

# **TVA-1000 Series**

## **Instruction Manual**

Response Factors

Part Number 50039

20Dec2007

© 2007 Thermo Fisher Scientific Inc. All rights reserved.

Specifications, terms and pricing are subject to change. Not all products are available in all countries. Please consult your local sales representative for details.

Thermo Fisher Scientific  
Air Quality Instruments  
27 Forge Parkway  
Franklin, MA 02038  
1-508-520-0430  
[www.thermo.com/aqi](http://www.thermo.com/aqi)

# TABLE OF CONTENTS

## PART ONE: INTRODUCTION

Flame Ionization Detection (FID).....	1-1
Photoionization Detection (PID).....	1-2
Dual Detectors.....	1-3
Response Factors.....	1-5
Using TVA Response Factor Data.....	1-7

## PART TWO: RESPONSE FACTORS

Acetic Acid.....	2-1
Acetone.....	2-2
Acetonitrile.....	2-3
Acrylic Acid.....	2-4
Allyl Alcohol.....	2-5
Ammonia.....	2-6
Amyl Alcohol.....	2-7
Aniline.....	2-8
Benzene.....	2-9
Benzyl Chloride.....	2-10
1,3-Butadiene.....	2-11
n-Butane.....	2-12
1-Butanol.....	2-13
2-Butanone (MEK).....	2-14
1-Butene.....	2-15
Butyl Acetate.....	2-16
Butyl Acrylate.....	2-17
Carbon Disulfide.....	2-18
CFC 12.....	2-19
CFC 113.....	2-20
Chlorobenzene.....	2-21
Chloroform.....	2-22
2-Chlorotoluene.....	2-23
m-Cresol.....	2-24
Cyclohexane.....	2-25
n-Decane.....	2-26
1,1-Dichloroethylene.....	2-27
Dimethylformamide.....	2-28
tert-Dodecanethiol.....	2-29
Ethane.....	2-30
Ethanol.....	2-31
2-Ethoxyethanol.....	2-32
Ethylbenzene.....	2-33
Ethyl Acetate.....	2-34

Ethyl Acrylate .....	2-35
Ethyl Lactate .....	2-36
Ethylene .....	2-37
Ethylene Oxide.....	2-38
Formaldehyde .....	2-39
Freon 22 .....	2-40
HCFC 123 .....	2-41
n-Heptane.....	2-42
n-Hexane (10.6 eV).....	2-43
n-Hexane (11.8 eV).....	2-44
Iodomethane.....	2-45
Isobutanol.....	2-46
Isobutylene.....	2-47
Isopropyl Alcohol .....	2-48
Isopropyl Ether.....	2-49
Methanol .....	2-50
MethylChloride.....	2-51
Methylcyclohexane.....	2-52
Methylene Chloride .....	2-53
MIBK .....	2-54
Methyl tert-Butyl Ether (MTBE).....	2-55
Nitrobenzene.....	2-56
n-Nonane.....	2-57
tert-Nonyl Mercaptan.....	2-58
n-Octane .....	2-59
1-Octene.....	2-60
n-Octyl Mercaptan .....	2-61
n-Pentane.....	2-62
PGME .....	2-63
PGMEA.....	2-64
Propane .....	2-65
Propylene .....	2-66
Styrene .....	2-67
Tetrachloroethylene .....	2-68
1,1,1,2-Tetrafluoroethane.....	2-69
Tetrahydrofuran .....	2-70
Toluene .....	2-71
Trichloroethylene.....	2-72
Triethylamine.....	2-73
Vinyl Acetate .....	2-74
Vinyl Chloride .....	2-75
Vinylidene Fluoride .....	2-76
Xylenes .....	2-77

# LIST OF ILLUSTRATIONS

<b>Figure</b>		<b>Page</b>
1-1	Typical Flame Ionization Detector .....	1-1
1-2	Typical Photoionization Detector .....	1-3
1-3	TVA-1000 Dual Detector Configuration.....	1-4



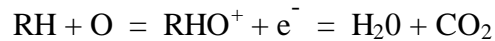
## **PART ONE**

### **INTRODUCTION**



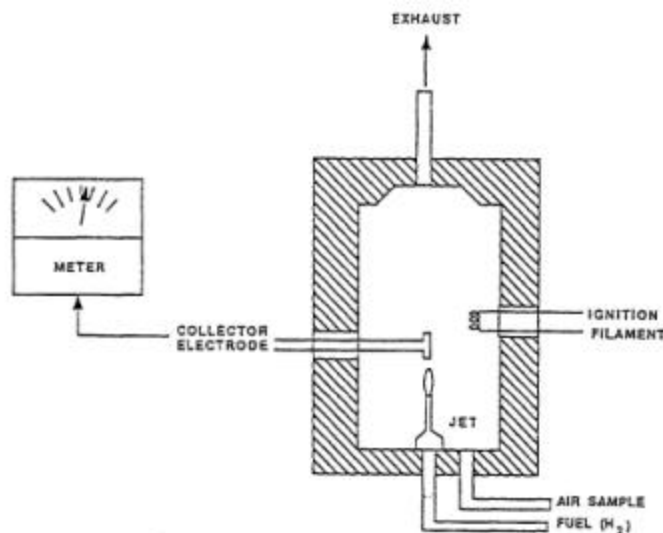
## FLAME IONIZATION DETECTION (FID)

An FID, or Flame Ionization Detector, measures organic compounds by utilizing a flame produced by the combustion of hydrogen and oxygen (air). When hydrocarbons in the sample are introduced to the detection zone, ions are produced by the following reaction:



A collector electrode with a polarizing voltage is also located within the detector chamber, and the ions produced by this reaction are attracted to it. As the ions migrate towards the collector, a current is produced which is directly proportional to the concentration of hydrocarbons introduced to the flame. This current is then amplified and sent to a microprocessor or analog readout device.

The FID has a wide dynamic range (0-50,000 ppm for the TVA-1000). This dynamic range can be further expanded by use of a dilutor kit which reduces very high VOC concentrations to within the dynamic range (or even linear range) of the analyzer. The dilutor kit can also be used to enrich oxygen deficient samples by adding ambient air that is rich in oxygen (20.9 % usually). Low oxygen can affect the characteristics of the hydrogen flame, causing readings to be artificially elevated and possibly extinguishing the flame. As a general rule of thumb, greater than 14 % oxygen is required to support the flame. If high concentrations of hydrocarbons or inert gas samples with low oxygen concentrations are to be measured by an FID, it is advised that a dilutor kit be used to combat the problem.



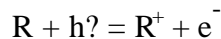
**Figure 1-1.** Typical Flame Ionization Detector

### Benefits Of Flame Ionization Detection:

- ?? Wide dynamic and linear range
- ?? High sensitivity to most hydrocarbons
- ?? Very stable and repeatable response
- ?? Ability to measure methane
- ?? Virtually unaffected by CO, CO<sub>2</sub>, and water vapor

## PHOTOIONIZATION DETECTION (PID)

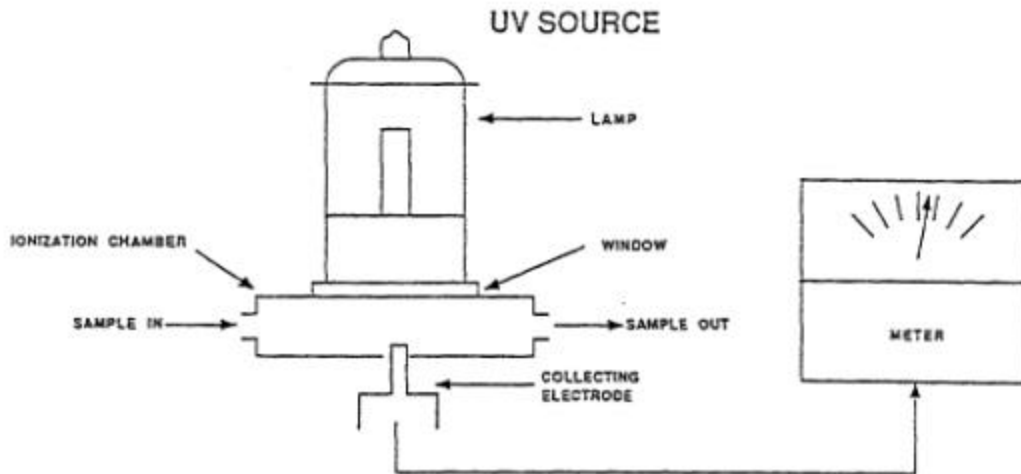
A PID, or Photoionization Detector, consists of a UV lamp of a specific energy and an ionization chamber.. Compounds passing through the chamber are excited by photons of UV energy from the lamp and ionized according to the following equation:



These ions are attracted to a collecting electrode, producing a current proportional to the concentration of the compound.

Whether or not a compound can be detected by a PID depends upon the lamp energy and the energy required to remove an electron from the compound (its *ionization potential*). If the lamp energy is greater than the compound's ionization potential, the PID will detect it. The standard lamp in the TVA is 10.6 eV, however other lamps are also available (9.6, 10.0, and 11.8 eV). The 11.8 eV lamp permits detection of many compounds not ionized by the standard lamp, while the lower energy lamps allow more selectivity by not responding to undesired compounds with a higher ionization potential.

Because of its smaller dynamic range (0-2000 ppm), the PID would not be the detector of choice for measuring high concentrations of vapors (unless a dilutor kit is used). A PID is also more susceptible to interference from water vapor than an FID. However, a PID does not require hydrogen or oxygen, so it would be the detector of choice when fuel is limited or unavailable, or when ambient oxygen concentrations are low. The PID is also more sensitive to aromatic and chlorinated compounds, and can measure some inorganic compounds that the FID does not detect at all (Ammonia, Carbon Disulfide, Carbon Tetrachloride, Chloroform, Ethylamine, Formaldehyde, and Hydrogen Sulfide, to name a few).



**Figure 1-2.** Typical Photoionization Detector

Benefits Of Photoionization Detection:

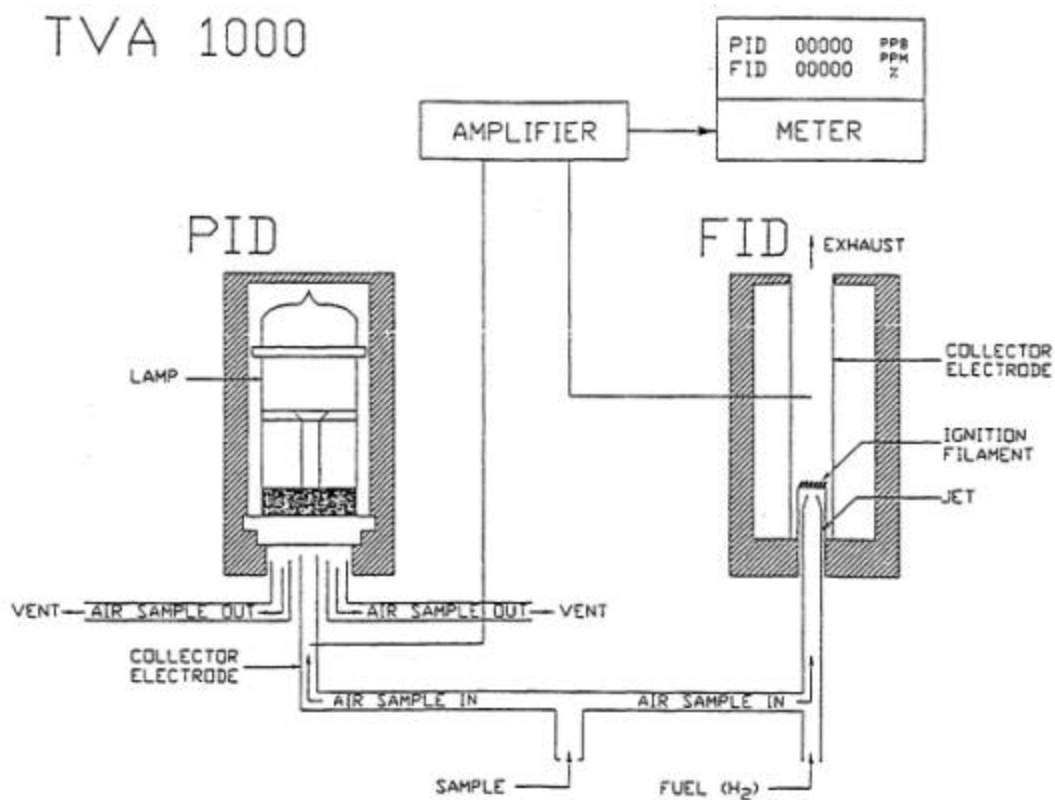
- ?? High sensitivity to aromatics, unsaturated hydrocarbons and chlorinated hydrocarbons
- ?? Ability to measure some inorganic gases
- ?? Very simple operation
- ?? No support gases required
- ?? Non—destructive detector allows sample to be recovered

## DUAL DETECTORS

The TVA-1000 is the first of its kind. Never before has an over-the-shoulder portable vapor analyzer offered both a photoionization detector (PID) and flame ionization detector (FID) operating simultaneously in a single instrument. The benefits of each individual detector are very clear: both the FID and the PID have their advantages and disadvantages. However, with either detector alone the number of vapors that one can detect is limited by that detector's measurement capabilities.

Before the TVA-1000, for truly complete survey monitoring of total vapors, two separate analyses with an FID and a PID were imperative. That could be inconvenient, time consuming, and expensive. With the TVA-1000, users can obtain complete information about organic and inorganic vapors quickly and easily. Most important of all, the TVA-1000 eliminates the need to purchase, learn, operate, and maintain two separate instruments - one analyzer does it all!

Also, since both detectors are displayed and logged simultaneously, the relative response of the two detectors can give some clues about the identity of the compound being measured. For instance, the PID does not respond to methane at all, but the FID responds very well. A high FID reading with virtually no PID response might indicate the presence of naturally occurring methane, commonly found at excavation sites. Consequently, PID's respond very well to some inorganic gases that FID's won't detect. A high PID reading with no FID reading might suggest the presence of an inorganic compound. With readings from both detectors readily available, the TVA-1000 can help a user make some decisions about the type of compound present and which detector reading to use.



**Figure 1-3.** TVA-1000 Dual Detector Configuration

**Benefits Of Dual Detectors:**

- ?? Excellent Value for FID/PID/Datalogger
- ?? Twice as much information as each detector alone
- ?? Distinguish Methane from non-Methane hydrocarbons
- ?? Detector response ratios can help characterize compounds
- ?? No need to carry two analyzers, both detectors are run and logged simultaneously in a single package

## RESPONSE FACTORS

The TVA-1000 is a portable vapor analyzer for gas survey monitoring. Each unit is factory calibrated with Methane (in the case of the FID) and Isobutylene (in the case of the PID). However, both detectors respond to many different compounds with differing levels of sensitivity. In order to adjust the analyzer reading from “ppm of Methane” or “ppm of Isobutylene” to ppm of the compound of interest, a correction factor must be applied to the reading. This correction factor is also known as a “Response Factor.”

Response factors can be expressed in several different formats. When you acquire a response factor from any source, it is important that you understand the format in which the response factor is expressed so that it can be applied properly. Following are the two most common response factor formats:

### 1. Response Factor Multiplier

The response factor multiplier is the most commonly used and most widely recognized response factor format. This type of response factor is calculated by dividing the actual concentration of a compound introduced to the analyzer by the detector response.

$$\text{Response Factor Multiplier} = \frac{\text{Actual Concentration}}{\text{Measured Response}}$$

For example, if 100 ppm of a compound produces a 50 ppm FID reading on an analyzer calibrated with methane, then the FID response factor for that compound would be 2.00 (100 divided by 50).

When using a response factor multiplier to correct a TVA reading, simply multiply the analyzer measured response by the response factor. As in the example given above, if a 50 ppm reading is achieved, multiply 50 times 2.00 to get the actual concentration (100 ppm).

### 2. Relative Response Factor

In some cases, a response factor may be expressed as a percent or a ratio of a compound's response to that of the calibration gas. This type of response factor is calculated by dividing the detector response by the actual concentration of a compound of interest.

$$\text{Relative Response Factor} = \frac{\text{Measured Response}}{\text{Actual Concentration}}$$

(Multiply by 100 to express as a percent)

Note that the relative response is the reciprocal of the response factor multiplier. (i.e.  $1/RR = RFM$ ). As in our example above, if 100 ppm of a compound of interest produces a response of 50 ppm, the relative response would be 50 divided by 100 (0.50 or 50 %).

When using a relative response factor to correct a TVA-1000 reading, simply divide the analyzer measured response by the relative response factor expressed as a decimal. As in the example given above, if a 50 ppm reading is achieved, divide 50 by 0.50 to get the actual concentration (100 ppm).

Like any FID or PID, the TVA-1000 will respond to many different compounds, producing a survey reading of all detectable compounds present. If a single compound is present, a response factor can be applied to correct for the response of that compound. If a mixture of compounds is present, the TVA-1000 will respond to all components of the mixture, and will not differentiate between them. In general, response factors are not available for mixtures of compounds. However, if the composition of the mixture is known, a response factor can be calculated by adding weighted fractions of the response factors of the individual compounds. For instance, if a 75 % Benzene, 25 % Toluene mixture is to be measured, multiply the Benzene response factor by 0.75, the Toluene response factor by 0.25 and add them together to achieve the “weighted” response factor.

The data from a survey analysis may be expressed in a number of different forms:

### **1. Relative to the calibration gas**

If the compound with which the TVA was calibrated is an acceptable standard, then results may be expressed in terms of that compound. For example, an FID reading of 100 ppm could be expressed as “100 ppm of Methane” if the calibration gas used was Methane. Please note that the TVA detectors can be calibrated with gases other than the factory standards as long as the detector has adequate response to that compound.

### **2. Response factor corrected**

If the TVA is used to measure a **single known compound**, a response factor from this set of response curves can be applied to correct the TVA reading for that compound. For example, if a survey of Acetone vapors yields a PID reading of 100 ppm, the response factor multiplier from the Acetone curve (1.417) could be applied to the reading to obtain the result of 141.7 ppm Acetone.

### 3. Relative to a standard other than the calibration gas

If a regulatory agency requires that data be referenced to a standard other than the calibration gas, the response factor for that standard can be applied to the reading. For example, suppose that a survey of total volatile organics must be measured, but the results must be reported in equivalents of benzene. The FID calibrated with methane can be used and the benzene response factor applied to correct the reading.

## USING TVA RESPONSE FACTOR DATA

Before choosing a response factor, you must know the following information:

- ??The name of the compound being measured
- ??The appropriate detector (FID or PID) and the appropriate lamp energy (if a PID is being used)
- ??The calibration gas used
- ??The concentration range

Every compound has its own unique response factor. This response factor is dependent upon the detector and the calibration gas used. All TVA response factors were determined using **Methane** as an FID calibration gas and **Isobutylene** as the PID calibration gas (single point calibration between approximately 100 to 500 ppm). If a different calibration gas is used, a new response factor must be generated. Also, response factors can change as the concentration changes, so the same factor that is applied to a 10000 ppm reading would not be the same factor applied to a 500 ppm reading.

The data in this book is in the form of response curves. The data used to create each response curve is also included for various challenge concentrations (usually starting at 10 ppm and going up to 10000 ppm unless the compound's maximum achievable vapor concentration prohibits). For each challenge concentration, the expected detector response is shown for both the FID and the PID, as well as response factors in both formats. In order to choose the appropriate response factor, refer to the curve data for the compound being monitored, and choose the factor which corresponds to the appropriate detector and the nearest concentration value. If the "EPA Format Response Factor" is chosen, **multiply** the TVA reading by the response factor to obtain the corrected concentration value. If the "Thermo Environmental Instruments Inc. Relative Response Factor" is chosen, **divide** the TVA reading by the response factor to obtain the corrected concentration value.

The TVA-1000 allows you to enter a response factor so that display readings are automatically corrected. Early versions of the TVA-1000 require use of a relative response factor. Newer versions allow the user to choose the format. If you are unsure about which response factor format to use in your TVA-1000, refer to your instruction manual or contact TEI. If you choose not to use this feature, the response factor must be set to 1.00 so that no correction is applied to the reading.

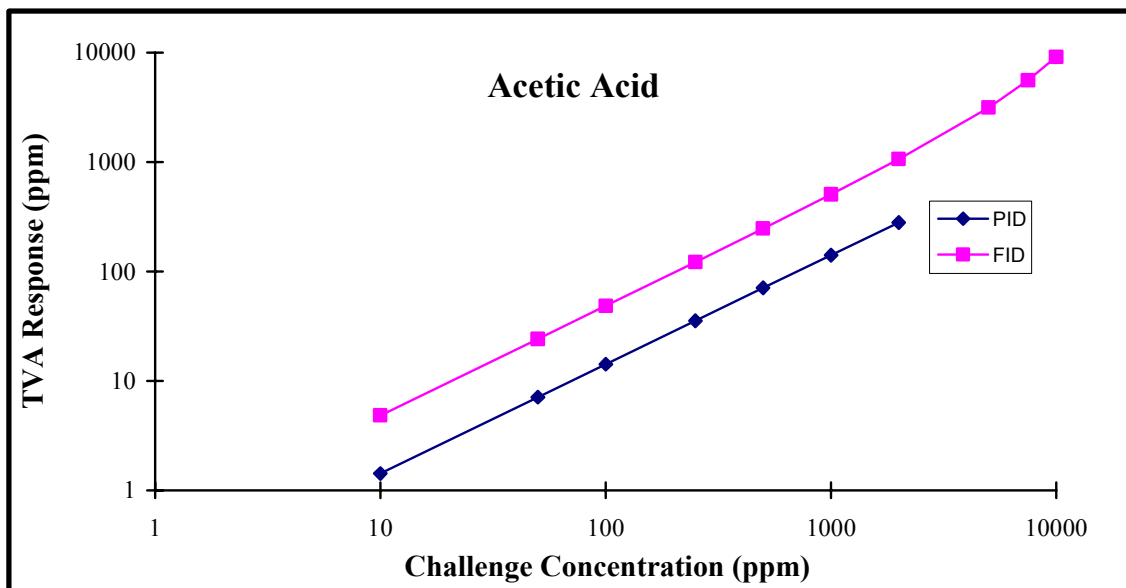


**PART TWO**  
**RESPONSE FACTORS**



# Acetic Acid

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent)		EPA/TVA-1000B (or equivalent)	
	Relative Response Factor PID	Relative Response Factor FID	Response Factor Multiplier PID	Response Factor Multiplier FID
10	0.170	0.339	7.021	2.071
50	0.185	0.453	7.024	2.067
100	0.187	0.467	7.026	2.062
250	0.187	0.477	7.035	2.047
500	0.184	0.482	7.049	2.023
1000	0.179	0.488	7.076	1.974
2000	0.168	0.498	7.132	1.876
5000		0.525		1.582
7500		0.548		1.338
10000		0.571		1.093

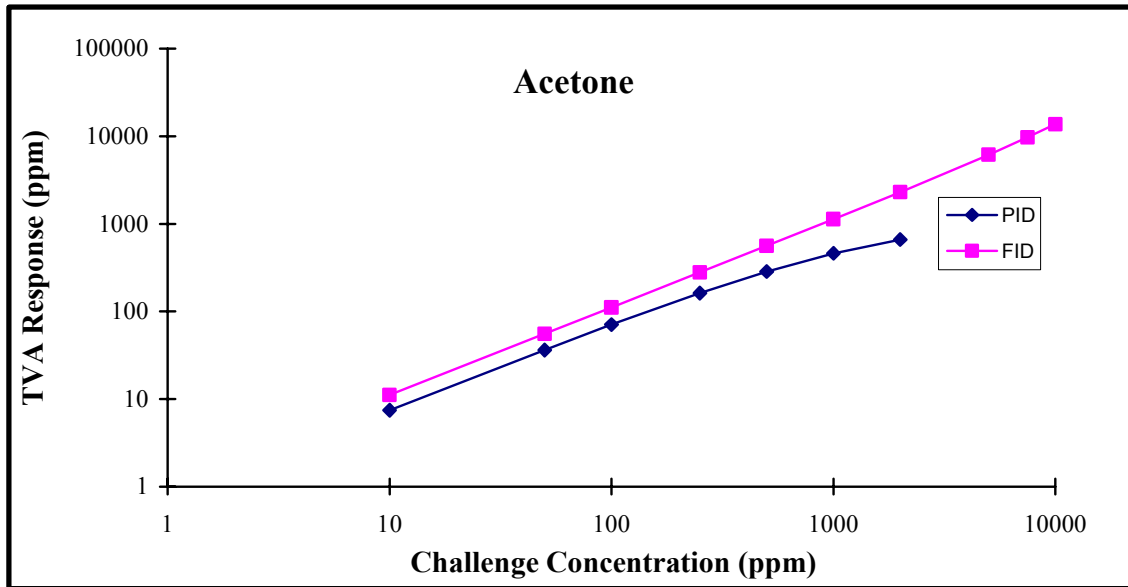


PID Lamp (eV): 11.8

TVA-1000B Response Curve Coefficients:		
PID	A 7.02	B -0.56
FID	2.07	0.98

# Acetone

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent)		EPA/TVA-1000B (or equivalent)	
	Relative Response Factor		Response Factor Multiplier	
	PID	FID	PID	FID
10	0.748	1.230	1.342	0.901
50	0.731	1.231	1.375	0.900
100	0.711	1.233	1.417	0.899
250	0.658	1.237	1.544	0.897
500	0.585	1.244	1.754	0.892
1000	0.479	1.258	2.174	0.884
2000	0.352	1.286	3.015	0.866
5000		1.371		0.815
7500		1.442		0.772
10000		1.513		0.728

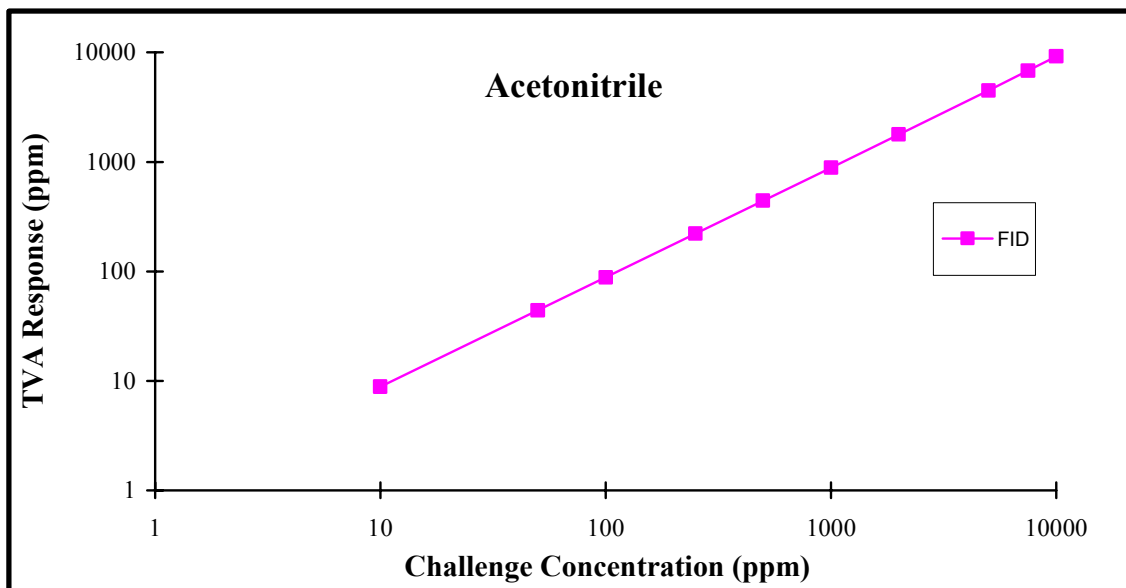


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:		
	A	B
PID	1.33	-8.41
FID	0.90	0.17

# Acetonitrile

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent)		EPA/TVA-1000B (or equivalent)	
	Relative Response Factor		Response Factor Multiplier	
	PID	FID	PID	FID
10			NF	1.134
50			NF	1.134
100			NF	1.134
250			NF	1.133
500			NF	1.132
1000			NF	1.129
2000			NF	1.125
5000				1.110
7500				1.098
10000				1.086

