



Diesel Particulate Matter (DPM)

INTRODUCTION

Following an internal programme to develop new capabilities to support major clients, ALS is pleased to announce NATA accreditation for Diesel Particulate Matter (DPM) on quartz filters. ALS reports DPM in the standard convention of – Diesel Particulate Matter (as Elemental Carbon). ALS can also report Organic Carbon by thermo optical analyser using NIOSH 5040 and Total Carbon by calculation using NIOSH 5040.

REPORT INFORMATION

ALS reports results as $\mu\text{g C}/\text{filter}$. ALS is also able to report DPM as $\mu\text{g}/\text{m}^3$ of air sampled where the volume of air sampled is provided to ALS on COCs. This calculation will not be NATA accredited unless the sampling has been performed by a NATA accredited sampling team and traceability exists.

WHERE IS DPM OF CONCERN

DPM can be found in most industries where larger diesel powered equipment is utilised. The diesel engine was invented over 115 years ago and improved the productivity of many nations, but one down side to the diesel engine can be potential exposure to the particulate fraction of the diesel exhaust emissions. This is increasingly of concern in major cities or where the exhaust fumes can concentrate such as underground mining, deep mine pits or vehicular tunnels, truck loading bays and ship holds. DPM is a key issue under discussion in the Sydney media at present with public concern over filtration and ventilation of existing and proposed tunnels.

METHOD INFORMATION

ALS METHOD CODE

EP016 – DPM

EP016 – OC/EC

LIMITS OF REPORTING (LOR)

DPM as elemental carbon - $10\mu\text{g C}/\text{Filter}$

Elemental, Organic and Total Carbon - $10\mu\text{g C}/\text{Filter}$

METHOD REFERENCE

NIOSH 5040

WHAT IS DPM?

Diesel Particulate Matter (DPM) is the term for fine particles produced by exhausts from diesel engines. Diesel exhaust emissions can be in two phases, either gas or particulates. The gas phase can include the following pollutants; acetaldehyde, acrolein, benzene, 1,3-butadiene, formaldehyde and polycyclic aromatic hydrocarbons. The particle phase can contain many different types of particles that can be classified by size or composition. Fine and ultra-fine particles cause the greatest health concern as these may be composed of elemental carbon with adsorbed compounds such as sulphate, nitrate, metals and other trace elements.

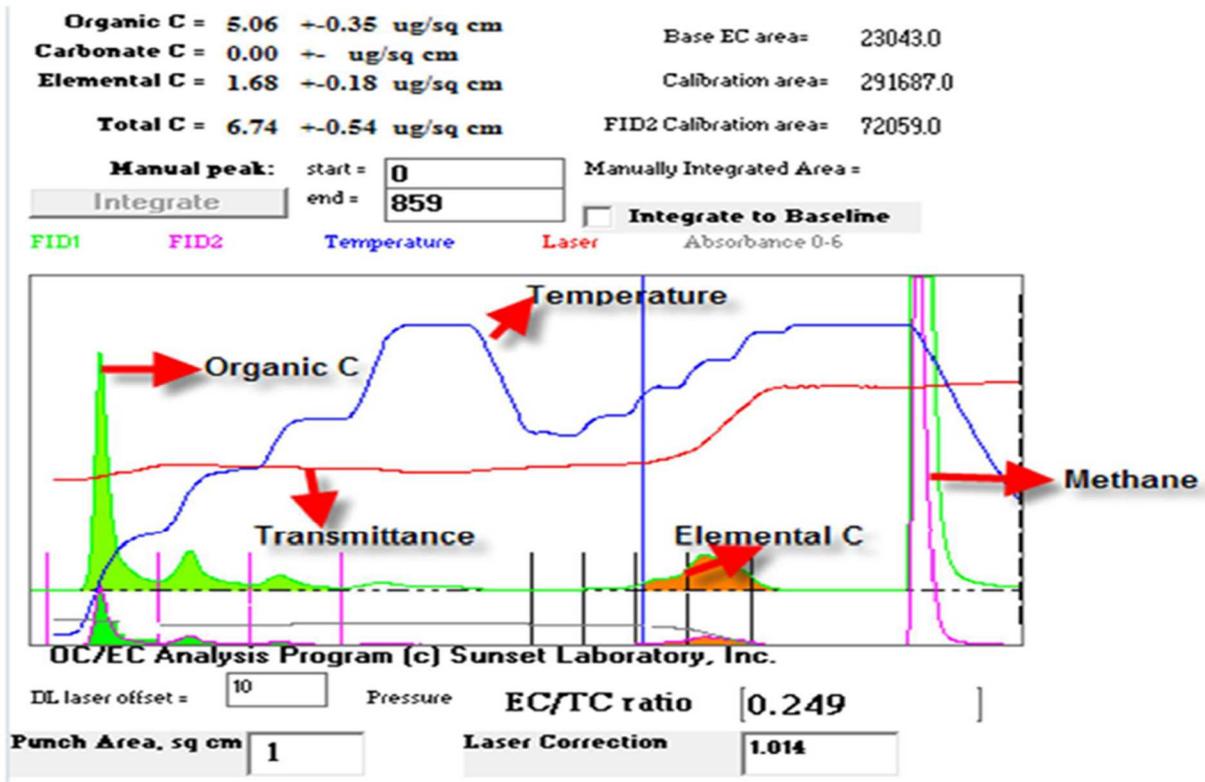
Diesel exhaust emissions can come from a range of engines such as trucks, buses, cars, locomotives, marine vehicles and heavy duty equipment.



