

Dihexyl phthalate (branched and linear isomers)  
Di-n-hexyl phthalate



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Method number: PV2076

Target concentration: 5 mg/m<sup>3</sup>

Procedure: Samples are collected by drawing a known volume of air through OVS-Tenax sampling tubes. Samples are extracted with toluene and analyzed by GC using a flame ionization detector (FID).

Recommended sampling time and sampling rate: 240 min at 1.0 L/min (240 L)

Reliable quantitation limit: 0.21 mg/m<sup>3</sup> dihexyl phthalate (branched and linear isomers)  
0.027 mg/m<sup>3</sup> di-n-hexyl phthalate

Status of method: Partially evaluated method. This method has been subjected to established evaluation procedures of the Methods Development Team and is presented for information and trial use.

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## 1. General Discussion

### 1.1 Background

#### 1.1.1 History

Air samples were received at SLTC collected on OVS-Tenax tubes requesting analysis for dihexyl phthalate. OVS-Tenax tubes contain a glass fiber filter in front of two resin beds of Tenax. Both the mixed isomers of dihexyl phthalate (DHP) and di-n-hexyl phthalate (DNHP) were studied because it was unknown which compound was collected on the samples. The DHP contained di-n-hexyl phthalate, along with straight and branched chain isomers of dihexyl phthalate. The analytical procedure chosen follows OSHA 104, with toluene extraction and analysis by GC-FID.<sup>1</sup> Toluene was found to give an extraction efficiency of 100% for DHP and DNHP from the glass fiber filter and Tenax. DHP and DNHP were found to be well retained on the glass fiber filter of the OVS-Tenax, with a retention efficiency recovery of 99.8% for DHP and 99.7% for DNHP, when 240-L of humid air was pulled through them. This indicates that these compounds could be sampled with a glass fiber filter if they were the only phthalate ester being sampled. OSHA method 104 indicates that the lighter phthalate esters, such as dimethyl phthalate, need the resin bed for collection, so the OVS-Tenax tube would be needed to sample for dimethyl phthalate with DHP or DNHP.<sup>2</sup> The storage stability recovery on Day 14 were 99.7% for DHP and 99.8% for DNHP with ambient storage.

#### 1.1.2 Toxic effects (This section is for information only and should not be taken as the basis of OSHA policy.)

Dihexyl phthalate is a contact irritant affecting the skin and mucous membranes.<sup>3</sup> In studies on mice, di-n-hexyl phthalate was a reproductive toxicant, stopping reproduction at concentrations in feed of 1.67 g/kg/day, greatly reducing reproduction at 0.8 g/kg/day, and at 0.38 g/kg/day the litter size was decreased. In the high dose male mice group, the testis weight was decreased by 70%, the epididymal sperm concentration was reduced by 93%, and motility was reduced by 80% as compared to the control group. DNHP was also found to affect the liver and kidney.<sup>4</sup>

#### 1.1.3 Workplace exposure<sup>5,6</sup>

DHP and DNHP are used in the manufacture of plasticizers and resins. They are components of molding and coating plastisols. They are used in the production of vinyl flooring. Production exceeds one million pounds annually.

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<sup>1</sup> Chan, Y., OSHA 104, Dimethyl phthalate, Diethyl phthalate, Dibutyl phthalate, Di-2-ethylhexyl phthalate, and Di-n-octyl phthalate, 1994, <http://www.osha.gov>, (accessed May 2001)

<sup>2</sup> Chan, Y., OSHA 104, Dimethyl phthalate, Diethyl phthalate, Dibutyl phthalate, Di-2-ethylhexyl phthalate, and Di-n-octyl phthalate, 1994, <http://www.osha.gov>, (accessed May 2001)

<sup>3</sup> Lewis, R., *Sax's Dangerous Properties of Industrial Materials*, Van Nostrand Reinhold: New York, 2000, p 1310.

<sup>4</sup> NIH, <http://ntp-server.niehs.nih.gov/htdocs/RT-studies/RACB84093.html> (accessed 5/10/01).

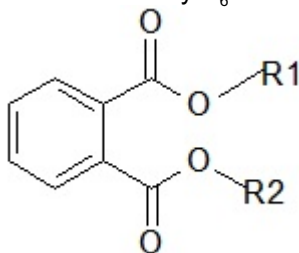
<sup>5</sup> ExxonMobile Chemical, [http://www.exxonchemical-products.com/chemical/customer/products/fa.../index\\_content.html](http://www.exxonchemical-products.com/chemical/customer/products/fa.../index_content.html) (accessed 5/10/01).

