POSTER NOTE

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# Optimizing the Analysis of Semi-volatiles by EPA Method 8270

David Steiniger[1], Tommaso Albertini[2] and Richard Law[3]
[1]Thermo Fisher Scientific, Austin, TX; [2]Thermo Fisher Scientific, Milan, Italy;
[3]Thermo Fisher Scientific, Runcorn, UK

## OVERVIEW

The results of this study show how the Thermo Scientific ISQ™ Series Single Quadrupole GC-MS system can meet United States Environmental Protection Agency (U.S. EPA) 8270D Method requirements. Thanks to the extended dynamic range detection system, the method range was 0.2-200ppm using the same column. The new Thermo Scientific™ Instant Connect Helium Saver Module was assessed in this study to show that significant financial costs savings can be realized throughout the lifetime of the GC-MS instrument without compromising the instrument's performance.

## INTRODUCTION

The U.S. EPA released the first Semi-Volatile Organic Compounds (SVOC) method by Gas Chromatography/Mass Spectrometry (Method 8270) at the end of 1980, which is a common method used in almost all environmental labs looking to analyze semi-volatile organic compounds in extracts prepared from many types of solid waste matrices, soils, air sampling media and water.[1] Since then, single quadrupole mass spectrometers have become much more sensitive and the source fragmentation has changed. Many original assumptions[2] about the origin and nature of the ion species have proven to be wrong or require correction, while the new generations of the mass spectrometers have proven to provide more response in the high-mass region,[3] resulting in adjustment of the tuning criteria to be met.[4] To adjust to these changes, the EPA has changed the ion abundance criteria for the passing of DFTPP in EPA Method 8270D.

## METHODS

### Tuning for DFTPP

The ISQ system was tuned with a built-in EPA 8270D specifically designed tune (DFTPP Tune). This assures fulfillment of all method requirements in terms of ion abundance criteria. A tune verification DFTPP solution was injected to verify that the ISQ system met the tuning requirements shown in Figure 1. The Thermo Scientific™ TraceFinder™ Environmental and Food Safety (EFS) software and Thermo Scientific™ Dionex™ Chromeleon Data System (CDS) software, with the Environmental Reporting package, automatically reports tune evaluation performance with Pass/Fail indicator (Table 1).

**Figure 1. Chromatogram and Spectra of Tune Mix.**

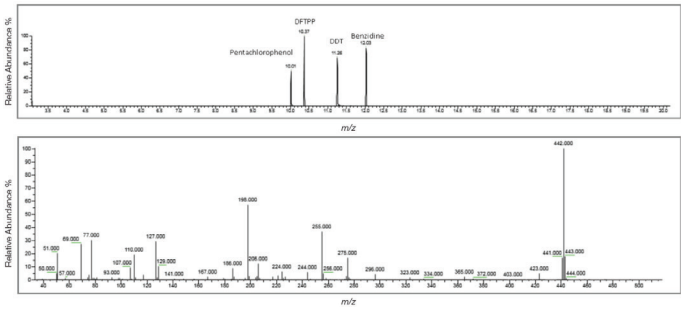


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**Table 1. Result report for DFTPP.**

| Eval Mass | Ion Abundance Criteria | % Relative Abundance | Pass/Fail |
|---|---|---|---|
| 51 | greater than or equal to 10% AND less than or equal to 80% of Base Peak | 20.7 | Pass |
| 68 | less than 2% of m/z 69 | 0.7 | Pass |
| 70 | less than 2% of m/z 69 | 0.5 | Pass |
| 127 | greater than or equal to 10% AND less than or equal to 80% of Base Peak | 29.4 | Pass |
| 197 | less than 2% of m/z 198 | 0.1 | Pass |
| 198 | greater than 50% AND less than or equal to 100% of Base Peak | 57.5 | Pass |
| 199 | greater than or equal to 5% AND less than or equal to 9% of m/z 198 | 5.9 | Pass |
| 275 | greater than or equal to 10% AND less than or equal to 60% of Base Peak | 17.2 | Pass |
| 365 | greater than 1% of m/z 198 | 4.6 | Pass |
| 441 | greater than 0% AND less than 24% of m/z 442 | 17.4 | Pass |
| 442 | greater than 50% AND less than or equal to 100% of Base Peak | 100 | Pass |
| 443 | greater than or equal to 15% AND less than or equal to 24% of m/z 442 | 18.1 | Pass |

### Sample Preparation

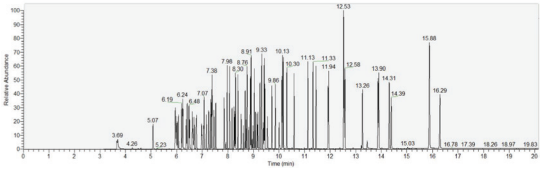
Standards (Restek 8270 MegaMix Cat. No. 31850, AccusStandard Internal Standard Cat. No. Z-014J, AccuStandard Surrogate Cat No. M-8270-SS) were prepared in methylene chloride and the internal standards were spiked at a concentration of 5 ppm for both the splitless and split methods. Spiking the range of 0.2 to 200 ppm with the same concentration of internal standards eliminated the necessity of preparing two different sets of calibration standards. Table 2 contains the calibration levels of both methods.