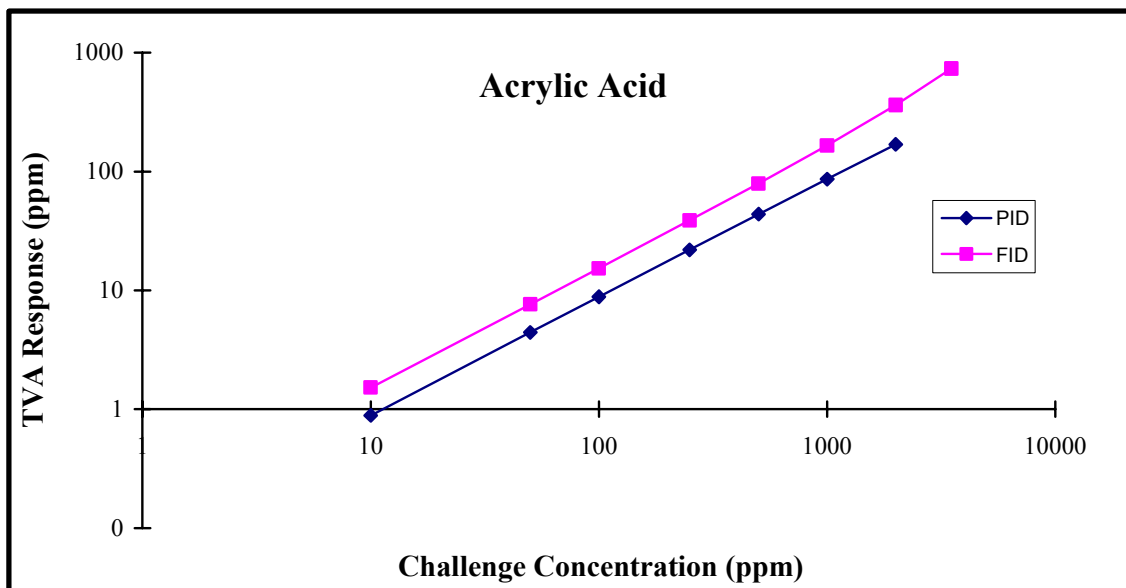


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:		
	A	B
PID	NF	NF
FID	1.13	0.05

# Acrylic Acid

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent)		EPA/TVA-1000B (or equivalent)	
	Relative Response Factor		Response Factor Multiplier	
	PID	FID	PID	FID
10			11.308	6.557
50			11.318	6.536
100			11.330	6.510
250			11.368	6.433
500			11.431	6.303
1000			11.558	6.044
2000			11.811	5.526
3500				4.749

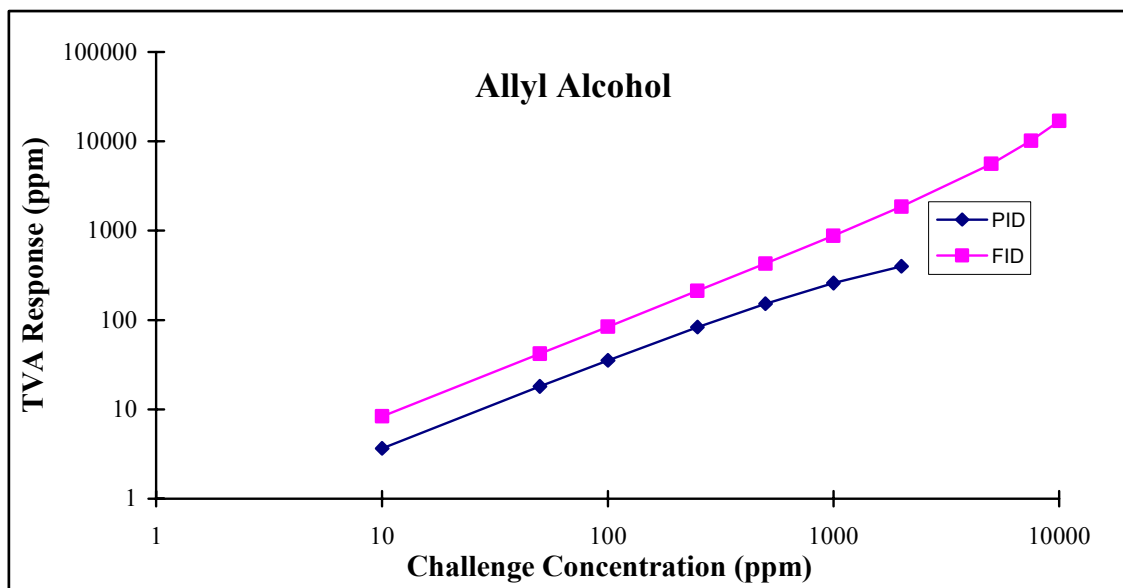


PID Lamp (eV): 11.8

TVA-1000B Response Curve Coefficients:		
	A	B
PID	11.31	-2.53
FID	6.56	5.18

# Allyl Alcohol

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent)		EPA/TVA-1000B (or equivalent)	
	Relative Response Factor PID	Relative Response Factor FID	Response Factor Multiplier PID	Response Factor Multiplier FID
10	0.303	0.676	2.723	1.193
50			2.768	1.190
100	0.298	0.681	2.825	1.187
250			2.995	1.178
500	0.250	0.701	3.278	1.163
1000	0.205	0.727	3.845	1.133
2000	0.155	0.778	4.979	1.073
5000		0.822		0.891
7500		0.935		0.740
10000		1.048		0.589

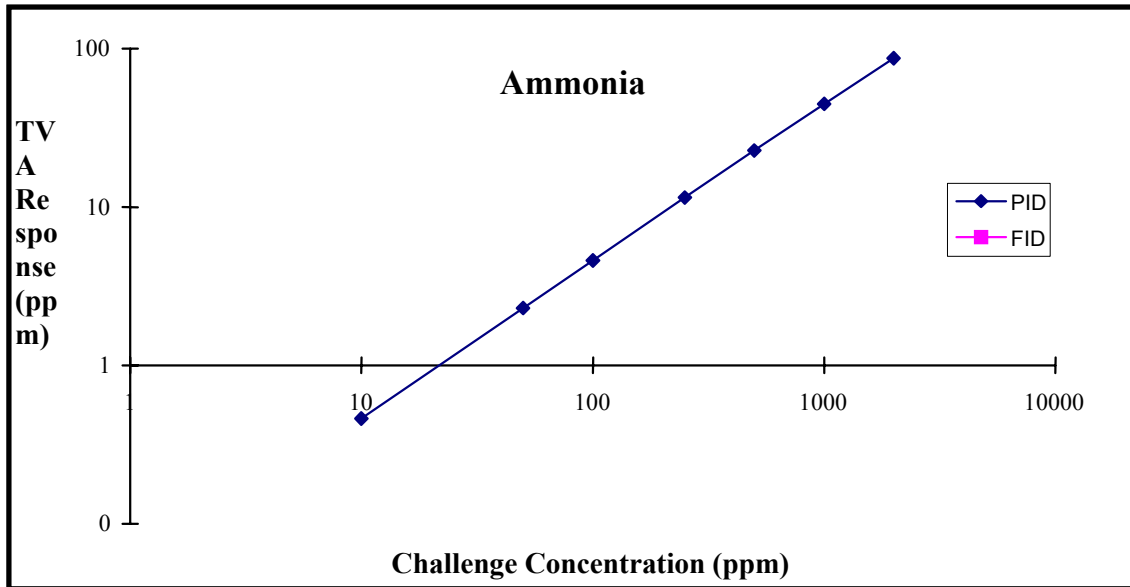


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:			
	A	B	
PID	2.71	-11.34	
FID	1.19	0.61	

# Ammonia

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent)		EPA/TVA-1000B (or equivalent)	
	Relative Response Factor PID	Relative Response Factor FID	Response Factor Multiplier PID	Response Factor Multiplier FID
10	0.200	NF	21.666	NF
50	0.199	NF	21.692	NF
100	0.198	NF	21.725	NF
250	0.196	NF	21.824	NF
500	0.173	NF	21.989	NF
1000	0.149	NF	22.319	NF
2000	0.122	NF	22.980	NF
5000		NF		NF
7500		NF		NF
10000		NF		NF

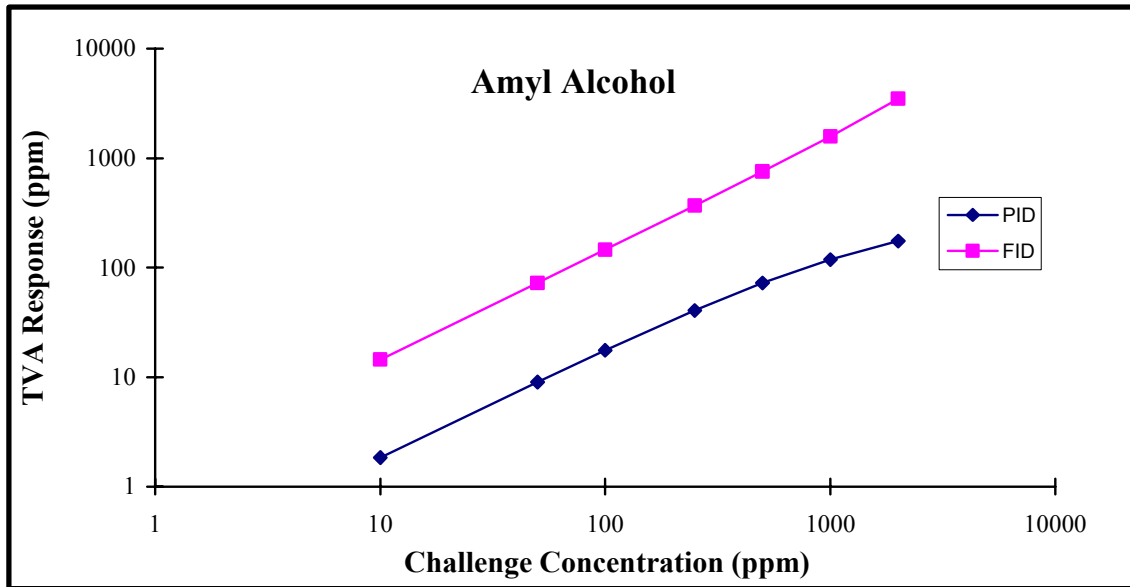


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:	A	B
PID	21.66	-6.60
FID	NF	NF

# Amyl Alcohol

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent)		EPA/TVA-1000B (or equivalent)	
	Relative Response Factor		Response Factor Multiplier	
	PID	FID	PID	FID
10	0.172	0.716	5.424	0.692
50			5.545	0.689
100	0.166	0.714	5.696	0.686
250			6.150	0.677
500	0.128	0.703	6.906	0.662
1000	0.096	0.689	8.419	0.632
2000	0.064	0.662	11.444	0.572
5000		0.511		
7500				
10000				

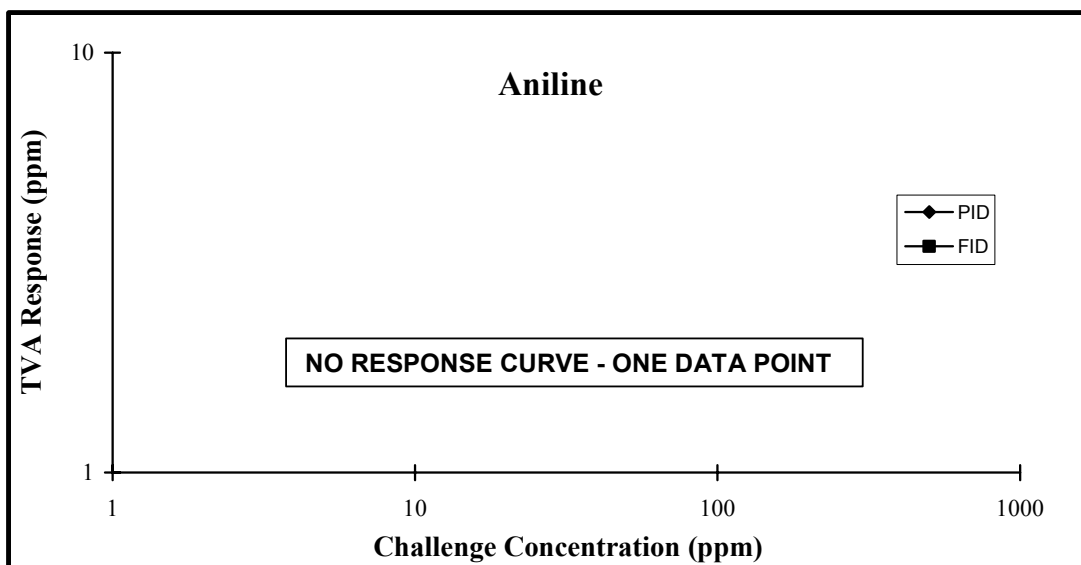


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:		
PID	A 5.39	B -30.26
FID	0.69	0.60

# Aniline

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent) Relative Response Factor		EPA/TVA-1000B (or equivalent) Response Factor Multiplier	
	PID	FID	PID	FID
789.5	N/A	N/A	4.900	6.400

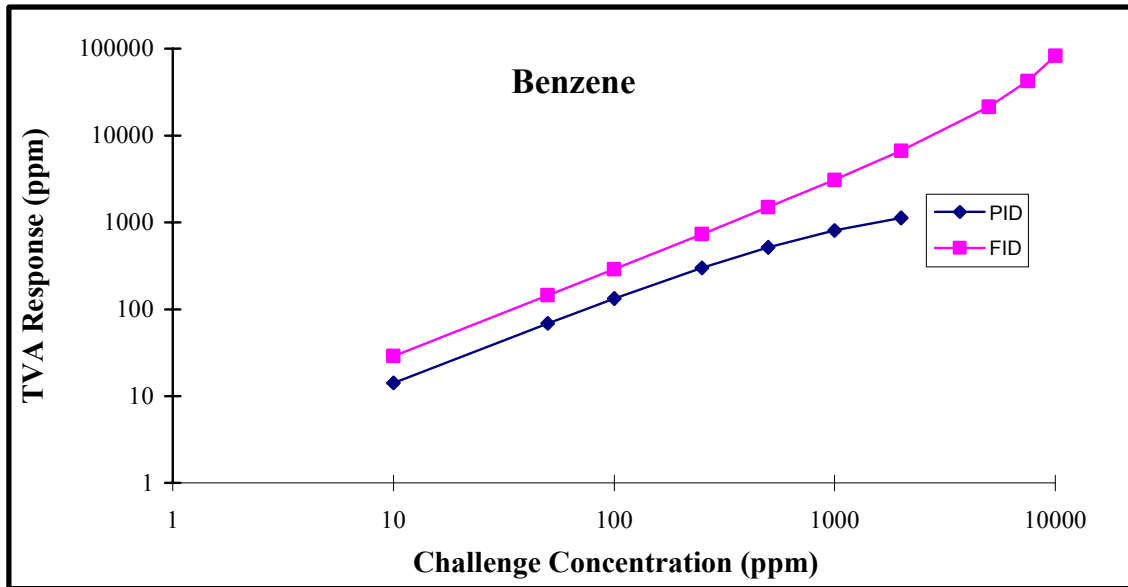


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:	A	B
PID	N/A	N/A
FID	N/A	N/A

# Benzene

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent)		EPA/TVA-1000B (or equivalent)	
	Relative Response Factor		Response Factor Multiplier	
	PID	FID	PID	FID
10	1.795	3.400	0.702	0.346
50	1.744	3.420	0.724	0.345
100	1.684	3.430	0.751	0.344
250	1.527	3.480	0.833	0.340
500	1.322	3.558	0.968	0.335
1000	1.041	3.713	1.239	0.323
2000	0.731	4.023	1.781	0.301
5000		4.953		0.233
7500		5.728		0.177
10000		6.503		0.121

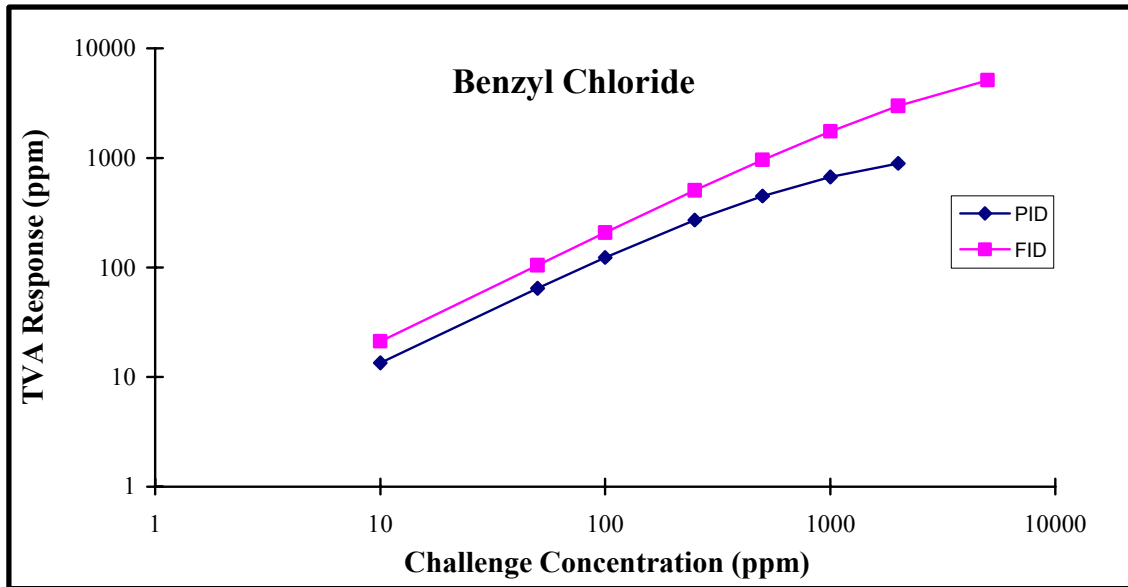


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:		
	A	B
PID	0.70	-5.42
FID	0.35	0.23

# Benzyl Chloride

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent)		EPA/TVA-1000B (or equivalent)	
	Relative Response Factor PID	Relative Response Factor FID	Response Factor Multiplier PID	Response Factor Multiplier FID
10	0.341	0.693	0.743	0.472
50			0.773	0.476
100	0.327	0.684	0.811	0.481
250			0.924	0.496
500	0.248	0.647	1.113	0.521
1000	0.184	0.606	1.492	0.571
2000	0.121	0.538	2.248	0.672
5000				0.974
7500				
10000				

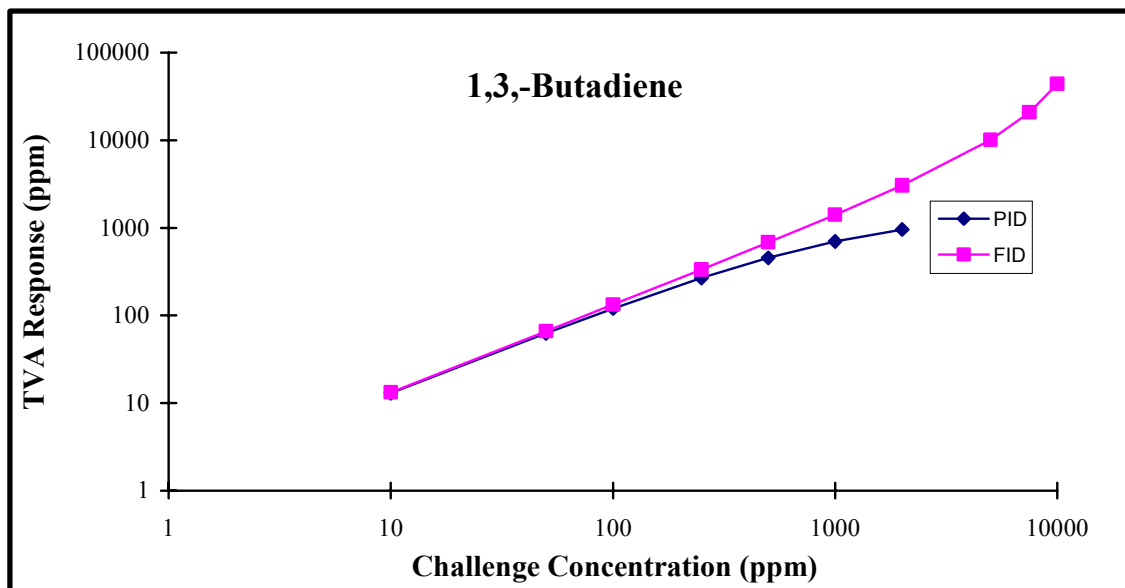


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:		
	A	B
PID	0.74	-7.57
FID	0.47	-1.01

# 1,3,-Butadiene

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent)		EPA/TVA-1000B (or equivalent)	
	Relative Response Factor PID	Relative Response Factor FID	Response Factor Multiplier PID	Response Factor Multiplier FID
10	1.281	1.466	0.773	0.758
50	1.243	1.474	0.799	0.756
100	1.198	1.484	0.832	0.754
250	1.082	1.514	0.932	0.746
500	0.931	1.565	1.097	0.732
1000	0.727	1.667	1.428	0.706
2000	0.506	1.871	2.091	0.653
5000		2.482		0.493
7500		2.991		0.360
10000		3.500		0.227

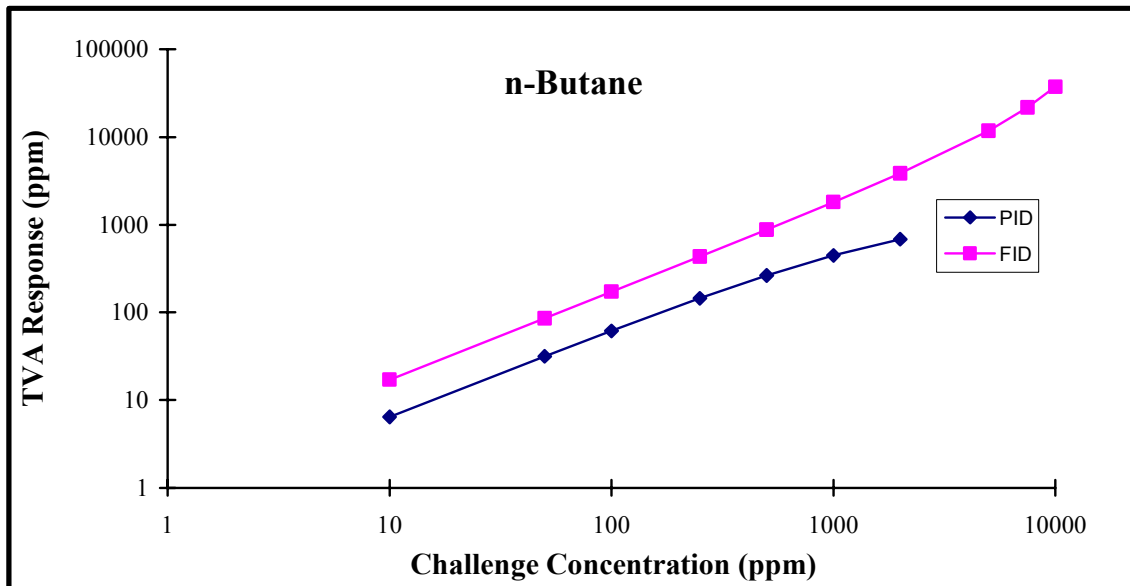


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:		A	B
PID		0.77	-6.62
FID		0.76	0.53

# n-Butane

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent) Relative Response Factor		EPA/TVA-1000B (or equivalent) Response Factor Multiplier	
	PID	FID	PID	FID
10	0.624	1.721	1.555	0.583
50	0.617	1.729	1.583	0.582
100	0.609	1.738	1.617	0.580
250	0.586	1.767	1.721	0.576
500	0.496	1.814	1.893	0.568
1000	0.394	1.909	2.238	0.552
2000	0.284	2.098	2.928	0.520
5000		2.497		0.425
7500		2.940		0.346
10000		3.384		0.267

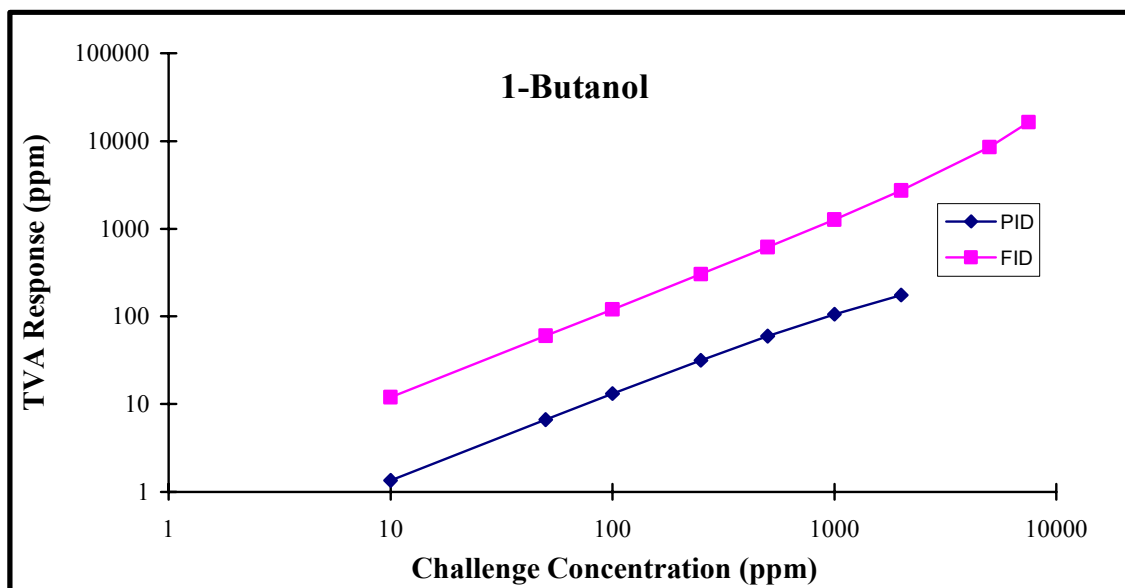


PID Lamp (eV): 11.8

TVA-1000B Response Curve Coefficients:		A	B
PID		1.55	-6.90
FID		0.58	0.32

# 1-Butanol

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent) Relative Response Factor		EPA/TVA-1000B (or equivalent) Response Factor Multiplier	
	PID	FID	PID	FID
10	0.114	1.179	7.408	0.835
50	0.113	1.181	7.489	0.833
100	0.112	1.184	7.590	0.831
250	0.107	1.191	7.891	0.823
500	0.101	1.203	8.394	0.811
1000	0.089	1.228	9.401	0.786
2000	0.073	1.277	11.413	0.736
5000		1.424		0.585
7500		1.546		0.460
10000				

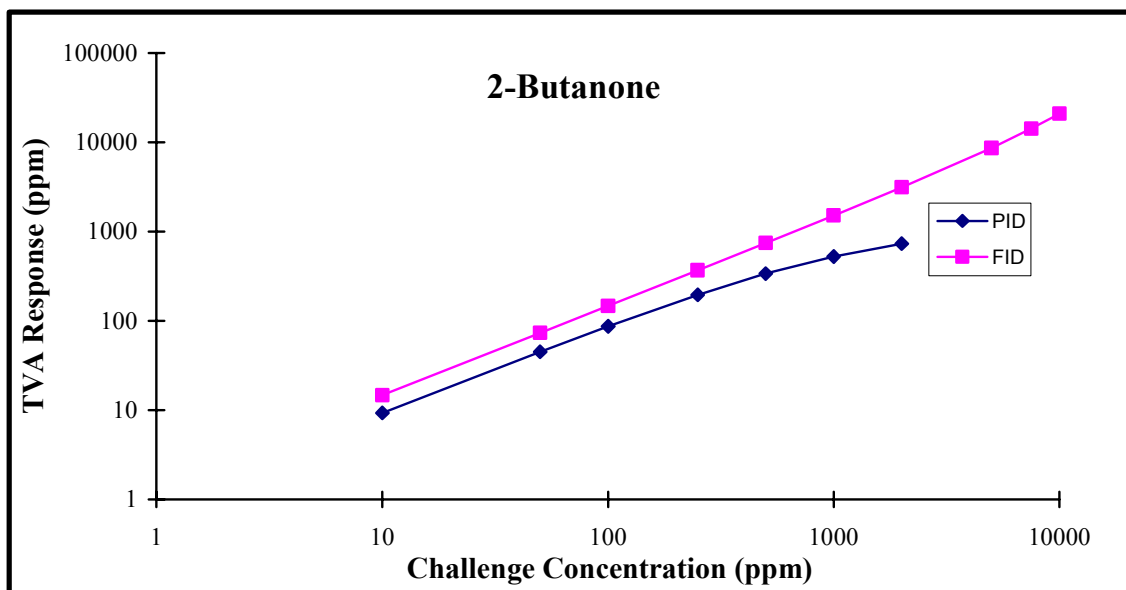


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:	A	B
PID	7.39	-20.12
FID	0.84	0.50

## 2-Butanone

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent)		EPA/TVA-1000B (or equivalent)	
	Relative Response Factor		Response Factor Multiplier	
	PID	FID	PID	FID
10	1.034	1.856	1.075	0.680
50	1.005	1.859	1.108	0.679
100	0.971	1.863	1.149	0.678
250	0.882	1.874	1.273	0.675
500	0.765	1.893	1.480	0.670
1000	0.604	1.930	1.893	0.660
2000	0.426	2.005	2.719	0.639
5000		2.223		0.578
7500		2.416		0.527
10000		2.603		0.475

