



RENT STABILIZATION ASSOCIATION • 123 William Street • New York, NY 10038

Mitchell L. Posilkin
General Counsel

Tel: (212) 214-9244
Fax: (212) 732-0617

April 24, 2009

Ms. Rena Bryant
Secretary to the Board of Health
125 Worth Street CN-31
New York, New York 10013

RE: NOTICE OF INTENTION TO REPEAL AND RE-ENACT ARTICLE 131
AND REPEAL ARTICLE 135 OF THE NEW YORK CITY HEALTH CODE

These comments are submitted on behalf of the 25,000 members of the Rent Stabilization Association who own and manage approximately one million apartments in the City of New York, in response to the Notice of Public Hearing issued by the Department of Health and Mental Hygiene/Board of Health relating to proposed amendments of the New York City Health Code.

The Department/Board propose, among other changes, to amend §131.07 of the Health Code to provide that the minimum temperature required for occupied buildings not used for dwelling purposes (with certain exceptions, such as child care, health care and school facilities) be decreased from 68 degrees F. to 65 degrees F. when the outside temperature falls below 50 degrees F. According to the Statement of Basis and Purpose set forth in the Notice of Public Hearing, this proposed action "is based on city-wide sustainability and energy saving efforts and is consistent with PlaNYC of 2007, as well as World Health Organization (WHO) recommendations for indoor temperatures.... WHO ... determined that there is little scientific evidence correlating indoor air temperature with public health...."

Notwithstanding the foregoing, the City's Housing Maintenance Code (and the Health Code) continues to require minimum heating requirements for dwellings in the City of at least 68 degrees F. (when the outside temperature falls below 55 degrees F. between the hours of six a.m. and ten p.m.). Given the scientific and policy reasons that the Department/Board have articulated and relied upon for the proposed decrease in the required minimum temperatures for occupied buildings not used as dwellings, we submit that based upon those very same reasons the Department/Board, in consultation with the private sector, should review the existing residential standards and consider decreasing the required minimum indoor temperatures for dwellings in the City. It is noteworthy that, but for the imposition of ever-increasing penalties for non-compliance, the standards for temperatures in housing accommodations have never been re-visited by the City since their initial adoption in the Housing Maintenance Code.

The Department/Board have also proposed, in §131.11 of the Health Code, a new requirement for the posting of signs in residential buildings relating to lead-based paint and windowguards. RSA strongly opposes this proposed new requirement. At present, the City requires the posting of at least **eight** notices in common areas by property owners. These notices include (1) the multiple dwelling registration number, (2) the location of the boiler room key, (3) the name and contact information for the managing agent or superintendent, (4) a "no smoking" sign, (5) a detailed smoke detector notice, (6) a detailed carbon monoxide detector notice, (7) an HPD Certificate of Inspection Visits, and (8) the building's detailed fire safety plan. In addition, signage to verify elevator inspection visits is required for a building's elevator cab. Despite an owner's compliance with these posting requirements, the removal of any or all of these signs, whether as a result of vandalism or otherwise, subjects a property owner to significant penalties.

Furthermore, owners are already required to provide tenants with a notice each year advising them of their right to have windowguards installed and to inform the owner of the presence of young children so that apartments may be inspected for peeling paint. In addition, the leases themselves contain these notifications to tenants. Each of those notifications acts as a specific prompt for tenants, reminding them to take action to protect their children and informing them of the obligations of the owner to respond and to take action.

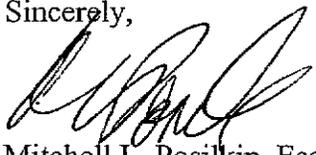
Most importantly, the City has, over the years, witnessed a remarkable decrease in the incidence of childhood lead poisoning and injuries to children from windowfalls. The record in that regard speaks for itself. These decreases demonstrate the dramatic success in these two areas resulting from the efforts by the City and the owners and managers of residential properties, as well as the parents of young children, and obviate the necessity for more notifications. To require the installation of yet another piece of signage would be of dubious value to tenants who are already adequately and repeatedly informed of their rights in this regard under existing laws and regulations and would needlessly subject property owners to yet another potential penalty for circumstances beyond their control. Further, the self-interest of owners and managers to comply with their existing notice and other legal obligations in these areas, without the necessity for further mandates, cannot be overstated.

Lastly, the proposed notice requirement set forth in §131.11(a)(2) contains separate and distinct provisions relating to lead-based paint, as well as windowguards, for buildings built in or after 1960. While the provisions relating to windowguards are substantively correct, the same cannot be said with regard to the notifications regarding lead-based paint in post-1960 buildings. Specifically, as in pre-1960 buildings, the proposed notice applicable to post-1960 buildings states that "Dry sanding and dry scraping of lead-based paint **or paint of unknown lead content** in any dwelling is prohibited." (Emphasis added.) However, Local Law 1 of 2004 is clear, in §27-2056.4(a), that with regard to post-1960 buildings, property owners are only obligated to comply with the notification and investigation requirements of that law where they have "actual knowledge of the presence of lead-based paint...." Again, in §27-2056.11(a)(2), Local Law 1 provides that

the detailed work practices required by that law apply to post-1960 buildings "where the owner has actual knowledge of the presence of lead-based paint...." Local Law 1 does not preclude the dry sanding or dry scraping of "paint of unknown lead content" in post-1960 buildings; instead, its provisions apply to post-1960 buildings only where the owner has "actual knowledge" of the presence of lead-based paint.

In conclusion, RSA (1) proposes that the Department/Board use the opportunity presented by these proposed amendments to the Health Code to initiate a review of the interior temperature standards applicable to housing accommodations and (2) urges the Department/Board to withdraw the proposed amendment to the Health Code which would impose additional signage requirements upon residential property owners relating to lead-based paint and windowguards. If the Department/Board proceed with the signage requirements, the provisions applicable to post-1960 buildings should be amended to reflect the state of the law with regard to lead-based paint.

Sincerely,

A handwritten signature in black ink, appearing to read "M. Posilkin", written over a horizontal line.

Mitchell L. Posilkin, Esq.



NORTHERN MANHATTAN
IMPROVEMENT CORPORATION

www.nmic.org

TESTIMONY OF MATTHEW J. CHACHÈRE
on behalf of

**NORTHERN MANHATTAN IMPROVEMENT CORPORATION,
the NEW YORK CITY COALITION TO END LEAD POISONING,
and the NEW YORK PUBLIC INTEREST RESEARCH GROUPS**

before the
NEW YORK CITY BOARD OF HEALTH
REGARDING

**NOTICE OF INTENTION TO REPEAL AND REENACT ARTICLE 131
AND TO REPEAL ARTICLE 135
OF THE NEW YORK CITY HEALTH CODE**

APRIL 29, 2009

125 Worth Street, New York, NY

I am a staff attorney with Northern Manhattan Improvement Corporation (NMIC), a non-profit multiservices provider in Washington Heights and Inwood. NMIC, among other things, provides free legal representation to low income tenants regarding housing problems. As attorneys, we also serve as counsel to the New York City Coalition to End Lead Poisoning (NYCCELP) and the New York Public Interest Research Group.

NYCCELP is a membership organization, founded in 1983, whose purpose is to educate and advocate for children at risk of lead poisoning and work to eliminate that risk. NYPIRG is a non-profit, non-partisan group formed in 1973 that has long been involved in policy reform concerning lead poisoning prevention.

We offer the following comments concerning the Board of Health's proposed repeal and reenactment of Health Code Article 131 and repeal of Article 135.

In general, we strongly support the proposed § 131.11 regarding posting signs to provide further information about owners' obligations regarding lead-based paint and window guards.

Legal Services Department • 76 Wadsworth Ave. • New York, NY 10033-7049

TEL: 212-822-8300 • FAX: 212-740-9645

Writer's direct dial: 212-822-8309 • EMAIL: chachere@igc.org

It has been gratifying to see that in the five years since the enactment of the New York Childhood Lead Poisoning Prevention Act, Local Law 1 of 2004, the incidences of children reported with elevated blood lead levels have continued to decrease. However, the fact remains that far too many children continue to be needlessly exposed to lead in their home environment from lead-based paint, and current trends indicate that New York City will not reach the federal objective of eliminating incidences of children with blood lead levels of 10 µg/dL or greater by 2010 (see U.S. Dep't of Health and Human Services, Office of Disease Prevention and Health Promotion, Healthy People 2010: Understanding and Improving Health, (2000), Objective 8-11).