A volume of 1 µL of the calibration standards was injected for all methods. Figure 2 shows the chromatogram of the 5 ppm calibration standard acquired in splitless mode.

**Table 2. Calibration Standards for Split and Splitless Methods.**

| Calibration Standard | Splitless | Split |
|---|---|---|
| | Conc, ppm | Conc, ppm |
| Cal 1 | 0.2 | 2.0 |
| Cal 2 | 0.5 | 5.0 |
| Cal 3 | 1.0 | 10.0 |
| Cal 4 | 2.0 | 20.0 |
| Cal 5 | 5.0 | 35.0 |
| Cal 6 | 10.0 | 50.0 |
| Cal 7 | 20.0 | 100.0 |
| Cal 8 | 35.0 | 200.0 |
| Cal 9 | 50.0 | |

**Figure 2. Chromatogram of 5 ppm Standard.**



# RESULTS

### Calibration (Splitless Method 0.2ppm-50ppm)

The average relative response factors of the 76 targeted compounds and six surrogates were calculated by analyzing the nine calibration standards from 0.2 ppm to 50 ppm in methylene chloride. Six compounds had Response Factors %RSD >20% and required an alternative curve fit. The %RSDs of those compounds calibrated using average response factors and r2 values for the six alternative fit compounds are shown in Table 3.

**Table 3. Relative Response Factor %RSDs for the 76 targeted compounds and internal standards, as well as $r^2$, for linear fit calibrations (splitless method 0.2ppm-50ppm).**

| Compound | %RSD | | %RSD | $r^2$ |
|---|---|---|---|---|
| N-Nitrosodimethylamine | 11.53 | acenaphthylene | 8.24 | |
| Pyridine | 10.23 | 1,2-Dinitrobenzene | 14.85 | |
| 2-fluorophenol(surrogate) | 5.57 | 3-Nitroaniline | 8.09 | |
| Phenol-d6(surrogate) | 4.99 | **Acenaphthene-d10** | 5.78 | |
| Aniline | 6.39 | Acenaphthene | 7.57 | |
| Phenol | 7.3 | 2,4-dinitrophenol | | 0.9867 |
| Bis(2-chloroethyl) ether | 7.95 | Phenol, 4-nitro- | 18.15 | |
| Phenol, 2-chloro- | 6.19 | dibenzofuran | 6.78 | |
| Benzene, 1,3-dichloro- | 6.29 | 2,4-dinitrotoluene | 12.32 | |
| **1,4-Dichlorobenzene-D4** | 4.9 | Phenol, 2,3,5,6-tetrachloro- | | 0.9957 |
| Benzene, 1,4-dichloro- | 7.57 | Phenol, 2,3,4,6-tetrachloro- | | 0.9965 |
| Benzyl alcohol | 7.33 | Diethyl Phthalate | 5.6 | |
| Benzene, 1,2-dichloro- | 7.43 | 4-chlorophenylphenylether | 6.5 | |
| Phenol, 2-methyl- | 6.27 | fluorene | 7.31 | |
| Bis(2-chloroisopropyl)ether | 6.31 | 4-nitroaniline | 7.88 | |
| Phenol, 3&4-methyl- | 6.52 | 4,6-Dinitro-2-methylphenol | | 0.9945 |
| N-Nitroso-di-n-propylamine | 6.63 | diphenylamine | 9.61 | |
| Ethane, hexachloro- | 5.8 | Azobenzene | 7.06 | |
| Nitrobenzene-D5(surrogate) | 5.9 | 2,4,6-tribromophenol (surrogate) | | 0.9963 |
| Benzene, nitro- | 3.2 | 4-bromophenylphenylether | 4.3 | |
| isophorone | 3.9 | hexachlorobenzene | 8.18 | |
| Phenol, 2-nitro- | 13.14 | Phenol, pentachloro- | | 0.996 |
| Phenol, 2,4-dimethyl- | 4.52 | Phenanthrene | 10.88 | |
| Bis(2-chloroethoxy)methane | 5.17 | **phenanthrene-D10-** | 3.54 | |
| Phenol, 2,4-dichloro- | 4.76 | Anthracene | 11.38 | |
| Benzene, 1,2,4-trichloro- | 6.17 | Carbazole | 9.69 | |
| Naphthalene | 8.26 | Di-n-butyl phthalate | 8.1 | |
| **Naphthalene-D8** | 5.02 | Fluoranthene | 10.94 | |
| p-Chloroaniline | 4.95 | Pyrene | 10.68 | |
| 1,3-Butadiene, 1,1,2,3,4,4-hexachloro- | 5.36 | p-Terphenyl-d14(surrogate) | 6.76 | |
| Phenol, 4-chloro-3-methyl- | 4.14 | Benzyl butyl phthalate | 8.69 | |
| Naphthalene, 2-methyl | 7.54 | Bis(2-ethylhexyl)adipate | 6.08 | |
| Naphthalene, 1-methyl- | 7 | Benz[a]anthracene | 9.68 | |
| Hexachlorocyclopentadiene | 9.8 | Chrysene | 9.38 | |
| Phenol, 2,4,5-trichloro- | 8.21 | **Chrysene-D12** | 4.02 | |
| Phenol, 2,4,6-trichloro- | 5.9 | bis(2-ethylhexyl)phthalate | 7.42 | |
| 2-fluorobiphenyl(surrogate) | 4.99 | di-n-octylphthalate | 6.3 | |
| Naphthalene, 2-chloro- | 7.24 | Benzo(b)fluoranthene | 6.7 | |
| 2-Nitroaniline | 10.43 | Benzo[(k]fluoranthene | 8.48 | |
| 1,4-Dinitrobenzene | 16.05 | benzo(a)pyrene | 6.11 | |
| Dimethyl phthalate | 5.66 | **Perylene-D12** | 5.73 | |
| Benzene, 1,3-dinitro- | 13.75 | Indeno[1,2,3-cd]pyrene | 6.36 | |
| 2,6-dinitrotoluene | 6.11 | dibenzo[a,h]anthracene | 6.39 | |
| | | Benzo[ghi]perylene | 7.75 | |