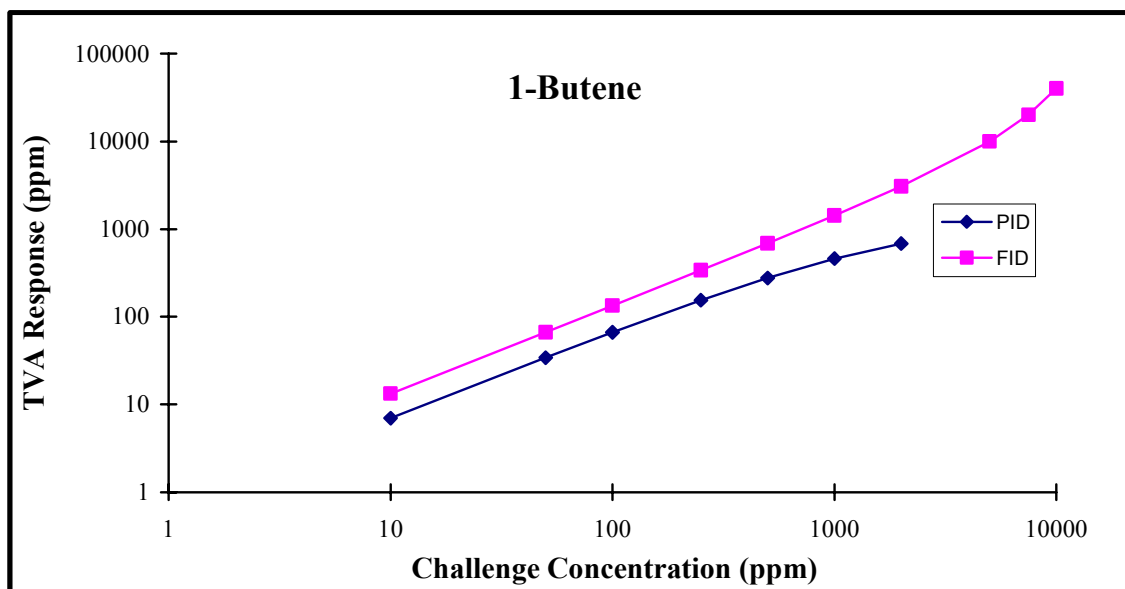


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:		A	B
PID		1.07	-8.26
FID		0.68	0.21

# 1-Butene

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent)		EPA/TVA-1000B (or equivalent)	
	Relative Response Factor PID	Relative Response Factor FID	Response Factor Multiplier PID	Response Factor Multiplier FID
10	0.812	1.570	1.438	0.750
50			1.468	0.748
100	0.791	1.592	1.505	0.745
250			1.616	0.738
500	0.641	1.692	1.802	0.725
1000	0.506	1.816	2.173	0.700
2000	0.362	2.065	2.916	0.650
5000		2.480		0.500
7500		3.028		0.374
10000		3.577		0.249

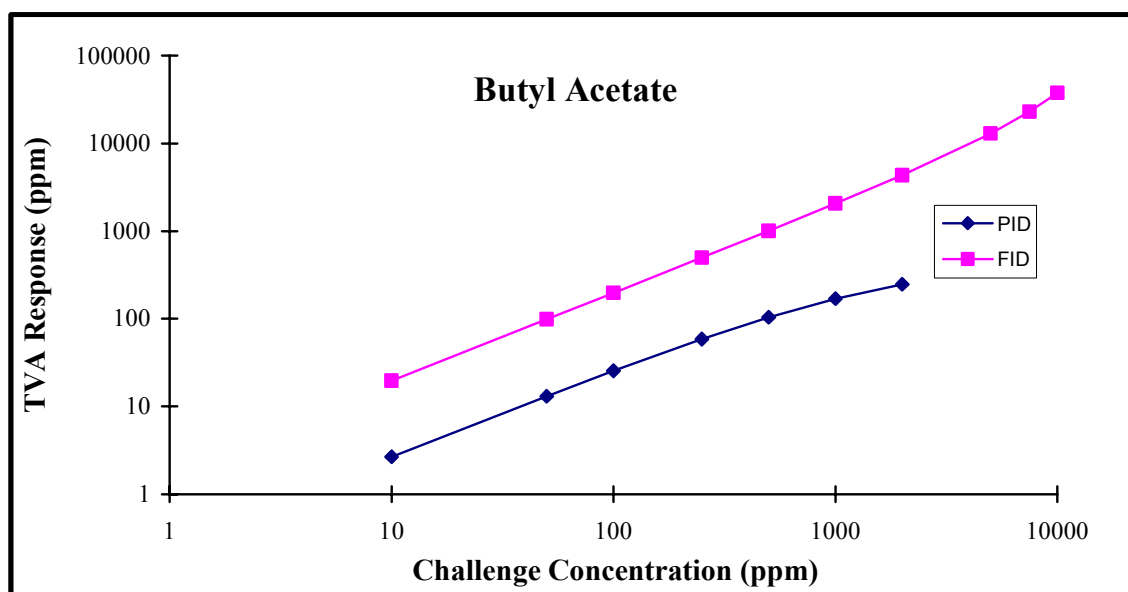


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:			
	A	B	
PID	1.43	-7.42	
FID	0.75	0.50	

# Butyl Acetate

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent)		EPA/TVA-1000B (or equivalent)	
	Relative Response Factor PID	Relative Response Factor FID	Response Factor Multiplier PID	Response Factor Multiplier FID
10	0.223	1.529	3.732	0.508
50	0.219	1.532	3.820	0.507
100	0.214	1.535	3.930	0.506
250	0.202	1.545	4.258	0.502
500	0.166	1.561	4.806	0.496
1000	0.125	1.594	5.902	0.484
2000	0.084	1.660	8.094	0.460
5000		1.739		0.387
7500		1.894		0.327
10000		2.048		0.266

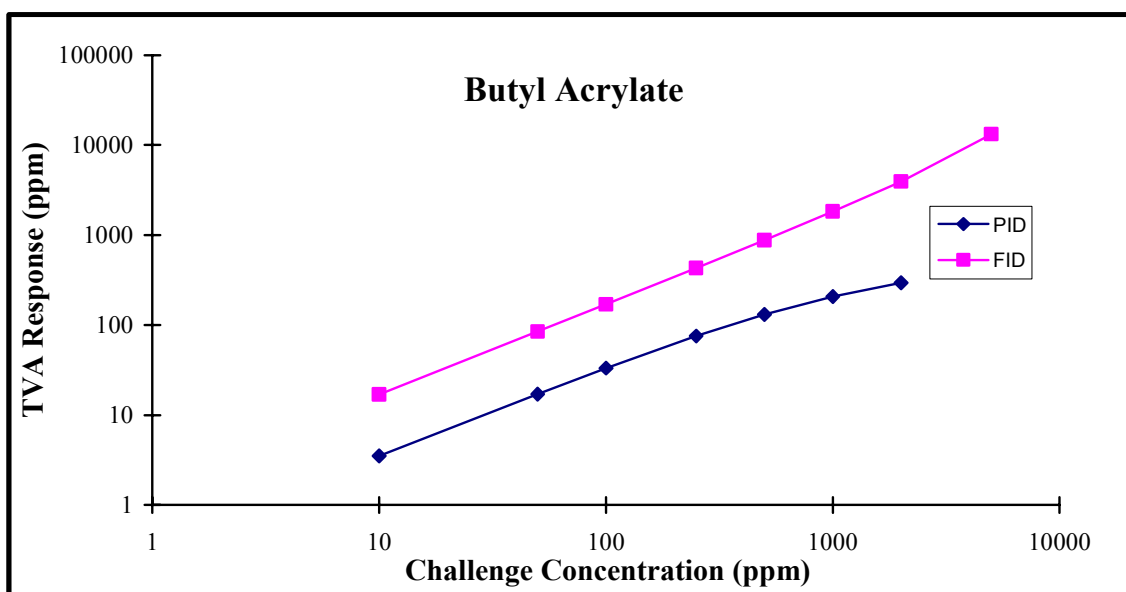


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:	A	B
PID	3.71	-21.92
FID	0.51	0.24

# Butyl Acrylate

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent)		EPA/TVA-1000B (or equivalent)	
	Relative Response Factor PID	Relative Response Factor FID	Response Factor Multiplier PID	Response Factor Multiplier FID
10	0.114	1.179	2.843	0.591
50	0.113	1.181	2.923	0.589
100	0.112	1.184	3.022	0.587
250	0.107	1.191	3.320	0.580
500	0.101	1.203	3.816	0.570
1000	0.089	1.228	4.808	0.549
2000	0.073	1.277	6.792	0.506
5000		1.424		0.379

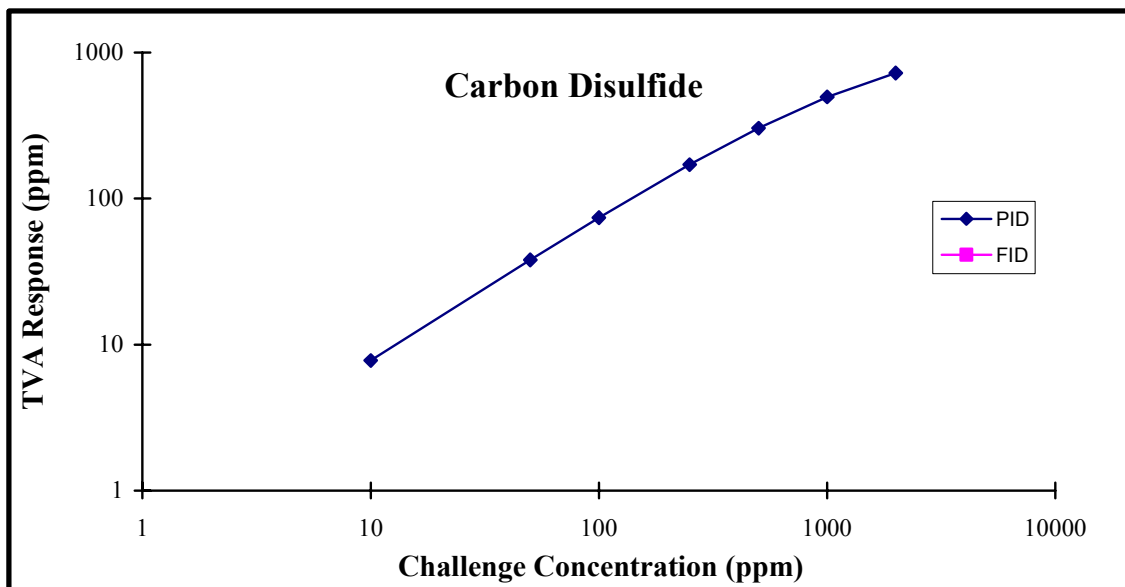


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:		
	A	B
PID	2.82	-19.84
FID	0.59	0.42

# Carbon Disulfide

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent)		EPA/TVA-1000B (or equivalent)	
	Relative Response Factor PID	FID	Response Factor Multiplier PID	FID
10	0.822		1.285	
50	0.812		1.314	
100	0.792		1.351	
250	0.740		1.462	
500	0.666		1.646	
1000	0.556		2.015	
2000	0.417		2.752	
5000				
7500				
10000				

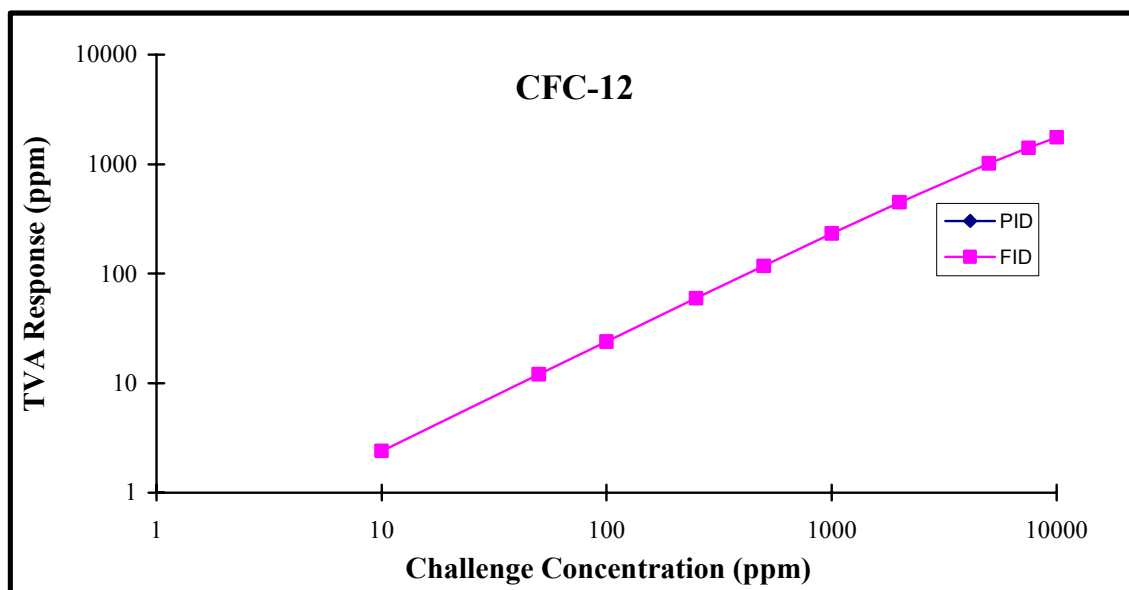


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:			
	A	B	
PID	1.28	-7.37	
FID	NF	NF	

# CFC-12

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent)		EPA/TVA-1000B (or equivalent)	
	Relative Response Factor		Response Factor Multiplier	
	PID	FID	PID	FID
10	NF	0.508	NF	4.157
50	NF	0.262	NF	4.163
100	NF	0.231	NF	4.170
250	NF	0.212	NF	4.194
500	NF	0.206	NF	4.232
1000	NF	0.203	NF	4.309
2000	NF	0.202	NF	4.463
5000		0.188		4.925
7500		0.188		5.310
10000		0.188		5.696

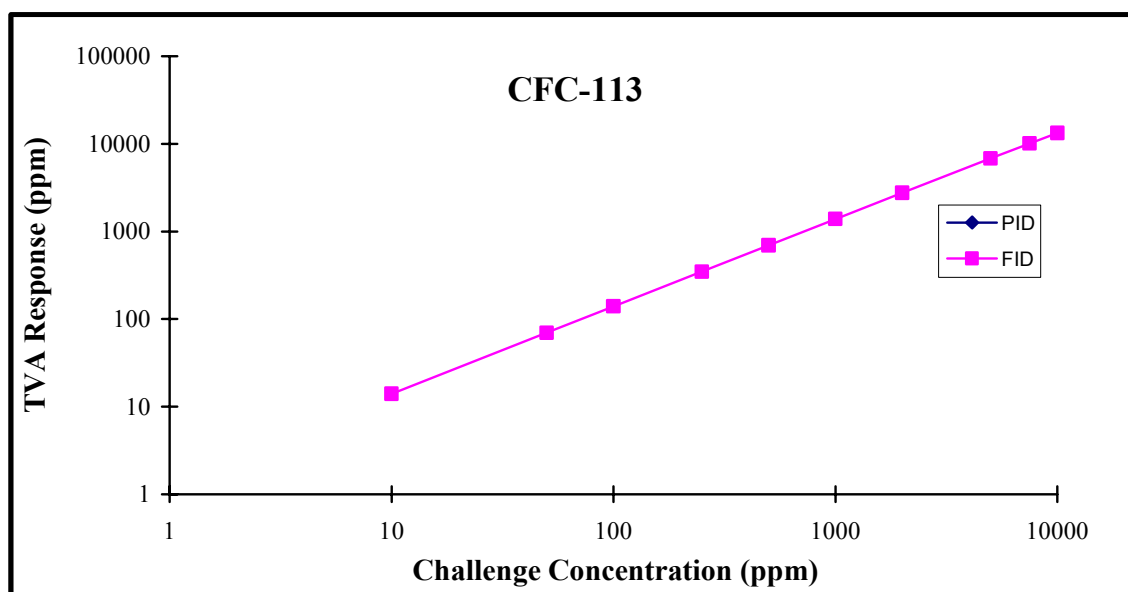


PID Lamp (eV): 0

TVA-1000B Response Curve Coefficients:			
	A	B	
PID	NF	NF	
FID	4.16	-1.54	

# CFC-113

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent)		EPA/TVA-1000B (or equivalent)	
	Relative Response Factor		Response Factor Multiplier	
	PID	FID	PID	FID
10	NF	1.395	NF	0.717
50	NF	1.394	NF	0.717
100	NF	1.392	NF	0.717
250	NF	1.388	NF	0.718
500	NF	1.381	NF	0.719
1000	NF	1.366	NF	0.720
2000	NF	1.338	NF	0.723
5000		1.173		0.733
7500		1.106		0.740
10000		1.039		0.748

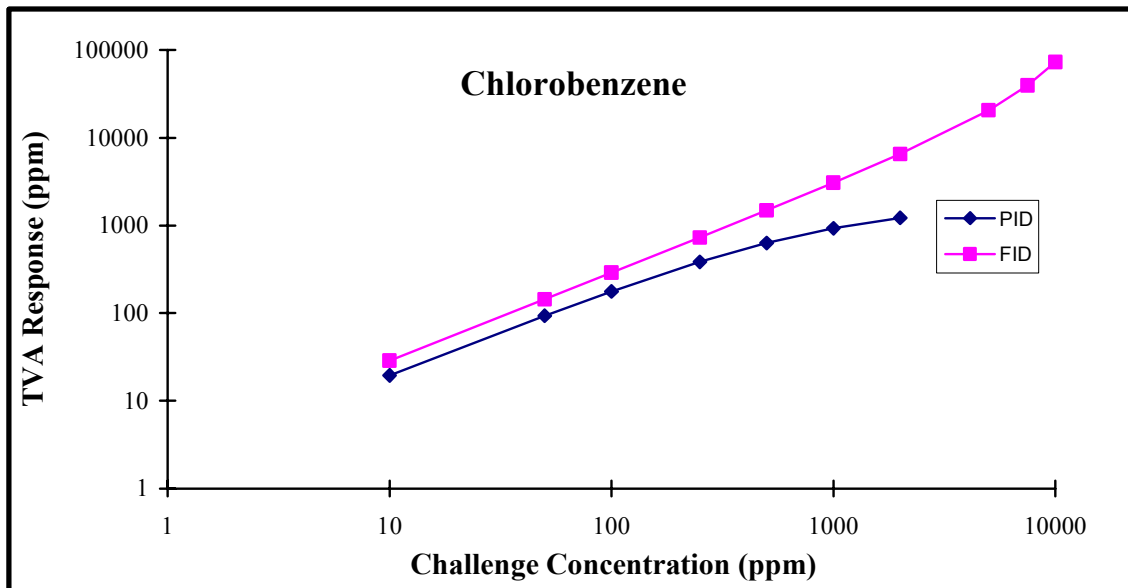


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:			
	A	B	
PID	NF	NF	
FID	0.72	-0.03	

# Chlorobenzene

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent)		EPA/TVA-1000B (or equivalent)	
	Relative Response Factor		Response Factor Multiplier	
	PID	FID	PID	FID
10	2.210	3.152	0.513	0.347
50	2.110	3.161	0.536	0.346
100	1.987	3.173	0.564	0.345
250	1.690	3.209	0.649	0.342
500	1.353	3.269	0.791	0.337
1000	0.967	3.389	1.074	0.326
2000	0.616	3.630	1.640	0.305
5000		4.351		0.242
7500		4.951		0.189
10000		5.552		0.137

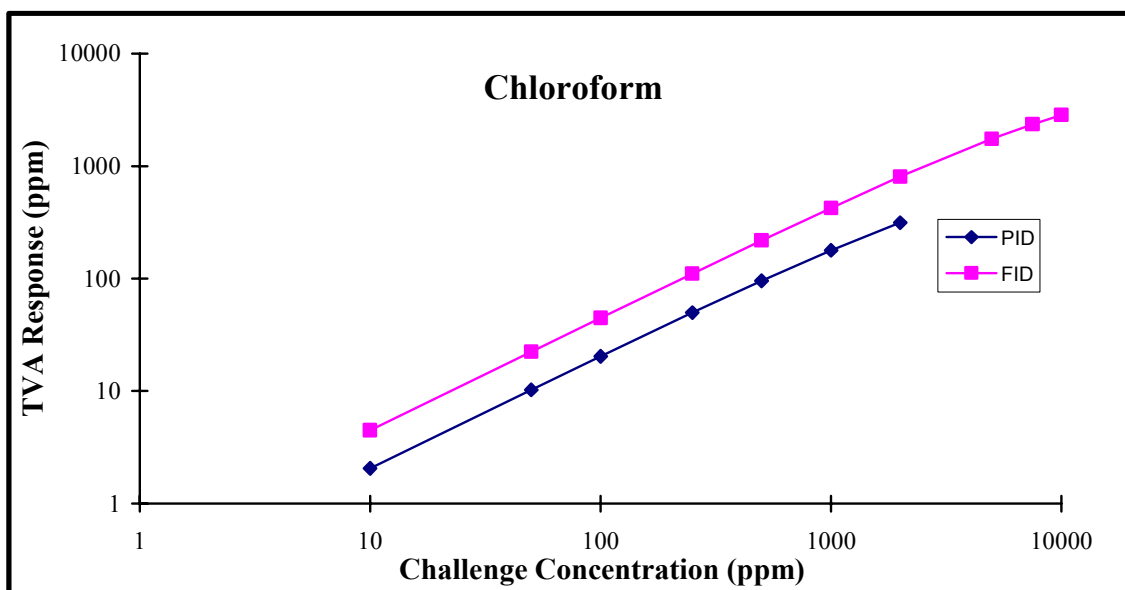


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:			
	A	B	
PID	0.51	-5.66	
FID	0.35	0.21	

# Chloroform

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent)		EPA/TVA-1000B (or equivalent)	
	Relative Response Factor		Response Factor Multiplier	
	PID	FID	PID	FID
10	0.343	0.817	4.838	2.229
50	0.339	0.616	4.870	2.234
100	0.334	0.545	4.909	2.241
250	0.321	0.464	5.026	2.260
500	0.271	0.411	5.221	2.292
1000	0.215	0.364	5.612	2.356
2000	0.154	0.322	6.393	2.484
5000		0.257		2.869
7500		0.239		3.190
10000		0.228		3.510

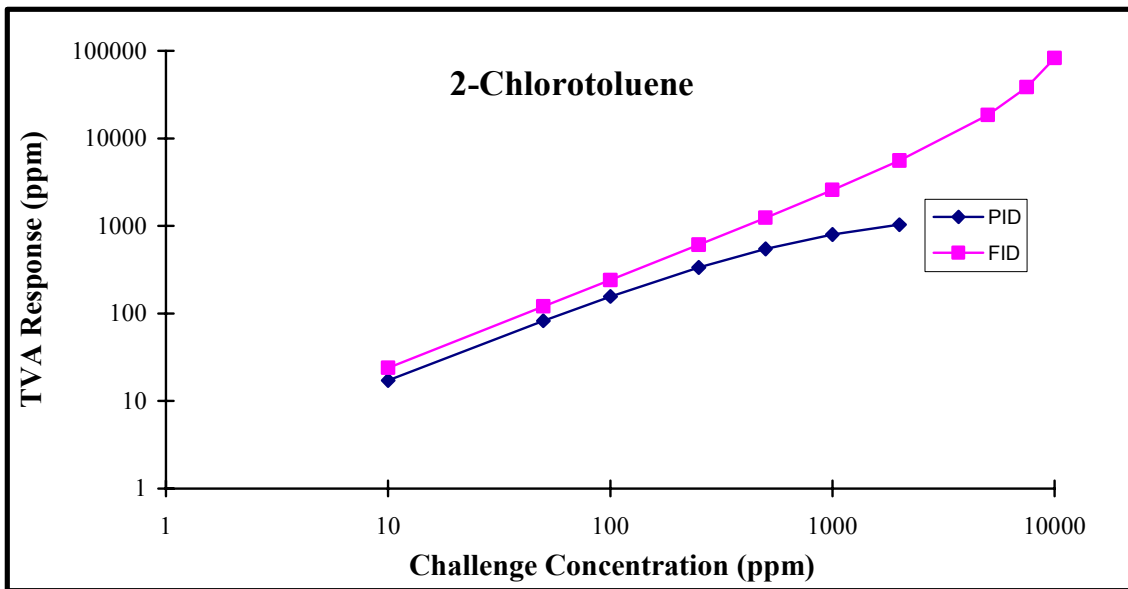


PID Lamp (eV): 11.8

TVA-1000B Response Curve Coefficients:			
	A	B	
PID	4.83	-7.81	
FID	2.23	-1.28	

## 2-Chlorotoluene

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent)		EPA/TVA-1000B (or equivalent)	
	Relative Response Factor		Response Factor Multiplier	
	PID	FID	PID	FID
10	1.868	4.912	0.580	0.417
50	1.782	4.912	0.607	0.416
100	1.685	4.930	0.641	0.414
250	1.449	4.989	0.744	0.410
500	1.174	5.098	0.914	0.402
1000	0.851	5.309	1.256	0.387
2000	0.549	5.735	1.938	0.358
5000		7.011		0.269
7500				
10000				

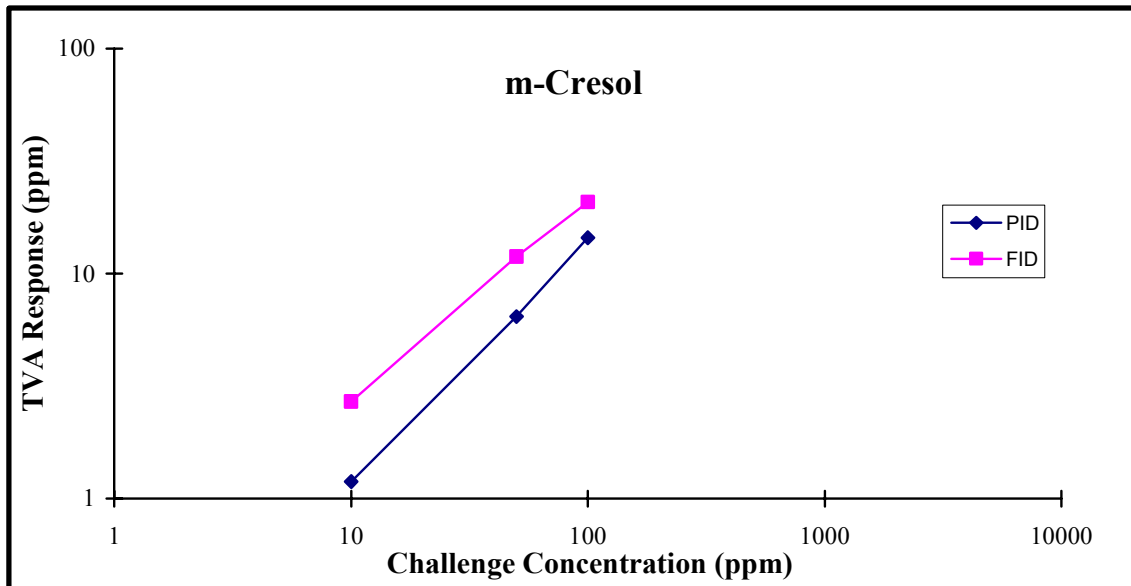


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:		
PID	A	B
	0.57	-6.83
FID	A	B
	0.42	0.30

# m-Cresol

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent) Relative Response Factor		EPA/TVA-1000B (or equivalent) Response Factor Multiplier	
	PID	FID	PID	FID
10			8.399	3.708
50			7.751	4.200
100			6.941	4.816
250				
500				
1000				
2000				
5000				
7500				
10000				

