



**Australian Government**

**Department of the Environment, Water, Heritage and the Arts**



# **NPI VOLATILE ORGANIC COMPOUND DEFINITION AND INFORMATION**

**VERSION 2.7 – SEPTEMBER 2009**

# Total Volatile Organic Compounds & the National Pollutant Inventory

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## Introduction

For the purposes of the National Pollutant Inventory (NPI), total volatile organic compounds (Total VOCs) are substances to be reported by facilities if the Total VOCs reporting threshold is exceeded. Total VOCs is an NPI substance because it represents photochemical smog precursors. As such Total VOCs can be generally defined as: any organic compound that participates in atmospheric photochemical reactions.

The intent of the inclusion of Total VOCs is in recognition of the combined effect of compounds that contribute to smog formation that may not otherwise have been captured due to individual substances not meeting a usage threshold in their own right. The most common sources of Total VOCs emissions are from the storage and use of liquid and gaseous fuels, the storage and use of solvents and the combustion of fuels.

## NPI VOC definition

For the purpose of NPI reporting, Total VOC are defined as any chemical compound based on carbon chains or rings with a vapour pressure greater than 0.01 kPa at 293.15 K (i.e. 20°C), that participate in atmospheric photochemical reactions.

- Specifically excluded are:
- carbon monoxide;
- methane;
- acrylamide;
- benzene hexachloro;
- biphenyl;
- chlorophenols;

- n-dibutyl phthalate;
- ethylene glycol;
- di-(2-ethylhexyl) phthalate (DEHP);
- 4,4-methylene bis 2,4 aniline (MOCA);
- Methylenebis;
- Phenol; and
- toluene-2,4-diisocyanate.

## **Total VOCs in fuel mixtures**

Most fossil fuels consist mainly of a mixture of a number of different carbon compounds. In many fuels, some of these carbon compounds will meet the above VOC definition, while others will not. There is a range of other substances in fuels which are not carbon compounds.

For more information about the composition of fuels see the NPI Emission Estimation Technique Manual Fuel and Organic Liquid Storage on the web [www.npi.gov.au/handbooks/approved\\_handbooks/fols.html](http://www.npi.gov.au/handbooks/approved_handbooks/fols.html).

## **Total VOCs in solvents and other products**

In a similar way to fuels, VOCs are often a component of products such as paints and solvents. The Material Safety Data Sheet is often the best means of identifying the Total VOCs content of a certain product.

## **Total VOCs thresholds**

There are two NPI facility reporting thresholds relating to Total VOCs:

### **Category 1a**

This threshold is tripped if, at a facility, 25 tonnes or more of Total VOCs is used in the reporting period.

For example, if a facility uses 300 tonnes per year of a fuel that consists of 10% Total VOCs by weight, then it is said to use 30 tonnes (300 x 10/100) of VOCs and hence trips this threshold.

### **Category 2**

This threshold is tripped if, at a facility, 400 tonnes or more of fuel or waste is burnt in the reporting period; or 1 tonne or more of fuel or waste is burnt in any hour (peak hourly usage) during the reporting period.

If this threshold is tripped, the facility is required to report emissions of a range of substances, including Total VOCs.

## **Total VOCs emissions**

Industry handbooks for the NPI provide emission estimation techniques for estimating Total VOCs from fuel burning, fuel storage and other solvent use.

For fuel storage, all losses from breathing and refilling are to be regarded as Total VOCs emissions.

For use of solvents, paints and other such products, the Total VOCs emissions often are equal to the Total VOCs content of the product. These emissions may be reduced by techniques such as vapour recovery.

## Total VOCs species

There are 41 substances included on the NPI reporting list which fall under the Total VOCs definition. This means these substances are VOCs. These substances are listed below. It is important to note that the reason for their inclusion as individual substances is on the basis of their toxicity to plant, animal and human health, not because of their activity as a precursor to the formation of smog.