It is clear that more needs to be done to further the objectives of Local Law 1. It has been our experience in working with tenants in the communities we serve that there is widespread non-compliance by building owners with numerous provisions that are meant to protect children from lead-poisoning, including the ban on dry scraping and dry sanding (Admin. Code § 17-181) and the annual inspections of the apartments (Admin. Code § 27-2056.4a), the results of which are supposed to be documented in writing and provided to the tenant. See, Admin. Code § 27-2056.4f.

Thus, while we believe the signage requirements in § 131.11(a) certainly will be helpful as is, we believe the effectiveness of this proposal could be improved. We would recommend the Board consider the following recommendations.

With regard to proposed § 131/11(a)(1):

First, the sign should indicate that occupants should call 311 not only if they fail to receive the window guard or lead inspection notices, but also if the owner violates any of the other provisions listed on the sign, including dry scraping or dry sanding of lead-based paint or paint of unknown lead content, or failing to perform the annual inspection.

Second, the sign should indicate that an owner is required to provide occupants with a copy of its written report of the annual inspection. We have almost never seen a landlord comply with this provision, even though it is specifically mandated in § 27-2056.4f and the failure to do so is punishable as a misdemeanor punishable by a fine of \$500 and/or up to six months' imprisonment (see Admin. Code § 27-2056.4g).¹

Third, the sign should make it clear that the owner is always required to safely repair peeling paint (i.e., not just repair annually).

Fourth, the sign should advise occupants how they can obtain more information about safe work practices (we have observed widespread non-compliance with the obligation to distribute pamphlets about safe work practices).

Fifth, the sign should use the word "occupants" rather than "tenants", since the obligations in Local Law 1 are not limited to tenants.

With regard to proposed § 131/11(a)(2):

Again, the sign should indicate that occupants should call 311 not only if they fail to receive the window guard, but also if the owner violates any of the other provisions listed on the sign, including dry scraping or dry sanding of lead-based paint or paint of unknown lead content.

With regard to proposed § 131/11(b):

Signage should also indicate the ban on dry scraping and dry scraping, and the need to call 311 if this provision is violated.

With regard to proposed § 131/11(c):

1. I note parenthetically that even though Admin. Code § 27-2056.4h provides HPD with the authority to perform audits to determine compliance, we have never known of an instance where a landlord was cited or punished for breaching this obligation (except as a response to a Commissioner's order to abate under § 173.13 referred to HPD via Admin. Code § 27-2056.7 for audit and inspection).

The signs should be in both English and Spanish, at a minimum; additional languages may be appropriate in some locations, even if the majority of the residents speak English or Spanish. In July 2008, the Mayor issued an executive order (EO 120) requiring all agencies that have direct interaction with the public should provide translations into the top six languages spoken by New Yorkers, which are defined as Spanish, Chinese, Russian, Korean, Italian and French Creole; thus the City should be able to make available the text of the required signs in these languages.

From: Steve Risotto [mailto:srisotto@hsia.org]
Sent: Thursday, May 28, 2009 11:28 AM
To: Martha Robinson
Subject: follow-up to HSIA comments on proposed reenactment of Article 131

Martha -

I have attached the sections of the ATSDR Toxicological Profile for Tetrachloroethylene (Perchloroethylene) describing the calculation of Minimal Risk Levels (MRL) for the solvent. As I outlined in my comments, HSIA would suggest that ATSDR's chronic MRL of 0.04 parts per million, equal to 266 micrograms per cubic meter ($\mu\text{g}/\text{m}^3$), is a more appropriate indoor air guideline than the 100 $\mu\text{g}/\text{m}^3$ value developed in 1991 by the New York State Department of Health.

We also note that ATSDR is careful to advise against the use of MRLs as standards. HSIA opposes the Department's proposal to establish an indoor air standard as part of the reenactment of Article 131, regardless of the value selected

A complete version of the ATSDR Toxicological Profile can be found at <http://www.atsdr.cdc.gov/toxprofiles/tp18.html>.

Please don't hesitate to contact me if you have any questions. My apologies for the delay in sending this information.

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Steve Risotto
srisotto@hsia.org
Halogenated Solvents Industry Alliance
703-741-5780
703-741-6077 (fax)

**TOXICOLOGICAL PROFILE FOR
TETRACHLOROETHYLENE**

**U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
Agency for Toxic Substances and Disease Registry**

September 1997

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2.4.3 Animal-to-Human Extrapolations

The difference in the toxic action of tetrachloroethylene in rats and mice correlates well with differences in the metabolism of the compound. Mice, which are most sensitive to the liver effects of tetrachloroethylene, produce the most TCA. The liver effects of TCA in mice are also thought to be a result of peroxisome proliferation, a response to chemical exposure that is minimal in humans (Bentley et al. 1993). Therefore, for liver effects, the mouse may not be the most appropriate model for humans.

Rats, which are most sensitive to the kidney effects of tetrachloroethylene, have the greatest potential for producing reactive intermediates from the glutathione conjugate of tetrachloroethylene through the activity of kidney β -lyase (Green et al. 1990). Male rats also develop α -2 μ -globulin nephropathy following exposure to tetrachloroethylene. Therefore, for kidney effects, the male rat seems to be a poor model for humans, especially at doses above saturation of the P-450 pathway, where the glutathione conjugation pathway may become important.

Nervous system effects have been well documented in humans. Although tetrachloroethylene is thought to be responsible for the nervous system effects, the possible role of metabolites has not been well studied. If tetrachloroethylene is the active nervous system toxicant, metabolism to TCA may serve to reduce nervous system toxicity. Therefore, rats, which metabolize less tetrachloroethylene to TCA than mice (Hattis et al. 1990), may serve as a better model of nervous system effects in humans.

2.5 RELEVANCE TO PUBLIC HEALTH

Inhalation and oral routes are the major routes of human exposure to tetrachloroethylene. In the following discussions, inhalation exposures are presented in ppm, and oral exposures are presented in mg/kg/day. Inhalation exposure may occur near hazardous waste sites as well as in urban and industrial areas. Occupational exposure to tetrachloroethylene (dry cleaners, chemical workers) is generally by inhalation. Because most of the absorbed tetrachloroethylene is slowly exhaled, this compound is not confined to the occupational setting. Workers exposed to tetrachloroethylene bring the compound home to their families. For example, the tetrachloroethylene concentration in the apartments of dry cleaners was 0.04 ppm relative to 0.0003 ppm in the control apartments (Aggazzotti et al. 1994a). Oral exposure to tetrachloroethylene is primarily through drinking contaminated

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groundwater. Because tetrachloroethylene readily volatilizes from water, contaminated water is also a source of inhalation exposure to tetrachloroethylene. Compared to inhalation exposure, little tetrachloroethylene vapor is absorbed across the skin (Riihimaki and Pfaffli 1978). However, when tetrachloroethylene is trapped against the skin beneath an impermeable barrier, small amounts of the solvent are absorbed (Stewart and Dodd 1964).

Central nervous system effects are the most predominant and sensitive effects of tetrachloroethylene in humans. Acute exposure (<2 hours) to high concentrations of tetrachloroethylene at 1,000-1,500 ppm has caused mood changes, slight ataxia, and dizziness (Carpenter 1937). Exposure to 100 ppm for 7 hours produced symptoms of headache, dizziness, difficulty in speaking, and sleepiness (Stewart et al. 1970). Subjective evaluation of electroencephalographic scores suggested cortical depression in subjects exposed to 100 ppm, 7.5 hours/day for 5 days (Hake and Stewart 1977). Altmann et al. (1990, 1992) found a significant increase in latency of pattern reversal visual-evoked potentials in male volunteers exposed to tetrachloroethylene at 50 ppm 4 hours/day for 4 days, compared to subjects exposed at 10 ppm for the same duration. No effects on brainstem auditory-evoked potentials were noted. Tests of visual contrast measured in a few individuals showed a tendency for loss of contrast in the low and intermediate spatial frequencies at 50 ppm (Altmann et al. 1990). Significant performance deficits for vigilance and eye-hand coordination were also observed at 50 ppm (Altmann et al. 1992). Following occupational exposure, Cai et al. (1991) reported an increase in subjective symptoms including dizziness and forgetfulness in workers exposed to tetrachloroethylene at a geometric mean concentration of 20 ppm relative to unexposed controls. Loss of color vision has also been reported in dry cleaning workers exposed to tetrachloroethylene at an average concentration of 7.3 ppm (Cavalleri et al. 1994); however, no effect on color vision was observed in workers exposed at average concentrations of 15.3 and 10.7 ppm for men and women, respectively (Nakatsuka et al. 1992). The American Conference of Governmental Industrial Hygienists (ACGIH) threshold limit value (TLV) of 25 ppm (ACGIH 1995) is very near the threshold for neurological effects in humans.