<sup>6</sup> Environmental Defense Fund. [http://www.scorecard.org/chemical-profiles/summary.tcl?edf\\_substance\\_id=68515-50-4](http://www.scorecard.org/chemical-profiles/summary.tcl?edf_substance_id=68515-50-4) (accessed 5/10/01).

#### 1.1.4 Physical properties and other descriptive information

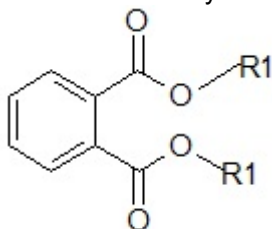
##### DHP<sup>7</sup>

CAS number:	68515-50-4	density:	1.01
molecular weight:	334.50	IMIS: <sup>8</sup>	D940
melting point:	-27 °C	boiling point:	350 °C
appearance:	clear liquid	molecular formula:	C <sub>20</sub> H <sub>30</sub> O <sub>4</sub>
odor:	aromatic	flash point:	192 °C (379 °F)(cc)
autoignition temperature:	>500 °C		
synonyms:	1,2-benzenedicarboxylic acid, mixed hexyl esters; Jayflex DHP; phthalic acid, mixed dihexyl esters		
solubility:	acetone, alcohol, benzene, carbon disulfide, carbon tetrachloride, and toluene		
structural formula:	where R1 = any C <sub>6</sub> isomer, and R2 = any C <sub>6</sub> isomer		



##### DNHP<sup>9</sup>

CAS number:	84-75-3	density:	1.01
molecular weight:	334.50	IMIS: <sup>10</sup>	D700
melting point:	-58 °C	boiling point:	345 °C
appearance:	clear liquid	molecular formula:	C <sub>20</sub> H <sub>30</sub> O <sub>4</sub>
odor:	aromatic	flash point:	192 °C (379 °F)(cc)
autoignition temperature:	>500 °C		
synonyms:	1,2-benzenedicarboxylic acid, n-hexyl ester; phthalic acid, dihexyl ester		
solubility:	acetone, alcohol, benzene, carbon disulfide, carbon tetrachloride, and toluene		
structural formula:	where R1 = n-hexyl		



<sup>7</sup> Material Safety Data Sheet: Jayflex DHP, ExxonMobile Chemical Co., Atlanta, GA, April, 2000.

<sup>8</sup> OSHA Chemical sampling Information. [http://www.osha-slc.gov/ChemSamp\\_data/CH\\_273990.html](http://www.osha-slc.gov/ChemSamp_data/CH_273990.html) (accessed 5/10/01).

<sup>9</sup> Material Safety Data Sheet: Di-n-hexyl phthalate, ChemService Chemical Co., West Chester, PA, December, 1990.

<sup>10</sup> OSHA Chemical sampling Information. [http://www.osha-slc.gov/ChemSamp\\_data/CH\\_273990.html](http://www.osha-slc.gov/ChemSamp_data/CH_273990.html) (accessed 5/10/01).

This method was evaluated according to the OSHA SLTC "Evaluation Guidelines for Air Sampling Methods Utilizing Chromatographic Analysis"<sup>11</sup>. The Guidelines define analytical parameters, specify required laboratory tests, statistical calculations and acceptance criteria. The analyte air concentrations throughout this method are based on the recommended sampling and analytical parameters.

## 1.2 Detection limit of the overall procedure (DLOP) and reliable quantitation limit (RQL)

The DLOP is measured as mass per sample and expressed as equivalent air concentrations, based on the recommended sampling parameters. Ten samplers were spiked with equal descending increments of analyte, such that the highest sampler loading was 200 µg of DHP, and ten more were spiked with DNHP with a highest loading of 36 µg. This is the amount spiked on a sampler that would produce a peak approximately 10 times the response for a sample blank. These spiked samplers were analyzed with the recommended analytical parameters, and the data obtained used to calculate the required parameters (standard error of estimate and slope) for the calculation of the DLOP. The DLOP from the plots were 15.4 µg DHP and 1.97 µg DNHP. The RQL is considered the lower limit for precise quantitative measurements. It is determined from the regression line parameters obtained for the calculation of the DLOP, providing 75% to 125% of the analyte is recovered. The RQL from the plots were 51.2 µg DHP and 6.56 µg DNHP.

