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PILOT INDUSTRIAL BATTERIES
KANKAKEE, ILLINOIS

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I. SUMMARY

In December 1990, the National Institute for Occupational Safety and Health (NIOSH) received a request from the Illinois Department of Public Health for technical assistance to evaluate worker exposure to inorganic lead at the Pilot Industrial Batteries facility in Kankakee, Illinois.

On February 13-14, 1991, NIOSH and Illinois Department of Public Health representatives conducted an industrial hygiene and medical survey. Personal breathing zone samples for lead and other metals were collected for eighteen employees. Area samples were collected in the lunchroom and the changing room associated with the pasting area. Work practices and engineering control measures were evaluated. Forty-three individuals (the 41 current and 2 former employees) completed an occupational health history questionnaire and provided a blood specimen for determination of blood lead level (BLL) and zinc protoporphyrin (ZPP) concentrations.

The personal breathing zone air concentrations of lead ranged from less than 10 up to 846 micrograms per cubic meter (µg/m^3), as time-weighted averages (TWAs). The areas of highest exposure were pasting (506-846 µg/m^3), plate wrapping (328-609 µg/m^3), and group burning (88-183 µg/m^3). Nine of the personal breathing zone sample results exceeded the Occupational Safety and Health Administration (OSHA) permissible exposure limit (PEL) for workplace exposure to airborne lead of 50 µg/m^3 as an 8-hour TWA. All employees were required to wear half-mask respirators with high efficiency particulate air filters (HEPA) in the production area. The lead concentration in the lunchroom was 10 µg/m^3, a level between the limit of detection (LOD) and the limit of quanitation (LOQ). The lead concentration in the pasters' change room was 107 µg/m^3. The personal breathing zone air concentrations of 29 other metals were well below existing guidelines and standards established by NIOSH and OSHA. One of the personal breathing zone air samples in group burning had an 8-hour TWA arsenic concentration of 3.8 µg/m^3, which is above the NIOSH recommended exposure limit (REL) of 2 µg/m^3 and below the OSHA PEL of 10 µg/m^3.

The average BLL for all persons tested was 41 micrograms per deciliter of whole blood (µg/dl), with a range of 12 to 66 µg/dl. An employee whose BLL is 40 µg/dl or greater must be retested every two months, and be removed from a lead-exposure job if his/her average BLL is 50 µg/dl or more on 3 occasions over a 6 month period. A BLL of 60 µg/dl or greater, confirmed by retesting within two weeks, is an indication for immediate medical removal. The highest mean BLLs were found among group burners (59 µg/dl), plate wrappers (49 µg/dl), and pasters (48 µg/dl). The average ZPP for all persons tested was

79 µg/dl, with a range of 16 to 322 µg/dl. A ZPP concentration in excess of 50 µg/dl in adults may indicate chronic overexposure to lead or iron deficiency. The job categories with the highest mean ZPP concentrations were pasters (129 µg/dl), assemblers (105 µg/dl), and plate wrappers (103 µg/dl). There was no correlation between the length of employment and the BLL/ZPP levels.

The industrial hygiene sampling data and biological monitoring results indicate that employees at this facility are exposed to lead at levels that do constitute a health hazard. Half-mask respirators do not provide adequate protection in some areas of this facility. Several recommendations are offered to improve conditions such as better use of existing local engineering controls, improved respiratory protection practices, and the establishment of a formal biological monitoring program.

KEYWORDS: SIC 3691 (storage batteries), lead, blood lead, zinc protoporphyrin, battery manufacturing, arsenic.

II. INTRODUCTION

In December 1990, the National Institute for Occupational Safety and Health (NIOSH) received a request from the Illinois Department of Public Health for technical assistance to evaluate worker exposure to inorganic lead at the Pilot Industrial Batteries facility in Kankakee, Illinois. On February 13-14, 1991, National Institute for Occupational Safety and Health (NIOSH) representatives, along with representatives from the Illinois Department of Public Health conducted an initial site visit to Pilot Industrial Batteries in Kankakee, Illinois.