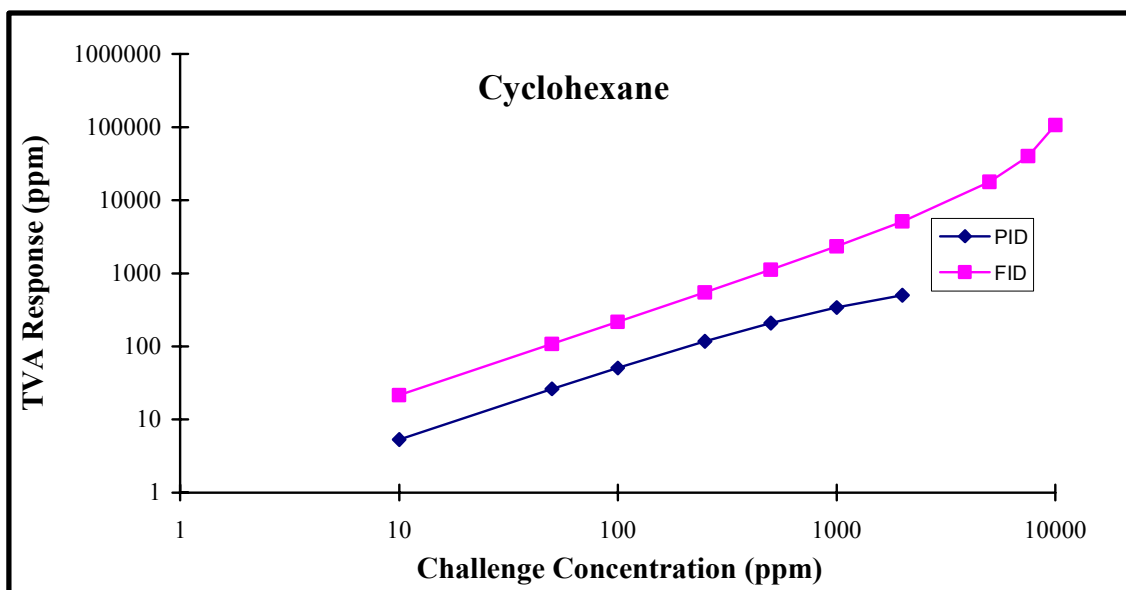


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:			
	A	B	
PID	8.56	161.93	
FID	3.58	-123.10	

# Cyclohexane

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent) Relative Response Factor		EPA/TVA-1000B (or equivalent) Response Factor Multiplier	
	PID	FID	PID	FID
10	0.546	2.395	1.875	0.467
50	0.531	2.411	1.917	0.465
100	0.513	2.431	1.970	0.463
250	0.467	2.491	2.128	0.458
500	0.406	2.590	2.392	0.448
1000	0.321	2.790	2.920	0.430
2000	0.227	3.190	3.975	0.392
5000		4.389		0.281
7500		5.388		0.187
10000		6.387		0.094

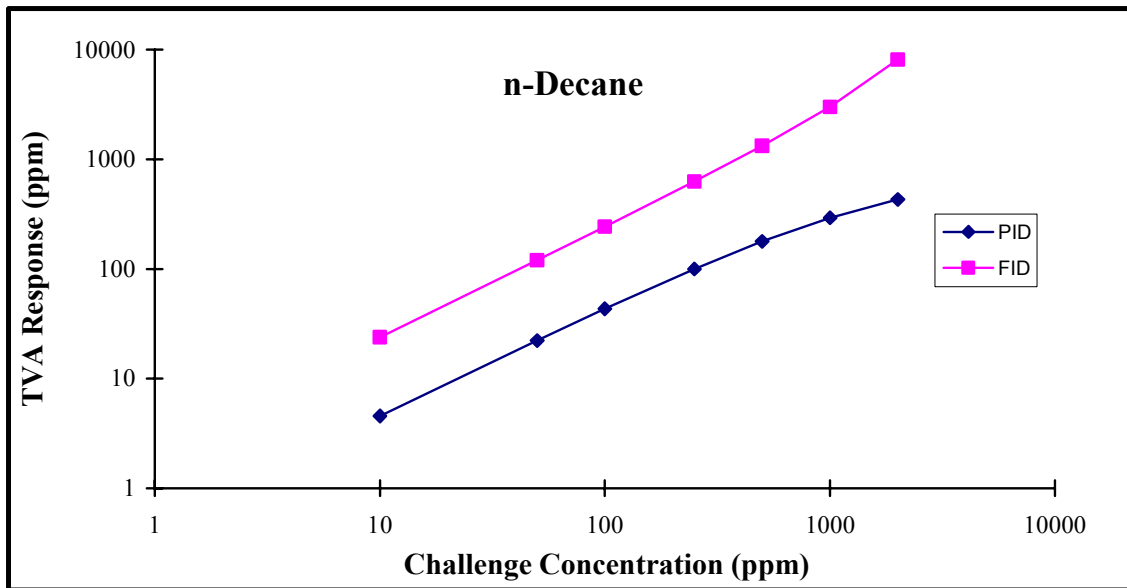


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:	A	B
PID	1.86	-10.55
FID	0.47	0.37

# n-Decane

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent)		EPA/TVA-1000B (or equivalent)	
	Relative Response Factor PID	Relative Response Factor FID	Response Factor Multiplier PID	Response Factor Multiplier FID
10	0.408	2.495	2.201	0.420
50	0.396	2.472	2.250	0.417
100	0.382	2.443	2.312	0.413
250	0.345	2.359	2.495	0.399
500	0.267	2.233	2.802	0.377
1000	0.185	2.016	3.415	0.333
2000	0.113	1.688	4.640	0.245
5000		1.063		
7500				
10000				

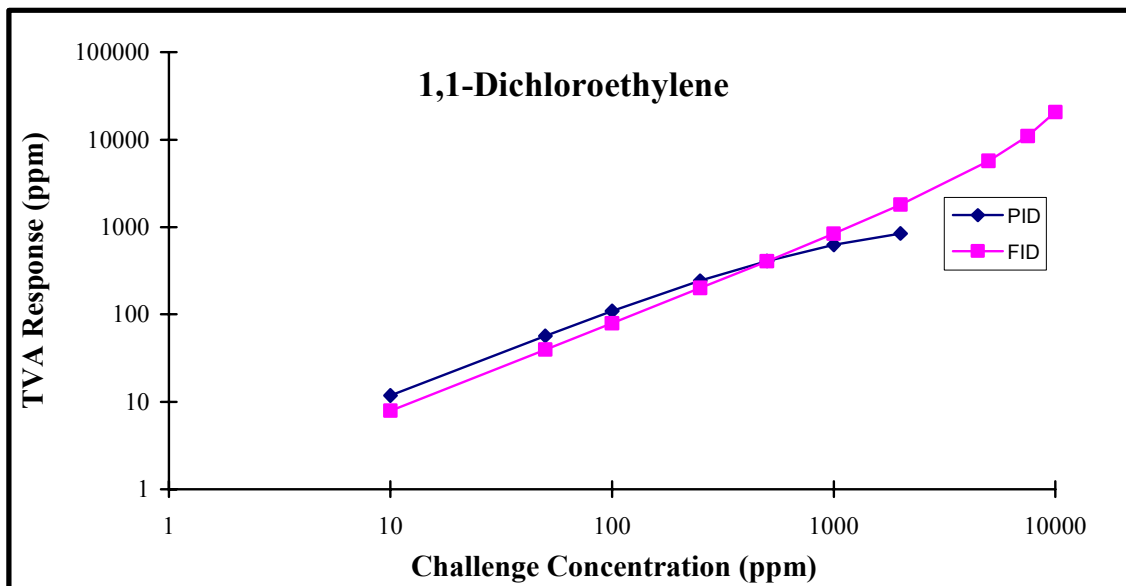


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:		A	B
PID		2.19	-12.26
FID		0.42	0.88

# 1,1-Dichloroethylene

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent) Relative Response Factor		EPA/TVA-1000B (or equivalent) Response Factor Multiplier	
	PID	FID	PID	FID
10	N/A	N/A	0.849	1.267
50			0.879	1.264
100			0.918	1.260
250			1.032	1.249
500			1.222	1.229
1000			1.603	1.190
2000			2.365	1.111
5000				0.877
7500				
10000				

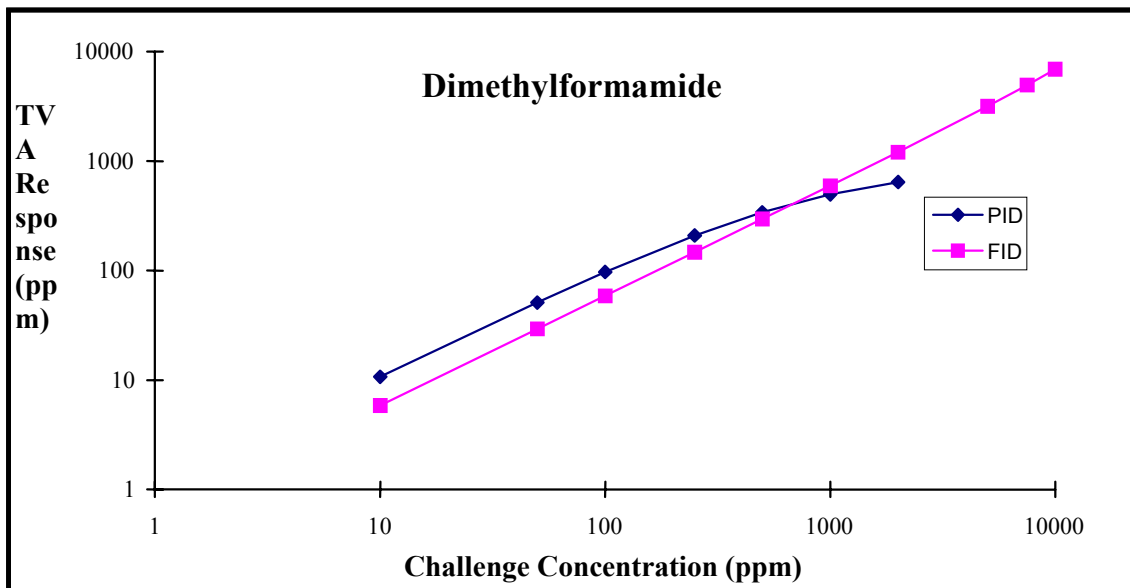


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:	A	B
PID	0.84	-7.62
FID	1.27	0.78

# Dimethylformamide

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent)		EPA/TVA-1000B (or equivalent)	
	Relative Response Factor PID	Relative Response Factor FID	Response Factor Multiplier PID	Response Factor Multiplier FID
10	0.419	0.228	0.936	1.710
50			0.980	1.709
100	0.412	0.228	1.035	1.707
250			1.200	1.704
500	0.345	0.226	1.474	1.697
1000	0.282	0.223	2.023	1.684
2000	0.212	0.218	3.122	1.659
5000		0.179		1.582
7500				
10000				

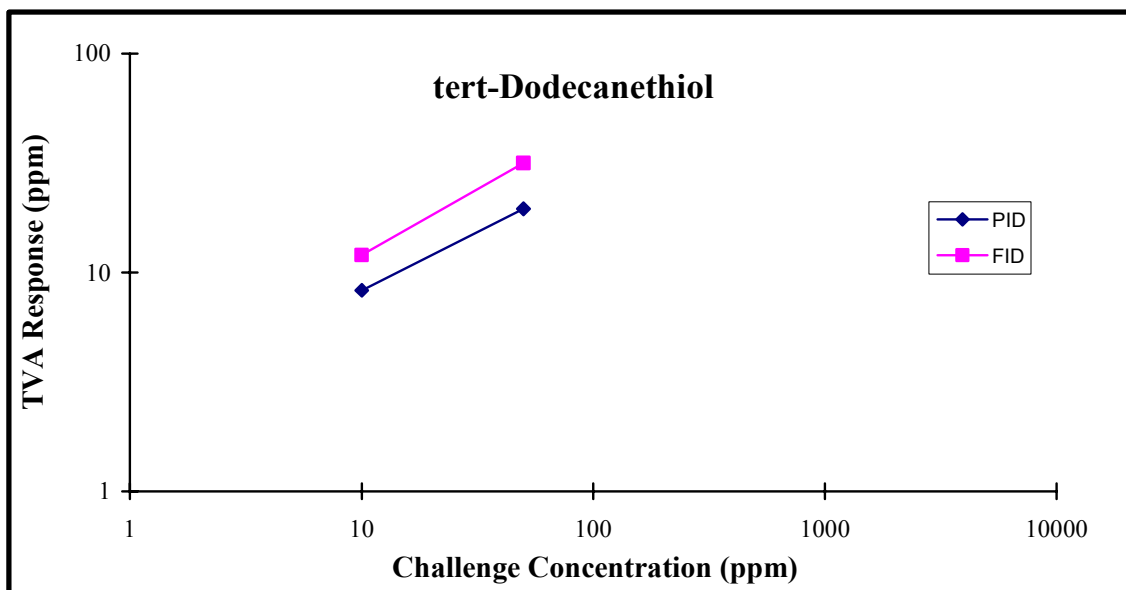


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:		
	A	B
PID	0.93	-10.98
FID	1.71	0.26

# tert-Dodecanethiol

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent) Relative Response Factor		EPA/TVA-1000B (or equivalent) Response Factor Multiplier	
	PID	FID	PID	FID
10			1.205	0.831
50			2.558	1.582
100				
250				
500				
1000				
2000				
5000				
7500				
10000				

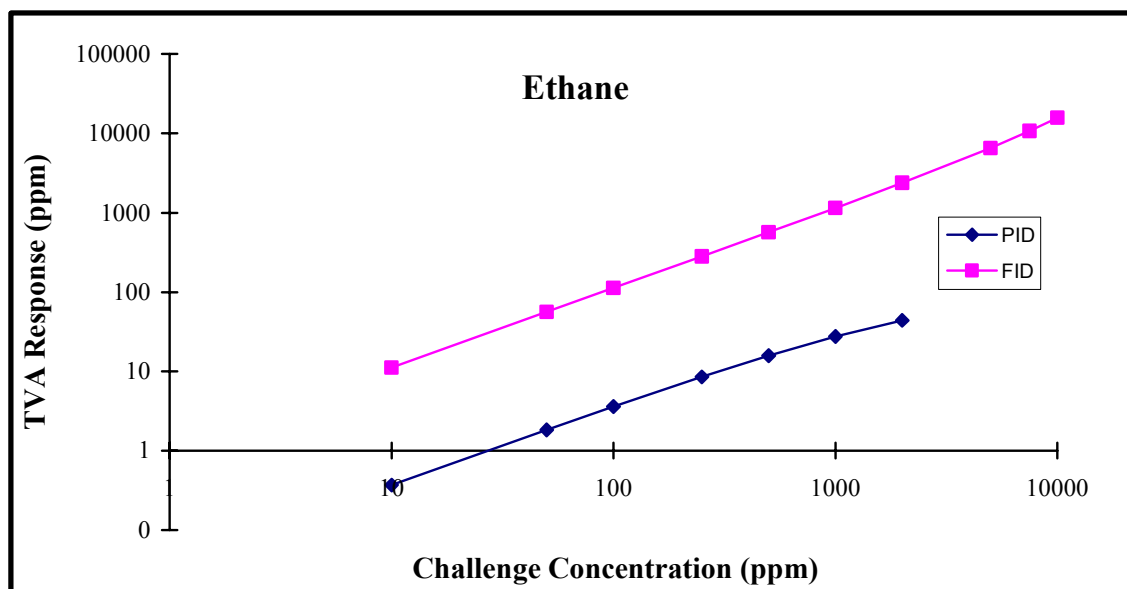


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:	A	B
PID	0.87	-338.18
FID	0.64	-187.76

# Ethane

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent)		EPA/TVA-1000B (or equivalent)	
	Relative Response Factor PID	Relative Response Factor FID	Response Factor Multiplier PID	Response Factor Multiplier FID
10	0.042	1.069	27.069	0.895
50	0.042	1.070	27.441	0.894
100	0.042	1.072	27.906	0.892
250	0.041	1.078	29.301	0.889
500	0.036	1.087	31.626	0.882
1000	0.030	1.106	36.275	0.869
2000	0.023	1.145	45.573	0.843
5000		1.179		0.765
7500		1.268		0.700
10000		1.358		0.635

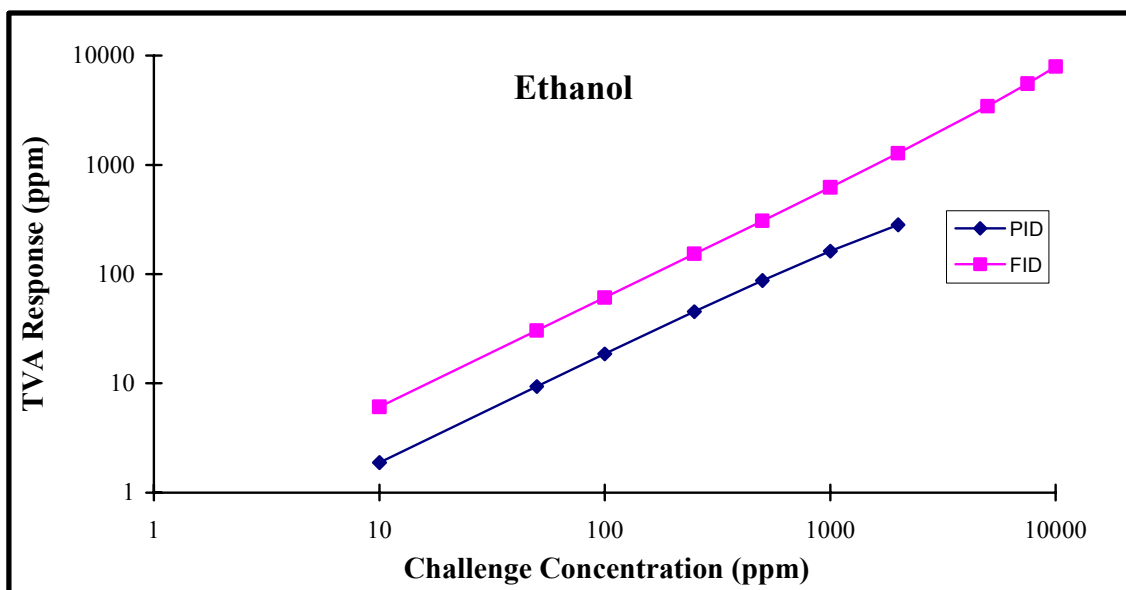


PID Lamp (eV): 11.8

TVA-1000B Response Curve Coefficients:			
	A	B	
PID	26.98	-92.98	
FID	0.90	0.26	

# Ethanol

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent)		EPA/TVA-1000B (or equivalent)	
	Relative Response Factor PID	Relative Response Factor FID	Response Factor Multiplier PID	Response Factor Multiplier FID
10	0.234	0.591	5.303	1.644
50	0.232	0.591	5.339	1.643
100	0.230	0.592	5.383	1.641
250	0.225	0.595	5.516	1.635
500	0.195	0.600	5.737	1.625
1000	0.161	0.609	6.180	1.606
2000	0.123	0.627	7.066	1.568
5000		0.638		1.454
7500		0.681		1.359
10000		0.724		1.264

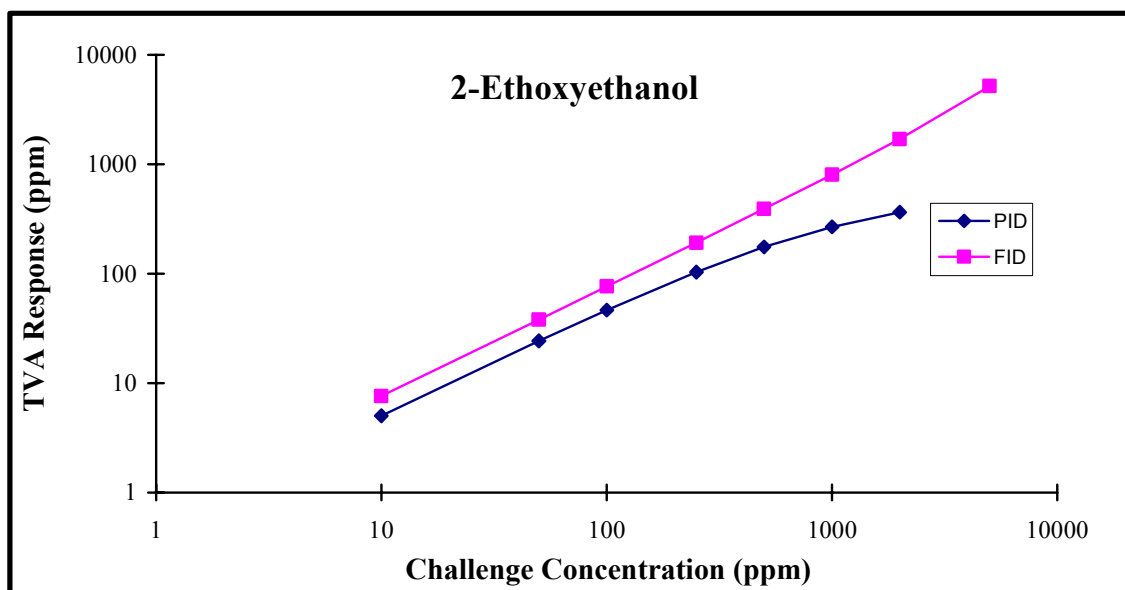


PID Lamp (eV): 11.8

TVA-1000B Response Curve Coefficients:	A	B
PID	5.29	-8.86
FID	1.64	0.38

## 2-Ethoxyethanol

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent)		EPA/TVA-1000B (or equivalent)	
	Relative Response Factor		Response Factor Multiplier	
	PID	FID	PID	FID
10	0.189	0.323	1.992	1.315
50			2.062	1.312
100	0.188	0.325	2.150	1.309
250			2.412	1.298
500	0.166	0.335	2.848	1.281
1000	0.143	0.347	3.721	1.246
2000	0.118	0.370	5.468	1.175
5000		0.389		0.964
7500		0.442		
10000		0.494		

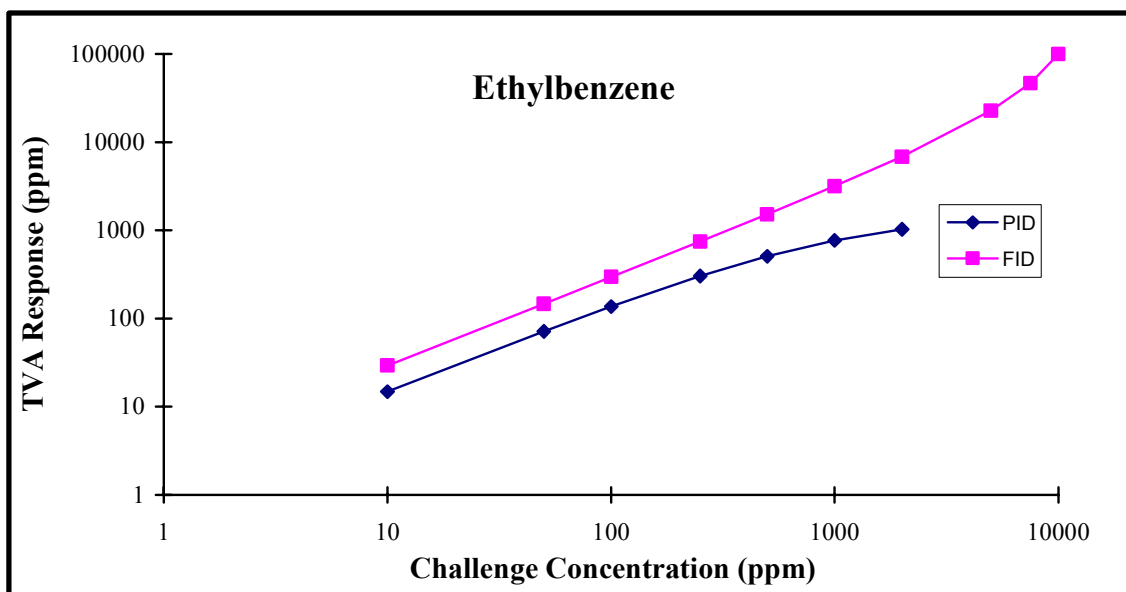


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:			
	A	B	
PID	1.98	-17.46	
FID	1.32	0.71	

# Ethylbenzene

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent)		EPA/TVA-1000B (or equivalent)	
	Relative Response Factor PID	Relative Response Factor FID	Response Factor Multiplier PID	Response Factor Multiplier FID
10	0.147	1.419	0.675	0.341
50	0.145	1.419	0.700	0.340
100	0.142	1.420	0.732	0.339
250	0.136	1.421	0.828	0.335
500	0.126	1.423	0.987	0.329
1000	0.110	1.427	1.306	0.317
2000	0.088	1.436	1.944	0.293
5000		1.462		0.221
7500		1.483		0.161
10000		1.505		0.101

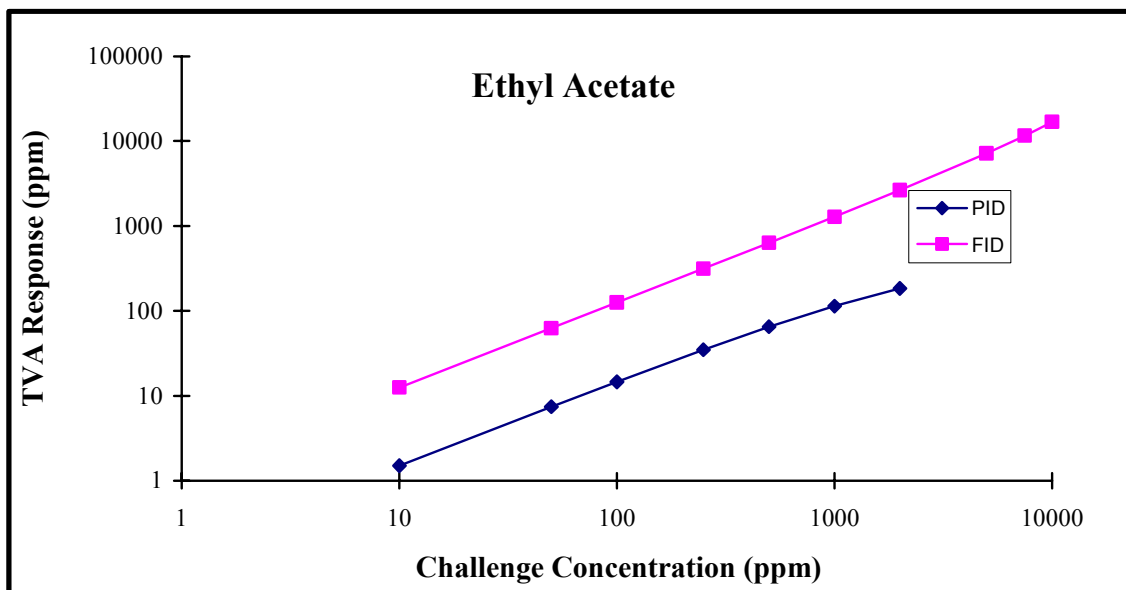


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:			
	A	B	
PID	0.67	-6.38	
FID	0.34	0.24	

# Ethyl Acetate

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent)		EPA/TVA-1000B (or equivalent)	
	Relative Response Factor PID	Relative Response Factor FID	Response Factor Multiplier PID	Response Factor Multiplier FID
10	0.147	1.419	6.639	0.799
50	0.145	1.419	6.724	0.799
100	0.142	1.420	6.831	0.798
250	0.136	1.421	7.152	0.794
500	0.126	1.423	7.687	0.789
1000	0.110	1.427	8.757	0.779
2000	0.088	1.436	10.896	0.758
5000		1.462		0.696
7500		1.483		0.644
10000		1.505		0.592

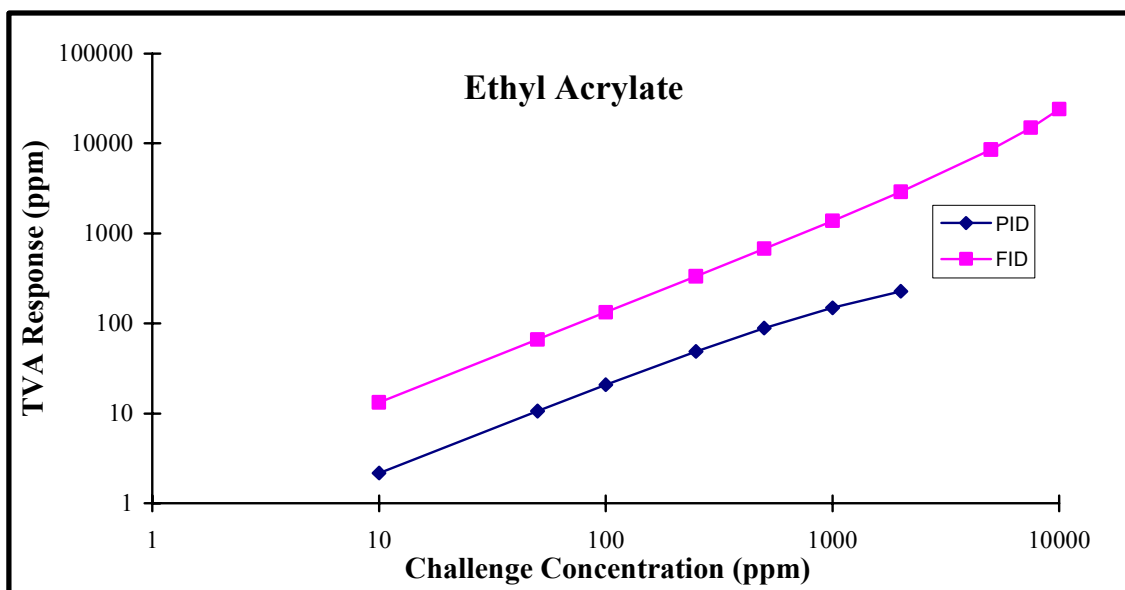


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:		
	A	B
PID	6.62	-21.40
FID	0.80	0.21