Table 1.2.1  
Detection Limit of the Overall Procedure  
for DHP

mass per sample (µg)	area counts (µV-s)
0.00	0
20.2	1657
40.4	2897
60.6	3969
80.8	5054
101	6273
121	7451
141	8970
162	9394
182	10231
202	11192

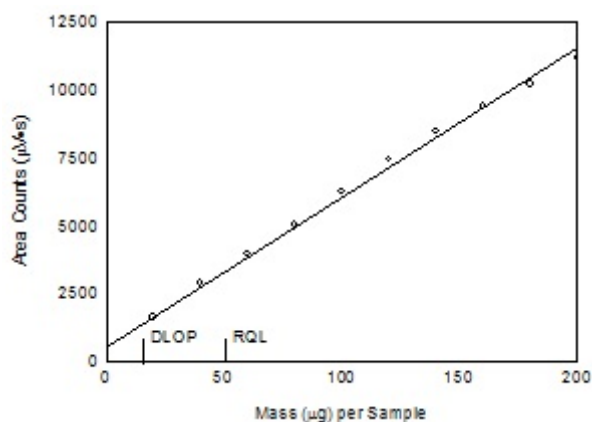


Figure 1.2.1. Plot of data to determine the DLOP/RQL for DHP, DLOP = 15.4µg and RQL = 51.2 µg. ( $Y = 55.1X + 547$ )

<sup>11</sup> Burright, D.; Chan, Y.; Eide, M.; Elskamp, C.; Hendricks, W.; Rose, M. C. *Evaluation Guidelines for Air Sampling Methods Utilizing Chromatographic Analysis*; OSHA Salt Lake Technical Center, U.S. Department of Labor: Salt Lake City, UT, 1999.

Table 1.2.2  
Detection Limit of the Overall Procedure  
for DNHP

mass per sample ( $\mu\text{g}$ )	area counts ( $\mu\text{V}\cdot\text{s}$ )
0.00	0
4.04	284
8.08	478
12.1	679
16.2	956
20.2	1301
24.2	1536
28.3	1854
32.3	2039
36.4	2302

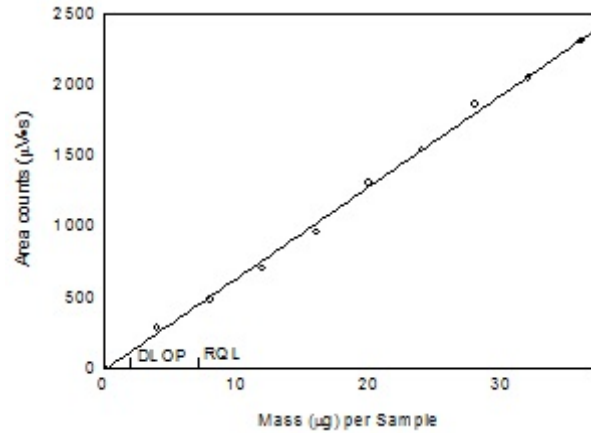


Figure 1.2.2. Plot of data to determine the DLOP/RQL for DNHP, DLOP =  $1.97\mu\text{g}$  and RQL =  $6.56\mu\text{g}$ . ( $Y = 64.8X - 20.7$ )

Below are chromatograms of the RQL level.

## 2. Sampling Procedure

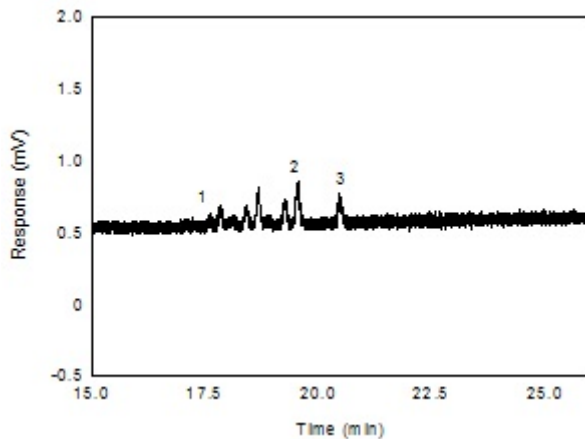


Figure 1.2.3. Chromatogram of the RQL of DHP. (1 through 2 = mixed isomers of dihexyl phthalate; 3 = di-n-hexyl phthalate)