III. BACKGROUND

Pilot Industrial Batteries manufactures custom batteries ranging from 500-5000 pounds in weight. The company, which has been in production since 1980, manufactures 120-130 different types of lead-acid batteries; the differences are based on the quantity and size of the plates. There were forty-one employees at the facility at the time of the site visit.

The production process is typical of a lead acid battery manufacturing operation. The battery grids (the metallic lattice used to make battery plates) are manufactured in one of three casting machines
(two automatic and one semi-automatic). Excess lead is removed using an automatic cut-off saw. Small parts are cast using a melt box.

Lead oxide is mixed with sulfuric acid, water, and other additives in rotary mixers to form a thick paste. This paste is automatically applied to the battery grids to form battery plates. These plates pass through a flash dryer to remove surface moisture and then through a drying oven. Fiberglass spacers are used as an insulator between the plates. The positive plates are wrapped in plastic to extend the life of the battery. The plates and insulators (as well as connector pieces) are welded together into cells (called group burning). In the finishing area, the cells are placed in plastic battery cases and the remaining small lead parts (intercell connectors) are attached, and the cover is installed. The batteries are taken to the rectify area, filled with sulfuric acid, and initially wet-charged by the application of an electric current. The acid in the batteries is replaced, and the batteries are recharged and placed in storage.

IV. STUDY DESIGN

A. Industrial Hygiene

Eighteen personal breathing zone air samples were collected and analyzed for lead; 5 of these samples were also analyzed for arsenic and 29 other metals. One air sample was accidently contaminated and not analyzed. General area air samples for lead analysis were collected in the employee lunch room and in the changing room adjacent to the pasting area.

Personal breathing zone and area air samples were collected on mixed-cellulose ester filters (37 milliliter diameter, 0.8-micron pore size) using a flowrate of 2.0

liters per minute. Samples were collected for a period as near as possible to an entire workshift.

Two analytical methods were used for the analyses. One method provided information about lead exposures and the other about other metal exposures. Twelve personal breathing zone and the two area samples were analyzed for lead according to NIOSH Method 7082.[1] The samples were wet-ashed using nitric acid and hydrogen peroxide. After heating, the sample solutions were allowed to cool, brought up to volume using deionized water, and then analyzed for lead using atomic absorption spectroscopy. The limit of detection (LOD) was 5 micrograms per filter. The limit of quantitation (LOQ) was 15 micrograms per filter.

Five personal breathing zone samples were analyzed for the following trace metals - aluminum, antimony, arsenic, barium, beryllium, calcium, cadmium, cobalt, chromium, copper, iron, lanthanum, lead, lithium, magnesium, manganese, molybdenum, nickel, phosphorus, platinum, selenium, silver, sodium, strontium, tellurium, titanium, thallium, vanadium, yttrium, zinc, and zirconium according to NIOSH Method 7300.[2] In the laboratory, the samples were wet-ashed with concentrated nitric and perchloric acids and the residues were dissolved in a dilute solution of the same acids. The resulting sample solutions were analyzed by inductively coupled plasma-atomic emission spectrometry. The LOQ was 1.0 microgram per filter for all elements.

B. Medical

All employees were invited to complete an occupational health history questionnaire and provide a blood specimen for determination of blood lead level (BLL) and zinc protoporphyrin (ZPP) concentrations. Forty-three persons (all 41 current and
2 former employees) participated in the survey. Blood was analyzed for lead by anodic stripping voltammetry and for ZPP by fluorometry. All interview and clinical laboratory data were entered and analyzed using the EPIINFO, Version 5.0 epidemiological software package.

V. EVALUATION CRITERIA AND TOXICOLOGY

A. Lead

Inhalation of lead dust and fumes is the major route of exposure in industrial environments. A secondary source of exposure may be from ingestion of lead deposited on food, cigarettes, or other objects. Absorbed lead interferes with red blood cell production and can damage the kidneys, peripheral and central nervous systems, and bone marrow. Symptoms that have been associated with high lead exposures include fatigue, weakness, irritability, mental deficiencies, digestive disturbances, high blood pressure, kidney damage, and slow reaction times. Chronic lead exposures have been associated with infertility among both sexes and with fetal damage in pregnant women.[3,4] The developing nervous systems of young children may be damaged by BLLs as low as 10 micrograms per deciliter (µg/dl).[5]

