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**BASE LEVEL GUIDE FOR THE
OCCUPATIONAL EXPOSURE TO
ISOCYANATES**

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1.0 PURPOSE

This fact sheet provides the current recommended sampling and analysis technique available by the U.S. Air Force School of Aerospace Medicine (USAFSAM) for determining occupational health risk from isocyanates.

2.0 BACKGROUND

The rescission of Air Force Occupational Safety and Health (AFOSH) Standard 48-8, *Controlling Exposures to Hazardous Materials*, left a policy gap in the sampling and analysis of many USAF hazards. Specifically, the loss of Attachment 11, *Isocyanates*, is the focus of this fact sheet.

3.0 SAMPLING AND ANALYSIS

To quantify both the oligomer as well as the monomer form of isocyanates, the ISO-CHEK® (Omega Specialty Instrument Co., Houston, TX) sampling protocol is the only sampling method recommended by the USAFSAM Occupational and Environmental Health Department (OE) for isocyanates listed in Table 1. ISO-CHEK® uses a two-stage filter arrangement that results in the separation of vapor from aerosol (Figure 1). Stage 1 contains an untreated polytetrafluoroethylene (PTFE) filter to collect the aerosol phase and stage 2 holds a glass fiber filter impregnated with 9-(N-methylaminomethyl) anthracene (MAMA) for the vapor phase of isocyanates. The required flow rate is 1 L/min with a maximum volume of 15 liters. This is important to note since it will drive a high filter change-out frequency, i.e., every 15 minutes. During its health hazard evaluations, the National Institute for Occupational Safety and Health has utilized, and USAFSAM recommends, the Bayer Corp./Oregon Occupational Safety and Health Administration (OSHA) permissible exposure limit of 0.5 mg/m³ for an 8-hour time-weighted average and 1.0 mg/m³ as a ceiling limit for comparison of hexamethylene diisocyanate (HDI) oligomer results. Monomer results should be compared to the latest edition of the American Conference of Governmental Industrial Hygienists threshold limit value booklet as well as OSHA ceiling limits.

4.0 RESPIRATORY PROTECTION AND PERSONAL PROTECTIVE EQUIPMENT (PPE)

The required level of respiratory protection should be based on the process evaluation, measured exposure levels, and assigned protection factors according to AFOSH Standard 48-137, Attachment 2 (Ref 1). The minimum required respiratory protection during spray painting is an air-purifying respirator with organic vapor (OV) cartridges and N-95 particulate pre-filters.

Task-specific PPE recommendations can be found in Technical Order 1-1-8 (Ref 2). PPE in this technical order include such items as air-purifying respirators with OV/high-efficiency particular air cartridge, cotton or Tyvek® coveralls, nitrile or neoprene gloves, and goggles or face shields and should be used as required to prevent respiratory and contact hazards.

Table 1. Isocyanates Available Using the ISO-CHEK® Protocol

Acronym	Isocyanate
1,6-HDI	1,6 Hexamethylene Diisocyanate Monomer
	1,6 Hexamethylene Diisocyanate Oligomer
MDI	Methylene Diphenyl Diisocyanate Monomer
	Methylene Diphenyl Diisocyanate Oligomer
IPDI	Isophorone Diisocyanate Monomer
	Isophorone Diisocyanate Oligomer
2,4-TDI	2,4 Toluene Diisocyanate Monomer
	2,4 Toluene Diisocyanate Oligomer
2,6-TDI	2,6 Toluene Diisocyanate Monomer
	2,6 Toluene Diisocyanate Oligomer

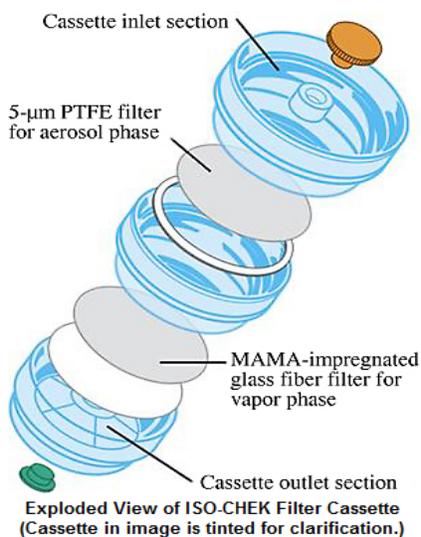


Figure 1. ISO-CHEK® Cassettes (image courtesy of SKC, Inc.)