Subtle renal effects such as increased urinary lysozyme, fibronectin, albumin, brush border antigens, transferrin, laminin fragments, and tissue-nonspecific alkaline phosphatase have been noted in humans occupationally exposed to tetrachloroethylene (Franchini et al. 1983; Lauwerys et al. 1983; Mutti et al. 1992; Price et al. 1995; Vyskocil et al. 1990). The observed changes could be a physiological adaptation to exposure or may represent an early state of progressive renal disease. Kidney effects, including cancer, following tetrachloroethylene exposure have also been noted in animals, predominantly male

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rats (Goldsworthy et al. 1988; Green et al. 1990; NCI 1977). The mechanism for the development of kidney effects in rats may differ from that in humans. After saturation of the P-450 metabolic pathway, which produces TCA, male rats produce more glutathione (GSH) conjugates of tetrachloroethylene than humans (Green et al. 1990). The GSH conjugates are then metabolized to reactive metabolites by β -lyase found in the kidneys. In addition, an accumulation of α -2 μ -globulin, which is a male rat-specific phenomenon, is observed in male rats exposed to tetrachloroethylene (Bergamaschi et al. 1992).

Liver effects including enlarged liver, fatty changes, and elevated SGOT have been reported in humans exposed to high levels of tetrachloroethylene (Coler and Rossmiller 1953; Hake and Stewart 1977; Levine et al. 1981). These limited case studies do not provide exposure concentrations.

Tetrachloroethylene is clearly a hepatic toxicant in rodents, with mice exhibiting a greater response than rats. The hepatic toxicity of tetrachloroethylene correlates well with the production of TCA (Travis et al. 1989), and mice metabolize more tetrachloroethylene to TCA than rats and humans (Hattis et al. 1990). Mice are also more sensitive to the hepatic effects of tetrachloroethylene because they respond to TCA with hepatic peroxisome proliferation, while humans are relatively insensitive to peroxisome proliferators, or do not respond at the doses that cause a marked response in mice (Bentley et al. 1993). Therefore, hepatotoxic effects from tetrachloroethylene in humans may result from a mechanism that differs from the mechanism that produces hepatotoxic effects in mice.

Limited studies of women occupationally exposed to tetrachloroethylene suggest an association with menstrual disorders (Zielhuis et al. 1989) and spontaneous abortions (Ahlborg 1990; Kyyrönon et al. 1989). Other studies have not found a significant association between tetrachloroethylene exposure and birth outcome (Bosco et al. 1986; McDonald et al. 1986; Olsen et al. 1990). An increase in the percentage of round and narrow sperm has been noted in dry cleaners relative to the unexposed controls, but the overall percentage of abnormal sperm was similar between the two groups (Eskenazi et al. 1991a). There is some indication from questionnaires that it may take slightly longer for wives of dry cleaners to become pregnant, and they are more likely to seek help for an infertility problem (Eskenazi et al. 1991a). In a multigeneration study, reduced litter size and reduced survival of offspring were the only reproductive effects noted in rats exposed to tetrachloroethylene at 1,000 ppm, a concentration that also resulted in sedation and kidney effects (Tinston 1995). No reproductive effects were identified at 300 ppm. Increased resorptions have also been noted in rats treated by

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gavage with tetrachloroethylene at 900 mg/kg/day on gestation days 6-13, a dose that also resulted in maternal toxicity (Narotsky and Kavlock 1995).

Without providing the data, Narotsky and Kavlock (1995) indicated that an increase in micro/anophthalmia was observed in the offspring of rats treated by gavage with tetrachloroethylene at 900 mg/kg/day on gestation days 6-19. At the 900-mg/kg/day dose, maternal ataxia and body weight gain approximately 25% less than controls were also observed. Hyperactivity in adult mice treated while the nervous system was developing was the most sensitive end point among oral studies of tetrachloroethylene (Fredriksson et al. 1993), suggesting that the developing nervous system may be especially sensitive to tetrachloroethylene. Infants can be exposed to tetrachloroethylene that has been transferred into breast milk, and by inhalation to tetrachloroethylene that has been exhaled or released from dry cleaned clothes. Therefore, because of both potential exposure and a sensitive and possibly permanent effect, infants should be considered a susceptible population for exposure to tetrachloroethylene.

Minimal Risk Levels for Tetrachloroethylene

Inhalation MRLs

- An MRL of 0.2 ppm has been derived for acute inhalation exposure (14 days or less) to tetrachloroethylene. This MRL is derived from the study by Altmann et al. (1992) in which human volunteers were exposed to tetrachloroethylene at 10 or 50 ppm, 4 hours/day for 4 days. At 50 ppm, pattern reversal visual-evoked potential latencies increased ($p < 0.05$), and significant performance deficits for vigilance ($p = 0.04$) and eye-hand coordination ($p = 0.05$) were observed. No effects on brainstem auditory-evoked potential were noted at either concentration. Because faint odor was reported by 33% of the subjects at 10 ppm and 29% of the subjects at 50 ppm on the first day of testing, and by 15% of the subjects at 10 ppm and 36% of the subjects at 50 ppm on the last day of testing, the investigators concluded that only a few subjects could identify their exposure condition. The MRL was derived based on the NOAEL of 10 ppm for neurological effects.

In a similar study by Altmann et al. (1990), significant ($p < 0.05$) increased latencies for pattern reversal visual-evoked potentials were observed in 10 male volunteers exposed to tetrachloro-

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ethylene at 50 ppm, compared to 12 men exposed at 10 ppm. Exposures in this study were also 4 hours/day for 4 days. Effects on brainstem auditory-evoked potentials were also not observed in the Altmann et al. (1990) study. Tetrachloroethylene in the blood increased with exposure duration, and linear regression to associate blood tetrachloroethylene with pattern reversal visual-evoked potential latencies was significant ($r = -0.45$, $p < 0.03$). Additional tests of neurological function were not conducted in this study.

Hake and Stewart (1977) did not find any changes in flash-evoked potentials and equilibrium tests in four male subjects exposed to increasing concentrations of tetrachloroethylene 7.5 hours/day for 5 days. The subjects were sequentially exposed to 0, 20, 100, and 150 ppm (each concentration 1 week). Subjective evaluation of EEG scores suggested cortical depression in subjects exposed at 100 ppm. Decreases in the Flanagan coordination test were observed at ≥ 100 ppm. This study confirms that the nervous system is a sensitive target following exposure to tetrachloroethylene. It does not serve as the basis of the acute-duration inhalation MRL because effects were observed at a lower concentration in the Altmann et al. (1992) study. The lack of effect on flash-evoked potentials in the Hake and Stewart (1977) study at concentrations up to 150 ppm compared to changes in pattern reversal visual-evoked potentials observed in the Altmann et al. (1992) at 50 ppm may reflect the greater inter- and intrasubject variability of flash-evoked potentials compared to pattern reversal visual-evoked potentials (Otto et al. 1988).

- An MRL of 0.04 ppm has been derived for chronic (≥ 1 year) inhalation exposure to tetrachloro-ethylene. This MRL is derived from the study by Ferroni et al. (1992) in which significantly prolonged reaction times were observed in women ($n=60$) who had been exposed to tetrachloroethylene at an average concentration of 15 ppm for an average period of 10 years. Tests that were significantly different from controls were a test of simple reaction times ($p < 0.0001$) and shape comparison tests which were constructed to test vigilance ($p < 0.005$) and moderate stress ($p < 0.005$). Exposure was estimated by determining tetrachloroethylene concentrations in both blood and air samples.