# Ethyl Acrylate

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent)		EPA/TVA-1000B (or equivalent)	
	Relative Response Factor PID	Relative Response Factor FID	Response Factor Multiplier PID	Response Factor Multiplier FID
10	0.289	1.492	4.628	0.758
50			4.712	0.756
100	0.279	1.501	4.818	0.755
250			5.134	0.749
500	0.216	1.540	5.661	0.741
1000	0.164	1.589	6.716	0.724
2000	0.111	1.687	8.824	0.690
5000		1.747		0.588
7500		1.963		0.502
10000		2.179		0.417

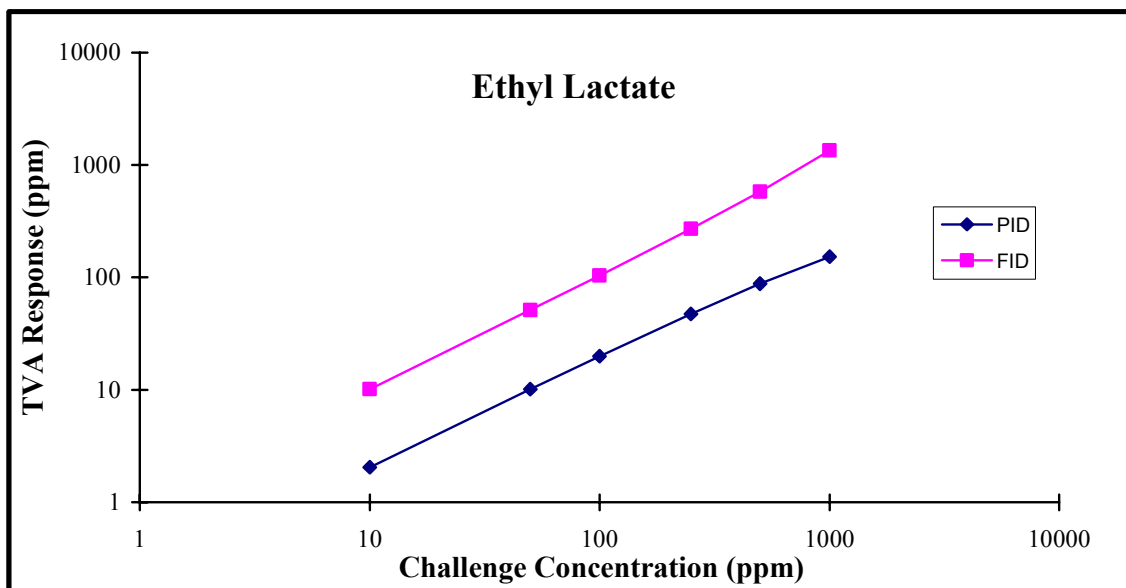


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:		
	A	B
PID	4.61	-21.09
FID	0.76	0.34

# Ethyl Lactate

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent) Relative Response Factor		EPA/TVA-1000B (or equivalent) Response Factor Multiplier	
	PID	FID	PID	FID
10			4.867	0.984
50			4.935	0.974
100			5.020	0.962
250			5.274	0.925
500			5.697	0.864
1000			6.544	0.741
2000				
5000				
7500				
10000				

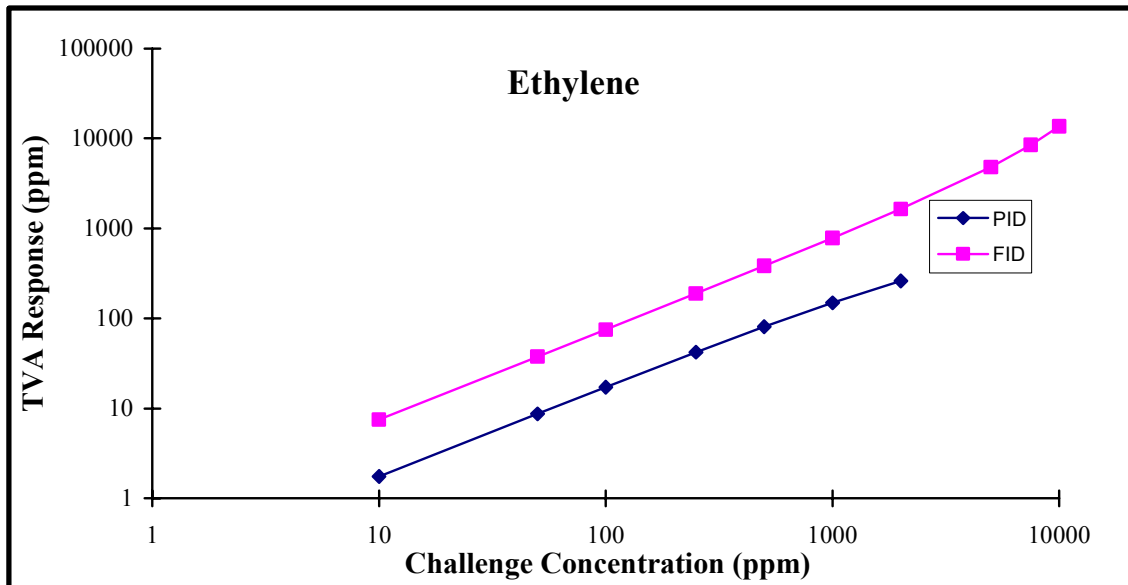


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:		
	A	B
PID	4.85	-16.93
FID	0.99	2.46

# Ethylene

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent) Relative Response Factor		EPA/TVA-1000B (or equivalent) Response Factor Multiplier	
	PID	FID	PID	FID
10	0.174	0.834	5.715	1.337
50			5.754	1.334
100	0.172	0.838	5.804	1.331
250			5.951	1.322
500	0.147	0.856	6.198	1.307
1000	0.123	0.879	6.690	1.277
2000	0.097	0.924	7.675	1.217
5000		0.993		1.037
7500		1.099		0.886
10000		1.205		0.736

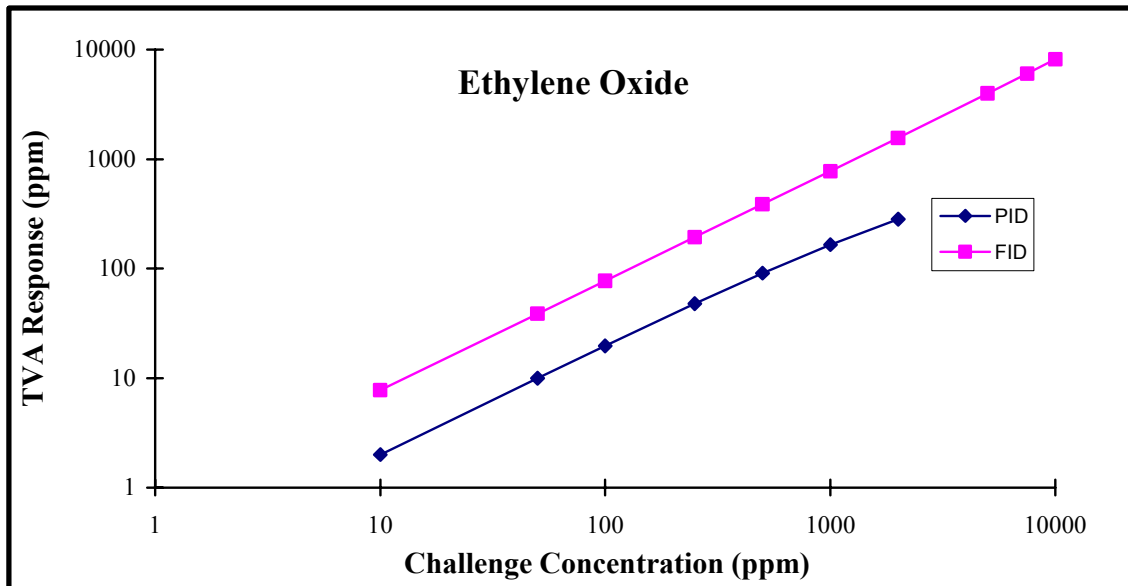


PID Lamp (eV): 11.8

TVA-1000B Response Curve Coefficients:	A	B
PID	5.71	-9.85
FID	1.34	0.60

# Ethylene Oxide

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent)		EPA/TVA-1000B (or equivalent)	
	Relative Response Factor		Response Factor Multiplier	
	PID	FID	PID	FID
10	0.300	1.000	4.986	1.294
50	0.280	0.800	5.028	1.294
100	0.280	0.770	5.080	1.293
250	0.272	0.760	5.238	1.292
500	0.260	0.756	5.500	1.290
1000	0.238	0.753	6.025	1.287
2000	0.204	0.753	7.075	1.280
5000		0.752		1.258
7500		0.751		1.240
10000		0.751		1.222

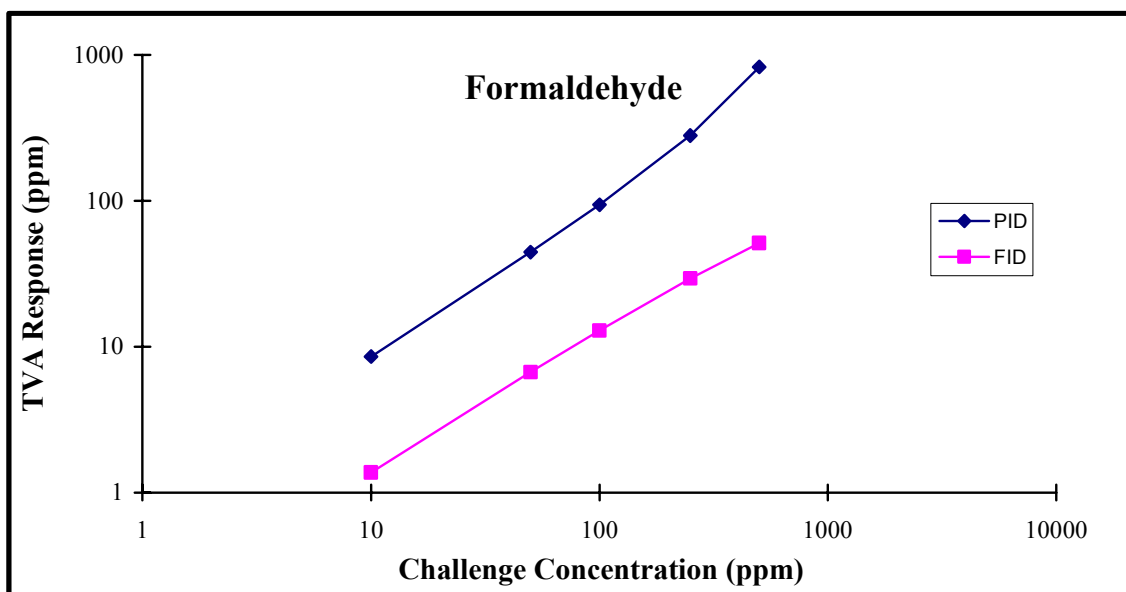


PID Lamp (eV): 11.8

TVA-1000B Response Curve Coefficients:	A	B
PID	4.98	-10.50
FID	1.29	0.07

# Formaldehyde

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent)		EPA/TVA-1000B (or equivalent)	
	Relative Response Factor PID	Relative Response Factor FID	Response Factor Multiplier PID	Response Factor Multiplier FID
10	1.160	25.000	1.169	7.286
50			1.123	7.488
100			1.065	7.740
250			0.893	8.497
500			0.605	9.760
1000				
2000				
5000				
7500				
10000				

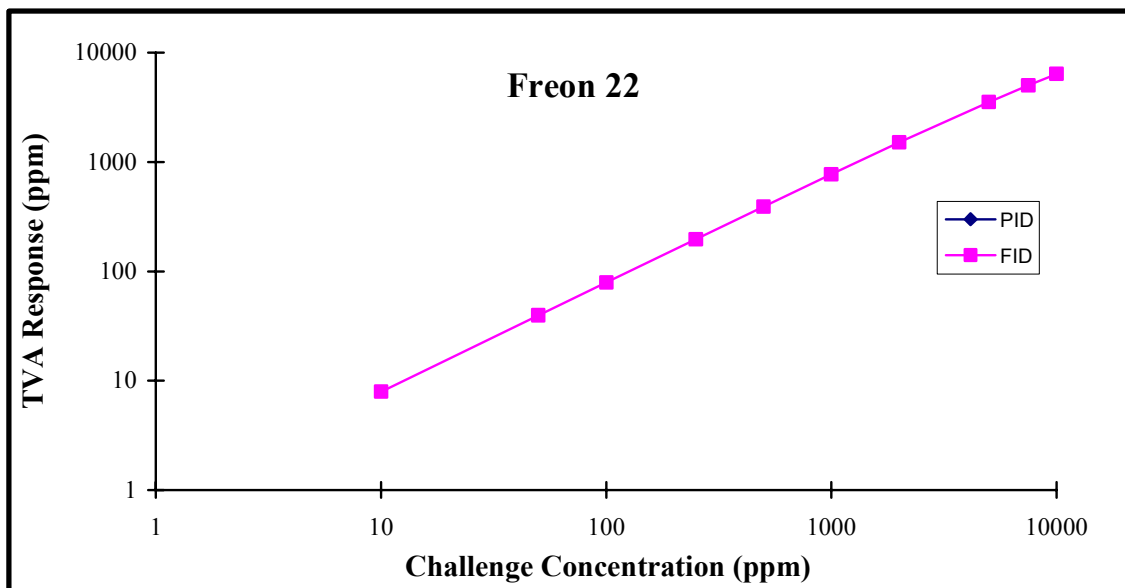


PID Lamp (eV): 11.8

TVA-1000B Response Curve Coefficients:		A	B
PID		1.18	11.50
FID		7.24	-50.49

## Freon 22

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent)		EPA/TVA-1000B (or equivalent)	
	Relative Response Factor		Response Factor Multiplier	
	PID	FID	PID	FID
10	N/A	1.375	N/A	1.263
50		1.374		1.264
100		1.373		1.266
250		1.369		1.270
500		1.364		1.278
1000		1.353		1.293
2000		1.332		1.323
5000		1.267		1.413
7500		1.213		1.488
10000		1.159		1.563

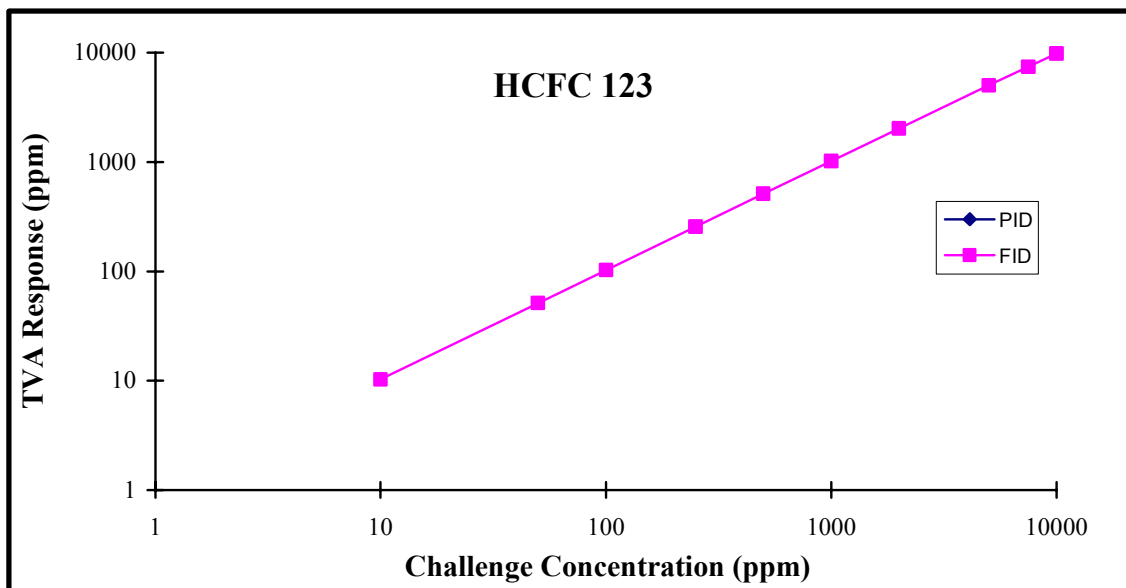


PID Lamp (eV): 11.8

TVA-1000B Response Curve Coefficients:		
	A	B
PID	N/A	N/A
FID	1.26	-0.30

# HCFC 123

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent)		EPA/TVA-1000B (or equivalent)	
	Relative Response Factor		Response Factor Multiplier	
	PID	FID	PID	FID
10	N/A	N/A	N/A	0.974
50				0.975
100				0.975
250				0.975
500				0.977
1000				0.979
2000				0.984
5000				0.998
7500				1.009
10000				1.021

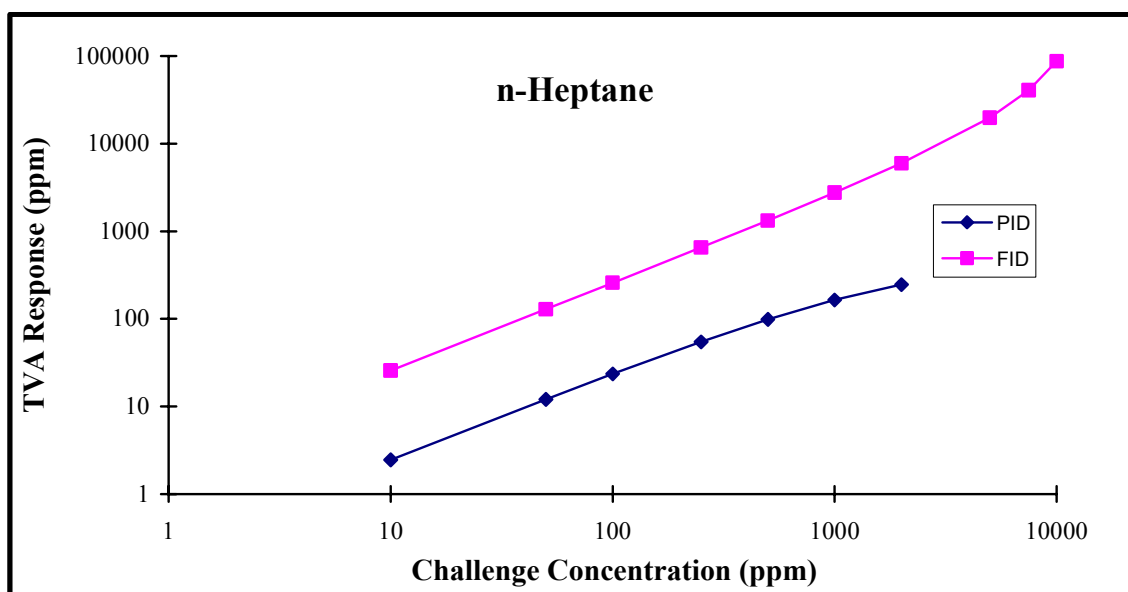


PID Lamp (eV): 11.8

TVA-1000B Response Curve Coefficients:			
	A	B	
PID	N/A	N/A	
FID	0.97	-0.05	

# n-Heptane

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent)		EPA/TVA-1000B (or equivalent)	
	Relative Response Factor		Response Factor Multiplier	
	PID	FID	PID	FID
10	0.276	2.639	4.074	0.390
50	0.270	2.658	4.156	0.389
100	0.262	2.681	4.258	0.388
250	0.243	2.752	4.564	0.384
500	0.195	2.871	5.074	0.377
1000	0.142	3.107	6.094	0.363
2000	0.092	3.580	8.133	0.335
5000		4.681		0.253
7500		5.788		0.183
10000		6.896		0.114

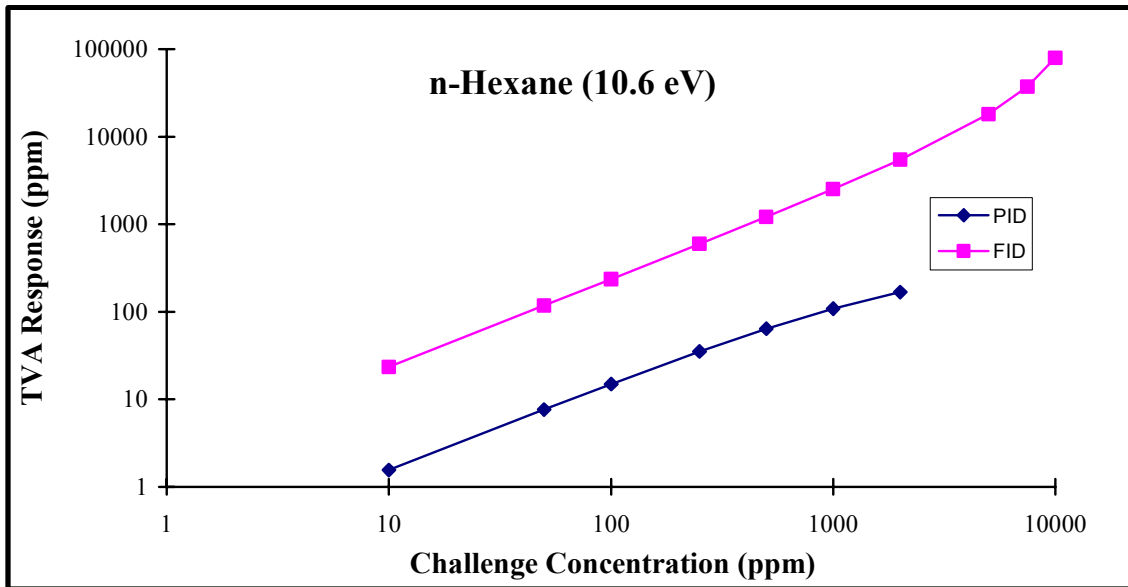


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:		
PID	A	B
	4.05	-20.40
FID	0.39	0.28

## n-Hexane (10.6 eV)

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent)		EPA/TVA-1000B (or equivalent)	
	Relative Response Factor		Response Factor Multiplier	
	PID	FID	PID	FID
10	0.151	2.321	6.434	0.426
50	0.148	2.336	6.545	0.425
100	0.144	2.354	6.683	0.424
250	0.135	2.411	7.097	0.419
500	0.121	2.504	7.787	0.412
1000	0.101	2.692	9.167	0.397
2000	0.075	3.067	11.926	0.367
5000		4.192		0.276
7500		5.130		0.201
10000		6.068		0.126

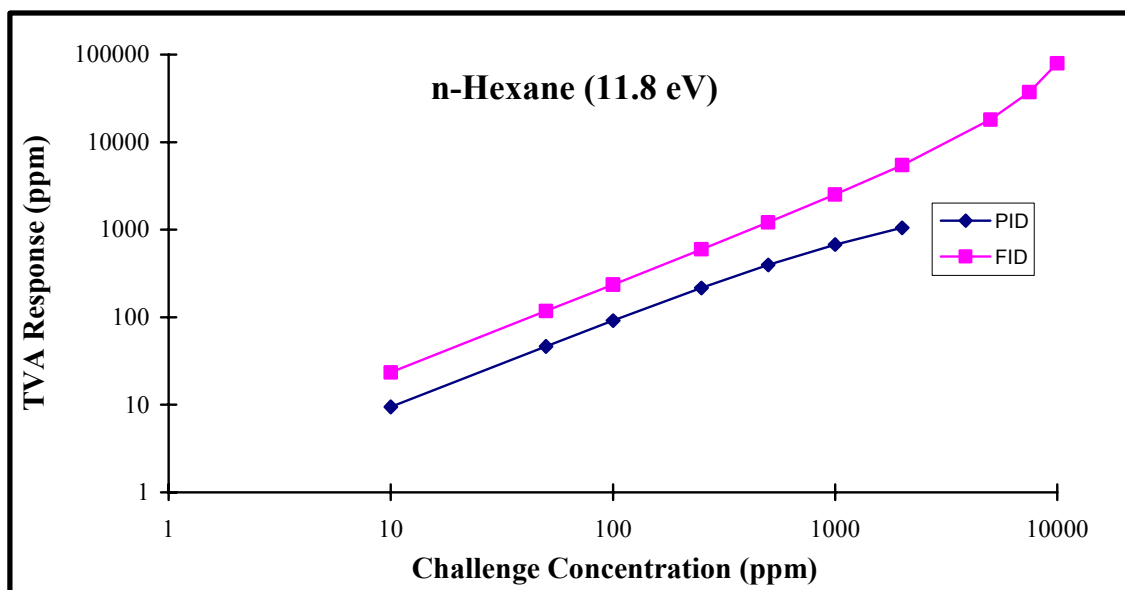


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:		
PID	A 6.41	B -27.60
FID	0.43	0.30

## n-Hexane (11.8 eV)

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent) Relative Response Factor		EPA/TVA-1000B (or equivalent) Response Factor Multiplier	
	PID	FID	PID	FID
10	1.199	2.321	1.058	0.426
50	1.182	2.336	1.075	0.425
100	1.161	2.354	1.096	0.424
250	1.102	2.411	1.159	0.419
500	0.914	2.504	1.264	0.412
1000	0.703	2.692	1.474	0.397
2000	0.484	3.067	1.895	0.367
5000		4.192		0.276
7500		5.130		0.201
10000		6.068		0.126

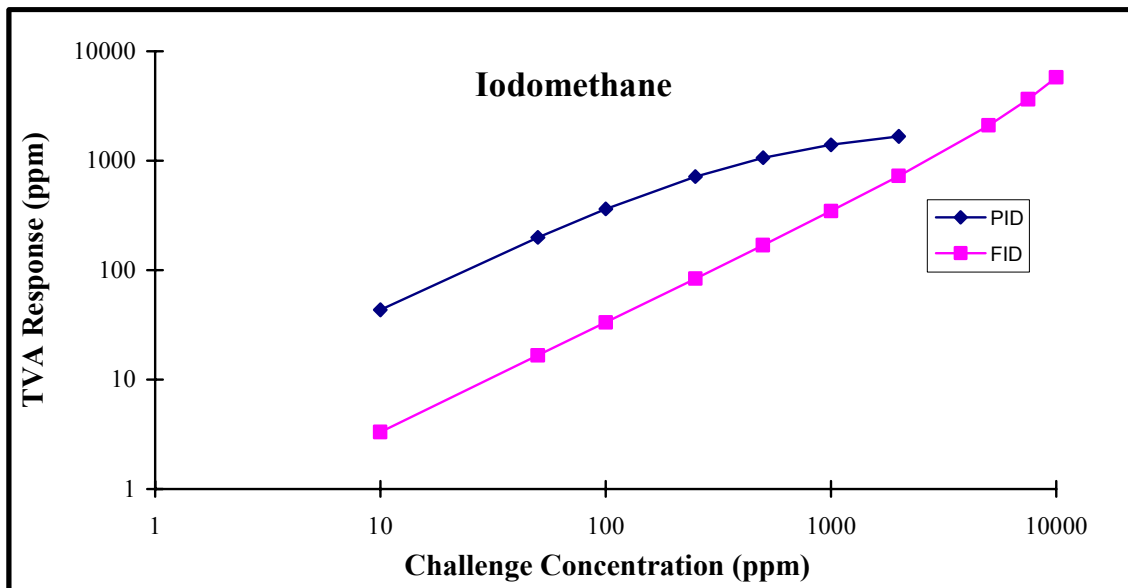


PID Lamp (eV): 11.8

TVA-1000B Response Curve Coefficients:		A	B
PID		1.05	-4.20
FID		0.43	0.30

# Iodomethane

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent) Relative Response Factor		EPA/TVA-1000B (or equivalent) Response Factor Multiplier	
	PID	FID	PID	FID
10			0.231	3.014
50			0.250	3.009
100			0.275	3.002
250			0.348	2.983
500			0.470	2.951
1000			0.714	2.887
2000			1.201	2.758
5000				2.373
7500				2.052
10000				1.731