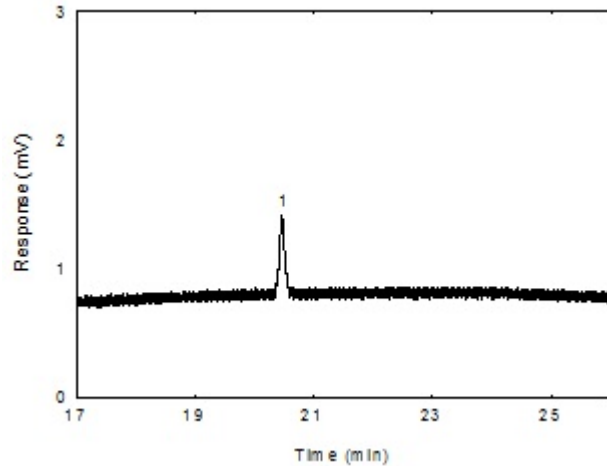


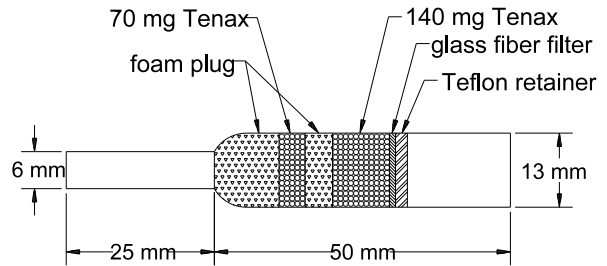
Figure 1.2.4. Chromatogram of the RQL of DNHP (1 = DNHP).

All safety practices that apply to the work area being sampled should be followed. The sampling equipment should be attached to the worker in such a manner that it will not interfere with work performance or safety.

### 2.1 Apparatus

- 2.1.1 Samples are collected using a personal sampling pump calibrated, with the sampling device attached, to within  $\pm 5\%$  of the recommended flow rate.

2.1.2 Samples are collected with OVS-Tenax tubes. The tube contains a glass fiber filter and two sections of Tenax separated by a urethane foam plug. For this evaluation, commercially prepared sampling tubes were purchased from SKC, Inc. (catalog no. 226-56).



## 2.2 Reagents

None required

## 2.3 Technique

- 2.3.1 Immediately before sampling, remove the end caps from the OVS-tenax tube. Use tube holders to minimize the hazard of broken glass. All tubes should be from the same lot.
- 2.3.2 The smaller section of the adsorbent tube is used as a back-up and is positioned nearest the sampling pump. Attach the tube holder to the sampling pump so that the adsorbent tube is in an approximately vertical position with the inlet facing down during sampling. Position the sampling pump, tube holder and tubing so they do not impede work performance or safety.
- 2.3.3 Draw the air to be sampled directly into the inlet of the tube holder. The air being sampled is not to be passed through any hose or tubing before entering the sampling tube.
- 2.3.4 After sampling for the appropriate time, remove the adsorbent tube and seal it with plastic end caps. Seal each sample end-to-end with an OSHA-21 form as soon as possible.
- 2.3.5 Submit at least one blank sample with each set of samples. Handle the blank sampler in the same manner as the other samples except draw no air through it.
- 2.3.6 Record sample air volumes (liters), sampling time (minutes) and sampling rate (mL/min) for each sample, along with any potential interferences on the OSHA-91A form.
- 2.3.7 Submit the samples to the laboratory for analysis as soon as possible after sampling. If delay is unavoidable, store the samples at refrigerator temperature. Ship any bulk samples separate from the air samples.

## 2.4 Extraction efficiency

The extraction efficiency was determined by liquid-spiking the glass fiber filter and the front section of the Tenax separately with DHP and DNHP at 0.1 to 2 times the target concentration. These samples were stored overnight at ambient temperature and then extracted with toluene for 30 minutes with occasional shaking, and analyzed. The mean extraction efficiency over the studied range for DHP was 100% for the glass fiber filters and 100% for the Tenax. The mean extraction efficiency over the studied range for DNHP was 100% for the glass fiber filters and 100% for the Tenax. The wet extraction efficiency was determined at 1 times the target concentration by liquid spiking the analyte onto either the glass fiber filter or Tenax of OVS-Tenax tubes which had 240-L humid air (absolute humidity of 15.9 mg/L of water, about 80% relative humidity at 23°C) drawn through them immediately before spiking. The mean recovery for DHP from the wet samples was 99.9% on the glass fiber filters and 100% on the Tenax. The mean recovery for DNHP from the wet samples was 100% on the glass fiber filters and 100.2% on the Tenax.