The U.S. Occupational Safety and Health Administration (OSHA) permissible exposure limit (PEL) for lead in air is 50 micrograms per cubic meter (µg/m^3) calculated as an 8-hour time-weighted average (TWA)[6]. This regulation also requires semi-annual blood lead monitoring of workers exposed to lead air concentrations of 30 µg/m^3 or greater. An employee whose BLL is 40 µg/dl or greater must be retested every two months, and removed from a lead-exposure job if his/her average BLL is 50 µg/dl or more over a 6 month period. A BLL of 60 µg/dl or greater, confirmed by retesting within two weeks, requires immediate medical removal. A worker on medical removal should not be returned to a lead-exposure job until his/her BLL is confirmed to be below 40 µg/dl. A medically removed worker in the U.S. has protection for wage, benefits, and seniority for up to 18 months until the BLL is below 40 µg/dl and he/she can be returned to lead exposure areas.[6] ZPP tests are not required by the OSHA standard, but they are suggested. The ZPP test measures an adverse metabolic effect of lead on the synthesis of heme (a component of hemoglobin, the oxygen-carrying substance in the red blood cells) and thus serves as an indicator of lead body burden.[6]

B. Metals

Arsenic and lead were the metals of major toxicologic importance which were detected in the air samples. Arsenic has been associated with lung and skin cancer. Other health effects from occupational exposure to arsenic include local skin and mucous membrane irritation.[7] The OSHA PEL for arsenic is 10 µg/m^3 as an 8-hour TWA and the NIOSH Recommended Exposure Limit (REL) is 2 µg/m^3 as a 15 minute ceiling limit.[8,9]

VI. RESULTS

A. Industrial Hygiene

Employee exposures to lead fume and dust were monitored throughout the production area. All employees in the production area wore half-mask high efficiency particulate air (HEPA) filter respirators. The lead sampling results analyzed using atomic absorption spectroscopy are shown in Table 1. Personal breathing zone lead concentrations ranged from 9.3 to 846 µg/m^3, as 8-hour TWAs. Personal breathing zone samples analyzed by both methods in the pasting, plate wrapping, and burning areas, exceeded the OSHA PEL for workplace exposure to airborne lead. The pasting area had the highest lead exposures, ranging from 506 to 846 µg/m^3. Lead exposures in plate wrapping ranged from 328 to 609 µg/m^3 and exposures in group burning ranged from 88 to 183 µg/m^3.

The lead concentration in the lunchroom was approximately 10 µg/m^3, a concentration between the LOD and the LOQ. The lead concentration in the pasters' change room was 107 µg/m^3. Employees were required to wear their respirators in the pasters' change room. Production employees were required to shower before leaving the facility.

Table 2 presents the results for arsenic and lead in samples analyzed using inductively coupled plasma-atomic emission (ICP) spectrometry. One personal breathing zone air sample contained a detectable concentration of arsenic, 3.8

μg/m^3, which was above the NIOSH REL of 2 μg/m^3, but below the OSHA PEL of 10 μg/m^3. NIOSH considers arsenic to be a potential human carcinogen. The lead concentrations for the paster and group burner exceeded the OSHA PEL. The two casters and the packer on the finishing line had exposures below the OSHA PEL on the day of the site visit. The concentrations of the other 29 metals were either non-detectable or present at concentrations at a level less than 10% the current OSHA PELs and NIOSH RELs for each substance.

B. Medical

All of the 41 current employees and 2 former employees participated in the survey. Because the former employees had left employment only 6 weeks before the survey, data from these 2 workers were included in all analyses. Table 3 shows BLLs by job category. The mean (average) BLL for all persons tested was 41 μg/dl. The BLLs ranged from 12 to 66 μg/dl. The BLLs of 4 persons exceeded 60 μg/dl. The BLLs of 10 workers were between 50 and 60 μg/dl. The highest mean BLLs were found among "burners," followed by "plate wrappers," and "pasters." The lowest mean BLL occurred among "chargers." No correlation was found between length of employment and BLL.