### Calibration (Split Method 2 ppm-200 ppm)

The average response factors of the 76 targeted compounds and six surrogates were calculated by analyzing eight calibration standards with concentrations ranging from 2 ppm to 200 ppm prepared in methylene chloride. Seven compounds had Response Factors %RSD >20% and required an alternate curve fit. The %RSDs of those compounds calibrated using average response factors and $r^2$ values for the seven alternative fit compounds are shown in Table 4.

**Table 4. Relative Response Factor %RSDs for the 76 targeted compounds and internal standards, as well as $r^2$, for alternative fit calibrations (split method 2 ppm-200 ppm).**

| Compound | %RSD | $r^2$ | Compound | %RSD | $r^2$ |
|---|---|---|---|---|---|
| N-Nitrosodimethylamine | 6.31 | | acenaphthylene | 6.59 | |
| Pyridine | 10.8 | | 1,2-Dinitrobenzene | 15.11 | |
| 2-fluorophenol(surrogate) | 4.3 | | 3-Nitroaniline | 14.42 | |
| Phenol-d6(surrogate) | 4.19 | | **Acenaphthene-d10** | **7.23** | |
| Aniline | 4.89 | | Acenaphthene | 7.98 | |
| Phenol | 5.48 | | 2,4-dinitrophenol | | 0.9984 |
| Bis(2-chloroethyl) ether | 4.45 | | Phenol, 4-nitro- | | 0.9982 |
| Phenol, 2-chloro- | 4.94 | | dibenzofuran | 8.91 | |
| Benzene, 1,3-dichloro- | 5.03 | | 2,4-dinitrotoluene | 18.65 | |
| **1,4-Dichlorobenzene-D4** | **6.01** | | Phenol, 2,3,5,6-tetrachlor | 17.58 | |
| Benzene, 1,4-dichloro- | 5.09 | | Phenol, 2,3,4,6-tetrachlor | 12.33 | |
| Benzyl alcohol | 9.21 | | Diethyl Phthalate | 7.83 | |
| Benzene, 1,2-dichloro- | 4.76 | | 4-chlorophenylphenyleth | 7.93 | |
| Phenol, 2-methyl- | 6.77 | | fluorene | 9.13 | |
| Bis(2-chloroisopropyl)ether | 4.85 | | 4-nitroaniline | 13.3 | |
| Phenol, 3&4-methyl- | 5.92 | | 4,6-Dinitro-2-methylphenol | | 0.9983 |
| N-Nitroso-di-n-propylamine | 6.23 | | diphenylamine | 8.13 | |
| Ethane, hexachloro- | 4.85 | | Azobenzene | 9.24 | |
| Nitrobenzene-D5(surrogate) | 10.59 | | 2,4,6-tribromophenol (sur | 13.23 | |
| Benzene, nitro- | 10.24 | | 4-bromophenylphenyleth | 6.37 | |
| isophorone | 5.18 | | hexachlorobenzene | 5.72 | |
| Phenol, 2-nitro- | 19.2 | | Phenol, pentachloro- | | 0.9981 |
| Phenol, 2,4-dimethyl- | 4.92 | | Phenanthrene | 6.32 | |
| Bis(2-chloroethoxy)methane | 8.67 | | **phenanthrene-D10-** | **6.95** | |
| Phenol, 2,4-dichloro- | 5.68 | | Anthracene | 7.23 | |
| Benzene, 1,2,4-trichloro- | 5.74 | | Carbazole | 11.25 | |
| Naphthalene | 5.74 | | Di-n-butyl phthalate | 6.69 | |
| **Naphthalene-D8** | **6.53** | | Fluoranthene | 7.64 | |
| p-Chloroaniline | 6.02 | | Pyrene | 6.93 | |
| 1,3-Butadiene, 1,1,2,3,4,4-hex | 5.54 | | p-Terphenyl-d14(surrogat | 6.38 | |
| Phenol, 4-chloro-3-methyl- | 8.26 | | Benzyl butyl phthalate | 6.97 | |
| Naphthalene, 2-methyl | 6.97 | | Bis(2-ethylhexyl)adipate | 6.16 | |
| Naphthalene, 1-methyl- | 7.35 | | Benz[a]anthracene | 7.43 | |
| Hexachlorocyclopentadiene | | 0.9991 | Chrysene | 6.17 | |
| Phenol, 2,4,5-trichloro- | 10.39 | | **Chrysene-D12** | **10.49** | |
| Phenol, 2,4,6-trichloro- | 7.92 | | bis(2-ethylhexyl)phthalat | 4.95 | |
| 2-fluorobiphenyl,(surrogate) | 6.45 | | di-n-octylphthalate | 8.7 | |
| Naphthalene, 2-chloro- | 8.16 | | Benzo(b)fluoranthene | 7.06 | |
| 2-Nitroaniline | 17.03 | | Benzo[(k)fluoranthene | 6.26 | |
| 1,4-Dinitrobenzene | | 0.998 | benzo(a)pyrene | 6.81 | |
| Dimethyl phthalate | 8.3 | | **Perylene-D12** | **14.99** | |
| Benzene, 1,3-dinitro- | | 0.9976 | Indeno[1,2,3-cd]pyrene | 6.15 | |
| 2,6-dinitrotoluene | 11.55 | | dibenzo[a,h]anthracene | 6.91 | |
| | | | Benzo[ghi]perylene | 7.06 | |

### Thermo Scientific™ Instant Connect Helium Saver Module

Method 8270D was also tested with the Instant Connect Helium Saver Module (P/N 19070013). Depending on the experimental conditions, the Helium Saver module allows up to 14 years of GC and GC-MS operation from a single helium cylinder. The inlet is supplied with two different gases; Nitrogen is used for the septum purge and split flows with only Helium supplying the analytical column. Because of this innovative and patented solution, Helium consumption is dramatically reduced.

After time for equilibration, the GC-MS tuning mixture was injected and passed the criteria for EPA Method 8270D. Standards for a calibration curve (0.2–50 ppm and 2–200 ppm) were injected, and the data processed. Table 5 shows the results for splitless method and Table 6 shows the results for split method. In both configurations (SSL and Helium Saver) and for both methods (Split and Splitless), less than 10% of compounds required an alternative curve fit. All the others had RSD% less than 20% with linear fit.