Table 2.4.1  
Extraction Efficiency (%) of DHP from Glass Fiber Filters

<u>level</u>		<u>sample number</u>						
× target concn	mg per sample	1	2	3	4	5	6	mean
0.1	0.12	98.7	98.8	100.4	99.4	101.1	100.1	99.8
0.25	0.30	99.9	100.4	100.8	99.7	100.4	100.3	100.3
0.5	0.60	99.3	100.7	101.8	98.6	100.1	101.0	100.3
1.0	1.2	99.3	98.0	99.9	98.5	102.2	101.1	99.8
1.5	1.8	100.1	100.4	99.5	99.3	99.9	100.1	99.9
2.0	2.4	99.2	101.2	100.5	97.2	99.6	99.3	99.6
1.0 (wet)	1.2	99.8	100.2	99.2	100.4	99.7	99.9	99.9

Table 2.4.2  
Extraction Efficiency (%) of DHP from Tenax

<u>level</u>		<u>sample number</u>						
× target concn	mg per sample	1	2	3	4	5	6	mean
0.1	0.12	99.6	101.3	100.4	100.0	100.2	99.6	100.1
0.25	0.30	99.1	100.2	100.5	99.4	99.9	100.3	99.9
0.5	0.60	100.4	98.9	99.8	100.2	100.0	100.9	100.2
1.0	1.2	99.7	100.1	99.0	99.9	100.4	99.6	99.8
1.5	1.8	100.8	99.7	100.9	99.7	99.9	100.5	100.3
2.0	2.4	99.0	100.9	99.7	99.2	98.5	101.2	99.8
1.0 (wet)	1.2	99.9	100.4	100.3	100.1	99.7	99.8	100

Table 2.4.3  
Extraction Efficiency (%) of DNHP from Glass Fiber Filters

<u>level</u>		<u>sample number</u>						
× target concn	mg per sample	1	2	3	4	5	6	mean
0.1	0.12	99.6	99.8	100.2	99.3	100.1	100.5	99.9
0.25	0.30	99.4	100.3	100.5	99.9	100.4	100.4	100.2
0.5	0.60	100.5	101.0	99.7	98.9	100.4	100.2	100.1
1.0	1.2	100.4	99.2	100.5	98.9	100.3	99.9	99.9
1.5	1.8	100.3	100.2	101.1	100.2	99.5	100.4	100.3
2.0	2.4	101.2	99.2	100.3	98.7	101.3	100.1	100.1
1.0 (wet)	1.2	100.3	99.4	99.7	100.8	99.4	100.3	100

Table 2.4.4  
Extraction Efficiency (%) of DNHP from Tenax

<u>level</u>		<u>sample number</u>						
× target concn	mg per sample	1	2	3	4	5	6	mean
0.1	0.12	99.9	99.4	101.0	100.3	100.5	99.1	100.0
0.25	0.30	100.1	100.0	100.4	99.2	100.2	99.0	99.8
0.5	0.60	100.8	100.3	99.5	98.6	101.0	100.7	100.2
1.0	1.2	99.9	101.2	98.7	100.8	99.7	100.5	100.1
1.5	1.8	100.6	99.3	99.1	99.9	99.3	100.8	99.8
2.0	2.4	100.2	99.6	100.6	98.9	100.1	99.4	99.8
1.0 (wet)	1.2	100.3	100.1	101.0	100.1	99.9	99.6	100.2

## 2.5 Retention efficiency

On twelve OVS-Tenax tubes, the glass fiber filter was moved from next to the Tenax resin to above the PTFE retaining ring. Six OVS-Tenax tubes were spiked with 2.4 mg DHP and the other six with 2.4 mg DNHP on the glass fiber filter and allowed to equilibrate for 4 h. The tubes had 240 L humid air (absolute humidity of 15.9 mg/L of water, about 80% relative humidity at 22.2 °C) pulled through them at 1 L/min. The samples were extracted and analyzed. The mean recovery was 99.8% for DHP and 99.7% for DNHP. There was no analyte found on the Tenax sections of any of the tubes.

Table 2.5.1  
Retention Efficiency (%) of DHP

section	sample number						mean
	1	2	3	4	5	6	
glass fiber filter	98.8	100.6	99.7	99.8	100.2	99.7	99.8
front Tenax section	0.0	0.0	0.0	0.0	0.0	0.0	0.0
back Tenax section	0.0	0.0	0.0	0.0	0.0	0.0	0.0
total	98.8	100.6	99.7	99.8	101.2	99.7	99.8

Table 2.5.2  
Retention Efficiency (%) of DNHP

section	sample number						mean
	1	2	3	4	5	6	
glass fiber filter	100.4	100.1	99.4	100.2	98.9	99.1	99.7
front Tenax section	0.0	0.0	0.0	0.0	0.0	0.0	0.0
rear Tenax section	0.0	0.0	0.0	0.0	0.0	0.0	0.0
total	100.4	100.1	99.4	100.2	98.9	99.1	99.7

## 2.6 Sample storage

Fifteen OVS-Tenax tubes were each spiked with 1.2 mg DHP and the same number with 1.2 mg DNHP. They were allowed to equilibrate for 4 h, then 240 L of air, with an absolute humidity of 15.7 milligrams of water per liter of air (about 80% relative humidity at 22.2 °C), was drawn through them. Three samples of each compound were analyzed immediately. The remaining samples were sealed, six of each compound were stored at room temperature (23° C), and the other six were stored at refrigerated temperature (4° C). Three samples from each forms of storage were analyzed after 7 days of storage and the remaining three after 14 days of storage. The amounts recovered, which are corrected for extraction efficiency, indicate good storage stability for the time period studied.

