



(OSHA = Occupational Safety and Health Administration)

Trichloroethylene

CAS No: 79-01-6

NOTE:

- (1) Efficacy of Medical Tests has not been evaluated by NIOSH.
- (2) NIOSH references include diagnostic, screening, and other tests.
- (3) Revised (2004) OSHA mandated medical tests [OSHA 6(b) (5) standards] are provided in yellow background and are listed first.
- (4) Only OSHA-regulated substances (29 CFR 1910.1000, Table Z-1 -- Air Contaminants) with published medical tests are included.

(5) N/R = Not Reported.

EDITOR(S) AUTHOR(S)	SPECIFIC MEDICAL TEST(S) and EXAMINATION(S) ANALYTIC METHOD(S) ANALYTE(S) PAGE(S)	REFERENCE(S)
US DHHS PHS CDC NIOSH and US DOL OSHA.	In General Trichloroethylene (TCE) is a Potential Human Carcinogen. Acute Inhalation of TCE by Multiple Species of Animals Caused Depressed Brain Function, Brain Damage, Liver and Kidney Injury, and Death due to Respiratory Failure or Cardiac Arrest. Chronic Inhalation by Multiple Species of Animals Caused Toxic Effects on the Nerves, Increases in Liver & Kidney weights, Suppression of Growth. Chronic Oral Administration to Mice Produced Cancers of the Liver and Lungs, and Chronic Inhalation by Female Mice Produced Cancers of the Lymph System and the Lungs. In Humans, Acute Inhalation or Ingestion of TCE has Caused Reversible Peripheral Nerve Degeneration, Injury to the Liver & Kidneys, & the Cardiovascular and Gastrointestinal Systems, Depression of Central Nervous System, Coma, and Sudden Death due to Respiratory Failure, Cardiac Arrhythmia or Liver or Kidney Failure. Chronic Exposure Has Caused Damage to the Liver, Kidneys, and Nervous System. Repeated Immersion of the Hands into Liquid TCE has Caused Paralysis of Fingers. The Ingestion of Alcohol, Caffeine, and Some Prescription Drugs has been Found to Potentiate the Effects of TCE Intoxication. Page 2 (1988).	NIOSH/OSHA Occupational Health Guidelines for Chemical Hazards DHHS (NIOSH) Pub No. 81-123; 88-118; Suppls. I-IV. 1981-1995. Pages 1-6 (1988).





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Trichloroethylene

Baselt RC.	 Whole Blood (Chemical/Metabolite) Gas Chromatography/Mass Spectrometry (GC-MS) As: Trichloroethylene (TCE) Pages 40-41; 357 (1997). If the Enzyme hydrolysis Step is eliminated, the Electron-Capture Method below may be used. Gas Chromatography/ Electron-Capture Detector (GC-ECD) As: Free Trichloroethanol Determination of TCE in Blood is Generally Not Considered Desirable as a Routine Practice, due to the Difficulty of Obtaining Specimens rather than on the Usefulness of the Blood Concentration Data. Page 357 (1997). 	Biological Monitoring Methods for Industrial Chemicals. 1st, 2nd, 3rd Editions. Chemical Toxicology Institute, 1980. 1988, 1997. Pages 40-41; 354-358 (1997).
Lauwerys RR, Hoet P.	 Whole Blood (Chemical/Metabolite) N/R As: Trichloroethylene (TCE) Reference Value: ND (< 2 μg/100ml – to be Confirmed). Page 609. 	Industrial Chemical Exposure. Guidelines for Biological Monitoring. 3rd Edition. Lewis Publishers. CRC Press, Inc. 2001. Page 609.
Atio A, Riihimaki V, Vainio H. eds.	Whole Blood (Chemical/Metabolite) • N/R As: Trichloroethylene (TCE) The Half-Life of TCE in Blood depends upon the Length of Exposure and upon the Time of Sampling after Exposure; the Concentration Follows a Multiexponential Curve. Page 112.	Biological Monitoring and Surveillance of Workers Exposed to Chemicals. Hemisphere Publishing Corporation. 1984. Page 112.