**Table 5. Calibration results using the Helium Saver in splitless mode.**

| Compound | %RSD | $r^2$ | Compound | %RSD | $r^2$ |
|---|---|---|---|---|---|
| N-Nitrosodimethylamine | 6.62 | | acenaphthylene | 7.34 | |
| Pyridine | 10.56 | | 1,2-Dinitrobenzene | 16.57 | |
| 2-fluorophenol(surrogate) | 6.37 | | 3-Nitroaniline | 19.06 | |
| Phenol-d6(surrogate) | 4.82 | | **Acenaphthene-d10** | **3.99** | |
| Aniline | 13.52 | | Acenaphthene | 4.68 | |
| Phenol | 5.41 | | 2,4-dinitrophenol | | 0.9938 |
| Bis(2-chloroethyl) ether | 17.24 | | Phenol, 4-nitro- | | 0.995 |
| Phenol, 2-chloro- | 6.34 | | dibenzofuran | 6.21 | |
| Benzene, 1,3-dichloro- | 5.8 | | 2,4-dinitrotoluene | | 0.9942 |
| **1,4-Dichlorobenzene-D4** | **2.53** | | Phenol, 2,3,5,6-tetrachloro- | | 0.9962 |
| Benzene, 1,4-dichloro- | 5.17 | | Phenol, 2,3,4,6-tetrachlor | 14.62 | |
| Benzyl alcohol | 18.38 | | Diethyl Phthalate | 5.69 | |
| Benzene, 1,2-dichloro- | 5.36 | | 4-chlorophenylphenyleth | 5.32 | |
| Phenol, 2-methyl- | 6.17 | | fluorene | 9.43 | |
| Bis(2-chloroisopropyl)ether | 4.53 | | 4-nitroaniline | 19.69 | |
| Phenol, 3&4-methyl- | 7.17 | | 4,6-Dinitro-2-methylphenol | | 0.9893 |
| N-Nitroso-di-n-propylamine | 7.58 | | diphenylamine | 6.12 | |
| Ethane, hexachloro- | 6.39 | | Azobenzene | 6.01 | |
| Nitrobenzene-D5(surrogate) | 8.67 | | 2,4,6-tribromophenol (sur | 16.16 | |
| Benzene, nitro- | 8.86 | | 4-bromophenylphenyleth | 8.54 | |
| isophorone | 5.52 | | hexachlorobenzene | 5.49 | |
| Phenol, 2-nitro- | 17.07 | | Phenol, pentachloro- | | 0.9971 |
| Phenol, 2,4-dimethyl- | 8.44 | | Phenanthrene | 7.12 | |
| Bis(2-chloroethoxy)methane | 8.87 | | **phenanthrene-D10-** | **2.95** | |
| Phenol, 2,4-dichloro- | 8.56 | | Anthracene | 12.18 | |
| Benzene, 1,2,4-trichloro- | 5.36 | | Carbazole | 6.86 | |
| Naphthalene | 5.91 | | Di-n-butyl phthalate | 6.59 | |
| **Naphthalene-D8** | **2.41** | | Fluoranthene | 8.46 | |
| p-Chloroaniline | 5.82 | | Pyrene | 7.82 | |
| 1,3-Butadiene, 1,1,2,3,4,4-hex | 4.82 | | p-Terphenyl-d14(surrogat | 7.49 | |
| Phenol, 4-chloro-3-methyl- | 8.96 | | Benzyl butyl phthalate | 5.81 | |
| Naphthalene, 2-methyl | 5.95 | | Bis(2-ethylhexyl)adipate | 9.11 | |
| Naphthalene, 1-methyl- | 6.54 | | Benz[a]anthracene | 5.79 | |
| Hexachlorocyclopentadiene | | 0.9959 | Chrysene | 6.9 | |
| Phenol, 2,4,5-trichloro- | 13.52 | | **Chrysene-D12** | **4.59** | |
| Phenol, 2,4,6-trichloro- | 9.81 | | bis(2-ethylhexyl)phthalat | 7.06 | |
| 2-fluorobiphenyl,(surrogate) | 6 | | di-n-octylphthalate | 7.84 | |
| Naphthalene, 2-chloro- | 5.66 | | Benzo(b)fluoranthene | 8.98 | |
| 2-Nitroaniline | 17.31 | | Benzo[(k)fluoranthene | 11.28 | |
| 1,4-Dinitrobenzene | | 0.9962 | benzo(a)pyrene | 7.47 | |
| Dimethyl phthalate | 5.88 | | **Perylene-D12** | **5.38** | |
| Benzene, 1,3-dinitro- | 17.9 | | Indeno[1,2,3-cd]pyrene | 8.02 | |
| 2,6-dinitrotoluene | 11.8 | | dibenzo[a,h]anthracene | 5.99 | |
| | | | Benzo[ghi]perylene | 7.43 | |