Table 2.6.1  
Storage Test for DHP

time (days)	ambient				refrigerated			
	1	2	3	mean	1	2	3	mean
0	100.9	97.9	100.2	99.7	100.2	99.0	99.8	99.7
7	98.6	99.6	100.1	99.4	99.6	100.4	99.5	99.8
14	99.8	100.2	99.2	99.7	99.9	100.8	99.8	100.2

Table 2.6.2  
Storage Test for DNHP

time (days)	ambient				refrigerated			
	1	2	3	mean	1	2	3	mean
0	100.3	99.1	101.2	100.2	100.2	99.8	99.1	99.7
7	99.8	99.4	100.2	99.8	99.9	99.5	100.1	99.8
14	99.6	99.5	100.3	99.8	99.3	99.8	100.0	99.7

## 2.7 Recommended air volume and sampling rate.



Based on the data collected in this evaluation, 240-L air samples should be collected at a sampling rate of 1.0 L/min for 240 minutes.

## 2.8 Interferences (sampling)

2.8.1 There are no known compounds which will severely interfere with the collection of DHP and DNHP. The following phthalates do not interfere under the analytical conditions used in this method: dimethyl phthalate, diethyl phthalate, dibutyl phthalate, di-sec-octyl phthalate, and di-*n*-octyl phthalate. Other interfering compounds may be eliminated by changing analytical conditions and/or column.

2.8.2 Suspected interferences should be reported to the laboratory with submitted samples.

## 3. Analytical Procedure

Adhere to the rules set down in your Chemical Hygiene Plan. Avoid skin contact and inhalation of all chemicals and review all appropriate MSDSs before starting analytical procedure.

### 3.1 Apparatus

3.1.1 A gas chromatograph equipped with an FID. For this evaluation, a Hewlett-Packard 5890A Series II Gas Chromatograph equipped with a 7673A Automatic Sampler was used.

3.1.2 A GC column capable of separating DHP and DNHP from the desorption solvent, internal standard and any potential interferences. A 60-m × 0.32-mm i.d. capillary DB-5 with a 1.5- $\mu$ m df (J&W Scientific, Folsom, CA) was used in the evaluation.

3.1.3 An electronic integrator or some other suitable means of measuring peak areas. A Waters Millennium<sup>32</sup> Data System was used in this evaluation.

3.1.4 Glass vials with poly(tetrafluoroethylene)-lined caps. For this evaluation 2-mL vials were used.

3.1.5 A dispenser capable of delivering 4.0 mL of desorbing solvent to prepare standards and samples. If a dispenser is not available, a 4.0-mL volumetric pipet may be used.

3.1.7 Volumetric flasks - 10-mL and other convenient sizes for preparing standards.

3.1.8 Calibrated 10- $\mu$ L syringe for preparing standards.

### 3.2 Reagents

3.2.1 Dihexyl phthalate (mixed isomers). Exxon Mobile Chemicals 99% (lot CCNDD2) was used in this evaluation.

3.2.2 Di-*n*-hexyl phthalate. ChemService 98% (lot 254-58B) was used in this evaluation.

3.2.2 Toluene, HPLC grade. Fisher 99.8% (lot 924028) was used for this evaluation.

3.2.3 *n*-Hexylbenzene, Reagent grade. Aldrich 99% (lot 11703TR) was used in this evaluation.

3.2.4 The extraction solvent was 0.25  $\mu$ L/mL *n*-hexylbenzene in toluene.

3.2.5 GC grade nitrogen, air, and hydrogen.

### 3.3 Standard preparation

- 3.3.1 Prepare working analytical standards by injecting microliter amounts of DHP and DNHP into volumetric flasks containing the extraction solvent. An analytical standard at a concentration of 0.303 mg/mL (0.3  $\mu$ L/mL) is equivalent to 5.05 mg/m<sup>3</sup> based on a 240-liter air volume.
- 3.3.2 Bracket sample concentrations with working standard concentrations. If sample concentrations are higher than the concentration range of prepared standards, either analyze higher standards, or dilute the sample. The higher standards should be at least as high in concentration as the highest sample. Diluted samples should be prepared with extracting solvent to obtain a concentration within the existing standard range. The range of standards used in this study was from .001 to 1.01 mg/mL.