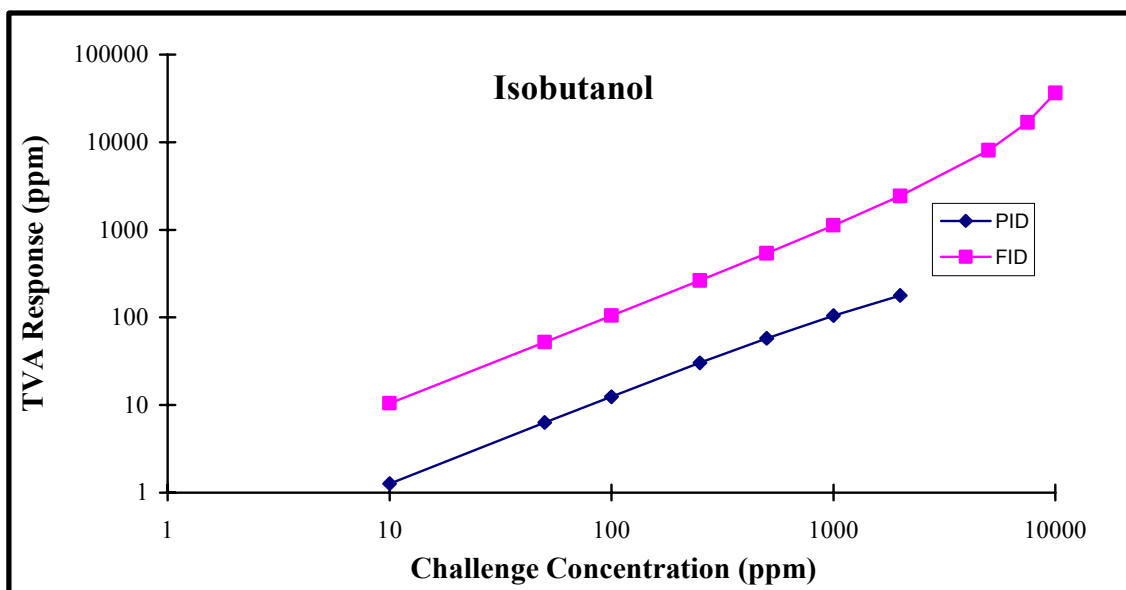


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:			
	A	B	
PID	0.23	-4.88	
FID	3.02	1.28	

# Isobutanol

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent) Relative Response Factor		EPA/TVA-1000B (or equivalent) Response Factor Multiplier	
	PID	FID	PID	FID
10	0.140	1.449	7.867	0.960
50	0.138	1.452	7.934	0.958
100	0.136	1.457	8.018	0.954
250	0.129	1.492	8.269	0.944
500	0.120	1.536	8.688	0.927
1000	0.104	1.623	9.526	0.892
2000	0.083	1.886	11.202	0.824
5000		2.105		0.618
7500		2.324		0.446
10000				0.274

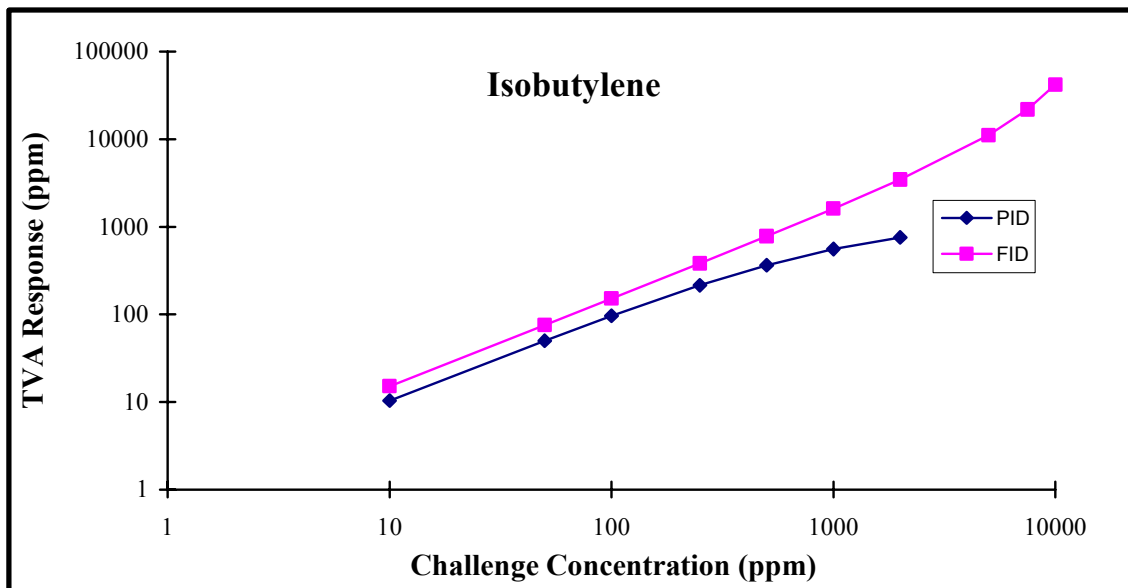


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:	A	B
PID	7.85	-16.76
FID	0.96	0.69

# Isobutylene

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent)		EPA/TVA-1000B (or equivalent)	
	Relative Response Factor		Response Factor Multiplier	
	PID	FID	PID	FID
10			1.000	0.663
50			1.000	0.661
100			1.000	0.659
250			1.164	0.652
500			1.374	0.642
1000			1.795	0.620
2000			2.635	0.578
5000				0.450
7500				0.344
10000				0.238

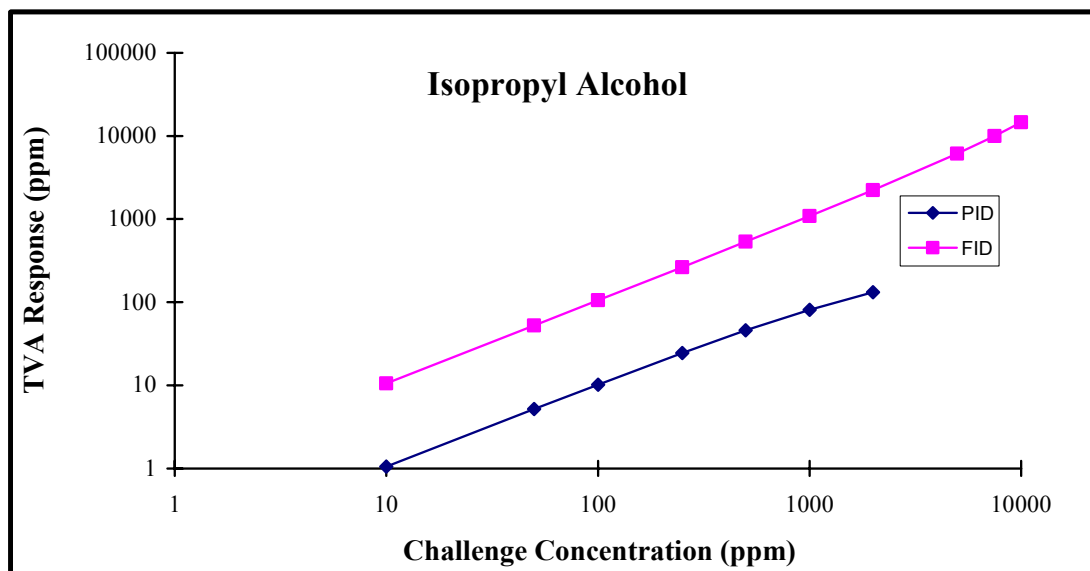


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:			
	A	B	
PID	0.95	-8.40	
FID	0.66	0.43	

# Isopropyl Alcohol

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent)		EPA/TVA-1000B (or equivalent)	
	Relative Response Factor PID	Relative Response Factor FID	Response Factor Multiplier PID	Response Factor Multiplier FID
10	0.120	1.240	9.555	0.950
50	0.119	1.242	9.669	0.949
100	0.117	1.245	9.811	0.948
250	0.112	1.252	10.237	0.944
500	0.104	1.264	10.949	0.937
1000	0.091	1.287	12.371	0.924
2000	0.073	1.335	15.215	0.898
5000		1.477		0.820
7500		1.596		0.755
10000		1.715		0.690

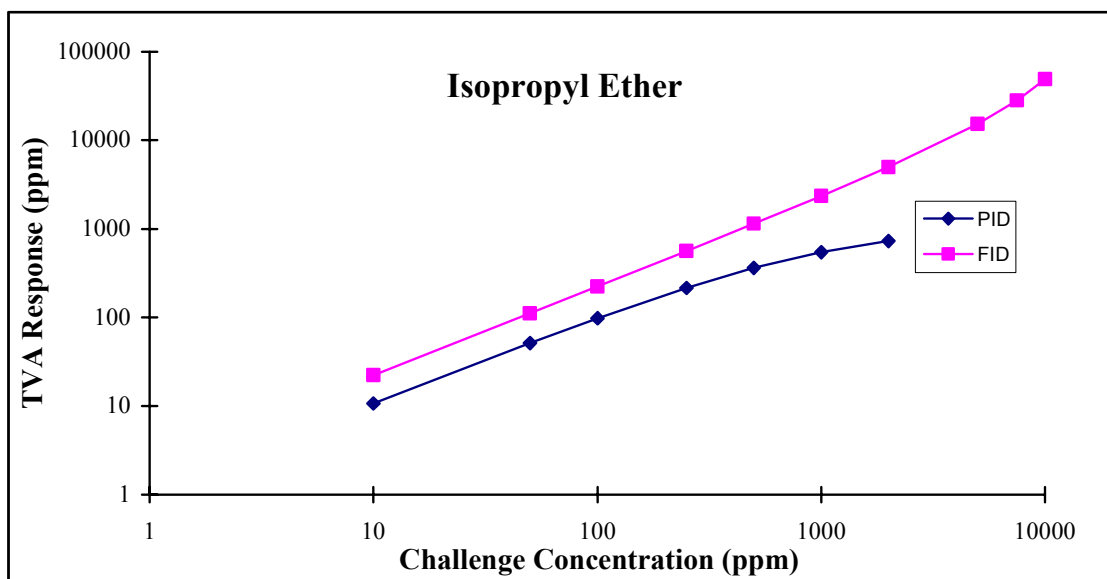


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:	A	B
PID	9.53	-28.44
FID	0.95	0.26

# Isopropyl Ether

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent)		EPA/TVA-1000B (or equivalent)	
	Relative Response Factor PID	FID	Response Factor Multiplier PID	FID
10			0.939	0.449
50			0.975	0.448
100			1.020	0.447
250			1.156	0.443
500			1.382	0.437
1000			1.834	0.425
2000			2.739	0.401
5000				0.327
7500				0.266
10000				0.205

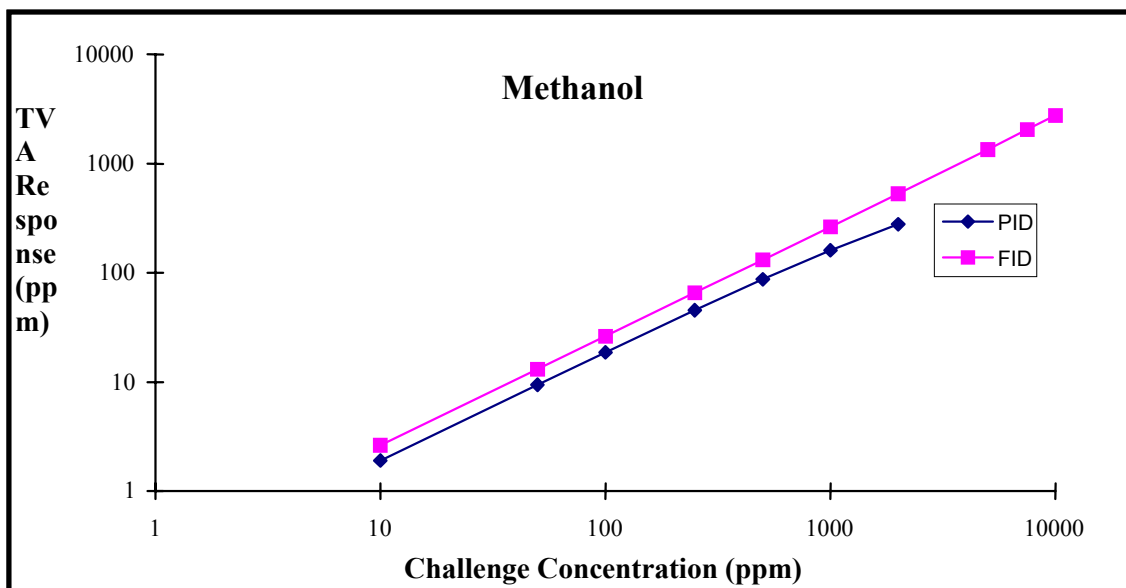


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:		A	B
PID		0.93	-9.04
FID		0.45	0.25

# Methanol

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent)		EPA/TVA-1000B (or equivalent)	
	Relative Response Factor		Response Factor Multiplier	
	PID	FID	PID	FID
10	0.229	0.448	5.265	3.815
50	0.228	0.299	5.303	3.814
100	0.227	0.280	5.351	3.813
250	0.222	0.269	5.494	3.810
500	0.194	0.265	5.733	3.805
1000	0.163	0.263	6.211	3.796
2000	0.128	0.262	7.167	3.776
5000		0.245		3.718
7500		0.245		3.670
10000		0.245		3.622

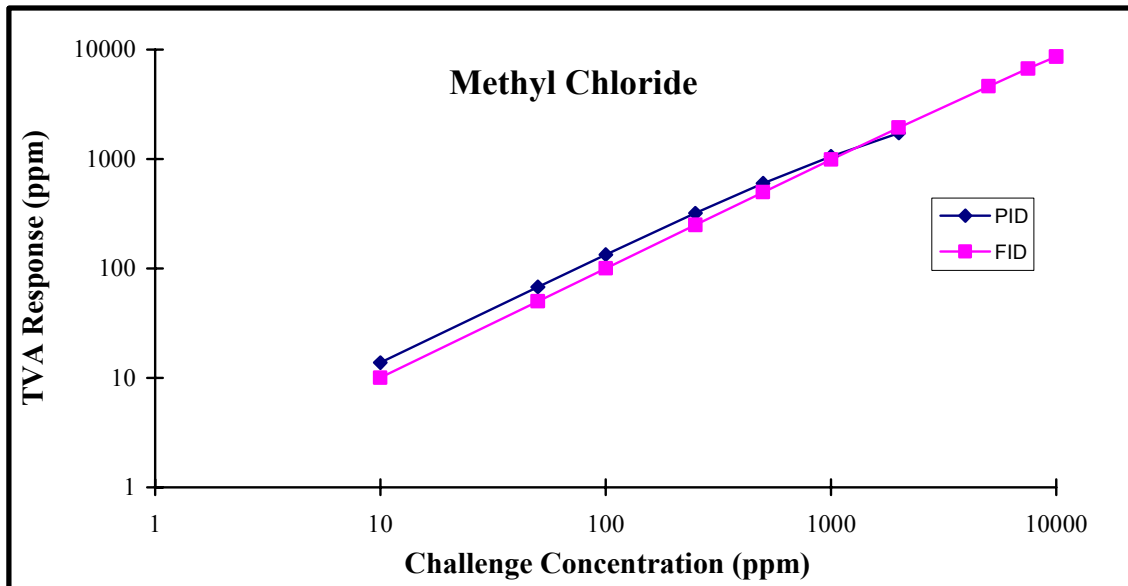


PID Lamp (eV): 11.8

TVA-1000B Response Curve Coefficients:	A	B
PID	5.26	-9.56
FID	3.82	0.19

# Methyl Chloride

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent)		EPA/TVA-1000B (or equivalent)	
	Relative Response Factor		Response Factor Multiplier	
	PID	FID	PID	FID
10	1.291	0.839	0.728	0.997
50	1.302	1.191	0.736	0.997
100	1.316	1.257	0.747	0.998
250	1.359	1.300	0.779	1.000
500	1.558	1.315	0.833	1.004
1000	1.963	1.323	0.941	1.012
2000	2.648	1.327	1.157	1.028
5000		1.420	1.805	1.076
7500		1.420		1.116
10000		1.421		1.156

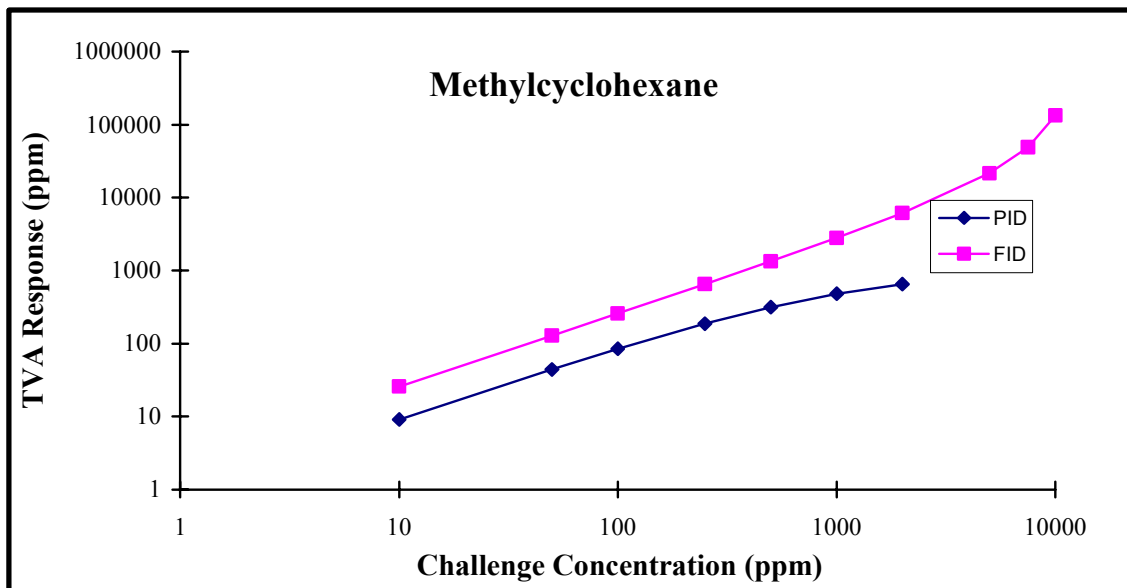


PID Lamp (eV): 11.8

TVA-1000B Response Curve Coefficients:	A	B
PID	0.73	-2.16
FID	1.00	-0.16

# Methylcyclohexane

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent) Relative Response Factor		EPA/TVA-1000B (or equivalent) Response Factor Multiplier	
	PID	FID	PID	FID
10	0.738	2.244	1.094	0.389
50			1.133	0.388
100	0.709	2.304	1.182	0.386
250			1.330	0.382
500	0.545	2.568	1.576	0.374
1000	0.410	2.898	2.068	0.358
2000	0.274	3.558	3.053	0.327
5000		4.883		0.232
7500		6.338		0.153
10000		7.792		0.075

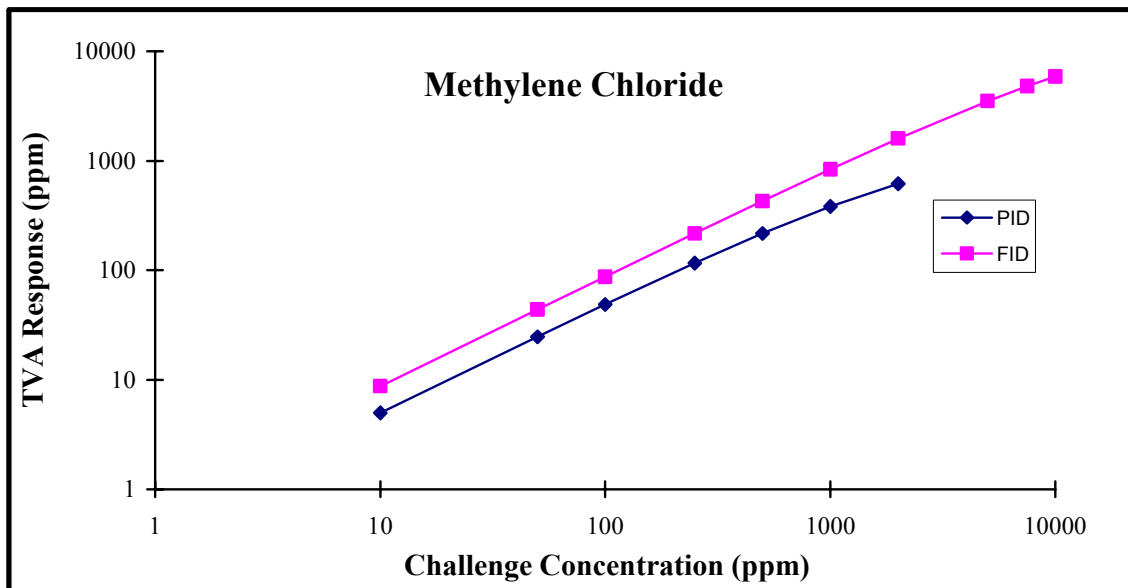


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:			
	A	B	
PID	1.08	-9.84	
FID	0.39	0.32	

# Methylene Chloride

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent)		EPA/TVA-1000B (or equivalent)	
	Relative Response Factor PID	Relative Response Factor FID	Response Factor Multiplier PID	Response Factor Multiplier FID
10	0.614	1.384	2.001	1.142
50	0.607	1.093	2.026	1.144
100	0.600	0.987	2.057	1.147
250	0.577	0.863	2.150	1.155
500	0.489	0.780	2.304	1.169
1000	0.388	0.705	2.614	1.197
2000	0.281	0.637	3.233	1.253
5000		0.521		1.421
7500		0.491		1.560
10000		0.471		1.700



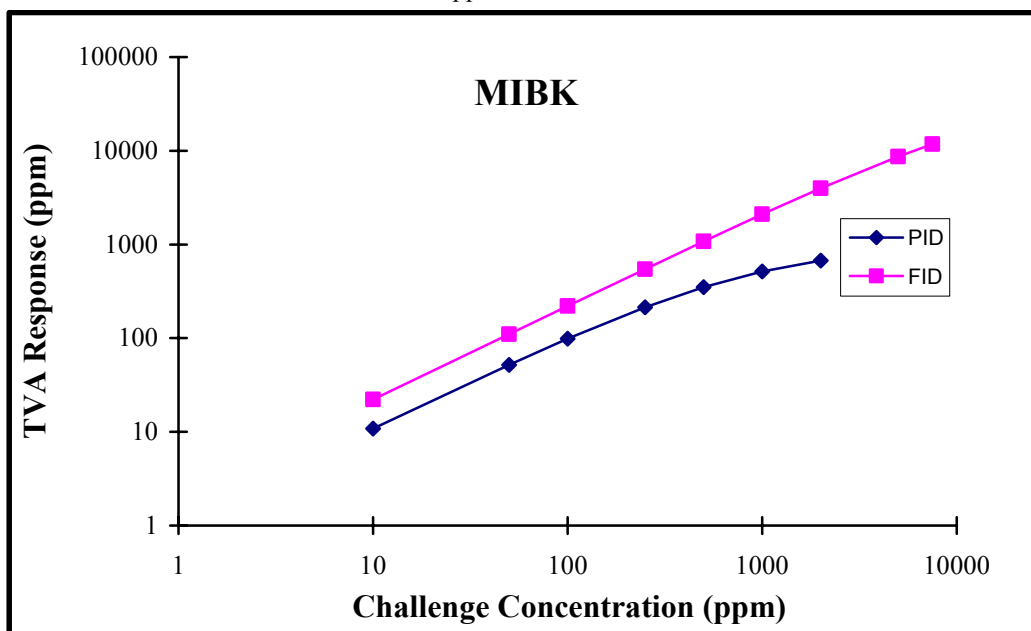
PID Lamp (eV): 11.8

TVA-1000B Response Curve Coefficients:		
	A	B
PID	2.00	-6.19
FID	1.14	-0.56

# MIBK

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent)		EPA/TVA-1000B (or equivalent)	
	Relative Response Factor PID	Relative Response Factor FID	Response Factor Multiplier PID	Response Factor Multiplier FID
10	0.864	1.763	0.921	0.452
50			0.962	0.453
100	0.832	1.777	1.014	0.455
250			1.169	0.458
500	0.644	1.840	1.427	0.464
1000	0.487	1.919	1.944	0.477
2000			2.977	0.501
5000		2.387		0.575
7500		2.755		0.636
10000				

Maximum Concentration at 25°C is 9800 ppm

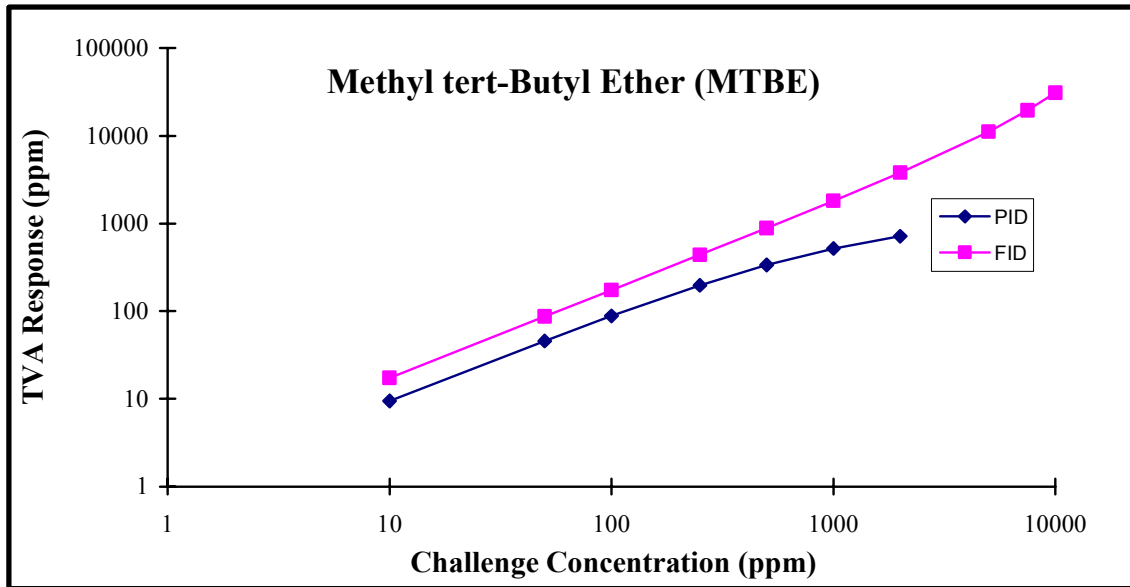


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:	A	B
PID	0.91	-10.33
FID	0.45	-0.25

## Methyl tert-Butyl Ether (MTBE)

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent)		EPA/TVA-1000B (or equivalent)	
	Relative Response Factor		Response Factor Multiplier	
	PID	FID	PID	FID
10	1.077	1.863	1.055	0.576
50			1.090	0.575
100	1.030	1.881	1.134	0.574
250			1.265	0.570
500	0.777	1.963	1.484	0.564
1000	0.574	2.065	1.921	0.551
2000	0.376	2.270	2.796	0.526
5000		2.543		0.450
7500		2.994		0.386
10000		3.445		0.323

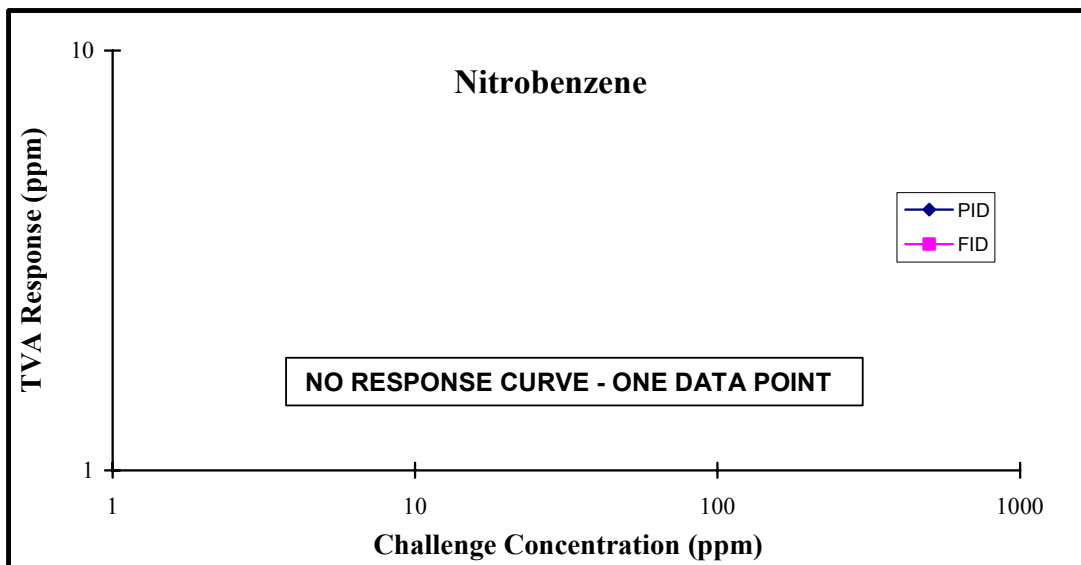


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:		
	A	B
PID	1.05	-8.75
FID	0.58	0.25

# Nitrobenzene

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent)		EPA/TVA-1000B (or equivalent)	
	Relative Response Factor		Response Factor Multiplier	
	PID	FID	PID	FID
394.7	N/A	N/A	13.100	4.600