5.0 COMMON ERRORS

When collecting isocyanate samples using the ISO-CHEK® protocol, follow the step-by-step procedures prepared by the Omega Specialty Instrument Co. and included in the original sampling supply kit from the manufacturer. The sampling procedures may also be accessed online through the [Omega Specialty Instrument Co.](#) **Note:** Isocyanate sampling has a very high sample collection and submission error rate. Attention to detail and strict adherence to the protocol are required to ensure the validity of sample results. Below are key points to remember when sampling using the ISO-CHEK® protocol:

- Bases should request the ISO-CHEK® protocol and list the specific isocyanate desired (i.e. 1,6-HDI, MDI, etc.) on sample submission paperwork. The default analytical report will include both monomer and oligomer fractions. If you have determined your sampling requires just the monomer or oligomer fraction, you may specify that on the sample submission paperwork as well.

- Be sure to order ISO-CHEK® kits that include the derivatizing solution (SKC 225-9023 or 225-9023A).
- Unplug and connect the cassette to a sample pump calibrated to 1 L/min.
- Take a 15-minute sample.
- Immediately after sampling, open the cassette and remove the PTFE filter with forceps (filter closest to air inlet). Do not remove the washer style support pad from the cassette.
- Match the cassette identification (ID) number with the reagent jar number, place the filter in the prepared jar containing the methoxy-2-phenyl-1 piperazine reagent in toluene.
- Keep the fiberglass filter in the cassette.
- Replug the cassette; wrap it in foil to protect the sample from light.
- Label both the cassette and corresponding reagent jar with the same Defense Occupational Environmental and Health Readiness System sample ID.
- A field blank should be prepared in the same manner, with the PTFE filter removed and placed in the reagent jar.
- Store collected samples in the refrigerator until ready for shipping.
- Ship all jars *and* cassettes to the laboratory as soon as possible (same business day). The manufacturer's original shipping container works well for sending field samples to the laboratory.
- Department of Transportation (DOT) regulations require that sorbent material be packed with the jars in case of a leak. The blue foam in the original shipping packaging meets this requirement. DOT regulations also require that the package be placed in another cardboard box prior to shipment. Use the 40 CFR 173.4 labels provided by the manufacturer to ship the package.
- To extend sample stability, ship samples with gel packs. Refrigerated samples are stable for 7 to 10 days. Contact Customer Service *prior* to shipping samples if they will arrive at the lab within 48 hours of the hold time expiring.
- Do not ship samples on Fridays. USAFSAM/OEA is not able to accept routine Saturday deliveries. Refrigerated samples shipped overnight on Friday will not be received by the lab until Monday morning.

Table 2 summarizes the technique for air sampling isocyanates.

Table 2. Isocyanate Air Sampling

Method	Collection Media	Comments
ISO-CHEK®, 1,6-HDI, MDI, IPDI, 2,4-TDI, 2,6-TDI	Dual filter cassette, 5.0-µm PTFE filter, MAMA-impregnated glass fiber filter	Transfer PTFE filter to the reagent jar immediately after sampling and protect sample from light (wrap in aluminum). Be sure to order the ISO-CHEK® kit that includes derivatizing solution. Store cold and ship with gel packs to the lab as soon as possible. Unrefrigerated samples are stable for 7 days; refrigerated samples are stable for 7 to 10 days.
	Sample kits can be ordered from SKC (225-9023 or 225-9023A)	

6.0 REFERENCES

1. U.S. Air Force, *Respiratory Protection Program*, AFOSHSTD48-137_IC2, Department of the Air Force, Washington, DC, 7 Apr 2009, URL: <http://www.e-publishing.af.mil/shared/media/epubs/AFOSHSTD48-137.pdf>.
2. U.S. Air Force, *Application and Removal of Organic Coatings, Aerospace and Non-Aerospace Equipment*, TO 1-1-8, Department of the Air Force, Washington, DC, 12 Jan 2010, URL: <http://www.robins.af.mil/shared/media/document/AFD-091006-030.pdf>.

LIST OF ABBREVIATIONS AND ACRONYMS

AFOSH	Air Force Occupational Safety and Health
DOT	Department of Transportation
HDI	hexamethylene diisocyanate
ID	identification
IPDI	isophorone diisocyanate
MAMA	9-(N-methylaminomethyl) anthracene
MDI	methylene diphenyl diisocyanate
OE	Occupation and Environmental Health Department
OSHA	Occupational Safety and Health Administration
OV	organic vapor
PPE	personal protective equipment
PTFE	polytetrafluoroethylene
TDI	toluene diisocyanate
USAFSAM	U.S. Air Force School of Aerospace Medicine