### 3.4 Sample preparation

- 3.4.1 Remove the plastic end caps from the sample tubes and carefully transfer the glass fiber filter and adsorbent sections to separate 4-mL vials. The glass fiber filter may be placed in the same vial with the front, larger, section of the adsorbent. If other phthalates are being analyzed from the same tube, such as dimethyl, diethyl, or dibutyl phthalate, the center urethane foam plug should be included with the adsorbent section. Discard the glass tube and back urethane foam plug.
- 3.4.2 Add 4.0 mL of extraction solvent to each vial using the same dispenser as used for preparation of standards.
- 3.4.3 Immediately seal the vials with poly(tetrafluoroethylene)-lined caps.
- 3.4.4 Shake the vials vigorously by shaker for 30 minutes.
- 3.4.5 Remove an aliquot of each sample and place into labeled 2-mL vials, to fit into the autosampler, for analysis.

### 3.5 Analysis

#### 3.5.1 Gas chromatograph conditions.

##### GC conditions

##### zone

temperatures: 220°C (column),  
hold 0 min, ramp  
at 10°C/min to  
260°C, hold 22  
min  
250°C (injector)  
250°C (detector)

run time: 26 min

column gas flow: 2.9 mL/min  
(hydrogen)

septum purge: 1.9 mL/min  
(hydrogen)

injection size: 1.0  $\mu$ L (19:1  
split)

column: 60-m  $\times$  0.32-mm  
i.d. capillary DB-5  
(1.5- $\mu$ m df)

retention times: 4.17 min (toluene); 5.46 min (n-hexyl benzene); 17.05 min through 19.54 (isomers of DHP); 20.466 min (DNHP)

##### FID conditions

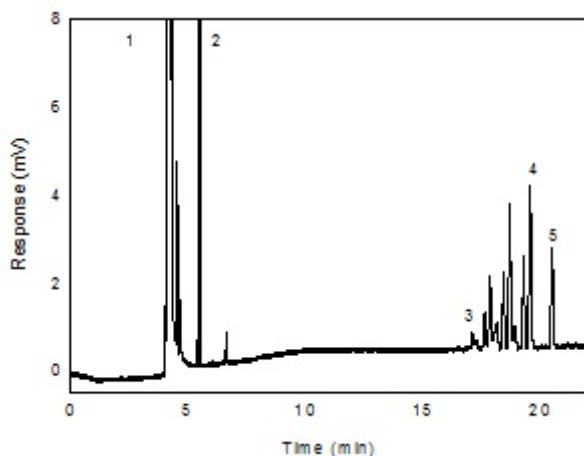


Figure 3.5.1. A chromatogram of 303  $\mu$ g/mL DHP in toluene with 0.25  $\mu$ L/mL n-hexyl benzene internal standard. Key: (1) toluene; (2) n-hexyl benzene; (3) through (4) branched and linear isomers of dihexyl phthalate; and (5) n-hexyl phthalate.

hydrogen flow: 38 mL/min  
air flow: 450 mL/min  
makeup flow: 30 mL/min  
(nitrogen)

3.5.2 Peak areas are measured by an integrator or other suitable means.

3.5.3 An internal standard (ISTD) calibration method is used. A calibration curve can be constructed by plotting ISTD-corrected response of standard injections versus milligrams of analyte per sample. Bracket the samples with freshly prepared analytical standards over a range of concentrations.

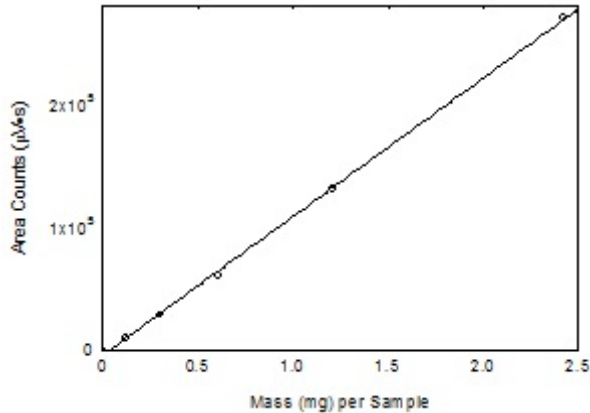


Figure 3.5.3.2. Calibration curve of DHP. ( $Y = 1.13E5x - 4031$ )