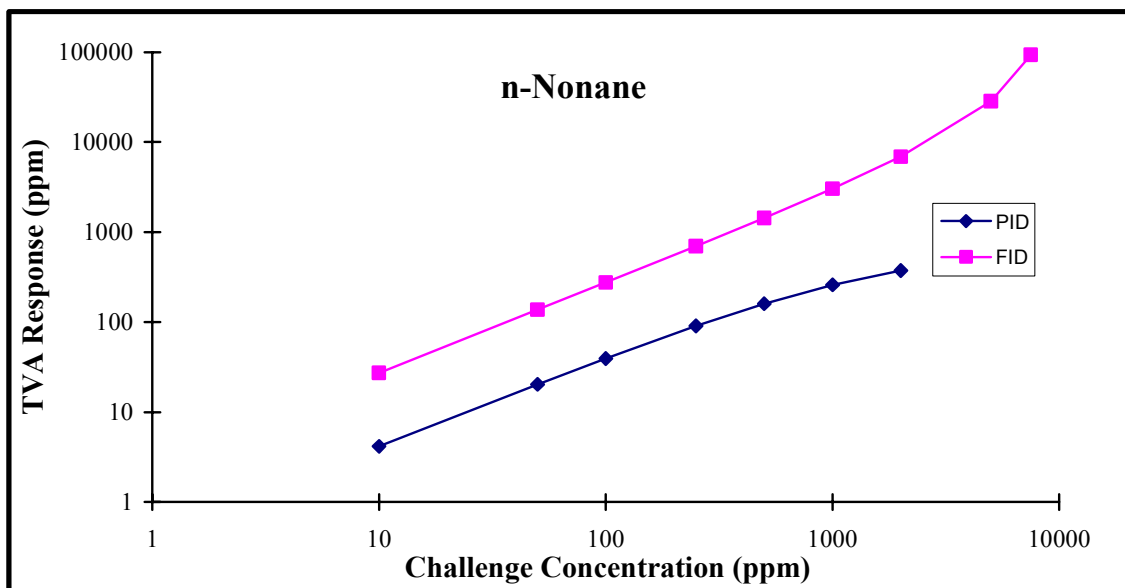


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:			
	A	B	
PID	N/A	N/A	
FID	N/A	N/A	

# n-Nonane

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent)		EPA/TVA-1000B (or equivalent)	
	Relative Response Factor		Response Factor Multiplier	
	PID	FID	PID	FID
10	0.386	2.623	2.404	0.367
50	0.378	2.626	2.463	0.365
100	0.368	2.629	2.536	0.364
250	0.340	2.640	2.757	0.358
500	0.272	2.657	3.125	0.348
1000	0.198	2.691	3.861	0.329
2000	0.127	2.759	5.334	0.291
5000		2.775		0.176
7500				
10000				

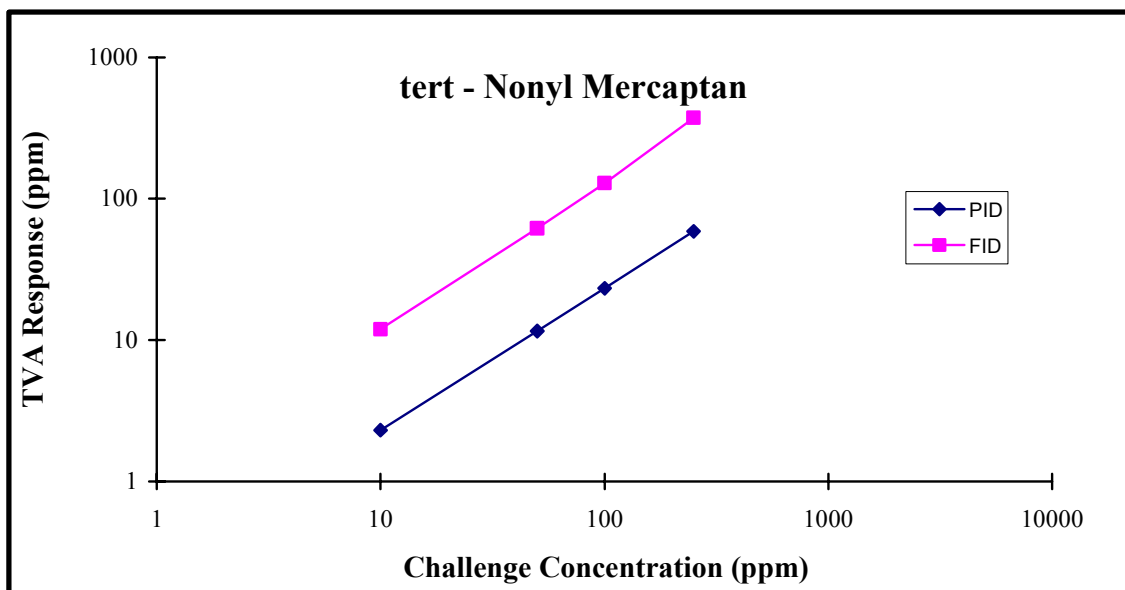


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:		
	A	B
PID	2.39	-14.72
FID	0.37	0.38

# tert - Nonyl Mercaptan

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent)		EPA/TVA-1000B (or equivalent)	
	Relative Response Factor		Response Factor Multiplier	
	PID	FID	PID	FID
10	N/A	N/A	4.338	0.838
50			4.325	0.810
100			4.310	0.775
250			4.262	0.669
500				
1000				
2000				
5000				
7500				
10000				

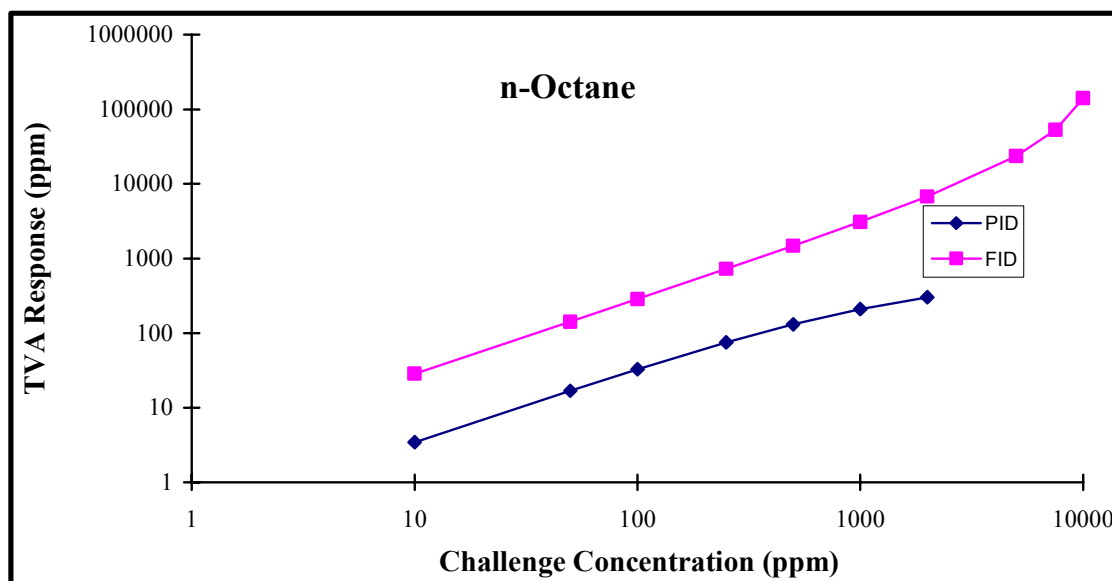


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:			
	A	B	
PID	4.34	3.19	
FID	0.85	7.05	

## n-Octane

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent)		EPA/TVA-1000B (or equivalent)	
	Relative Response Factor PID	FID	Response Factor Multiplier PID	FID
10	0.369	2.888	2.883	0.351
50	0.360	2.905	2.957	0.350
100	0.350	2.926	3.051	0.349
250	0.323	2.988	3.331	0.344
500	0.258	3.092	3.799	0.337
1000	0.187	3.300	4.734	0.323
2000	0.119	3.715	6.603	0.295
5000		4.646		0.211
7500		5.619		0.141
10000		6.592		0.071

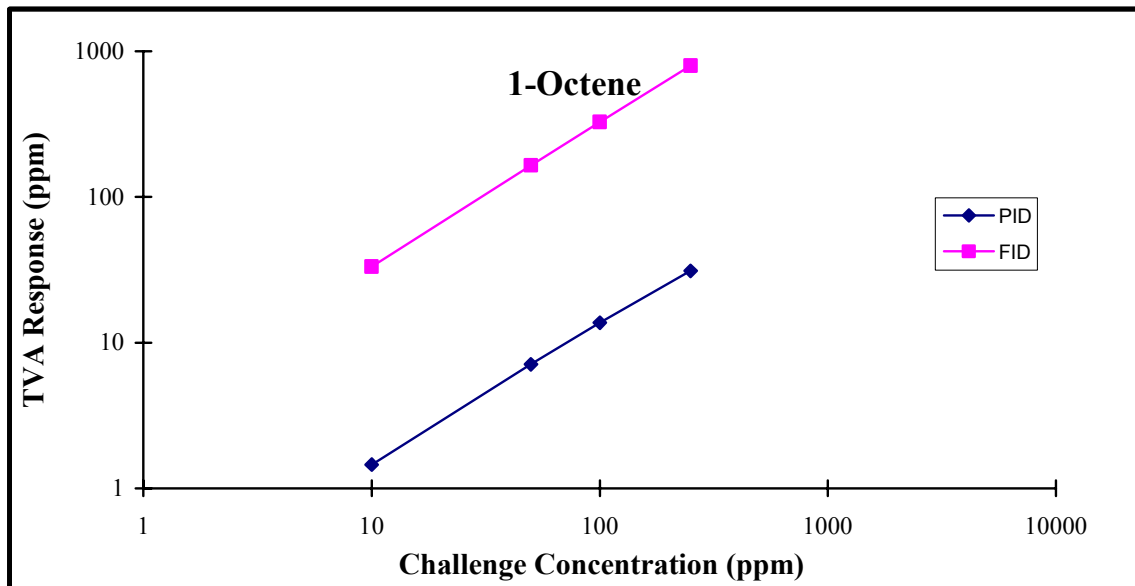


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:		
	A	B
PID	2.86	-18.70
FID	0.35	0.28

# 1-Octene

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent)		EPA/TVA-1000B (or equivalent)	
	Relative Response Factor PID	Relative Response Factor FID	Response Factor Multiplier PID	Response Factor Multiplier FID
10	N/A	N/A	6.865	0.301
50			7.058	0.303
100			7.300	0.306
250			8.024	0.314
500				
1000				
2000				
5000				
7500				
10000				

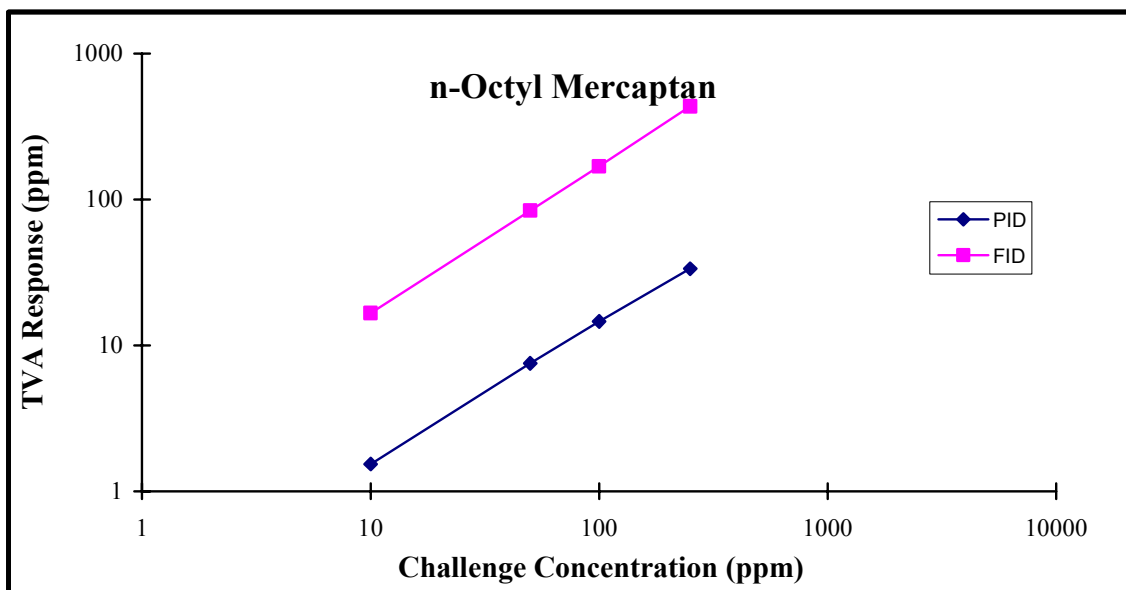


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:	A	B
PID	6.82	-48.32
FID	0.30	-0.54

# n-Octyl Mercaptan

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent)		EPA/TVA-1000B (or equivalent)	
	Relative Response Factor		Response Factor Multiplier	
	PID	FID	PID	FID
10	N/A	N/A	6.492	0.600
50			6.650	0.596
100			6.847	0.591
250			7.439	0.575
500				
1000				
2000				
5000				
7500				
10000				

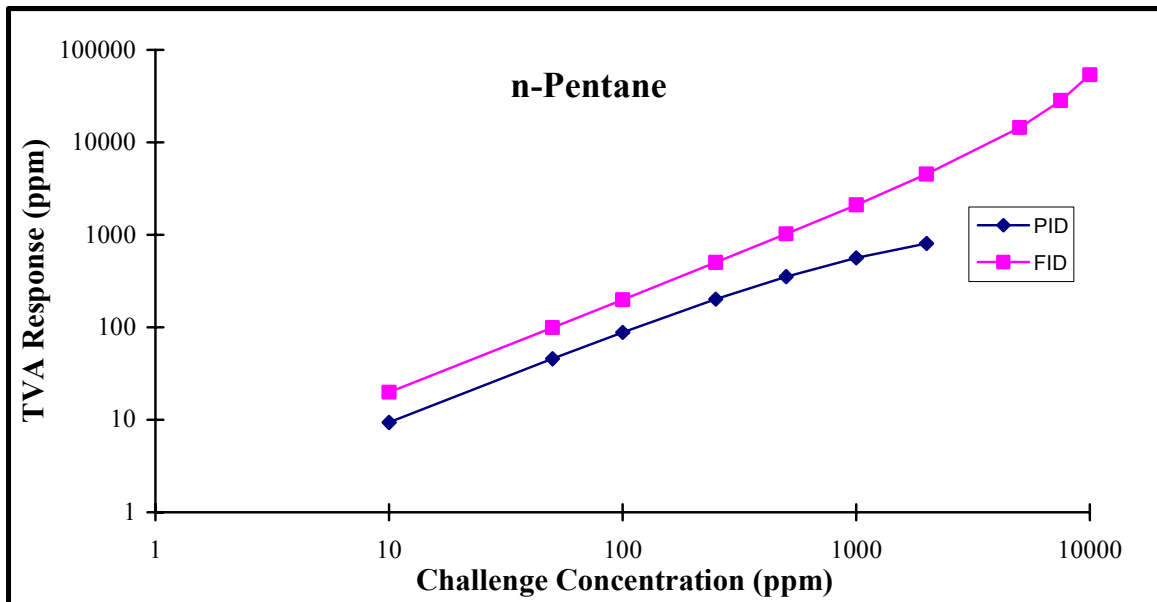


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:			
	A	B	
PID	6.45	-39.44	
FID	0.60	1.06	

# n-Pentane

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent)		EPA/TVA-1000B (or equivalent)	
	Relative Response Factor		Response Factor Multiplier	
	PID	FID	PID	FID
10	1.017	1.929	1.068	0.505
50	1.005	1.940	1.096	0.504
100	0.990	1.953	1.132	0.502
250	0.948	1.993	1.238	0.498
500	0.796	2.060	1.415	0.490
1000	0.625	2.195	1.770	0.474
2000	0.443	2.463	2.479	0.442
5000		3.060		0.346
7500		3.689		0.266
10000		4.317		0.186

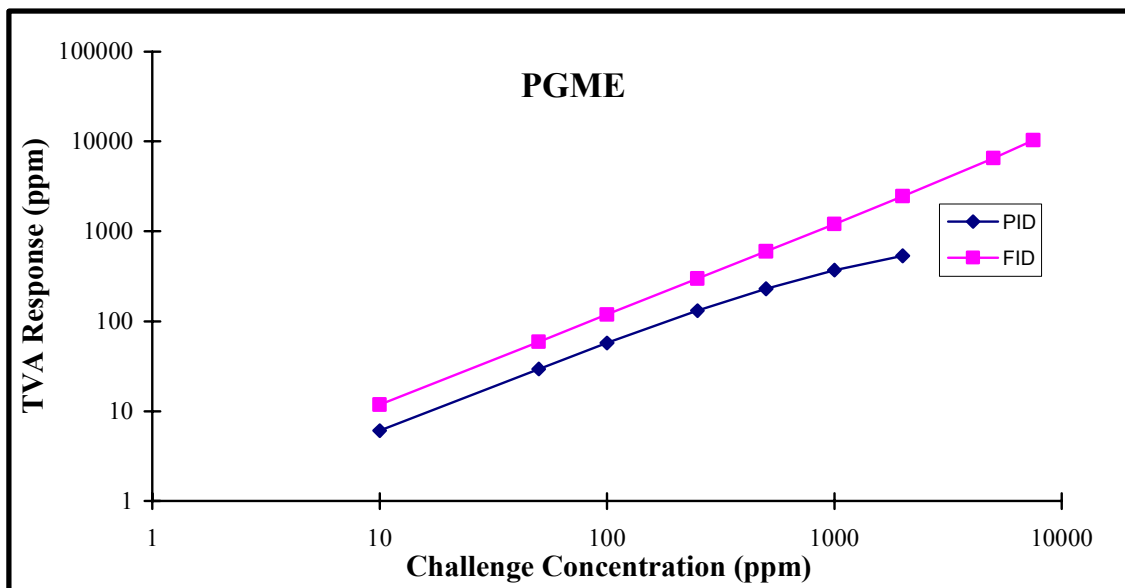


PID Lamp (eV): 11.8

TVA-1000B Response Curve Coefficients:	A	B
PID	1.06	-7.09
FID	0.51	0.32

# PGME

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent)		EPA/TVA-1000B (or equivalent)	
	Relative Response Factor		Response Factor Multiplier	
	PID	FID	PID	FID
10			1.650	0.844
50			1.692	0.843
100			1.745	0.842
250			1.903	0.840
500			2.167	0.836
1000			2.695	0.828
2000			3.750	0.813
5000				0.767
7500				0.728
10000				

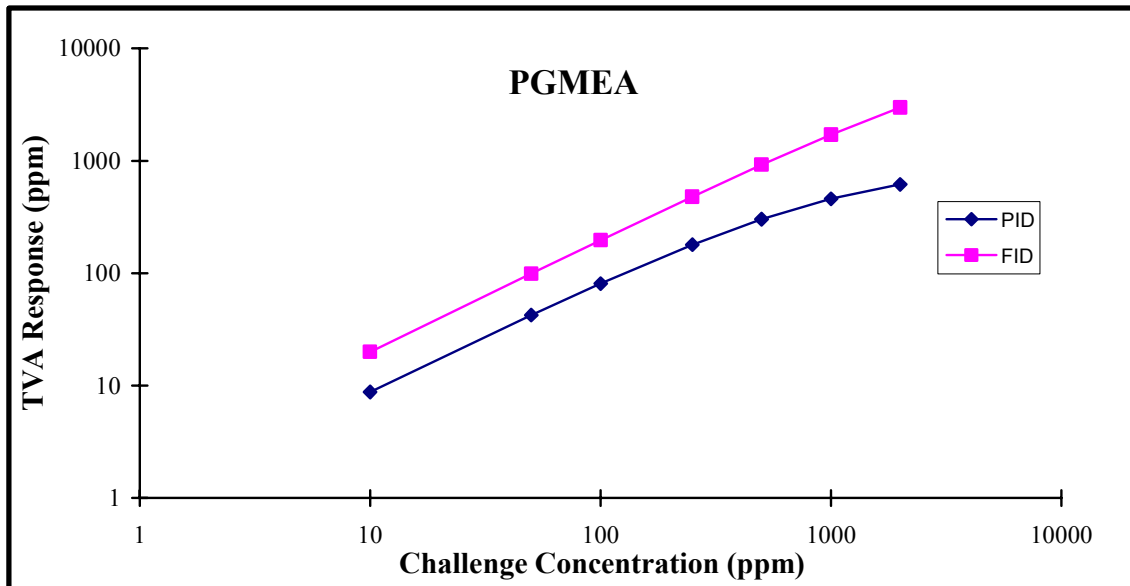


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:		
	A	B
PID	1.64	-10.55
FID	0.84	0.15

# PGMEA

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent)		EPA/TVA-1000B (or equivalent)	
	Relative Response Factor		Response Factor Multiplier	
	PID	FID	PID	FID
10			1.141	0.502
50			1.183	0.506
100			1.236	0.510
250			1.395	0.523
500			1.661	0.545
1000			2.191	0.588
2000			3.252	0.674
5000				
7500				
10000				

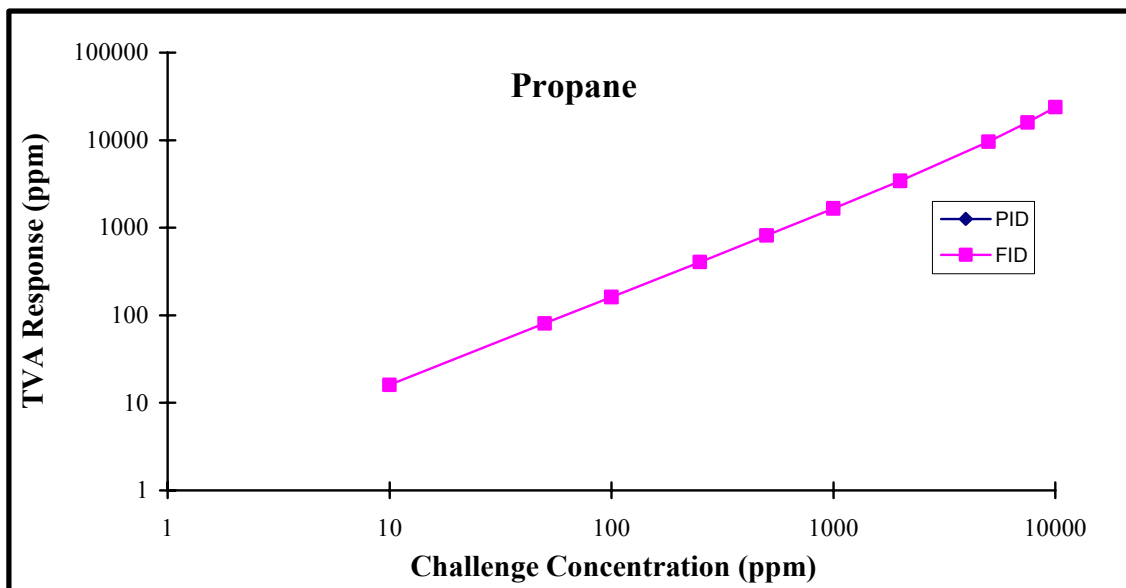


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:			
	A	B	
PID	1.13	-10.61	
FID	0.50	-0.86	

# Propane

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent)		EPA/TVA-1000B (or equivalent)	
	Relative Response Factor PID	Relative Response Factor FID	Response Factor Multiplier PID	Response Factor Multiplier FID
10	0.316	1.385		0.623
50	0.314	1.389		0.623
100	0.311	1.394		0.622
250	0.302	1.409		0.618
500	0.259	1.434		0.613
1000	0.212	1.485		0.603
2000	0.159	1.587		0.583
5000		1.772		0.521
7500		2.010		0.469
10000		2.248		0.418

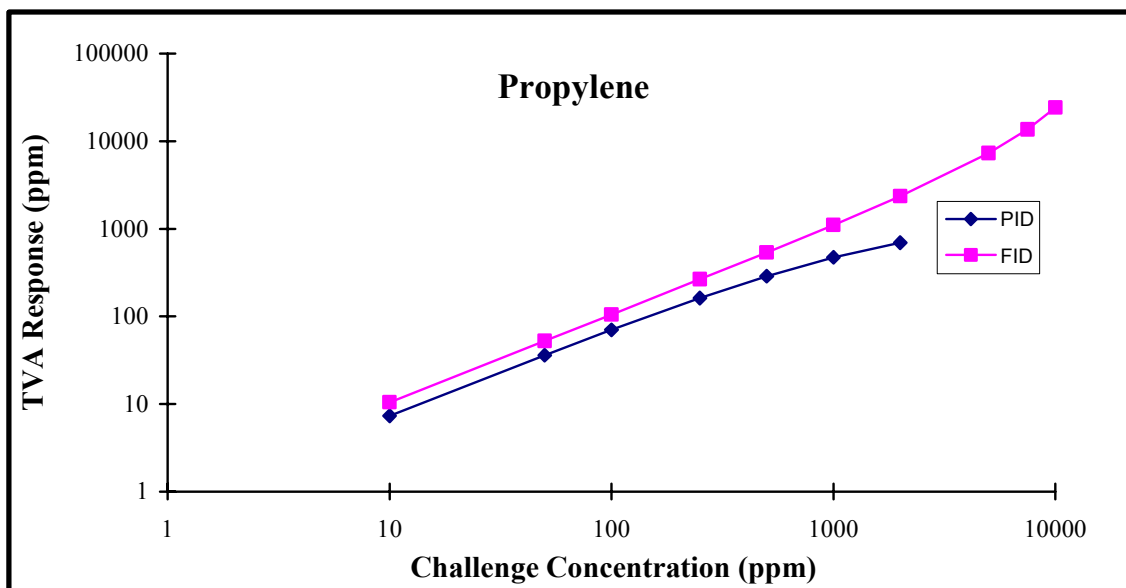


PID Lamp (eV): 11.8

TVA-1000B Response Curve Coefficients:		A	B
PID		N/A	N/A
FID		0.62	0.21

# Propylene

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent)		EPA/TVA-1000B (or equivalent)	
	Relative Response Factor		Response Factor Multiplier	
	PID	FID	PID	FID
10	0.711	1.074	1.359	0.957
50			1.389	0.955
100	0.695	1.085	1.428	0.952
250			1.542	0.944
500	0.568	1.136	1.732	0.930
1000	0.453	1.199	2.113	0.903
2000	0.329	1.326	2.875	0.848
5000		1.504		0.685
7500		1.782		0.549
10000		2.061		0.413

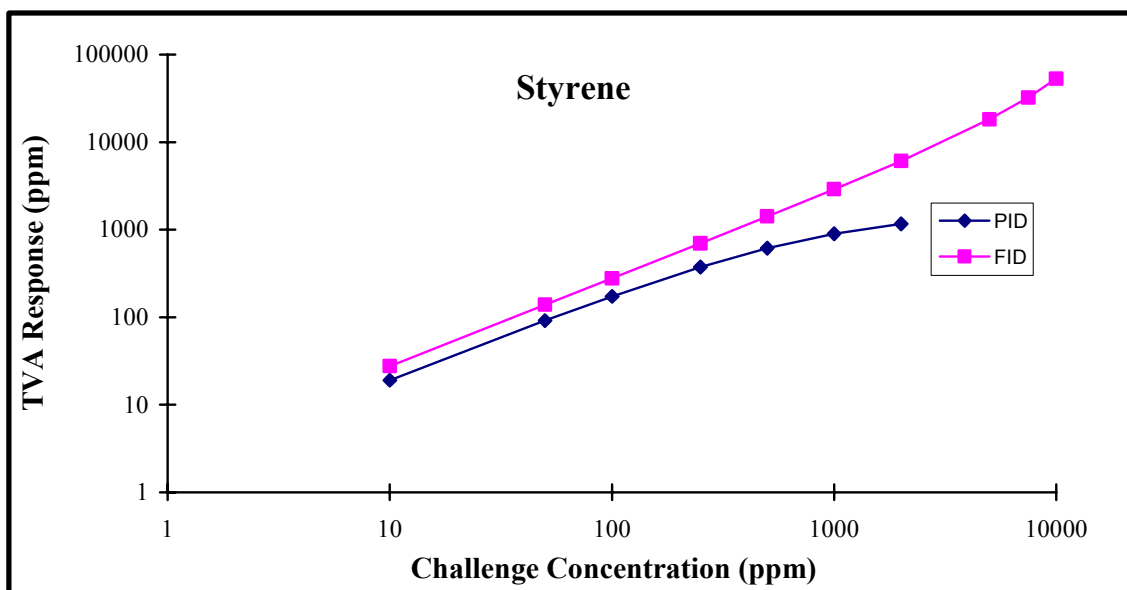


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:	A	B
PID	1.35	-7.62
FID	0.96	0.54