Table 4 shows the results of ZPP analyses. The average ZPP for all persons tested was 79 μg/dl, with a range of 16 to 322 μg/dl. The job categories with the highest mean ZPP concentrations were "pasters," "assemblers," and "plate wrappers." The lowest mean ZPP occurred in "management" personnel. No correlation was found between length of employment and ZPP.

A ZPP concentration in excess of 50 μg/dl in adults may indicate chronic overexposure to lead or iron deficiency. An individual with a ZPP of 50 μg/dl or greater should consult a physician for appropriate evaluation. The ZPPs of 23 workers exceeded 50 μg/dl.

VII. OBSERVATIONS OF ENGINEERING CONTROLS AND WORK PRACTICES

A. Pasting Area

The general ventilation system was designed to operate at 20,000 cubic feet per minute (cfm). The area was separated from the rest of the production areas by plastic curtains and was under negative pressure with regard to the rest of the facility. The mixing of the oxide paste was done in a controlled area separated from the rest of the pasting department by plastic curtains and barricades. Employees entered the area to perform maintenance work on the mixers and to add lead oxide and other ingredients to the paste mixers. A barrel in which the empty lead oxide bags were placed was equipped with local exhaust ventilation.

Although the pasting process is automated, the operators are required to scrape out the container on the top of the machine several times during a normal working shift. The flash dryer and oven were connected to a local exhaust ventilation system. The workers who stacked the dried plates at the end of the conveyor belt worked over downdraft benches. Using smoke tubes to identify air patterns, the local exhaust ventilation systems and downdraft benches appeared to be effective.

The changing area for the pasting department was adjacent to the rectify area. Because it was under negative pressure, the changing room contained a noticeable odor of sulfuric acid. The company had been trying to use a push-pull ventilation system in the pasting department to better control exposures. However, according to company officials, it did not function as well as anticipated and increased ambient lead levels in the adjacent areas. At the time of the site visit, the make-up air was turned off; however, the exhaust was functioning to keep the pasting department under negative pressure with respect to the rest of the facility.

B. Plate Wrapping and Assembly Area

The plastic wrapping area used side slot benches. The group burning area used downdraft benches. The finishing area had a side slot hood behind the conveyor belt. Using smoke tubes to identify air patterns, the local exhaust ventilation systems appeared to be effective. One of the downdraft benches in the group burning area had an air leak in the ductwork, which was scheduled to be repaired.

C. Respiratory Protection

While the company had a written respirator policy and used qualitative fit testing, according to company representatives, a medical determination of fitness was not performed before a half-mask respirator was issued to an employee. All employees in the production area were required to wear MSA Comfort II half-mask respirators with HEPA filters. NIOSH-approved dust masks were used by employees in the areas of the facility where the final product was formed. There was one person in charge of cleaning the respirators, and employees replaced their filters when breathing became more difficult.

VIII. DISCUSSION

The results of workplace environmental monitoring indicate that airborne lead exposures exceed the OSHA PEL in many areas of the plant. The results of biological monitoring of exposed workers indicate that overexposure to lead has occurred in workers in many job categories. The required half-mask respirators do not provide adequate protection in the pasting area of the facility.

The OSHA lead standard was enacted to protect workers from excess occupational lead exposure. Under this standard, a BLL up to 40 µg/dl is acceptable for adult workers. However, this level is not adequate to protect a developing fetus. Because lead freely crosses the placenta, the fetal and maternal BLLs are equivalent. The fetus is susceptible to adverse developmental effects of lead at BLLs as low as 10 µg/dl. Chronic lead exposure has been associated with infertility among both sexes. All worker protection programs should therefore include consideration of these factors.

IX. RECOMMENDATIONS

1. In accordance with the OSHA lead standard, those workers whose airborne lead exposures exceeded 500 (but less than 2500 µg/m^3), should use a full-face piece respirator with a high efficiency particulate air filter. There should also be a prescribed schedule for replacing filters on the respirators.

2. Better ways to use the ventilated workbench in the plate wrapping area should be explored. One possible change is to relocate the stacked plates from their current location on top of the bench. There was no ventilation at that point, and the plates were handled and rubbed together, which can generate dust. Another suggestion is to stack fewer fiberglass separators on the ventilated bench. The stacked supply on the vented bench at the time of the site visit was effectively blocking the air flow.