**Table 6. Calibration results using the Helium Saver in split mode.**

| Compound | %RSD | $r^2$ | Compound | %RSD | $r^2$ |
|---|---|---|---|---|---|
| N-Nitrosodimethylamine | 6.62 | | acenaphthylene | 7.25 | |
| Pyridine | 13.09 | | 1,2-Dinitrobenzene | 17.76 | |
| 2-fluorophenol(surrogate) | 6.02 | | 3-Nitroaniline | 18.05 | |
| Phenol-d6(surrogate) | 5.71 | | **Acenaphthene-d10** | **4.15** | |
| Aniline | 6.13 | | Acenaphthene | 7.36 | |
| Phenol | 6.52 | | 2,4-dinitrophenol | | 0.9965 |
| Bis(2-chloroethyl) ether | 5.69 | | Phenol, 4-nitro- | | 0.9978 |
| Phenol, 2-chloro- | 7.17 | | dibenzofuran | 6.9 | |
| Benzene, 1,3-dichloro- | 7.28 | | 2,4-dinitrotoluene | 18.32 | |
| **1,4-Dichlorobenzene-D4** | **3.26** | | Phenol, 2,3,5,6-tetrachloro- | | 0.9957 |
| Benzene, 1,4-dichloro- | 8.13 | | Phenol, 2,3,4,6-tetrachlor | 17.05 | |
| Benzyl alcohol | 14.15 | | Diethyl Phthalate | 6.09 | |
| Benzene, 1,2-dichloro- | 6.95 | | 4-chlorophenylphenyleth | 8.11 | |
| Phenol, 2-methyl- | 6.68 | | fluorene | 8.51 | |
| Bis(2-chloroisopropyl)ether | 6.28 | | 4-nitroaniline | 19.17 | |
| Phenol, 3&4-methyl- | 6.42 | | 4,6-Dinitro-2-methylphenol | | 0.9987 |
| N-Nitroso-di-n-propylamine | 7.31 | | diphenylamine | 7.24 | |
| Ethane, hexachloro- | 9.32 | | Azobenzene | 7.28 | |
| Nitrobenzene-D5(surrogate) | 10.02 | | 2,4,6-tribromophenol (sur | 14.93 | |
| Benzene, nitro- | 11.59 | | 4-bromophenylphenyleth | 7.06 | |
| Isophorone | 6.7 | | hexachlorobenzene | 7.82 | |
| Phenol, 2-nitro- | 14.78 | | Phenol, pentachloro- | | 0.9991 |
| Phenol, 2,4-dimethyl- | 5.9 | | Phenanthrene | 8.55 | |
| Bis(2-chloroethoxy)methane | 5.64 | | **phenanthrene-D10-** | **3.85** | |
| Phenol, 2,4-dichloro- | 5.96 | | Anthracene | 6.87 | |
| Benzene, 1,2,4-trichloro- | 6.67 | | Carbazole | 8.99 | |
| Naphthalene | 4.81 | | Di-n-butyl phthalate | 7.05 | |
| **Naphthalene-D8** | **3.84** | | Fluoranthene | 7.25 | |
| p-Chloroaniline | 5.55 | | Pyrene | 6.05 | |
| 1,3-Butadiene, 1,1,2,3,4,4-hex | 7.15 | | p-Terphenyl-d14(surrogat | 6.25 | |
| Phenol, 4-chloro-3-methyl- | 7.32 | | Benzyl butyl phthalate | 5.92 | |
| Naphthalene, 2-methyl | 5.92 | | Bis(2-ethylhexyl)adipate | 6.32 | |
| Naphthalene, 1-methyl- | 6.15 | | Benz[a]anthracene | 7.37 | |
| Hexachlorocyclopentadiene | | 0.9985 | Chrysene | 6.9 | |
| Phenol, 2,4,5-trichloro- | 12.06 | | **Chrysene-D12** | **4.81** | |
| Phenol, 2,4,6-trichloro- | 12.35 | | bis(2-ethylhexyl)phthalat | 6.27 | |
| 2-fluorobiphenyl,(surrogate) | 7.3 | | di-n-octylphthalate | 6.56 | |
| Naphthalene, 2-chloro- | 7.68 | | Benzo(b)fluoranthene | 6.55 | |
| 2-Nitroaniline | 17.72 | | Benzo[(k]fluoranthene | 9.18 | |
| 1,4-Dinitrobenzene | 19.53 | | benzo(a)pyrene | 7.4 | |
| Dimethyl phthalate | 7.46 | | **Perylene-D12** | **8.17** | |
| Benzene, 1,3-dinitro- | 18.89 | | Indeno[1,2,3-cd]pyrene | 8.23 | |
| 2,6-dinitrotoluene | 13.59 | | dibenzo[a,h]anthracene | 7.15 | |
| | | | Benzo[ghi]perylene | 6.5 | |