**Table 1: VOCs that are NPI substances**

Substance	CASR Number	Substance	CASR Number
Acetaldehyde	75-07-0	Ethyl butyl ketone	106-35-4
Acetic acid (ethanoic acid)	64-19-7	Ethylbenzene	100-41-4
Acetone	67-64-1	Ethylene oxide	72-21-8
Acetonitrile	75-05-8	Formaldehyde (methyl aldehyde)	50-00-0
Acrolein	107-02-8	Glutaraldehyde	111-30-8
Acrylonitrile (2propenenitrile)	107-13-1	n- Hexane	110-54-3
Acrylic Acid	79-10-7	Methanol	67-56-1
Aniline (benzenamine)	62-53-3	2- Methoxyethanol	109-86-4
Benzene	71-43-2	2- Methoxyethanol acetate	110-49-6
1,3 – Butadiene	106-99-0	Methyl ethyl ketone	78-93-3
Chloroethane (ethyl chloride)	75-00-3	Methyl isobutyl ketone	108-10-1
Chloroform (trichloromethane)	67-66-3	Methyl methacrylate	80-62-6
Cumene (1methylethylbenzene)	98-82-8	Styrene (ethenylbenzene)	100-42-5
Cyclohexane	110-82-7	1,1,2,2- Tetrachloroethane	79-34-5
1,2- Dibromoethane	106-93-4	Tetrachloroethylene	127-18-4
1,2- Dichloroethane	107-06-2	Toluene (methylbenzene)	108-88-3
Dichloromethane	75-09-2	1,1,2- Trichloroethane	79-00-5
Ethanol	64-17-5	Trichoroethylene	79-01-6
2- Ethoxyethanol	110-80-5	Vinyl Chloride Monomer	75-01-4
2- Ethoxyethanol acetate	111-15-9	Xylenes (individual or mixed isomers)	1330-20-7
Ethyl acetate	141-78-6		

## References

1. USEPA, AP-42 1996.
2. "Measurement of Motor Vehicle Pollutants and Fleet Average Emission Factors in Melbourne," EPA Publication No. 652, June 1999.
3. "Volatile Organic Compounds in the Ambient Air of Greater Vancouver 1990 to 1996," Greater Vancouver District, Air Quality Department, 1999.
4. Report on the Kalgoorlie NPI Trial, 1999.
5. Correspondence from South Australian and Tasmanian NPI Teams
6. National Pollutant Inventory database: Contextual information on Total VOCs [www.npi.gov.au/database/substance-info/profiles/88.html](http://www.npi.gov.au/database/substance-info/profiles/88.html)
7. CRC Handbook of Chemistry & Physics.
8. Merck Index.
9. Ms Natalie Smrk, BP Australia Marketing and Technical Services.

## Abbreviations and definitions

Term	Definition
NPI	National Pollutant Inventory
Total VOCs	Total Volatile Organic Compounds
VOCs	Volatile Organic Compounds

## Erratum

### Page/details      Outline of alteration

#### Version 2.7 – updated from Version 2.6 – September 2009

VOC definition	Removed exemption clause:  <i>"There is one exemption to this definition. For bulk storage facilities, the threshold is only exceeded if their design capacity also exceeds 25 kilotonnes (25,000 tonnes). It is important to note that this only applies to facilities solely engaged in bulk storage."</i>
Table 1:	1,1,1,2 tetrachloroethane has been removed and replaced with 1,1,2,2 tetrachloroethane

#### Version 2.6 – updated from Version 2.5 – March 2009

VOC definition	Definition of Total VOC temperature and pressure conditions amended to increase comparability with other PRTR's, exclusion list amended to clarify the definition.
General	Acrolein added to the list of VOCs that are NPI substances

#### Version 2.5 – updated from Version 2.4 – September 2006

VOC definition	As tetrachloroethylene does not contain hydrogen, the reference to the compound containing hydrogen has been amended.
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#### Version 2.4 – updated from version 2.3 – 23 March 2003

General	Use the acronym Total VOCs consistently and correctly. Added a section for abbreviations and definitions.
VOC definition	Combined the note into the actual definition. Will change this in other NPI documents as they are updated.
Fuel composition table	This was previously Table 1 in this document. The table has been removed and users referred to the NPI Fuel and Organic Liquid Storage manual.
Table 1: NPI substances which are VOCs	In previous versions this was Table 2. Methylenebis (CASR 101-68-8) was removed as it does not fit the definition of VOC. Glutaraldehyde was added as it is a VOC (vapour pressure is 16.4mmHg at 20°C). Reference to NPI table 1 and table 2 was removed as all substances are now required to be considered by reporting facilities.
References	Corrected web link for reference 6.

#### Version 2.3 – updated from version 2.2 – 21 October 2003

Table 2 page 3	The substances do not fit the NPI definition of VOCs. The substances removed are: Di-(2-Ethylhexyl) phthalate (DEHP) and 4,4- Methylene bis 2,4 aniline (MOCA).
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