(OSHA = Occupational Safety and Health Administration)

Trichloroethylene

LaDou J, ed.	Whole Blood (Chemical/Metabolite) End-Of-Shift • N/R As: Free Trichloroethanol No Adverse Effect Level: 4 mg/L Terminal Half-Time: 12 Hours. Page 643.	Occupational & Environmental Medicine. 2nd Edition. Appleton and Lange. 1997. Page 643.
Fiserova-Berg erova V, Vlach J.	Whole Blood (Chemical/Metabolite) End-Of-Shift • N/R As: Trichloroethylene (TCE) Half-Life (BEI): 12 Hours. Since Half-Life is < 45 Hours, Sampling Should be Done after 1 Week of Exposure. Pages 349; 352.	Timing of sample collection for biological monitoring of occupational exposure. Ann Occup Hyg 41/3:345-353, 1997.
ACGIH.	Whole Blood (Chemical/Metabolite) End of Shift at End of Workweek • N/R As: Trichloroethylene (TCE) This Determinant is an Indicator of Exposure to the Chemical but it is not Quantitative. It May be Used as a Screening Test if a Quantitative Test is not Practical or as a Confirmatory Test if the Quantitative Test is not Specific. Hence, no BEI is Recommended. Without Hydrolysis: • N/R As: Trichloroethanol The BEI is 0.5 mg/L with a Notation of "Nonspecific" since the Determinant is also Observed after Exposure to other Chemicals. ACGIH Considers TCE to Be a Suspected Human Carcinogen. Pages 60; 77; 104; 115.	2021 Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices. ACGIH Worldwide. 2021. Pages 60; 77; 104; 115.





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Trichloroethylene

Lauwerys RR, Hoet P.	Whole Blood (Chemical/Metabolite) End of Workweek (after 5-day Exposure) • N/R As: Trichloroethanol Tentative Maximum Permissible Concentration: 0.4 mg/100 ml • N/R As: Trichloroacetic Acid. Tentative Maximum Permissible Concentration: 5 mg/100 ml Page 609.	Industrial Chemical Exposure. Guidelines for Biological Monitoring. 3rd Edition. Lewis Publishers. CRC Press, Inc. 2001. Page 609.
LaDou J, ed.	Whole Blood (Chemical/Metabolite) End of Workweek • N/R As: Free Trichloroethanol No Adverse Effect Level: 4 mg/L Terminal Half-Time: 12 Hours. Page 643.	Occupational & Environmental Medicine. 2nd Edition. Appleton and Lange. 1997. Page 643.
	Whole Blood (Chemical/Metabolite) End of Workweek • N/R As: Trichloroethylene (TCE) Page 352.	Timing of sample collection for biological monitoring of occupational exposure. Ann Occup Hyg 41/3:345-353, 1997.





(OSHA = Occupational Safety and Health Administration)

Trichloroethylene

Linch AL.	 Infrared Spectroscopy (IR) As: Trichloroethylene (TCE) Trichloroethylene has Been Detected in Post-Exposure Exhaled Air. Page 79. 	Biological Monitoring for Industrial Chemical Exposure Control. CRC Press. 1974. Page 79.
Proctor NH, Hughes JP.	Exhaled Air Special Test: Breath Analysis May be Useful in Estimating the Extent of Exposure of Workers to Trichloroethylene. Page 491.	Chemical Hazards of the Workplace. JB Lippincott Company. 1978. Page 491.
Atio A, Riihimaki V, Vainio H. eds.	N/R As: Trichloroethylene (TCE) The Concentration of TCE in Alveolar Air Decreases Fast in the first ½ hour after Exposure from about 25% at End of Exposure to about 5% of inhaled Air. Workload during Exposure Increases the Concentrations in Alveolar Air over the Whole Post-exposure Period. Alcohol Consumption during Exposure Increases the Concentration in Alveolar Air. The Concentration in Alveolar Air Seems to be Somewhat Lower in Women than in Men. Page 114.	Biological Monitoring and Surveillance of Workers Exposed to Chemicals. Hemisphere Publishing Corporation. 1984. Page 114.





