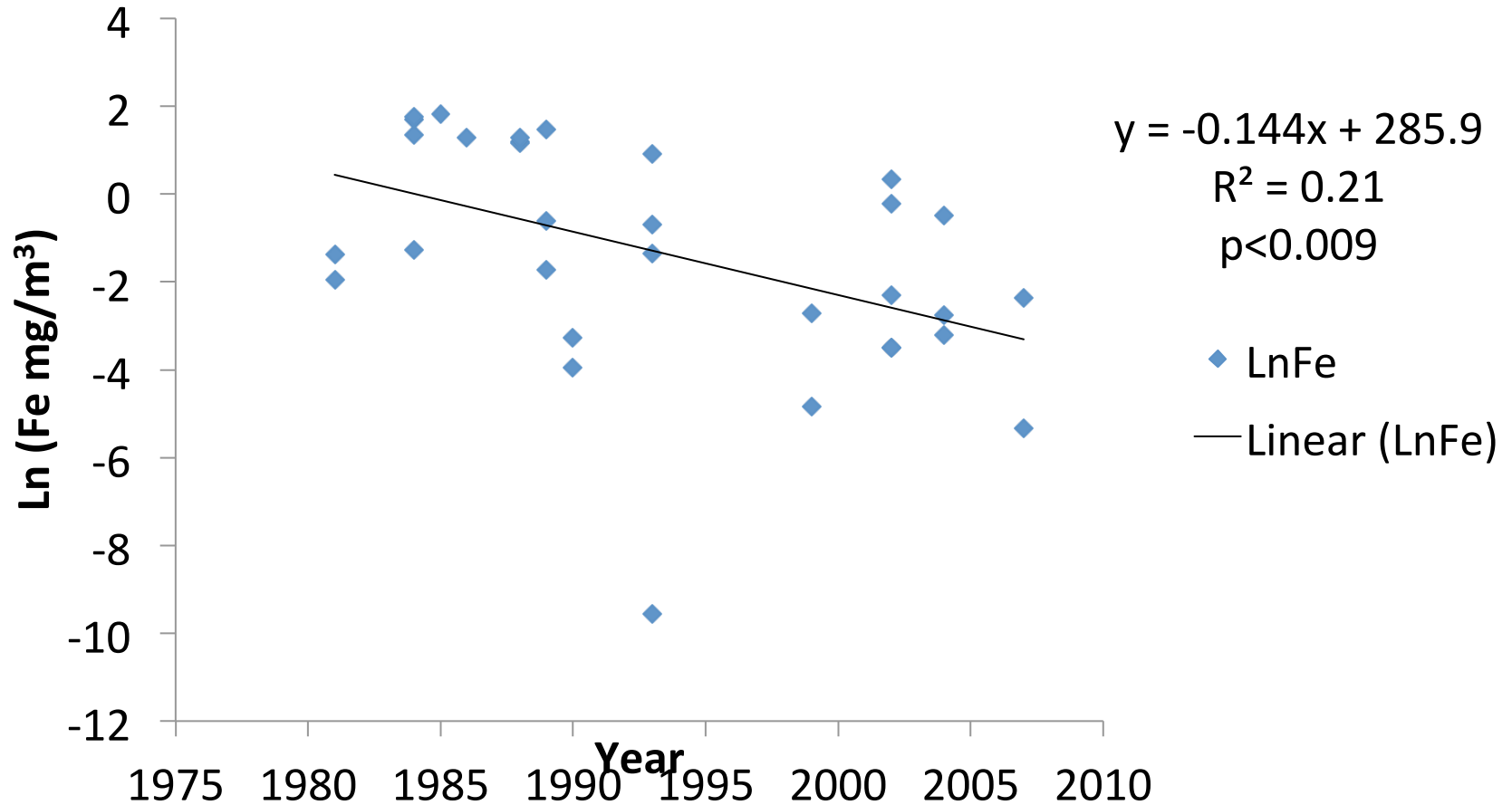
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Additive exposures Pb and Mn: SIC 1791 86% > 1; SIC 1629 50% > 1

SAMPLE	Mn / TLV	Pb / TLV	SUM
1	2.00	0.66	2.66
2	1.48	0.32	1.80
3	1.10	2.40	3.50
4	3.40	0.74	4.14
5	3.34	0.64	3.95
6	1.18	0.00	1.18
7	0.06	0.00	0.06
AVERAGE =	1.79	0.68	2.47
NUMBER > 1	6	1	6 (86%)

Iron Exposures vs. Year SIC 1799



Conclusions

- Welders in construction have been exposed to a wide variety of substances at levels in excess of current OELs.
- Lead, cadmium, copper, zinc, and hexavalent chrome were exposures with mean values over the PEL.
- Mean exposure of Mn was over the current TLV



Conclusions

- Heavy Construction NOC and Structural Steel Erection had elevated risk of overexposure (TLV) to Mn and Pb jointly. A neurological health concern.
- Limited evidence of declines in exposures over time; one detected - Fe in Special Trade Contractors



Recommendations

- Reduce the PEL for Mn.
- Increase the use of local exhaust ventilation.
- Target joint exposures e.g. Mn and Pb
- Target carcinogens: Cd, CrVI.



Summary of Select Exposure Data

Substance	Count (N)	Zeros (F)	Mean	Median
Mn	182	27	0.10	0.04
Fe	418	14	1.77	0.74
Total	112	7	3.28	1.97
Cu	238	41	0.12	0.005
Pb	455	239	0.22	0
Ni (ins)	201	115	0.045	0
Cd	149	115	0.013	0
CrVI	6	1	0.006	0.00006
Cr	238	92	0.056	0.002
Zn	293	36	2.67	0.03