**Table 7. EPA Method 8270D minimum relative response factors and those produced by the Thermo Scientific ISQ Single Quadrupole system.**

| | | Splitless | Splitless Helium Saver | Split (10:1) | Split Helium Saver |
|---|---|---|---|---|---|
| Compound | EPA 8270D Minimum Response | Thermo Minimum | Thermo Minimum | Thermo Minimum | Thermo Minimum |
| Phenol | 0.8 | 1.990 | 2.895 | 2.603 | 2.767 |
| Bis(2-chloroethyl) ether | 0.7 | 1.499 | 2.225 | 1.929 | 2.134 |
| Phenol, 2-chloro- | 0.8 | 1.516 | 1.884 | 1.882 | 1.869 |
| Phenol, 2-methyl- | 0.7 | 1.412 | 1.802 | 1.719 | 1.771 |
| Phenol, 3&4-methyl- | 0.6 | 1.495 | 1.933 | 1.767 | 1.897 |
| N-Nitroso-di-n-propylamine | 0.5 | 1.110 | 1.886 | 1.254 | 1.579 |
| Ethane, hexachloro- | 0.3 | 0.530 | 0.439 | 0.716 | 0.690 |
| Benzene, nitro- | 0.2 | 0.316 | 0.469 | 0.404 | 0.471 |
| Isophorone | 0.4 | 0.708 | 0.989 | 0.869 | 0.995 |
| Phenol, 2-nitro- | 0.1 | 0.160 | 0.170 | 0.152 | 0.157 |
| Phenol, 2,4-dimethyl- | 0.2 | 0.389 | 0.453 | 0.430 | 0.465 |
| Bis(2-chloroethoxy)methane | 0.3 | 0.432 | 0.589 | 0.530 | 0.586 |
| Phenol, 2,4-dichloro- | 0.2 | 0.282 | 0.269 | 0.313 | 0.288 |
| Naphthalene | 0.7 | 1.085 | 1.247 | 1.176 | 1.260 |
| p-Chloroaniline | 0.01 | 0.464 | 0.493 | 0.497 | 0.546 |
| 1,3-Butadiene, 1,1,2,3,4,4-hexachloro- | 0.01 | 0.112 | 0.118 | 0.175 | 0.116 |
| Phenol, 4-chloro-3-methyl- | 0.2 | 0.342 | 0.394 | 0.382 | 0.418 |
| Naphthalene, 2-methyl | 0.4 | 0.785 | 0.730 | 0.726 | 0.724 |
| Hexachlorocyclopentadiene | 0.05 | 0.236 | 0.128 | 0.213 | 0.044 |
| Phenol, 2,4,6-trichloro- | 0.2 | 0.345 | 0.322 | 0.372 | 0.298 |
| Phenol, 2,4,5-trichloro- | 0.2 | 0.324 | 0.286 | 0.368 | 0.300 |
| Naphthalene, 2-chloro- | 0.8 | 1.232 | 1.388 | 1.314 | 1.349 |
| 2-Nitroaniline | 0.01 | 0.335 | 0.406 | 0.339 | 0.455 |
| Dimethyl phthalate | 0.01 | 1.361 | 1.511 | 1.442 | 1.482 |
| 2,6-dinitrotoluene | 0.2 | 0.229 | 0.259 | 0.258 | 0.242 |