(OSHA = Occupational Safety and Health Administration)

Trichloroethylene

Lauwerys RR, Hoet P.	Exhaled Air During Exposure • N/R As: Trichloroethylene (TCE) Tentative Maximum Permissible Concentration: 10 ppm. Page 609.	Industrial Chemical Exposure. Guidelines for Biological Monitoring. 3rd Edition. Lewis Publishers. CRC Press, Inc. 2001. Page 609.
ACGIH.	Exhaled Air End-of-Shift at End of Workweek • N/R As: Trichloroethylene (TCE) This Determinant is an Indicator of Exposure to the Chemical but it is not Quantitative. It May be Used as a Screening Test if a Quantitative Test is not Practical or as a Confirmatory Test if the Quantitative Test is not Specific. Hence, no BEI is Recommended. ACGIH Considers TCE to Be a Suspected Human Carcinogen. Pages 60; 77; 104; 115.	2021 Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices. ACGIH Worldwide. 2021. Pages 60; 77; 104; 115.
LaDou J, ed.	Exhaled Air End of Workweek • N/R As: Trichloroethylene (TCE) No Adverse Effect Level: 0.5 ppm Terminal Half-Life: 30 hours. Page 643	Occupational & Environmental Medicine. 2nd Edition. Appleton and Lange. 1997. Page 643.





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Trichloroethylene

	Alveolar Air Concentrations of TCE have been shown to Correlate well with both the Actual Environmental TCE Level as well as the Time-Weighted Average Exposure for an Individual Worker, depending upon when the Breath Specimen was obtained. Most Investigators agree that for Routine Monitoring Purposes Alveolar Air Sample Should be taken at least 6 hours after the End of Exposure; and for Convenience may be obtained just Prior to the Start of the Next Working Day. Page 356 (1997).	Methods for Industrial Chemicals. 1st, 2nd, 3rd Editions. Chemical Toxicology Institute, 1980. 1988, 1997. Page 356 (1997).
LaDou J, ed.	Exhaled Air Prior to Next Shift • N/R As: Trichloroethylene (TCE) No Adverse Effect Level: 0.5 ppm Terminal Half-Life: 30 hours. Page 643.	Occupational & Environmental Medicine. 2nd Edition. Appleton and Lange. 1997. Page 643.
Lauwerys RR, Hoet P.	Exhaled Air 16 Hours after End of Exposure • N/R As: Trichloroethylene (TCE) Tentative Maximum Permissible Concentration: 0.5 ppm. Page 609.	Industrial Chemical Exposure. Guidelines for Biological Monitoring. 3rd Edition. Lewis Publishers. CRC Press, Inc. 2001. Page 609.





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Trichloroethylene

US DHHS PHS CDC NIOSH and US DOL OSHA.	Liver Function Tests Trichloroethylene is a Potential Human Carcinogen. Chronic Exposure to Trichloroethylene has Caused Injury to the Liver. A Baseline Value of Liver Function Tests Should be Taken for each Worker before Exposing the Worker to TCE to Identify an Excessive Decrease or Adverse Trend in the Integrity and Physiological Function of the Liver. Page 2 (1988).	NIOSH/OSHA Occupational Health Guidelines for Chemical Hazards DHHS (NIOSH) Pub No. 81-123; 88-118; Suppls. I-IV. 1981-1995. Pages 1-6 (1988).
US DHHS PHS CDC NIOSH and US DOL OSHA.	Pulmonary Function Tests Baseline Values of Pulmonary Function Tests Should Be Obtained before Exposing the Worker to TCE to Identify an Excessive Decrease or Adverse Trend in the Integrity and Physiological Function of the Respiratory System. Medical Surveillance for Respiratory Disease Should be Conducted by Using the Principles and Methods Recommended by NIOSH and The American Thoracic Society (ATS). Page 2 (1988).	NIOSH/OSHA Occupational Health Guidelines for Chemical Hazards DHHS (NIOSH) Pub No. 81-123; 88-118; Suppls. I-IV. 1981-1995. Pages 1-6 (1988).