The nervous system is a well-established target of tetrachloroethylene exposure in humans, and logistic regression of toxicity data suggests that it may be the most sensitive target (Rao et al. 1993). Cai et al. (1991) reported increased subjective symptoms including dizziness and forgetfulness in workers exposed to tetrachloroethylene at an average of 20 ppm for

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1-120 months. Exposure was measured using diffusive sampling with carbon cloth. Additional details were not provided. In a study in which the duration of exposure is unclear (Seeber 1989), perceptual speed and digit reproduction as a memory test were impaired in workers exposed to an average of 12 ppm. No detrimental effects on critical flicker fusion, simple and 9-choice visual reaction time, and a sustained attention test were observed in 22 workers exposed to tetrachloroethylene at an average of 21 ppm for about 6 years (Lauwerys et al. 1983). In this study, the neurological function tests were completed both before and after work; therefore, training effects and effects of tetrachloroethylene exposure on learning may have contributed to the difference between the Ferroni et al. (1992) study and the Lauwerys et al. (1983) study. Although exposure measurements were more comprehensive in the Lauwerys et al. (1983) study (the investigators measured urinary TCA daily for 1 week, air concentrations with personal air samplers and badges, and breath and blood concentrations of tetrachloroethylene), the measurements were completed during 1 week, while in the Ferroni et al. (1992) study, the more limited measurements were completed during the summer and winter and may better represent chronic exposure.

Loss of color vision has also been reported in dry cleaners exposed to tetrachloroethylene at an average of 7.3 ppm for an average of 106 months (Cavalleri et al. 1994). Although this study seems to identify an effect at a lower concentration than the Ferroni et al. (1992), fewer subjects were studied (n=22 exposed subjects), and exposure concentrations were only measured in air on 1 day, while Ferroni et al. (1992) completed air and blood measurements in both the winter and summer. In addition, no effect on blue-yellow color vision was noted in 30 men or in 34 women occupationally exposed to tetrachloroethylene at average concentrations of 15.3 and 10.7 ppm, respectively (Nakatsuka et al. 1992). Therefore, because of inconsistent reports on the effect of tetrachloroethylene on color vision, and because of the better exposure assessment and the larger number of subjects (n=60) in the Ferroni et al. (1992) study compared to the Cavallari et al. (1994) study, the Ferroni et al. (1992) study was chosen as the basis for the MRL.

An additional study did not reveal any effects on neurological function among 14 persons who lived above or next to dry cleaning facilities for 1-30 years compared to 23 controls matched for age (± 1 year, in two cases 3 and 5 years) and gender when the absolute values of the tests were examined (Altmann et al. 1995). Median tetrachloroethylene exposure concentrations were 0.2 ppm in the apartments of the exposed individuals and 0.0003 ppm in the apartments of

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control subjects, and blood concentrations were 17.8 ± 46.9 $\mu\text{g/L}$ in exposed individuals and less than the detection limit of 0.5 $\mu\text{g/L}$ in the controls. When multivariate analysis was completed to adjust for age, gender, and education, an increased response time in a continuous performance test ($p < 0.05$), increased simple reaction time to a visual stimuli ($p < 0.05$), and decreased performance in a test of visual memory ($p < 0.05$) were observed. No effect on pattern reversal visual-evoked potentials was observed. The 0.2 -ppm concentration is considered a NOAEL because of the lack of effect on the absolute values of the tests. This study does suggest that further studies of larger populations exposed to very low levels of tetrachloroethylene would be useful.

Additional studies of workers exposed to relatively low concentrations of tetrachloroethylene have also reported minor indicators of renal tubular damage. Franchini et al. (1983) reported increased urinary levels of lysozyme and β -glucuronidase in workers occupationally exposed to tetrachloroethylene at a TWA concentration of 10 ppm for an average of 14 years. Mutti et al. (1992) found increased urinary albumin, transferrin, the brush-border membrane antigens B50, BBA, and HF5, and tissue nonspecific alkaline phosphatase in workers exposed to an average tetrachloroethylene concentration of 15 ppm for an average period of 10 years. Urinary fibronectin was significantly decreased relative to the controls. The investigators concluded that the results showed increased shedding of epithelial membrane components from tubular cells. Vyskocil et al. (1990) found an increase in urinary lysozyme in workers exposed to tetrachloroethylene at an average of 23 ppm for 9 years. No effects on urinary β_2 -microglobulin, creatinine, lysozyme activity, glucose, low-density lipoprotein, or total proteins were noted.

Although both nervous system and mild kidney effects appear to occur at similar concentrations in persons occupationally exposed to tetrachloroethylene, the nervous system effects were considered a more appropriate basis for the MRL. The nervous system effects noted (decreased reaction times), could lead to accidents, and at higher concentrations for shorter time periods, tetrachloroethylene clearly produces incoordination (Stewart et al. 1970). The significance of the mild kidney changes observed following low-level occupational exposure to tetrachloroethylene is not clear. The kidney changes may be an adaptive effect rather than an adverse effect. In addition, in the study reporting kidney effects at 10 ppm (Franchini et al. 1983), the exposure level was estimated using urinary TCA concentrations, so the actual exposure concentrations are unknown.

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An intermediate-duration inhalation MRL was not derived. The only available intermediate-duration human studies were two case reports (Abedin et al. 1980; Meckler and Phelps 1966) and a case control study of reproductive outcome in women occupationally exposed (Ahlborg 1990) that did not identify exposure concentrations. Minimal changes in flash-evoked potential were observed in rats exposed to 800 ppm tetrachloroethylene 6 hours/day, 5 days/week, for 13 weeks, with no effects at 200 ppm (Mattsson et al. 1992). The testing was completed 1 week after the end of exposure. A study in mice (Kjellstrand et al. 1984) indicates that liver enlargement occurs following intermediate-duration exposure (30 days, 24 hours/day) at 9 ppm, a less-serious LOAEL for animals. Because mice metabolize more tetrachloroethylene to TCA than humans, and because the peroxisomal proliferative response in mice is much greater than in humans, data in humans were considered more appropriate for the derivation of MRLs.

Oral MRLs

- An MRL of 0.05 mg/kg/day has been derived for acute-duration oral exposure to tetrachloroethylene. This MRL is derived from the study by Fredriksson et al. (1993) in which a significant ($p < 0.01$) increase in total spontaneous activity (locomotion and rearing) was observed in 60-day-old mice treated with tetrachloroethylene for 7 days beginning at 10 days of age. Hyperactivity was observed at both 5- and 320-mg/kg/day doses which did not cause observable symptoms of toxicity or differences in body weight gain. Behavior was similar to that of the controls in mice tested at 17 days of age. The change in behavior at 60 days of age was similar in both dose groups. An inhalation study (Nelson et al. 1980) in which hyperactivity was observed in 31- and 32-day-old rats that were exposed during gestation (900 ppm) supports the observation that the developing nervous system is a target of tetrachloroethylene toxicity. The developing nervous system is also at risk because tetrachloroethylene is known to cross the placenta, and it is found in breast milk (Schreiber 1993).

Intermediate- and chronic-duration oral MRLs were not derived. Longer term oral studies in animals have not focused on neurological effects, the principal effect of tetrachloroethylene in humans. Intermediate-duration oral studies have noted liver effects in rats (Hayes et al. 1986) and mice (Buben and O'Flaherty 1985) and kidney effects in male rats (Hayes et al. 1986). There are species differences in the metabolism of tetrachloroethylene and the response to metabolites which contribute to the liver effects. The kidney effects are associated with α -2 μ -globulin, a male rat-specific protein.

2. HEALTH EFFECTS

Therefore, the liver and kidney effects were not considered appropriate for the derivation of an MRL. Chronic-duration oral studies in animals have not identified NOAELs or less serious LOAELs at doses below those causing decreased survival of rats and mice (NCI 1977).