3. The effectiveness of the ventilation system on the drum used for the disposal of the red iron oxide bags should be evaluated. Short-term but possibly significant exposures to airborne lead could occur as employees push the empty, but still dusty, bags into the 55 gallon storage drums.

4. More efficient ways of moving the plates in the plate wrapping area and the cells in the finishing area should be investigated. The plates in the plate wrapping area had to be lifted down from overhead. The completed cells were then manually carried over to the finishing line bench.

5. According to OSHA regulation 29 CFR 1910.134,[10] a medical determination of fitness to wear the equipment while performing the required work should be made by a physician before any worker is issued a respirator.

6. The results of the blood lead monitoring program should be reviewed by a physician, preferably one with training in occupational medicine, as part of the OSHA medical surveillance program. This would also include determining if any employees should be removed from high lead-exposure jobs based on BLL levels. According to the OSHA lead standard, each employee with a BLL in excess of 60 µg/dl on one occasion or an average of 50 µg/dl on three occasions must be removed from further exposure to lead at the action level in air of 30 µg/m^3 or above. The employee may be reinstated to a lead-exposure job only when 2 BLLs performed at least one month apart are each below 40 µg/dl. Additional requirements for the medical surveillance program of lead-exposed workers are included in the OSHA lead standard.

7. All blood lead analyses should be performed by clinical laboratories certified by OSHA. A list of such laboratories is available from the OSHA Analytical Laboratory in Salt Lake City, Utah. The telephone number is (801) 524-4270.

8. Respirators should be worn into the battery storage areas before removal. We observed some respirators left on machinery during scheduled breaks.

9. The potential exposure to sulfuric acid in the pasting area change room should be evaluated. The negative pressure in the pasting area change room may have to be reduced to minimize exposure to sulfuric acid.

10. The access cover on the drying conveyor in the pasting department should be replaced.

11. The floor drain near the plate wrapping area should be covered to eliminate a tripping hazard.

12. Employees should wear their respirators until they have changed out of their contaminated clothes.

X. REFERENCES

1. NIOSH (1984). Lead: Method No. 7082. In: Eller PM, ed. NIOSH Manual of Analytical Methods. rev ed. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service Centers for Diseases Control, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 84-100.

2. NIOSH (1984). Elements (ICP): Method No. 7300. In. Eller PM, ed. NIOSH Manual of Analytical Methods. 3rd rev. ed. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Health, DHHS (NIOSH) Publication No. 84-100.

3. Hernberg S, Dodson WN, and Zenz C (1988). Lead and its compounds. In: Zenz C, Occupational medicine, 2nd ed. Chicago: Year Book Medical Publishers, pp. 547-582.

4. Landrigan PJ, Froines JR, and Mahaffey KR (1986). Body lead burden: summary of epidemiological data on its relation to environmental sources and toxic effects. In: Mahaffey KR ed. Dietary and environmental lead: human health effects." Amsterdam: Elsevier Science Publishers.

5. ATSDR (1988). The nature and extent of lead poisoning in children in the United States: a report to Congress. U.S. Department of Health and Human Services, Public Health Service, Agency for Toxic Substances and Disease Registry. 10-11.

6. Code of Federal Regulations (1978). OSHA: Occupational Exposure to Lead-Final Standard. 29 CFR 1910.1025. Washington, DC: U.S. Governmental Printing Office, Federal Register.

7. NIOSH (1986). Occupational Respiratory Diseases. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 86-102.

8. Code of Federal Regulations (1989). OSHA Table Z-1. 29 CFR 1910.1000. Washington, DC: U.S. Governmental Printing Office, Federal Register.

9. CDC (1988). NIOSH Recommendations for Occupational Safety and Health Standards 1988. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health. MMWR 37 (Supp. No. S-7).

10. Code of Federal Regulations (1984). OSHA: Occupational Exposure to Lead-Final Standard. 29 CFR 1910.134. Washington, DC: U.S. Governmental Printing Office, Federal Register.