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Trichloroethylene

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US DHHS PHS CDC NIOSH and US DOL OSHA.	Skin Examination Short-term Exposure to TCE has Caused Irritation of the Skin. Long-Term Exposure to TCE can also Cause Dryness of the Skin, Blisters and Dermatitis. Repeated Immersion of the Hands into Liquid TCE has Caused Paralysis of the Fingers. A Dermal Response is seen as a Reddening of the Face, Neck, Back, and Shoulders known as "Degreaser's Flush" in Chronically Exposed Workers after Ingestion of Alcohol. Page 2 (1988).	NIOSH/OSHA Occupational Health Guidelines for Chemical Hazards DHHS (NIOSH) Pub No. 81-123; 88-118; Suppls. I-IV. 1981-1995. Pages 1-6 (1988).
Lauwerys RR, Hoet P.	Urine (Chemical/Metabolite) N/R As: Trichloroethanol Reference Value: ND (< 5 mg/L – to be Confirmed) Tentative Maximum Permissible Concentration: 150 mg/g Creatinine N/R As: Trichloroacetic Acid (TCA) Reference Value: ND (< 5 mg/L – to be Confirmed) Tentative Maximum Permissible Concentration: 75 mg/g Creatinine	Industrial Chemical Exposure. Guidelines for Biological Monitoring. 3rd Edition. Lewis Publishers. CRC Press, Inc. 2001. Page 609.

Page 609.





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Atio A, Riihimaki V, Vainio H. eds. Urine (Chemical/Metabolite)

In Most Investigations the Amounts of Trichloroethanol (TCEOH) & Trichloroacetic Acid (TCA) are expressed as 24-Hour Amounts.

Conclusions reached for a Single Exposure:
A Major Portion of TCEOH is Excreted in the first 24
Hours after Start of Exposure.

A Major Portion of TCA is Excreted in the 2nd and 3rd 24 Hour after Exposure. The Excretion of TCA Continues for a Long Time, According to the Half-Life of about 70-100 hours.

Alcohol Consumption during Exposure Decreased Excretion of Both TCEOH and TCA.

Workload during Exposure Increases the Excretion of both TCE and TCA.

Males seem to Excrete more TCEOH in the first 24 Hours after Exposure than Females, but Females excreted more TCA than Males.

Conclusions Reached In Repeated Exposures of Amounts of TCEOH and TCA Excreted on the First 24 Hours and Last day of Exposure:

Accumulation of TCEOH During the Week seems to be Small, about 50% to 80%.

Amounts of TCA Excreted in Urine per 24 Hour on 5th Day are 5 times Higher than on 1st Day.

Fluctuation Concentrations in Air seem to have only Small Influences in Amounts Excreted.

Alcohol Consumption during Exposure Decreases the amounts of TCEOH and TCE Excreted in the Urine.

Pages 116-117.

Biological Monitoring and Surveillance of Workers Exposed to Chemicals. Hemisphere Publishing Corporation. 1984. Pages 116-117.





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Trichloroethylene

US DHHS PHS CDC NIOSH.	 Urine (Chemical/Metabolite) Gas Chromatography/ Electron-Capture Detector (GC-ECD) As: Trichloroacetic Acid, Methyl Ester 	NIOSH Manual of Analytical Methods. 4th Edition. DHHS (NIOSH) Publication No. 94-113, 1994.
	This Method can be used for the Determination of Trichloroacetic Acid (TCAA) in Urine Specimens. TCAA is one of Several Metabolites Detected after Exposure to a Variety of Chlorinated Compounds or From Contaminated Drinking Water.	5th Edition. Webpage. www.cdc.gov/niosh/nm am Method # 8322, 5 pages.
	Pages 1-5.	
LaDou J, ed.	Urine (Chemical/Metabolite) End-Of-Shift • N/R As: Trichloroethanol (TCE) & Trichloroacetic Acid (TCAA). No Adverse Effect Level: 300 mg/L Comment: Large Individual Variability Page 643.	Occupational & Environmental Medicine. 2nd Edition. Appleton and Lange. 1997. Page 643.
Fiserova-Berg erova V, Vlach J.	Urine (Chemical/Metabolite) End-Of-Shift • N/R As: Trichloroethylene (TCE) + Trichloroacetic Acid (TCAA). Page 352.	Timing of sample collection for biological monitoring of occupational exposure. Ann Occup Hyg 41/3:345-353, 1997.