Death. At high concentrations (>1,000 ppm), tetrachloroethylene vapor acts as an anesthetic agent, producing collapse, loss of consciousness, and death in humans. Death may be related to depression of respiratory centers of the central nervous system or cardiac arrhythmia and heart block. Death following acute inhalation of concentrations that produce unconsciousness has been confirmed by animal studies (Carpenter 1937; NTP 1986). Oral exposure of a malnourished man to a dose of 152 mg tetrachloroethylene/g resulted in death (Chaudhuri and Mukerji 1947). Animal studies of oral exposure suggest that anesthesia and death would be likely occurrences in humans if high doses were swallowed (Berman et al. 1995; Hayes et al. 1986; Wenzel and Gibson 1951). There are no reports of fatalities in humans or animals exposed solely by the dermal route.

It appears unlikely that death would occur in humans exposed to the levels of tetrachloroethylene that occur in the environment or in the vicinity of hazardous waste sites.

Systemic Effects

Respiratory Effects Respiratory tract irritation has been reported at concentrations as low as 216 ppm in volunteers exposed for 45 minutes to 2 hours (Rowe et al. 1952). At concentrations of >1,000 ppm, tetrachloroethylene is intensely irritating (Carpenter 1937; Rowe et al. 1952). Changes in pulmonary function tests were not observed in four male volunteers exposed to 0, 20, 100, or 150 ppm tetrachloroethylene for 7.5 hours/day, 5 days/week, for 1 week at each exposure concentration (Stewart et al. 1981). Exposure of mice to 300 ppm of tetrachloroethylene (300 ppm) for 6 hours/day for 5 days has resulted in degeneration of the olfactory and respiratory mucosa (Aoki et al. 1994). Respiratory effects were not reported in animals after oral exposure (NCI 1977). Environmental exposure to tetrachloroethylene in air or water is unlikely to pose a risk to the respiratory system.

Cardiovascular Effects. Despite the relatively large number of people occupationally exposed to tetrachloroethylene, there are few reported cases of tetrachloroethylene-associated cardiotoxicity. Cardiac arrhythmias in a small number of Woburn residents cannot be directly related to chronic tetrachloroethylene exposure (Byers et al. 1988). Experimental exposure studies have not found

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ATSDR MINIMAL RISK LEVEL

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) [42 U.S.C. 9601 et seq.], as amended by the Superfund Amendments and Reauthorization Act (SARA) [Pub. L. 99-499], requires that the Agency for Toxic Substances and Disease Registry (ATSDR) develop jointly with the U.S. Environmental Protection Agency (EPA), in order of priority, a list of hazardous substances most commonly found at facilities on the CERCLA National Priorities List (NPL); prepare toxicological profiles for each substance included on the priority list of hazardous substances; and assure the initiation of a research program to fill identified data needs associated with the substances.

The toxicological profiles include an examination, summary, and interpretation of available toxicological information and epidemiologic evaluations of a hazardous substance. During the development of toxicological profiles, Minimal Risk Levels (MRLs) are derived when reliable and sufficient data exist to identify the target organ(s) of effect or the most sensitive health effect(s) for a specific duration for a given route of exposure. An MRL is an estimate of the daily human exposure to a hazardous substance that is likely to be without appreciable risk of adverse noncancer health effects over a specified duration of exposure. MRLs are based on noncancer health effects only and are not based on a consideration of cancer effects. These substance-specific estimates, which are intended to serve as screening levels, are used by ATSDR health assessors to identify contaminants and potential health effects that may be of concern at hazardous waste sites. It is important to note that MRLs are not intended to define clean-up or action levels.

MRLs are derived for hazardous substances using the no-observed-adverse-effect level/uncertainty factor approach. They are below levels that might cause adverse health effects in the people most sensitive to such chemical-induced effects. MRLs are derived for acute (1-14 days), intermediate (15-364 days), and chronic (365 days and longer) durations and for the oral and inhalation routes of exposure. Currently, MRLs for the dermal route of exposure are not derived because ATSDR has not yet identified a method suitable for this route of exposure. MRLs are generally based on the most sensitive chemical-induced end point considered to be of relevance to humans. Serious health effects (such as irreparable damage to the liver or kidneys, or birth defects) are not used as a basis for establishing MRLs. Exposure to a level above the MRL does not mean that adverse health effects will occur.

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MRLs are intended only to serve as a screening tool to help public health professionals decide where to look more closely. They may also be viewed as a mechanism to identify those hazardous waste sites that are not expected to cause adverse health effects. Most MRLs contain a degree of uncertainty because of the lack of precise toxicological information on the people who might be most sensitive (e.g., infants, elderly, nutritionally or immunologically compromised) to the effects of hazardous substances. ATSDR uses a conservative (i.e., protective) approach to address this uncertainty consistent with the public health principle of prevention. Although human data are preferred, MRLs often must be based on animal studies because relevant human studies are lacking. In the absence of evidence to the contrary, ATSDR assumes that humans are more sensitive to the effects of hazardous substance than animals and that certain persons may be particularly sensitive. Thus, the resulting MRL may be as much as a hundred fold below levels that have been shown to be nontoxic in laboratory animals.

Proposed MRLs undergo a rigorous review process: Health Effects/MRL Workgroup reviews within the Division of Toxicology, expert panel peer reviews, and agencywide MRL Workgroup reviews, with participation from other federal agencies and comments from the public. They are subject to change as new information becomes available concomitant with updating the toxicological profiles. Thus, MRLs in the most recent toxicological profiles supersede previously published levels. For additional information regarding MRLs, please contact the Division of Toxicology, Agency for Toxic Substances and Disease Registry, 1600 Clifton Road, Mailstop E-29, Atlanta, Georgia 30333.

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MINIMAL RISK LEVEL

Chemical Name: Tetrachloroethylene
CAS Number: 127-18-4
Date: October 1996
Profile Status: Post-Public Comments
Route: Inhalation Oral
Duration: Acute Intermediate Chronic
Graph Key: 16
Species: Human

Minimal Risk Level: 0.2 mg/kg/day ppm

Reference: Altmann et al. 1992

Experimental design:

Male volunteers were exposed to tetrachloroethylene at 10 or 50 ppm for 4 hours/day for 4 days. A total of 28 subjects were exposed; 12 at 10 ppm, 16 at 50 ppm. The 10 ppm concentration was considered the control exposure and was used because it exceeded the odor threshold of tetrachloroethylene. Therefore, the subjects were supposedly blinded to the exposure conditions. Altmann et al. (1992) state that faint odor was reported by 33% of the subjects at 10 ppm and 29% of the subjects at 50 ppm on the first day of testing, and by 15% of the subjects at 10 ppm and 36% of the subjects at 50 ppm on the last day of testing leading the investigators to conclude that only a few subjects could identify their exposure condition.

Pattern reversal and pattern onset visual-evoked potentials (VEPs), brainstem auditory evoked potentials (BAEPs), and tests of cognitive and psychomotor performance, and mood ratings were completed 72 hours before exposure, and during or after the exposure. VEPs and BAEPs were measured after 2 hours of exposure. Peak latencies of three components of VEPs (N75, P100 and N150) were measured. Measurements were made at the same time each day (10 AM-12 PM) to exclude circadian variations. The test battery completed included finger tapping, eye-hand coordination using a sine wave tracking test, simple reaction times, a continuous performance test, symbol-digit test, visual retention, pattern recognition test, digit learning, paired associates learning and retention, vocabulary test, and mood scales. Blood concentrations of tetrachloroethylene were measured before each day's exposure, in the middle of the exposure and at the end of the exposure.

Effects noted in study and corresponding doses:

At 50 ppm, pattern reversal VEP latencies increased over the course of the exposure period, while at 10 ppm, pattern reversal VEP latencies decreased as a result of training. The difference between the two groups was statistically significant ($p < 0.05$). No effect on pattern onset VEPs or BAEPs were noted.

Using analysis of covariance, with preexposure baseline values as the covariates, significant performance deficits for vigilance ($p = 0.04$), and eye-hand coordination ($p = 0.05$) as well as a borderline increase in simple reaction times ($p = 0.09$) at 50 ppm were found. For these tests, both exposure groups improved over the course of the experiment, but there was a greater improvement in the

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10 ppm group compared to the 50 ppm group. No significant effects were noted for the tapping tests, or the learning and memory tests, or mood ratings.