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1. Pilot Industrial Batteries
2. The Illinois Department of Public Health
3. OSHA, Region V

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

Table 1
Results of Personal Breathing Zone and Area Air Samples for Lead
Atomic Absorption Technique

Pilot Industrial Batteries
Kankakee, Illinois
HETA 91-077

February 14, 1991

Job Category	Sampling Duration	Sample Volume	Lead Conc. (TWA-µg/m^3)*
Area:			
Lunch Room	7:57-15:06	878 liters	10.3**
Change Room in Pasting Dept.	8:07-15:06	838	107
Personal:			
Plate Wrapper	7:44-14:59	870	609
Assembly Line	7:24-15:02	916	109
Paster	7:34-9:33 10:47-12:43 13:29-14:52	636	708
Paster	7:29-9:33 10:38-12:34 13:25-14:50	650	846
Plate Wrapper	7:52-14:59	854	328
Paster	7:31-9:32 10:50-12:39 13:28-14:54	632	506
Casting	7:37-14:56	878	23
Casting Small Parts	7:27-14:51	888	27
Group Burning	7:42-15:00	876	88
Cut-off Saw	7:30-14:55	890	36
Formation	7:51-15:01	860	9.3**
Finish Line	7:46-15:02	872	18.3
OSHA Permissible Exposure Limit:			50

Limit of Detection (LOD): 5 ug/filter
Limit of Quantitation (LOQ): 15 ug/filter
* TWA-µg/m^3 - Time-weighted average-micrograms per cubic meter
** Concentration between LOD and LOQ

Table 2

Results of Personal Breathing Zone Samples for Arsenic and Lead
Using Inductively Coupled Plasma Emission Spectroscopy (ICP)

Pilot Industrial Batteries
Kankakee, Illinois
HETA 91-077

February 14, 1991

Job Category	Sampling Duration	Sample Volume	Metal Concentrations (TWA-µg/m^3)*	
			As#**	Pb#
Paster	7:37-9:31 10:50-12:45 13:27-15:04	652	<1	759
Casting	7:35-14:52	874	<1	45.1
Casting	7:32-14:54	884	<1	37.4
Group Burning	7:40-14:58	876	3.8	183
Burner/Packing on Finishing Line	8:20-15:00	800	<1	27.9
OSHA Permissible Exposure Limit (PEL):			10	50
NIOSH Recommended Exposure Limit (REL):			2	

* TWA-µg/m^3 - Time-weighted Averages expressed in micrograms per cubic meter

- As-Arsenic and Pb-Lead

** - Arsenic is considered by NIOSH to be a suspected human carcinogen and exposures should be kept as low as feasibly possible.

Limit of Quantitation (LOQ): 1.0 µg/filter

Table 3

Results of Blood Lead Analyses by Job Category

Pilot Industrial Batteries
Kankakee, Illinois
HETA 91-077

February 13-14, 1991

Job Category	Number of Workers	Blood Lead Concentration (µg/dl)*		
		Mean	Standard Deviation	Range
Burner	4	59	2.6	56-62
Plate Wrapper	4	49	10.9	34-57
Paster	6	48	13.4	26-66
Assembler	6	41	10.3	27-52
Caster	6	41	14.1	26-58
Management	10	32	15.4	14-62
Other	4	32	16.6	12-52
Charger	3	27	10.4	20-39
Totals	43	41	15.0	12-66

* µg/dl - micrograms per deciliter

Table 4

Results of Zinc Protoporphyrin Analyses
by Job Category

Pilot Industrial Batteries
Kankakee, Illinois
HETA 91-077

February 13-14, 1991

Job Category	Number of Workers	Zinc Protoporphyrin Concentration (µg/dl)*		
		Mean	Standard Deviation	Range
Paster	6	129	109.0	22-322
Assembler	6	105	93.5	26-277
Plate Wrapper	4	103	38.1	49-134
Burner	4	88	22.8	57-112
Other	4	83	75.3	49-134
Charger	3	69	57.2	30-135
Caster	6	60	47.2	16-186
Management	10	32	13.6	16-59
Totals	43	79	67.6	16-322

* µg/dl - micrograms per deciliter