3M

Technical Brief

Novec™ 1230
Fire Protection Fluid

Safety Assessment

The safety of 3M™ Novec™ 1230 Fire Protection Fluid has been investigated with two specific purposes in mind. First, 3M has conducted the necessary toxicity tests to establish the levels to which an individual can be safely exposed upon its release from a fire protection system. Second, 3M has also established the safe level for routine handling of the material during the manufacture of fire protection systems. Dramatic differences exist in the frequency and magnitude of exposure anticipated from these two very distinct scenarios. Exposures from fire protection systems are very high (4-6%) but occur infrequently and exposures during the manufacturing process are very low but occur regularly.

Safety Assessment of Fire Protection Systems

One of the principle concerns for short term, high exposure to volatile fluorochemicals such as halons or HFCs is cardiac sensitization. Cardiac sensitization is one of the first studies conducted on Novec 1230 fluid. The purpose of the cardiac sensitization study is to identify chemicals that sensitize the heart to the effects of endogenous epinephrine and, in doing so, result in potentially fatal arrhythmias. In general, the study involves predosing restrained animals with epinephrine in order to establish a minimal effect using epinephrine alone. This first stage is then followed up with dosing Novec 1230 fluid via inhalation and challenging, again, with epinephrine. The study protocol is conservative in that it calls for dosing with epinephrine at doses far larger than normally present in the heart. The No Effect Level (NOEL) for cardiac sensitization for Novec 1230 fluid was established at 10%.

Other end points of acute toxicity were assessed using a 4 hr. acute inhalation study (rat) at 10%, a 2 hr. acute inhalation study (rat) at 10% and a 28-day inhalation study (rat) at 2.0% No signs of acute toxicity were observed in these studies. On the basis of this information, the No Effect Level (NOEL) for any end-point of acute toxicity for Novec 1230 fluid has been established at 10%.

Safety Assessment for Worker Exposure

The 28-day inhalation study was also used to establish the air concentration to which workers can be safely exposed during routine handling. The No Adverse Effect Level (NOAEL) from the 28-day inhalation study was determined to be 4000 ppm. Traditional methodologies for establishing exposure guidelines for workplace handling require that safety factors be applied to account for uncertainties in the data such as those which exist when extrapolating test results from animal to human. As a result, the 8 hr. time weighted average (TWA) exposure guideline has been established at 150 ppm. This concentration represents the concentration to which workers can be exposed for eight hrs/day, 40 hours/week without suffering adverse health effects.

Additional Background

Other toxicity studies conducted have concluded that Novec 1230 fluid is only minimally irritating to the eye, non-irritating to the skin, does not cause skin sensitization, is not mutagenic in the Ames assay and does not cause chromosomal aberrations in CHO cells.

Novec 1230 fluid is a highly fluorinated chemical with low polarizability, and, therefore, has very low water solubility. Novec 1230 fluid is also extremely volatile with a vapor pressure of 237 mmHg at 20° C. Consequently, insignificant exposure should occur through the skin and most of the material inhaled should be exhaled unchanged. The relatively small fraction

absorbed across the lung-air interface will be hydrolyzed to perfluoropropionic acid and heptafluoropropane. This process likely occurs through physical hydrolysis in biological media rather than through metabolic bioactivation. The perfluoropropionic acid is highly water soluble (5% solutions have been generated) and readily excreted in the urine. Heptafluoropropane is a gas with very low water solubility and, therefore, will be quickly exhaled. Both products of hydrolysis will have a very short half-life in the body.

Anecdotal human experience with exposures in the range of anticipated design concentrations support the observations and conclusions that have been derived from animal studies. There have not been any complaints of adverse health effects from these experiences.

Conclusions

To date, other independent assessments of the toxicity of Novec 1230 fluid include a review by the U.S. EPA, German Hygiene Institute, the U.K. Halon Alternatives Group (HAG) and an independent consulting firm, Environ. In conclusion, there is general consensus that 3M™ Novec™ 1230 Fire Protection Fluid is not only safe for its intended use but provides a large margin of safety relative to anticipated design concentrations of fire protection systems and during the manufacture of those systems.

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