| Acenaphthylene | 0.9 | 1.899 | 2.216 | 2.063 | 2.165 |
| 3-Nitroaniline | 0.01 | 0.298 | 0.336 | 0.428 | 0.541 |
| 2,4-dinitrophenol | 0.01 | 0.055 | 0.042 | 0.045 | 0.025 |
| Acenaphthene | 0.9 | 1.312 | 1.574 | 1.383 | 1.417 |
| 2,4-dinitrotoluene | 0.2 | 0.304 | 0.327 | 0.316 | 0.330 |
| Dibenzofuran | 0.8 | 1.840 | 1.907 | 1.811 | 1.863 |
| Phenol, 4-nitro- | 0.01 | 0.167 | 0.042 | 0.124 | 0.055 |
| Diethyl Phthalate | 0.01 | 1.335 | 1.676 | 1.508 | 1.518 |
| 4-chlorophenylphenylether | 0.4 | 0.740 | 0.609 | 0.692 | 0.621 |
| 4-nitroaniline | 0.01 | 0.306 | 0.360 | 0.315 | 0.296 |
| Fluorene | 0.9 | 1.434 | 1.647 | 1.471 | 1.470 |
| 4,6-Dinitro-2-methylphenol | 0.01 | 0.079 | 0.057 | 0.063 | 0.047 |
| Diphenylamine | 0.01 | 0.683 | 0.897 | 0.750 | 0.799 |
| 4-bromophenylphenylether | 0.1 | 0.477 | 0.332 | 0.241 | 0.206 |
| Hexachlorobenzene | 0.1 | 0.324 | 0.256 | 0.283 | 0.267 |
| Phenol, pentachloro- | 0.05 | 0.131 | 0.077 | 0.064 | 0.049 |
| Phenanthrene | 0.7 | 1.125 | 1.335 | 1.289 | 1.275 |
| Anthracene | 0.7 | 1.270 | 1.138 | 1.272 | 1.347 |
| Carbazole | 0.01 | 1.070 | 1.407 | 1.006 | 1.156 |
| Di-n-butyl phthalate | 0.01 | 1.314 | 1.856 | 1.517 | 1.626 |
| Fluoranthene | 0.6 | 1.263 | 1.123 | 1.268 | 1.234 |
| Pyrene | 0.6 | 1.072 | 1.326 | 1.296 | 1.487 |
| Benzyl butyl phthalate | 0.01 | 0.496 | 0.906 | 0.677 | 0.847 |
| Bis(2-ethylhexyl)phthalate | 0.01 | 0.741 | 1.225 | 0.941 | 1.144 |
| Chrysene | 0.7 | 1.025 | 1.110 | 1.164 | 1.102 |
| Benz[a]anthracene | 0.8 | 1.068 | 1.228 | 1.171 | 1.124 |
| Di-n-octylphthalate | 0.01 | 1.465 | 2.673 | 2.084 | 2.413 |
| Benzo[b]fluoranthene | 0.7 | 1.364 | 1.417 | 1.592 | 1.432 |
| Benzo[k]fluoranthene | 0.7 | 1.292 | 1.185 | 1.586 | 1.396 |
| Benzo[a]pyrene | 0.7 | 1.353 | 1.420 | 1.500 | 1.414 |
| Indeno[1,2,3-cd]pyrene | 0.5 | 1.600 | 1.794 | 1.727 | 1.866 |
| Dibenzo[a,h]anthracene | 0.4 | 1.393 | 1.645 | 1.472 | 1.617 |
| Benzo[g,h,i]perylene | 0.5 | 1.302 | 1.560 | 1.406 | 1.636 |