Tetrachloroethylene in the blood increased with exposure duration. By the end of the last exposure period, tetrachloroethylene concentrations "exceeded 1.5 mg/L, and 0.3 mg/L" at 50 and 10 ppm, respectively.

Dose and endpoint used for MRL derivation:

NOAEL LOAEL

10 ppm

Uncertainty Factors used in MRL derivation:

- 10 for use of a LOAEL
- 10 for extrapolation from animals to humans
- 10 for human variability

Was a conversion used from ppm in food or water to a mg/body weight dose?

If so, explain:

If an inhalation study in animals, list the conversion factors used in determining human equivalent dose:

To extrapolate from intermittent exposure, the 10 ppm concentration was multiplied by 4/24 hours.

Other additional studies or pertinent information which lend support to this MRL:

In a similar study by Altmann et al. (1990), increased latencies ($p < 0.05$) for pattern reversal VEPs were observed in 10 male volunteers exposed to tetrachloroethylene at 50 ppm, compared to 12 men exposed at 10 ppm. Exposures in this study were also 4 hours/day for 4 days. Effects on BAEPs were also not observed in the Altmann et al. (1990) study. Tetrachloroethylene in the blood increased with exposure duration, and linear regression to associate blood tetrachloroethylene with pattern reversal VEP latencies was significant ($r = -0.45$, $p < 0.03$). Additional tests of neurological function were not completed in this study.

Hake and Stewart (1977) did not find any changes in flash evoked potentials (FEPs) and equilibrium tests in 4 male subjects exposed to increasing concentrations of tetrachloroethylene for 7.5 hours/day for 5 days. The subjects were sequentially exposed to 0, 20, 100 and 150 ppm (each concentration 1 week). Subjective evaluation of EEG scores suggested cortical depression in subjects-exposed at 100 ppm. Decreases in the Flanagan coordination test were observed at ≥ 100 ppm. No significant changes in FEPs were observed. Otto et al. (1988) notes that FEPs are subject to large inter- and intrasubject variability of waveforms, and that pattern reversal VEPs are more useful clinically than FEPs. Therefore, the lack of effect on FEPs at 100 ppm in the Hake and Stewart (1977) study may reflect the lower sensitivity of the FEPs compared to the pattern reversal VEPs. The Hake and Stewart (1977) study does confirm that the nervous system is a sensitive target in humans. Rao et al. (1993) completed a logistic regression analysis of tetrachloroethylene toxicity data and concluded that the nervous system was a sensitive target of tetrachloroethylene toxicity in humans.

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Acute studies in animals have reported serious effects at much higher concentrations. Hypoactivity and ataxia were observed in rats following a 2 week exposure (6 hours/day, 5 days/week) at 1750 ppm (NTP 1986). Anesthesia has been reported in mice exposed to tetrachloroethylene at 2328 ppm for 4 hours and 1750 ppm for 2 weeks (6 hours/day, 5 days/week) (NTP 1986). The lowest LOAEL in an acute study in animals was 200 ppm for fatty degeneration of the livers of mice exposed to tetrachloroethylene for 4 hours (Kylin et al. 1963). Therefore, the comparison of animal and human data following acute inhalation exposure suggests that humans are more sensitive to tetrachloroethylene, or that sensitive neurological endpoints have not been examined in animal studies.

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Chemical Name: Tetrachloroethylene
CAS Number: 127-18-4
Date: October 1996
Profile Status: Post-Public Comments
Route: Inhalation Oral
Duration: Acute Intermediate Chronic
Graph Key: 64
Species: Human

Minimal Risk Level: 0.04 mg/kg/day ppm

Reference: Ferroni et al. 1992

Experimental design:

Neurobehavioral effects were studied in 60 women exposed to tetrachloroethylene in dry cleaning shops for an average of 10.1 years. Thirty women who worked at a cleaning plant where solvents were not used served as controls. Tetrachloroethylene levels were measured in blood samples collected during the work day and in air samples collected over 4-hour periods during the workweek. Blood and air samples were taken during the summer and winter to allow for seasonal variation. The median tetrachloroethylene concentration in air was 15 ppm (range 1-67 ppm), and the median tetrachloroethylene blood concentration was 145 mg/L (range 12-864 mg/L). Neurobehavioral tests completed were: finger tapping with dominant and nondominant hands, simple reaction times, digit symbol, shape comparison in two versions to test vigilance and the response to stress. It is not clear when in relation to the working day the neurobehavioral tests were completed.

Effects noted in study and corresponding doses:

Tetrachloroethylene-exposed workers had increased reaction times in all tests: simple reaction times, exposed 259 ± 40 , controls 235 ± 22 , $p < 0.0001$; shape comparison - vigilance, exposed 635 ± 68 , controls 589 ± 72 , $p < 0.005$; shape comparison - stress, exposed 557 ± 66 , controls 501 ± 72 , $p < 0.005$. The duration of exposure and tetrachloroethylene blood levels were not significantly correlated with performance test scores.

Dose and end point used for MRL derivation:

NOAEL LOAEL

15 ppm, increased reaction times

Uncertainty Factors used in MRL derivation:

- 10 for use of a LOAEL
- 10 for extrapolation from animals to humans
- 10 for human variability

Was a conversion used from ppm in food or water to a mg/body weight dose? No,
If so, explain:

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If an inhalation study in animals, list the conversion factors used in determining human equivalent dose:

To convert from occupational exposure to continuous exposure, the 15-ppm concentration was multiplied by 8/24 hours and 5/7 days.

Other additional studies or pertinent information which lend support to this MRL:

The nervous system is a well established target of tetrachloroethylene exposure in humans, and logistic regression of toxicity data suggests that it may be the most sensitive target (Rao et al. 1993). Cai et al. (1991) reported increased subjective symptoms including dizziness and forgetfulness in workers exposed to tetrachloroethylene at an average of 20 ppm for 1-120 months. Exposure was measured using diffusive sampling with carbon cloth. Additional details were not provided. In a study in which the duration of exposure is unclear (Seeber 1989), perceptual speed and digit reproduction as a memory test were impaired in workers exposed to an average of 12 ppm. No detrimental effects on critical flicker fusion, simple and g-choice visual reaction time and a sustained attention test were observed in 22 workers exposed to tetrachloroethylene at an average of 21 ppm for about 6 years (Lauwerys et al. 1983). In this study, the neurological function tests were completed both before and after work so that training effects and effects of tetrachloroethylene exposure on learning may have contributed to the difference between the Ferroni et al. (1992) study and the Lauwerys et al. (1983). Although exposure measurements were more comprehensive in the Lauwerys et al. (1983) study (the investigators measured urine trichloroacetic acid daily for one week, air concentrations with personal air samplers and badges and breath and blood concentrations of tetrachloroethylene), the measurements were completed during one week, while in the Ferroni et al. (1992) study, the more limited measurements were completed during the summer and winter and may better represent chronic exposure.

Loss of color vision has also been reported in dry cleaners exposed to tetrachloroethylene at an average of 7.3 ppm for an average of 106 months (Cavalleri et al. 1994). Although this study seems to identify an effect at a lower concentration than the Ferroni et al. (1992) study, fewer subjects were studied (n=22 exposed subjects), and exposure concentrations were only measured in air on one day, while Ferroni et al. (1992) completed air and blood measurements in both the winter and summer. In addition, no effect on blue-yellow color vision was noted in 30 men, or in 34 women occupationally exposed to tetrachloroethylene at average concentrations of 15.3 and 10.7 ppm, respectively (Nakatsuka et al. 1992). Therefore, because of inconsistent reports on the effect of tetrachloroethylene on color vision, and because of the better exposure assessment and the larger number of subjects (n=60) in the Ferroni et al (1992) study compared to the Cavallari et al. (1994) study, the Ferroni et al. (1992) study was chosen as the basis for the MRL.