HEALTH ISSUES OF DPM

There have been many studies into diesel exhaust health effects including lung cancer e.g. 1988 study by the *US National Institute of Occupational Safety and Health* (NIOSH). Other associations that have conducted reviews of the link between diesel emissions and lung cancer are *The Health Effects Institute* (HEI), *Mines Safety and Health Administration* (MSHA) & *United State Environmental Protection Agency*.

FIGURE 1: EXAMPLE OF A DPM TRACE ANALYSIS



ANALYSIS

Analysis of DPM is via a dedicated thermo-optical analyser. A fixed size sub-sample portion of the filter is heated in the instrument oven in an inert atmosphere. This includes a series of increases in temperature, which first leads to the volatilisation of relatively light organic carbon and then to the pyrolysis of heavier organic carbon matter (pyrolytic charring). The sample is subject to a second temperature program in an oxidising atmosphere which combusts the elemental carbon. Laser light transmission through the quartz filter is used to detect the occurrence of charring (heavy organic carbon) and its combustion at lower temperatures under oxygen. The occurrence and subsequent combustion of the char material provides the cut-off between elemental and organic carbon – see the blue vertical line in the illustrated thermogram above.

When performed in accordance with the prescribed sampling and analysis method, the elemental carbon detected is quantified and reported deemed to be 'diesel particulate matter'.

SAMPLING AND SUBMISSION

NIOSH method 5040 is the standard for DPM, which is, in essence, defined by both the mode of sampling and the specific method of analysis. Sampling needs to be performed on the prescribed quartz filter papers usually purchased, pre-cleaned and loaded into a cassette. There are two types of filter cassette – first a sub-micron impactor and second a standard housing that must be used in conjunction with a cyclonic device to ensure that only respirable carbon particles are captured. These filters and cassettes are available through retailers of sampling equipment e.g. SKC

These cassettes can be shipped via airbag with no requirement for chilling or preservation.

REFERENCES

1. Australian Institute of Occupational Hygienists – DPM Position Paper (09.07.2013)
2. NIOSH Method 5040: DIESEL PARTICULATE MATTER (As Elemental Carbon) from NIOSH Manual of Analytical Methods (NMAM), Fourth Edition
3. United States Environmental Protection Agency: Region 1: EPS New England – Diesel Particulate Matter

For further information regarding Diesel Particulate Matter, please contact your local ALS representative or the Sydney laboratory at ALSEnviro.sydney@alsglobal.com