## Minimum Response Factors

EPA Method 8270D requires a minimum relative response factor (RRF) for any point of the calibration curve for several compounds in the targeted list. Table 7 presents those minimum relative response factor requirements and the minimum RRF across all curves performed on the ISQ single-quadrupole GC-MS system.

## CONCLUSION

- The Thermo Scientific ISQ Series Single Quadrupole GC-MS systems are the perfect solution to perform the EPA 8270D Method. Thanks to the extended dynamic range detection system, the ISQ system allows you to cover a 0.2–200 ppm range with the same column and liner.
- 76 compounds were reported and each fulfilled the EPA 8270D requirements in terms of minimum response factors and linearity.
- Thermo Scientific™ Dionex™ Chromeleon Data System (CDS) software, with the Environmental Reporting package, offers unparallel flexibility, scalability, and compliance. The Thermo Scientific™ TraceFinder™ EFS software is tailored to support compliance with EPA 8270D Method requirements offering a full complement of standard reports including DFTPP Tune Check report, Breakdown report, Internal Standard Summary report, Tentatively Identified Compounds report, various quality control reports for check standards, laboratory control samples, matrix spikes, surrogate recoveries, and more.
- The Thermo Scientific Instant Connect Helium Saver Module is a unique tool that can be used to reduce the cost per analysis, without compromising the results. The Helium Saver Module makes the laboratories more efficient and environmentally friendly, saving 90% of Helium during each run.
- The ISQ system also incorporates a new source design that lets your system stay cleaner, longer.
- When the instrument finally requires cleaning, the new source design can be fully removed—including all of the lenses and the repeller—through the front vacuum interlock, without venting the system. This allows you to clean the source, swap it, or change ionization type, and be ready to run samples within minutes, not hours or days.

## REFERENCES


1. U.S. EPA. July 2014. *Method 8270D (SW-846): Semivolatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)*, Revision 5. https://www.epa.gov/sites/production/files/2015-12/documents/8270d.pdf, Accessed August 08th, 2016.
2. James W. Eichelberger, Lawrence E. Harris, and William L. Budde, Reference Compound to Calibrate Ion Abundance Measurements in Gas Chromatography-Mass Spectrometry Systems, *Anal. Chem.*, **1975**, *47* (7), 995–1000.
3. Joseph R. Donnelly, Ion Abundance Criteria for Gas Chromatographic /Mass Spectrometric Environmental Analysis, *J. Assoc. Off. Anal. Chem.*, **1988**, *71* (2), 434–439.
4. Yves Tondeur, Warren J. Niederhutl, Joseph E. Campana, Ronald K. Mitchum, G. Wayne Sovocool, Joseph R. Donnelly, Ion Chemistry of a Gas Chromatographic/Mass Spectrometric Ion Abundance Calibrant, *Biomedical and Environmental Mass Spectrometry Journal of Mass Spectrometry* **1988**, *15* (8), 429–439.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