Causes and Effects

EFFECTS OF CONTAMINANTS ON THE BODY

The ill effects of contaminants in compressed air can be classified into two categories: (1) those that have no harmful effect on the lungs but pass from the lungs directly into the bloodstream, either impairing the oxygen-carrying capacity of the red blood cells or affecting other parts of the body, possibly causing delirious effects, and (2) those that cause disease of the lung tissue or damage the lung to impair its function.

CATEGORY 1 – No Harmful Effect on the Lungs

GASEOUS CONTAMINANTS

CARBON MONOXIDE is the deadliest of the toxic gases commonly found in compressed air. The fact that it is colorless and odorless makes it virtually impossible to detect. CO combines readily with red blood cells and prevents the transfer of oxygen to the tissues causing oxygen starvation (hypoxia)

EFFECTS: Headaches, heart palpitations, loss of equilibrium, confusion, unconsciousness and ultimately death.

ALLOWABLE LIMITS: According to the Compressed Gas Association (CGA) and Occupational Safety and Health Administration (OSHA) CO in compressed air should be limited to 10 ppm. This limit is set for Grade D breathing air for industry and general respiratory use. For sport scuba diving up to 125 feet, the limit is 10 ppm (Grade E). The NFPA recommends a lower limit of 5 ppm set for firefighting.

CARBON DIOXIDE is also classified as a toxic gas, but can be tolerated at much higher concentrations than CO.

EFFECTS: Similar to those of carbon monoxide; however, first stimulates the respiratory center which causes an increased rate and depth of breathing, especially dangerous not only because it speeds up the effects of CO_2 but also increases the intake of other contaminants that may be present.

ALLOWABLE LIMITS: Grade D, Grade E, NFPA 1989 – 1000 ppm

TOTAL GASEOUS HYDROCARBONS are currently not limited by the CGA/OSHA Grade D specifications but are by the NFPA 1989 and Grade E at 25 ppm. All analyses on compressed air done by TRI include analysis of gaseous hydrocarbons.

EFFECTS: Because of the 1000's of possible gaseous hydrocarbons that might be present, no general statement can be made about their effect.

ALLOWABLE LIMITS: none given for CGA/OSHA Grade D; CGA Grade E, NFPA 1989 and US Navy Dive limits are 25 ppm.

CATEGORY 2 – Those Causing Damage to the Lungs

OTHER CONTAMINANTS

CONDENSED HYDROCARBONS (oil mist and particulate matter) larger particles entering the body in small amounts can be removed by routine bodily functions; however, smaller particles are retained and, depending on the type of oil and the amount of retention in the body, can be dangerous or fatal.

EFFECTS: Excess oil mist deposits in the alveoli can cause an intense inflammation known as lipoid pneumonia, and can cause alveoli to dilate and rupture decreasing the total surface area available for the transfer of oxygen and carbon dioxide known as emphysema.

ALLOWABLE LIMITS: Grade D, Grade E, and US Navy Dive – 5 mg/m^3; NFPA 1989 – 2 mg/m^3

WATER in compressed air is as much a contaminant as others, but for a different reason.

EFFECTS: In cold climates, excess water vapor can cause the regulator or valve to freeze up and cause the SCBA (self-contained breathing apparatus) to become inoperative, defeating its life-supporting purpose. Excess H_2O can promote cylinder corrosion and rust, and may negate the effectiveness of the catalyst in a purification system which converts CO to CO_2.

ALLOWABLE LIMITS: The CGA states that water content of compressed air required for any particular grade may vary with the intended use from saturated to very dry. OSHA 1910.134 requires a dew point: 1) lower than -50 degrees F (67 ppm) in purchased cylinders of breathing air or 2) for compressor supplied breathing air at least 10 degrees F below the ambient temperature. NFPA 1989 requirements are not to exceed -65°F (24 ppm v/v).

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Causes and Effects

CAUSES AND SOURCES OF CONTAMINATION

There are potentially two* major sources that cause contamination in compressed air.

(1) The intake air.
(2) Contaminants produced within the compressor.

FROM INTAKE AIR

CARBON MONOXIDE	CARBON DIOXIDE	GASEOUS HYDROCARBONS	PARTICULATES & CONDENSED HYDROCARBONS	WATER
Motor exhaust	Recirculated air from central air conditioning and or heating in highly populated areas (shopping malls, industrial plants, etc.). Also motor exhaust	Vapors from nearby dry cleaning shops, beauty salons, chemical plants, industrial / manufacturing plants, motor exhaust, cleaning solvents	Dust, pollen, motor exhaust.	Humidity.

FROM WITHIN COMPRESSOR

CARBON MONOXIDE	CARBON DIOXIDE	GASEOUS HYDROCARBONS	PARTICULATES & CONDENSED HYDROCARBONS	WATER
Combustion product of hydrocarbon fuels and lubricants can be caused by over - heated oils Oxidation of charcoal filters due to overheating	Certain CO filters convert CO into CO_2 CO_2 which has accumulated on a filter can be released when a drop in operating pressure occurs	Overheating compressor lubricants can cause the generation of lubricant vapor.	Oil mist can be generated from compressor lubricants escaping through faulty piston rings. Inorganic particulates can be caused by carbon from an activated charcoal filter or rust from steel piping	Moisture can remain in the output air when water separators are not properly maintained.

**It is also possible for an individual cylinder to accumulate excess oil or water over a period of time. It is for this reason that TRI makes the following recommendation:

Air quality testing should be performed at the same location that self-contained breathing apparatus are filled and/or respirators are used. We do not recommend sampling directly from a filled airpak due to the settling of oil on the sides of the container and because of the possibility of prior contamination of that particular SCBA. This method does not allow for representative analysis of your entire system.

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