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Trichloroethylene

ACGIH.	Urine (Chemical/Metabolite) End of Shift at End of Workweek • N/R As: Trichloroacetic Acid (TCAA). The BEI is 15 mg/L with a Notation of "Nonspecific" since the Determinant is also Observed after Exposure to other Chemicals. ACGIH Considers Trichloroethylene (TCE) to Be a Suspected Human Carcinogen. Pages 60; 77; 104; 115.	2021 Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices. ACGIH Worldwide. 2021. Pages 60; 77; 104; 115.
LaDou J, ed.	Urine (Chemical/Metabolite) End of Workweek • N/R As: Trichloroethanol (TCA) & Trichloroacetic Acid (TCAA). No Adverse Effect Level: 300 mg/L Comment: Large Individual Variability • N/R As: Trichloroacetic Acid (TCAA). No Adverse Effect Level: 100 mg/L Clinical Effect Level: 200 mg/L Terminal Half-Life: 50-100 Hours. Comment: Large Individual Variability. Page 643.	Occupational & Environmental Medicine. 2nd Edition. Appleton and Lange. 1997. Page 643.





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Fisero	va	a-Berg
erova	٧,	Vlach
J.		

Urine (Chemical/Metabolite)

End of Workweek

N/R

As: Trichloroacetic Acid (TCAA).

Half-Life (BEI): 3 Days. Since Half-Life is < 9 days, Sampling Should be done after 1 Month of Employment.

Pages 349; 352.

Timing of sample collection for biological monitoring of occupational exposure. Ann Occup Hyg 41/3:345-353, 1997.

Baselt RC.

Urine (Chemical/Metabolite)

Prior to Next Shift

Determination of Urinary Metabolites of TCE has Not Been Fully Successful as an Index of Exposure, due to Interindividual Variation in Metabolism, the Tendency of Accumulation of Metabolites during Chronic Exposure and Delayed Urinary Excretion (Esp. for TCA), and the fact that Other Chemicals (Chloral Hydrate, Tetrachlorethylene & Trichloroethane) Produce the Same Metabolic Products in Humans. Total Trichloro compounds Have been Measured by Several Investigators and Found to Offer an Approximate Guide to Exposure; in a Urine Specimen Collected at the End of a Work Shift from a Worker Chronically Exposed to 100 ppm TCE, the Trichloro compounds Should Average 500-600 mg/g Creatinine.

Finally, Urine Trichloroethanol Concentrations Have been Claimed to Be a Fairly Accurate Index (Continued on Next Page)

Biological Monitoring Methods for Industrial Chemicals. 1st, 2nd, 3rd Editions. Chemical Toxicology Institute, 1980. 1988, 1997. Pages 354-362 (1997).





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Trichloroethylene

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Baselt RC.	Urine (Chemical/Metabolite)	Biological Monitoring
	(Continued From Previous Page)	Methods for Industrial
		Chemicals. 1st, 2nd, 3rd
	of Exposure, and Should be Measured in a	Editions. Chemical
	Specimen Collected Just Before the Start of the Next	Toxicology Institute,
	Work Period; Trichloroethanol in such a Specimen	1980. 1988, 1997.
	Should not Exceed 300 mg/L in Workers Exposed to	Pages 354-362 (1997).
	100 ppm of TCE on a Daily Basis.	
	Colorimetry	
	As: Trichloroacetic Acid & Trichloroethanol	
	Gas Chromatography/Electron Capture	
	As: Trichloroethanol	

As: Trichloroacetic Acid. Page 356; 360-362. (1997).