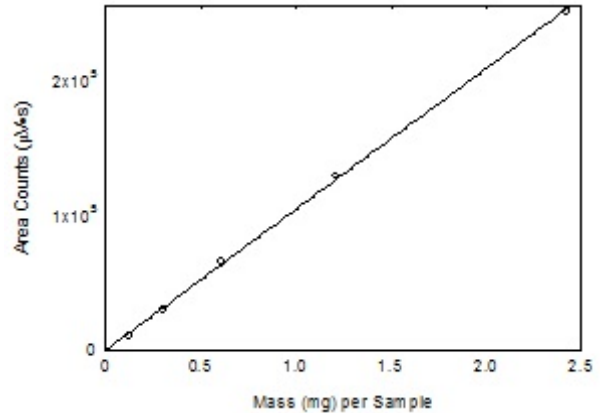


Figure 3.5.3.3. Calibration curve of DNHP. ( $Y = 1.05E5x - 89.4$ )

### 3.6 Interferences (analytical)

3.6.1 Any compound that produces a GC response and has a similar retention time as the analyte is a potential interference. If any potential interferences were reported, they should be considered before samples are extracted. Generally, chromatographic conditions can be altered to separate an interference from the analyte.

3.6.2 When necessary, the identity or purity of an analyte peak may be confirmed by mass spectrometry or by another analytical procedure. The mass spectrum in Figure 3.6.2.1, 3.6.2.2, and 3.6.2.3 were from the NIST spectral library. Mass spectra of other isomers of dihexyl phthalate were not available.

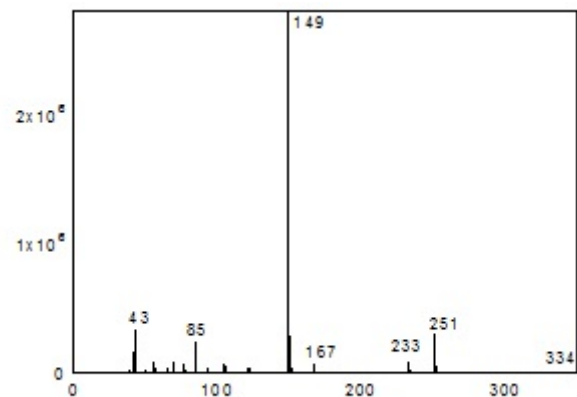


Figure 3.6.2.1. Mass spectra of di-n-hexyl phthalate.

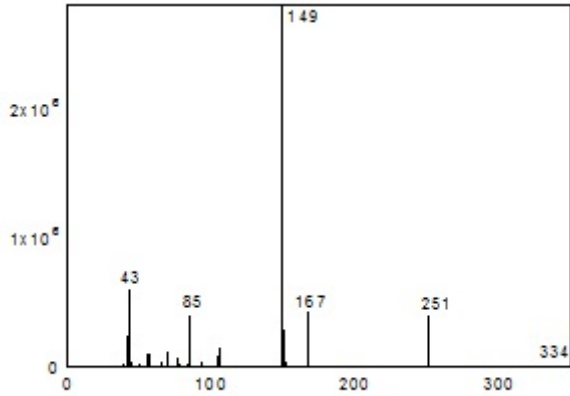


Figure 3.6.2.2. Mass spectra of di(2-ethylbutyl) phthalate.

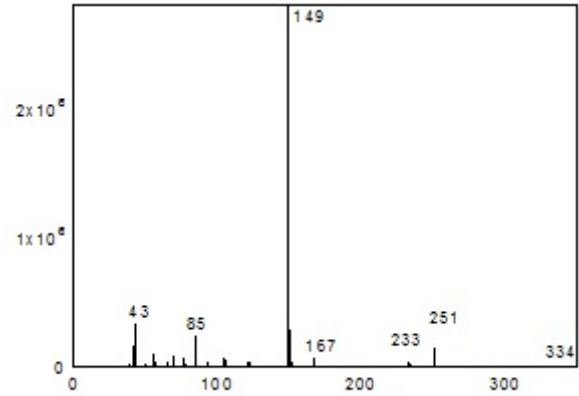


Figure 3.6.2.3. The mass spectrum of di(4-methylpentyl) phthalate..

### 3.7 Calculations

The amount of analyte per sampler is obtained from the appropriate calibration curve in terms of micrograms per sample, uncorrected for extraction efficiency. This total amount is then corrected by subtracting the total amount (if any) found on the blank. The air concentration is calculated using the following formulas.

$$C_M = \frac{M}{VE_E}$$

where  $C_M$  is concentration by weight ( $\text{mg}/\text{m}^3$ )  
 $M$  is micrograms per sample  
 $V$  is liters of air sampled  
 $E_E$  is extraction efficiency, in decimal form

### 4. Recommendations for Further Study

Collection, reproducibility, and other detection limit studies need to be performed to make this a validated method.