# Styrene

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent)		EPA/TVA-1000B (or equivalent)	
	Relative Response Factor PID	Relative Response Factor FID	Response Factor Multiplier PID	Response Factor Multiplier FID
10	2.511	3.275	0.523	0.362
50	2.375	3.289	0.547	0.361
100	2.225	3.306	0.577	0.360
250	1.871	3.356	0.666	0.358
500	1.478	3.441	0.815	0.353
1000	1.041	3.611	1.114	0.345
2000	0.654	3.951	1.710	0.327
5000		4.969		0.275
7500		5.818		0.232
10000				0.188

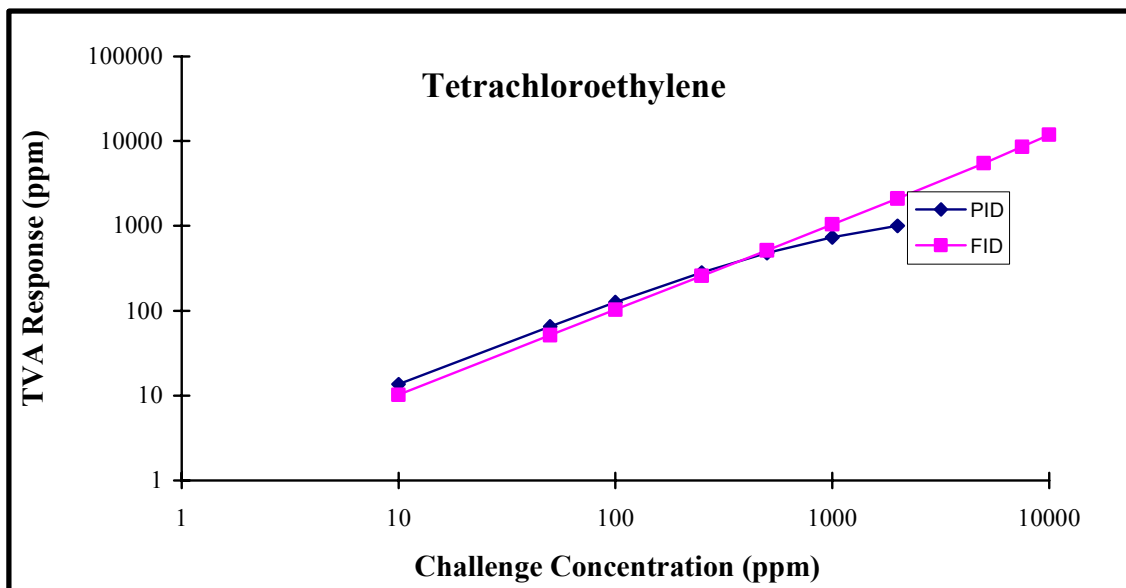


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:	A	B
PID	0.52	-5.97
FID	0.36	0.17

# Tetrachloroethylene

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent)		EPA/TVA-1000B (or equivalent)	
	Relative Response Factor		Response Factor Multiplier	
	PID	FID	PID	FID
10	1.582	1.060	0.738	0.974
50	1.524	1.058	0.763	0.973
100	1.458	1.059	0.795	0.972
250	1.290	1.060	0.889	0.970
500	1.082	1.062	1.046	0.967
1000	0.818	1.063	1.361	0.961
2000	0.550	1.068	1.990	0.948
5000		1.081		0.909
7500		1.091		0.876
10000		1.102		0.843

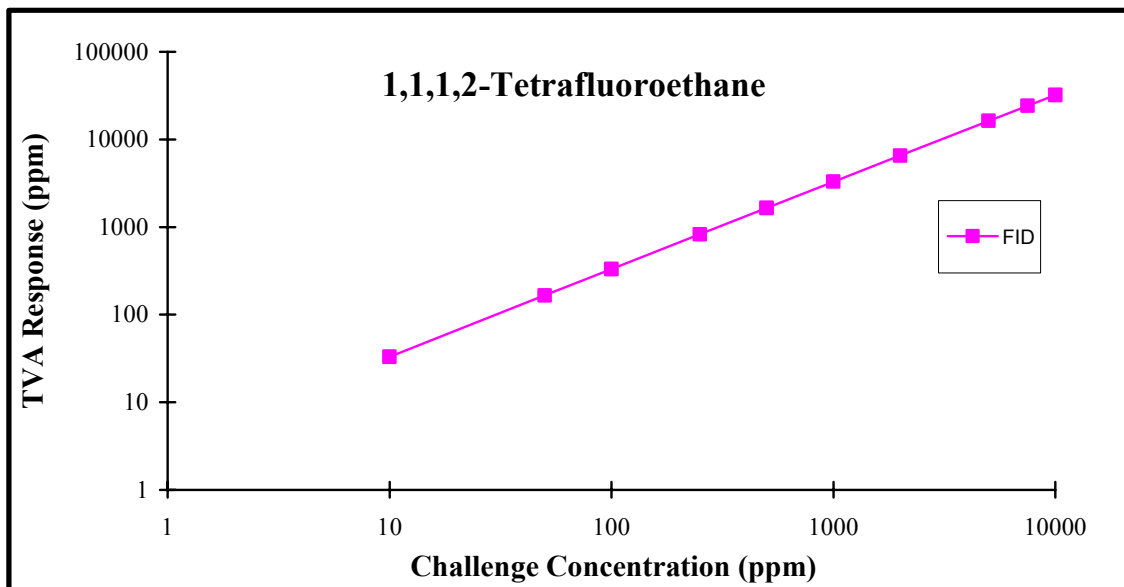


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:		
PID	A 0.73	B -6.29
FID	0.97	0.13

# 1,1,1,2-Tetrafluoroethane

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent) Relative Response Factor		EPA/TVA-1000B (or equivalent) Response Factor Multiplier	
	PID	FID	PID	FID
10	NF	not available	NF	0.302
50	NF	not available	NF	0.302
100	NF	not available	NF	0.302
250	NF	not available	NF	0.302
500	NF	not available	NF	0.303
1000	NF	not available	NF	0.303
2000	NF	not available	NF	0.304
5000	NF	not available	NF	0.307
7500	NF	not available	NF	0.310
10000	NF	not available	NF	0.312

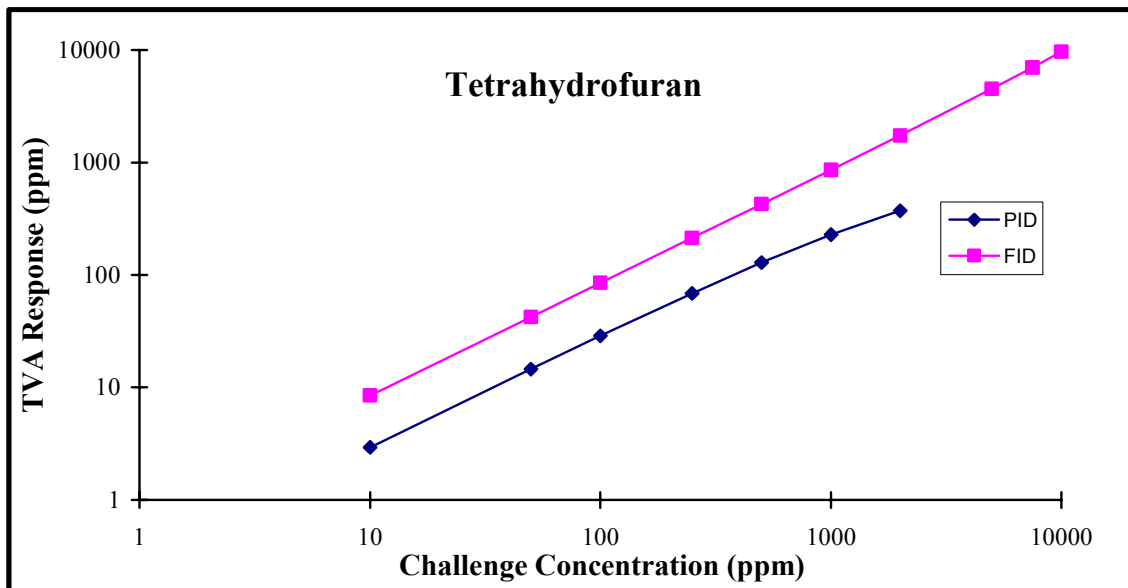


PID Lamp (eV): 0

TVA-1000B Response Curve Coefficients:	A	B
PID	NF	NF
FID	0.30	-0.01

# Tetrahydrofuran

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent)		EPA/TVA-1000B (or equivalent)	
	Relative Response Factor		Response Factor Multiplier	
	PID	FID	PID	FID
10	0.611	1.255	3.400	1.180
50	0.601	1.258	3.439	1.179
100	0.589	1.260	3.489	1.179
250	0.554	1.269	3.636	1.177
500	0.505	1.283	3.883	1.173
1000	0.430	1.314	4.375	1.166
2000	0.330	1.378	5.360	1.152
5000		1.617		1.110
7500		1.889		1.075
10000		2.273		1.040

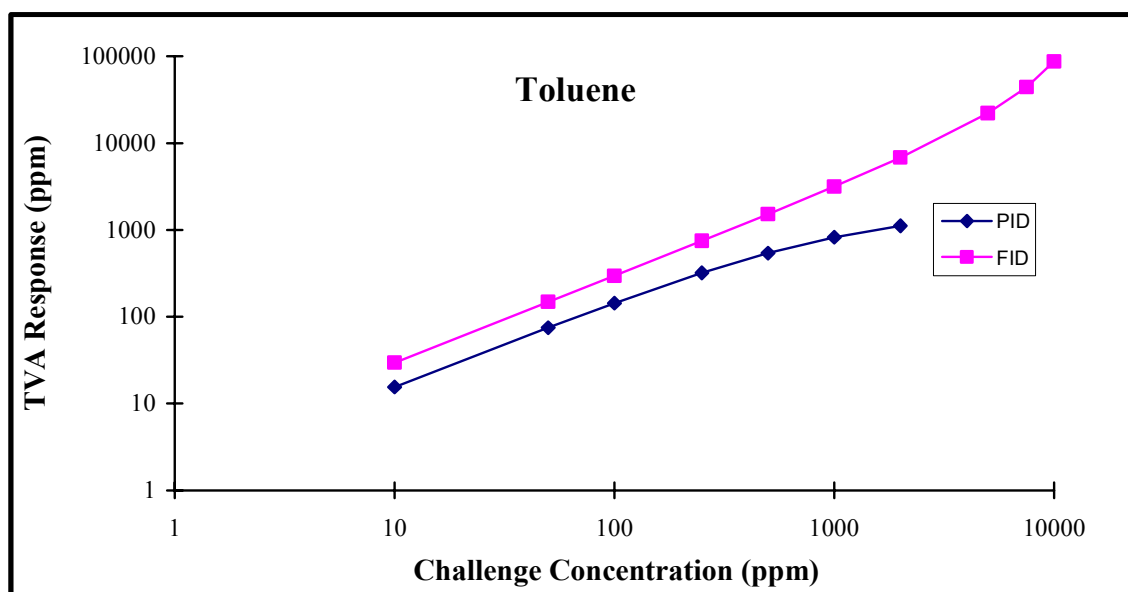


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:		
PID	A 3.39	B -9.85
FID	1.18	0.14

# Toluene

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent)		EPA/TVA-1000B (or equivalent)	
	Relative Response Factor		Response Factor Multiplier	
	PID	FID	PID	FID
10	1.813	2.771	0.644	0.339
50	1.748	2.787	0.668	0.338
100	1.674	2.808	0.696	0.337
250	1.484	2.870	0.783	0.334
500	1.249	2.972	0.928	0.328
1000	0.948	3.178	1.217	0.317
2000	0.640	3.589	1.795	0.294
5000		4.822		0.227
7500		5.850		0.171
10000		6.878		0.114

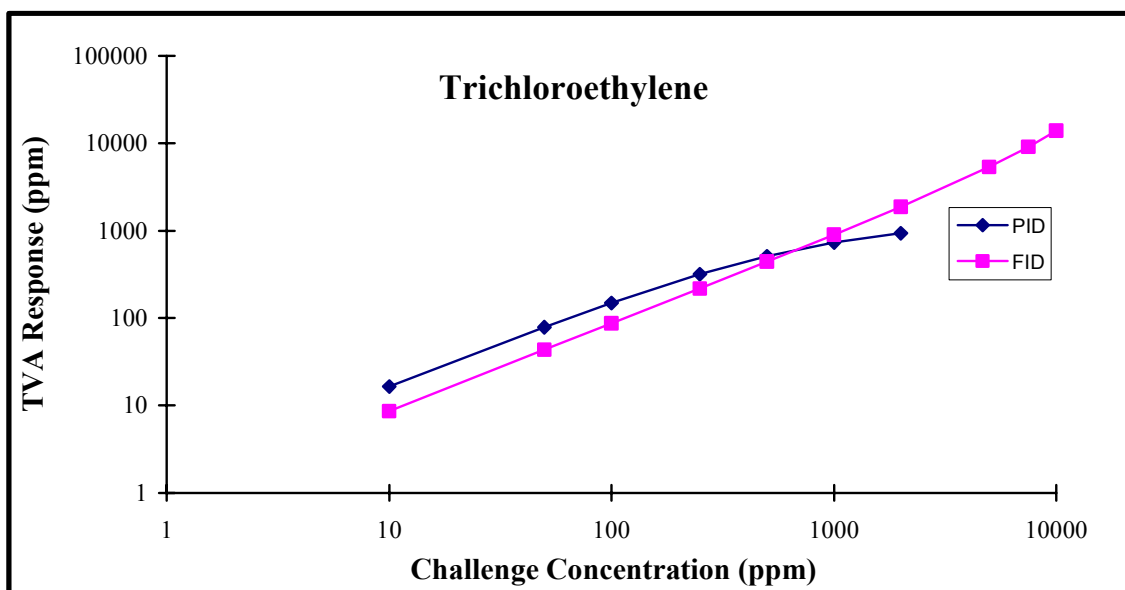


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:	A	B
PID	0.64	-5.78
FID	0.34	0.23

# Trichloroethylene

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent)		EPA/TVA-1000B (or equivalent)	
	Relative Response Factor PID	Relative Response Factor FID	Response Factor Multiplier PID	Response Factor Multiplier FID
10	1.820	0.931	0.605	1.156
50	1.731	0.932	0.636	1.154
100	1.632	0.933	0.674	1.152
250	1.392	0.936	0.789	1.146
500	1.118	0.940	0.980	1.135
1000	0.803	0.950	1.363	1.113
2000	0.513	0.969	2.129	1.069
5000		1.025		0.938
7500		1.072		0.828
10000		1.119		0.719

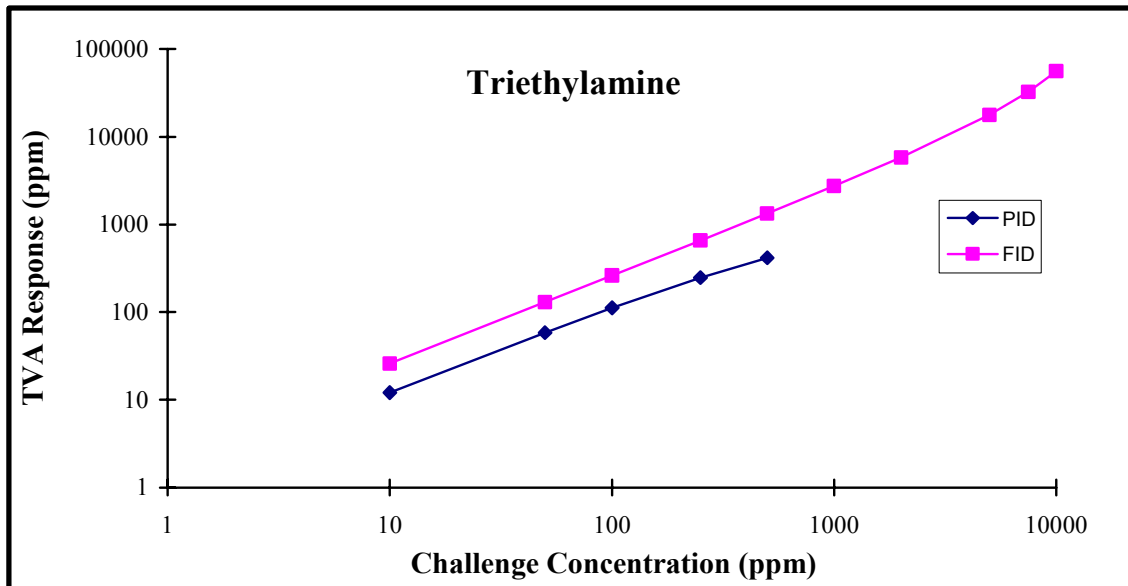


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:			
	A	B	
PID	0.60	-7.66	
FID	1.16	0.44	

# Triethylamine

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent)		EPA/TVA-1000B (or equivalent)	
	Relative Response Factor		Response Factor Multiplier	
	PID	FID	PID	FID
10	0.538	1.139	0.825	0.385
50			0.856	0.384
100	0.535	1.168	0.894	0.383
250			1.007	0.380
500	0.468	1.295	1.197	0.375
1000	0.402	1.453		0.365
2000	0.327	1.771		0.344
5000		2.401		0.282
7500		3.101		0.231
10000		3.800		0.179

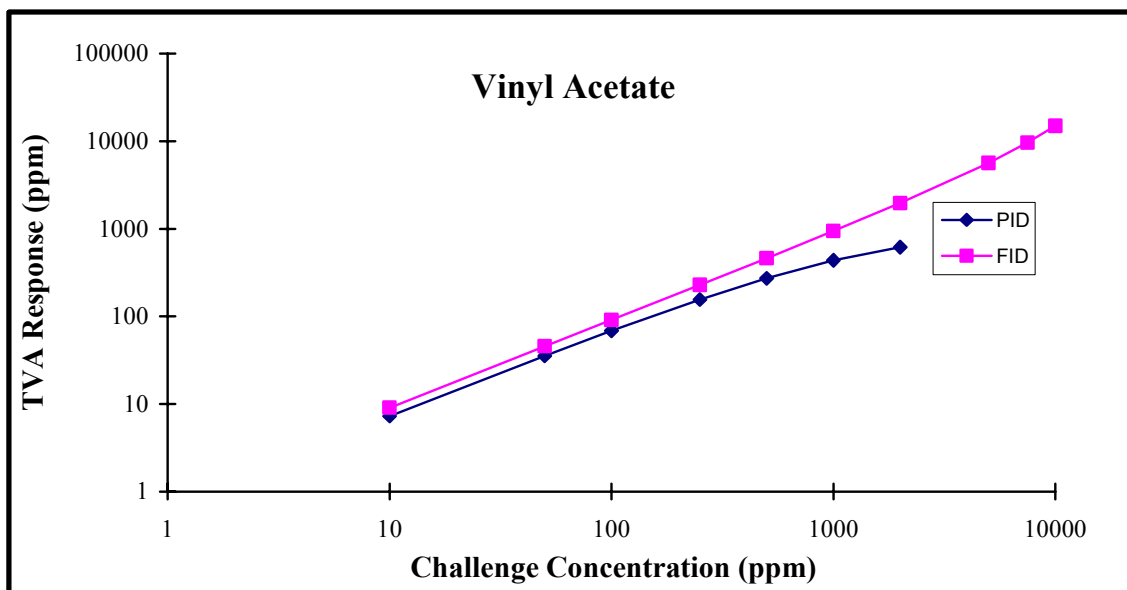


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:	A	B
PID	0.82	-7.59
FID	0.39	0.21

# Vinyl Acetate

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent) Relative Response Factor		EPA/TVA-1000B (or equivalent) Response Factor Multiplier	
	PID	FID	PID	FID
10	0.746	0.824	1.377	1.102
50			1.414	1.100
100	0.725	0.829	1.461	1.098
250			1.600	1.091
500	0.581	0.849	1.832	1.080
1000	0.454		2.297	1.059
2000	0.320	0.925	3.227	1.015
5000		0.950		0.886
7500		1.061		0.777
10000		1.173		0.669

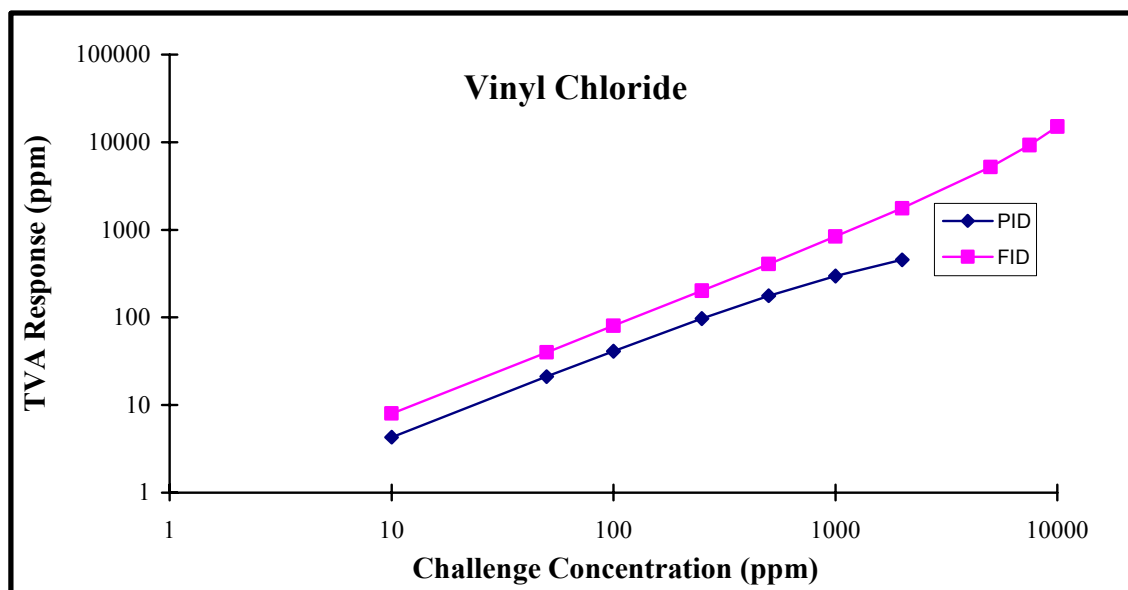


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:			
	A	B	
PID	1.37	-9.30	
FID	1.10	0.43	

# Vinyl Chloride

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent)		EPA/TVA-1000B (or equivalent)	
	Relative Response Factor PID	Relative Response Factor FID	Response Factor Multiplier PID	Response Factor Multiplier FID
10	0.513	0.835	2.334	1.253
50			2.376	1.251
100	0.496	0.841	2.428	1.248
250			2.583	1.239
500	0.389	0.871	2.842	1.224
1000	0.298	0.908	3.360	1.195
2000	0.204	0.983	4.397	1.135
5000		1.063		0.958
7500		1.228		0.809
10000		1.392		0.661

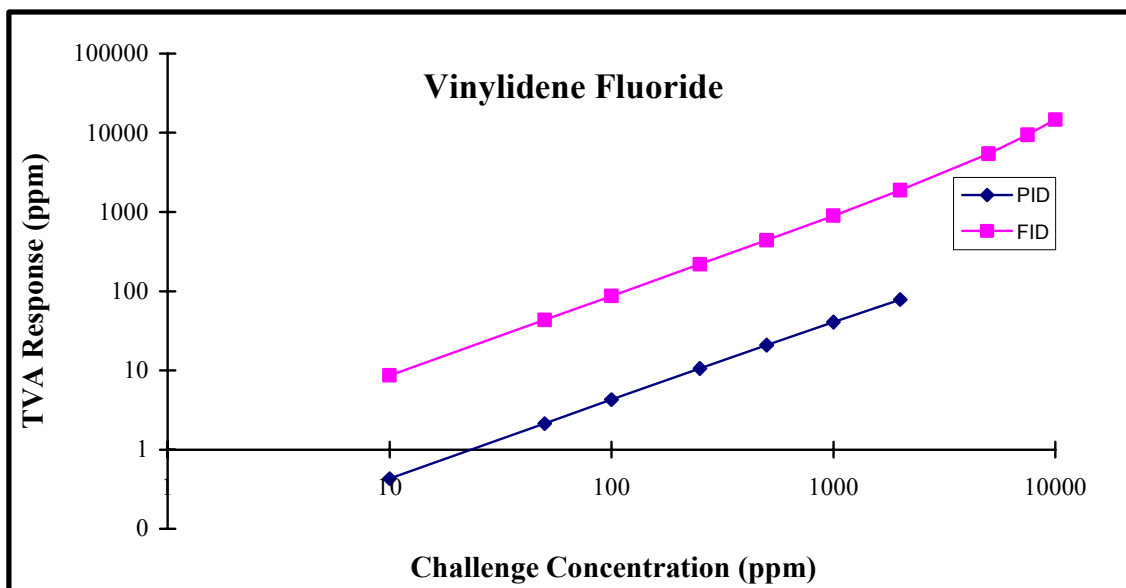


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:		A	B
PID		2.32	-10.36
FID		1.25	0.59

# Vinylidene Fluoride

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent)		EPA/TVA-1000B (or equivalent)	
	Relative Response Factor		Response Factor Multiplier	
	PID	FID	PID	FID
10	N/A	N/A	23.387	1.157
50	N/A	N/A	23.431	1.156
100	N/A	N/A	23.485	1.153
250	N/A	N/A	23.650	1.146
500	N/A	N/A	23.924	1.134
1000	N/A	N/A	24.473	1.110
2000	N/A	N/A	25.570	1.062
5000	N/A	N/A		0.918
7500	N/A	N/A		0.798
10000	N/A	N/A		0.678

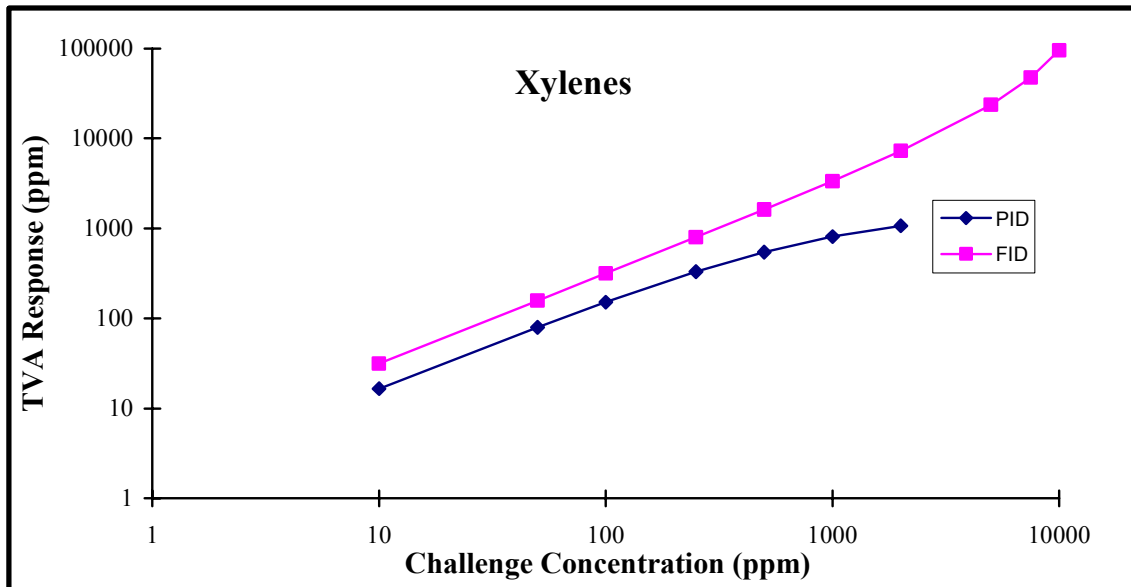


PID Lamp (eV): 10.8

TVA-1000B Response Curve Coefficients:	A	B
PID	23.38	-10.97
FID	1.16	0.48

# Xylenes

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent) Relative Response Factor		EPA/TVA-1000B (or equivalent) Response Factor Multiplier	
	PID	FID	PID	FID
10	1.603	2.790	0.605	0.319
50	1.569	2.802	0.630	0.318
100	1.529	2.817	0.662	0.317
250	1.420	2.860	0.758	0.314
500	1.269	2.933	0.917	0.308
1000	1.046	3.079	1.236	0.298
2000	0.774	3.371	1.873	0.276
5000		4.246		0.212
7500		4.975		0.158
10000		5.704		0.104



PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:		A	B
PID		0.60	-6.38
FID		0.32	0.21