An additional study did not report any effects on neurological function among 14 persons who lived above or next to dry cleaning facilities for 1 to 30 years compared to 23 controls matched for age (± 1 year, in two cases 3 and 5 years) and gender when the absolute values of the tests were examined (Altmann et al. 1995). Median tetrachloroethylene exposure concentrations were 0.2 ppm in the apartments of the exposed individuals, and 0.0003 ppm in the apartments of control subjects, and blood concentrations were 17.8 ± 46.9 $\mu\text{g/L}$ in exposed, and less than the detection limit of 0.5 $\mu\text{g/L}$ in the control individuals. When multivariate analysis was completed to adjust for age, gender, and education, an increased response time in a continuous performance test, increased simple reaction time to a visual stimuli, and decreased performance in a test of visual memory were observed. No effect on pattern reversal visual-evoked potentials was observed. The 0.2 ppm concentration is considered a

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NOAEL because of the lack of effect on the absolute values of the tests. This study does suggest that further studies of larger populations exposed to very low levels of tetrachloroethylene would be useful.

Additional studies of workers exposed to relatively low concentrations of tetrachloroethylene have also reported minor indicators of renal tubular damage. Franchini et al. (1983) reported increased urinary levels of lysozyme and beta-glucuronidase in workers occupationally exposed to tetrachloroethylene at a time-weighted average of 10 ppm for an average of 14 years. Mutti et al. (1992) found increased urinary albumin, transferrin, the brush-border membrane antigens B50, BBA, and HF5, and tissue nonspecific alkaline phosphatase in workers exposed to an average tetrachloroethylene concentration of 15 ppm (measured in air over a wide period to account for seasonal variation) for an average of 10 years. Urinary fibronectin was significantly decreased relative to controls. The investigators concluded that the results showed increased shedding of epithelial membrane components from tubular cells. Vyskocil et al. (1990) found an increase in urinary lysozyme in workers exposed to tetrachloroethylene at an average of 23 ppm for 9 years. No effects on urinary β_2 -microglobulin, creatinine, lysozyme activity, glucose, LDH, and total proteins were noted.

Other studies of renal function in workers occupationally exposed to tetrachloroethylene at relatively low TWA concentrations have not found any effects. Cai et al. (1991) found no effects on BUN or creatinine in workers exposed to an average of 20 ppm for 1-120 months. Urinary β_2 -microglobulin, retinol binding protein, and albumin were not affected in workers exposed to tetrachloroethylene at an average concentration of 21 ppm for 6 years (Lauwerys et al. 1983). Solet and Robins (1991) found no effects on total protein, albumin, *N*-acetyl-glucosaminidase, or creatinine in workers exposed to tetrachloroethylene at an average concentration of 14 ppm.

Although nervous system and mild kidney effects appear to occur at similar concentrations in persons occupationally exposed to tetrachloroethylene, the nervous system effects were considered a more appropriate basis for the MRL. The nervous system effects noted, decreased reaction times, could lead to serious accidents, and at higher concentrations, tetrachloroethylene clearly produces incoordination (Stewart et al. 1970). The significance of the mild kidney changes observed following low level occupational exposure to tetrachloroethylene is unknown. The kidney changes may be an adaptive effect rather than an adverse effect. In addition, in the study reporting kidney effects at 10 ppm (Franchini et al. 1983), the exposure level was estimated using urinary TCA concentrations, so the actual exposure concentrations are unknown.

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Chemical Name: Tetrachloroethylene
CAS Number: 127-18-4
Date: October 1996
Profile Status: Post-Public Comments
Route: Inhalation Oral
Duration: Acute Intermediate Chronic
Graph Key: 19
Species: Mouse

Minimal Risk Level: 0.05 [mg/kg/day ppm

Reference: Fredriksson et al. 1993

Experimental design:

Groups of 12 male NMRI mice from 3-4 different litters were treated by gavage with tetrachloroethylene in egg lecithin:peanut oil (10:1) at 0, 5, or 320 mg/kg/day for 7 days beginning at 10 days of age. The high dose was 5% of the LD₅₀ and did not sedate the pups. Although the study indicates that female pups were dosed, results in female pups are not presented. At 17 and 60 days of age, behavioral testing (locomotion, rearing, total activity) was completed during three 20-minute testing periods from 8 a.m.-12 p.m.

Effects noted in study and corresponding doses:

No symptoms of toxicity were observed throughout the experimental period, and there were no differences in body weight gain. No effects on behavior were noted when the animals were tested at 17 days of age. At 60 days of age, treated mice showed an increase in locomotion and total activity which was statistically different from controls ($p < 0.05$ or $p < 0.01$) at both doses and over the three 20-minute test periods. The increase in activity measures was similar at both doses. A significant decrease ($p < 0.01$) in rearing was observed in mice treated only at the high dose during the first and second, but not the third, 20-minute test period. The investigators indicate that the results show a disruption of a simple nonassociative learning process, habituation. The mice were not followed to determine if the increase in activity persisted beyond 60 days.

The changes in behavior observed at the lowest dose (5 mg/kg/day) is a LOAEL and serves as the basis for the acute oral MRL.

Dose and end point used for MRL derivation:

NOAEL LOAEL

5 mg/kg/day, hyperactivity

Uncertainty Factors used in MRL derivation:

10 for use of a LOAEL

10 for extrapolation from animals to humans

1 for human variability

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Was a conversion used from ppm in food or water to a mg/body weight dose? No.

If so, explain:

If an inhalation study in animals, list the conversion factors used in determining human equivalent dose:

Other additional studies or pertinent information which lend support to this MRL:

In a behavioral teratology study, pregnant Sprague-Dawley rats were exposed to 0, 100, or 900 ppm tetrachloroethylene on days 14-20 of gestation and to 0 or 900 ppm tetrachloroethylene on days 7-13 (Nelson et al. 1980). Effects occurred after exposure to 900 ppm for both exposure periods, but not after exposure to 100 ppm. Dams had reduced feed consumption and weight gain, without liver or kidney histological alterations. Pups of dams exposed to 900 ppm on gestation days 7-13 had decreased performance during tests of neuromuscular ability (ascent on a wire mesh screen and rotarod balancing) on certain days. Offspring (before weaning) from dams exposed to 900 ppm on days 14-20 performed poorly on the ascent test on test day 14 only, but later in development their performance in the rotarod balancing test was superior to the controls, and they were more active in an open-field test. Brains of 21-day-old offspring exposed to 900 ppm prenatally had significant decreases in neurotransmitters (dopamine in those exposed on gestation days 14-20 and acetylcholine in those exposed on days 7-13 or 14-20). The lower concentration (100 ppm) produced no significant differences from controls. There were no microscopic brain lesions.

This study confirms that behavioral effects can occur if exposure to tetrachloroethylene occurs while the nervous system is developing. Additional studies which determine if the effect is permanent, and studies in rats which may be a better model for neurological effects would increase the confidence in the use of developmental neurotoxicity as the end point for the development of the oral MRL.

April 29, 2009

Board of Health
Department of Health and Mental Hygiene
City of New York
125 Worth Street, CN-31
New York, NY 10013

Re: Proposed revision of the New York City Health Code regarding dry cleaning facilities (§131.17)

To Whom It May Concern:

The Halogenated Solvents Industry Alliance, Inc. (HSIA) opposes the proposal to designate 100 micrograms per cubic meter ($\mu\text{g}/\text{m}^3$) of perchloroethylene (“perc”) from dry cleaning facilities as a nuisance level in “dwellings, child-occupied facilities, or other occupied premises,” subject to remediation. HSIA represents manufacturers and some users of perc and other chlorinated solvents. Although the proposal would codify what HSIA understands is the Department’s current practice for residences co-located with dry cleaning facilities, the language would appear to extend enforcement of an indoor air level for perc to all buildings in the city. HSIA also challenges the scientific validity of the proposed “nuisance” level which is based on a guideline established by the state Department of Health (NYSDOH) assuming continuous exposure and sensitive populations.

Standard vs Guideline

HSIA opposes the proposal to establish the NYSDOH value as a standard under the city’s Health Code. The conservative nature of the NYSDOH calculation and the uncertainty about the health end points evaluated (see below) provide persuasive arguments for continuing to use the value as an informal guideline in a “case-by-case evaluation” of individual situations.¹ The conservative, uncertain nature of the value is, no doubt, the reason that neither NYSDOH nor the state Department of Environmental Conservation (DEC) have sought to incorporate it into regulation, despite the fact that it has existed for nearly 20 years.

The Department already has a regulatory mechanism for correcting situations where indoor air levels exceed a specified guideline – referral to the City’s Department of Environmental Protection (DEP) to ensure compliance with the state’s drycleaning regulation (6 NYCRR Part 232). It is not clear what “mechanical ventilating systems or other devices” exist

¹ NYSDOH, Fact Sheet - Tetrachloroethene (PERC) in Indoor and Outdoor Air (May 2003).

that are not already part of Part 232 requirements for cleaners located in residential buildings. The Department's proposal, therefore, duplicates the existing regulatory structure without providing any public health benefit. In light of the significant fiscal constraints currently faced by the City and small businesses in the City, such a proposal is ill-advised.

Extension to All Occupied Premises

By proposing that the nuisance level be enforced in "dwellings, child-occupied facilities, or other occupied premises," the Department seeks to extend the requirement to all buildings in the city. Yet the proposal provides no explanation for why such a gross expansion of the Department's activities is necessary, nor does it offer any justification for the extension of the conservative assumptions about exposures and potential health risks to all indoor exposure situations. Implementation of the equipment, ventilation, and inspection requirements of Part 232 has all but eliminated concern about perc exposures in co-located residences. Since the occupants of these residences have the highest potential exposure to the solvent, there is no reason to expect that exposures in other buildings would be of concern.

The proposed nuisance level is based on a brief analysis conducted by NYSDOH in 1991 which concluded that –

[NYSDOH] recommends, based on an evaluation of the non-carcinogenic effects of [perc], that the average ambient air level in a residential community not exceed [250 $\mu\text{g}/\text{m}^3$] for adults, *considering continuous lifetime exposure. If a child's inhalation rate and body weight are used, the guideline becomes [100 $\mu\text{g}/\text{m}^3$].² (emphasis added)*

Assuming continuous exposure, while overly conservative for residential settings, stretches the limits of credibility when applied to other, non-residential buildings. Potential exposures in non-residential settings are limited to a few hours per day, at most, and occur over a considerably shorter period than the 70-year lifetime assumed by NYSDOH.

ATSDR Analysis

The Department's proposal references NYSDOH's fact sheet for perc which offers a brief summary of the state's guideline of 100 $\mu\text{g}/\text{m}^3$, but provides no explanation for how it was derived. In fact, the conclusions of this nearly 20-year old analysis are based on results from central nervous system (CNS) effects in worker studies and liver effects in laboratory mice.

² NYSDOH, Center for Environmental Health, Tetrachloroethene Ambient Air Criteria Document, Final Report, Appendix 1 – New York State Department of Health, Tetrachloroethene Health Effects, November 6, 1991 (October 1997).

A more recent analysis by the federal Agency for Toxic Substances and Disease Registry (ATSDR),³ however, dismisses the studies used by the state as a basis for establishing its minimal risk levels (MRLs).⁴ Regarding the mouse liver data, ATSDR concludes that the available human data are a better basis for developing MRLs. While ATSDR determines that CNS effects are the most appropriate end point for calculating risk levels, the Agency concludes that the worker study considered by NYSDOH does not provide sufficiently robust data for calculating MRLs because the duration of exposure is unclear, the results do not exhibit a dose-response characteristic of a causative agent, and there is no correlation between the test results and individual exposure levels (as measured by blood and urinary analysis).⁵

Using more robust data on CNS effects in workers exposed to perc, ATSDR calculates a chronic MRL of 0.04 parts per million (ppm), or 266 $\mu\text{g}/\text{m}^3$ for exposure periods of one year or more.⁶ Although ATSDR is careful to advise against the use of MRLs as standards, HSIA believes they represent a better basis for Department action than NYSDOH's 20-year old analysis.

Cancer Epidemiology

No consideration of perc is complete without a discussion of the solvent's carcinogenic potential. Since ATSDR's MRLs and the NYSDOH indoor air guideline do not consider the potential carcinogenicity, the Board may believe it appropriate to include the additional level of conservatism in its nuisance guideline. While it is generally agreed that perc is an animal carcinogen, the human evidence is far less conclusive. Prior studies of dry cleaners, primarily from the United States, have indicated that perc exposure might increase the risk of certain cancers. These earlier studies suffered from limitations, however, that include exposure to solvents other than perc and the inability to take into account lifestyle factors (*e.g.*, smoking) known to affect the incidence of the identified cancers.

As described in a 2003 review of the existing epidemiological literature by Mundt *et al.*,⁷ the existing studies are limited by a "widespread lack of valid exposure measurements or other adequate indicators of potential for exposure." Based on these limitations, the Mundt review concludes that the "current epidemiological evidence does not support a conclusion that occupational exposure to [perc] is a risk factor for cancer of any specific site."

³ ATSDR, Toxicological Profile for Tetrachloroethylene (September 1997). Available at <http://www.atsdr.cdc.gov>.

⁴ An MRL is defined as an estimate of daily human exposure to a substance that is likely to be without an appreciable risk of adverse effects (noncarcinogenic) over a specific duration of exposure. MRLs are derived when reliable and sufficient data exist to identify the target organ(s) of effect or the most sensitive health effect(s) for a specified duration within a given route of exposure.

⁵ ATSDR, Toxicological Profile for Tetrachloroethylene (September 1997) at 47.

⁶ ATSDR also calculates an acute MRL of 0.2 ppm (1,333 $\mu\text{g}/\text{m}^3$) for exposures of 14 days or less.

⁷ Mundt *et al.*, Critical Review of the Epidemiological Literature on Occupational Exposure to Perchloroethylene and Cancer, *International Archives of Occupational and Environmental Health* 76: 473-491 (2003).

A recent epidemiological study by Lynge *et al.*⁸, moreover, provides strong evidence that the incidence of several important cancer types among dry cleaning workers in the Nordic countries was not related to perc exposure. This study presents important information directly relevant to any assessment of potential cancer risk from perc use in drycleaning.

The Nordic study, conducted by five prominent European epidemiologists, responds to most of the shortcomings identified by Mundt *et al.* The Nordic study was undertaken as a series of case-control studies nested in groups of laundry and dry cleaning workers identified from 1970 census data in Denmark, Norway, Sweden and Finland – a total of over 46,000 persons. It covers a period when perc was the dominant solvent and includes all persons working in dry cleaning in the four countries in 1970. The nested case-control design allowed the researchers to compare the cancer risks of dry cleaners with those of laundry workers, a similar group apart from the use of perc. In particular, cigarette smoking was equally frequent among exposed and unexposed subjects.

Lynge *et al.* find that the risks of esophageal, liver, kidney, pancreatic, and gastric cardia cancer and NHL are not increased among the Nordic dry cleaners. An elevated incidence of cervical cancer is not observed in women directly involved in dry cleaning, and is determined by the researchers not to be related to perc exposure. The authors observe a small increase in bladder cancer that also is not associated with the extent of exposure to perc, consistent with previous studies where incidence of this cancer was not increased in the study populations exposed only to perc.

In light of some of the previous findings, perhaps the most significant finding in the Nordic study is the absence of an increase in esophageal cancer. Prior studies of smaller groups of U.S. workers reported an increase in esophageal cancer, which is associated with smoking, alcohol consumption, and poor nutrition. The Nordic researchers note that, while the U.S. studies compared cancer incidence among dry cleaners with that of the national population, the current study controlled for the possible effects of smoking and other lifestyle factors by comparing incidence between two similar groups – dry cleaning and laundry workers. In sum, the Nordic study methodology significantly improves the ability to detect the potential for an increase in cancer incidence as the result of perc exposure, and finds no increases in cancer associated with perc exposure using that improved methodology.

Summary

For the reasons outlined above, HSIA opposes the proposed establishment of a nuisance level for perchloroethylene from drycleaning facilities in buildings in the city. We strongly encourage the Department to maintain the flexibility it has shown in the past, by applying its indoor air value in co-residential settings as a guideline rather than a standard, and to review the

⁸ Lynge *et al.*, Cancer in Persons Working in Dry Cleaning in the Nordic Countries, *Environmental Health Perspectives* 114: 213-219 (2006). Available at <http://www.ehponline.org>.

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appropriateness of the NYSDOH's value in light of the MRLs developed more recently by ATSDR.

Please do not hesitate to contact me if you have any questions or wish to discuss the above information in greater detail.

Sincerely,

Steve Risotto

Stephen P. Risotto
Executive Director