

PAH Analysis: GC Column Selection and Best Practices for Success

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Abstract

Incomplete combustion of organic fuels such as coal, petroleum and wood leads to the formation of polycyclic aromatic hydrocarbons (PAHs) that can then enter the environment or the food supply. Mixtures of these materials can spread widely from an original combustion source in the form of smoke, particulates in the air, or contaminants in soil or water. Some of the components in this chemical class are carcinogenic and need ongoing monitoring to preserve the health of both our food supply and environment worldwide.

European Union (EU) regulation of PAHs focuses on contamination in the food supply while US-Environmental Protection Agency (EPA) regulation has historically focused on PAHs from environmental sources. The regulated lists of PAHs from each authority are distinct with some overlapping compounds. The EU list contains heavier molecular weight PAHs that require higher elution temperatures for GC/MS. Separation of 3 isomers of benzo[fluoranthene] is particularly challenging. A variety of non-polar and moderately polar capillary GC columns have been used for these analytes. Non-polar phases are more effective for the lower boiling US-EPA set, while moderately polar phases are more effective for the EU 15 + 1 set.

Important criterion to consider when selecting a column for a given PAH analysis include the sample set being analyzed, the speed of analysis desired, critical pairs to be separated, potential matrix effects and instrument capabilities. Often the analyst must find an appropriate balance of these factors to achieve optimal results in their laboratory. The focus of this presentation is a discussion of best practices in achieving better PAH analysis results.

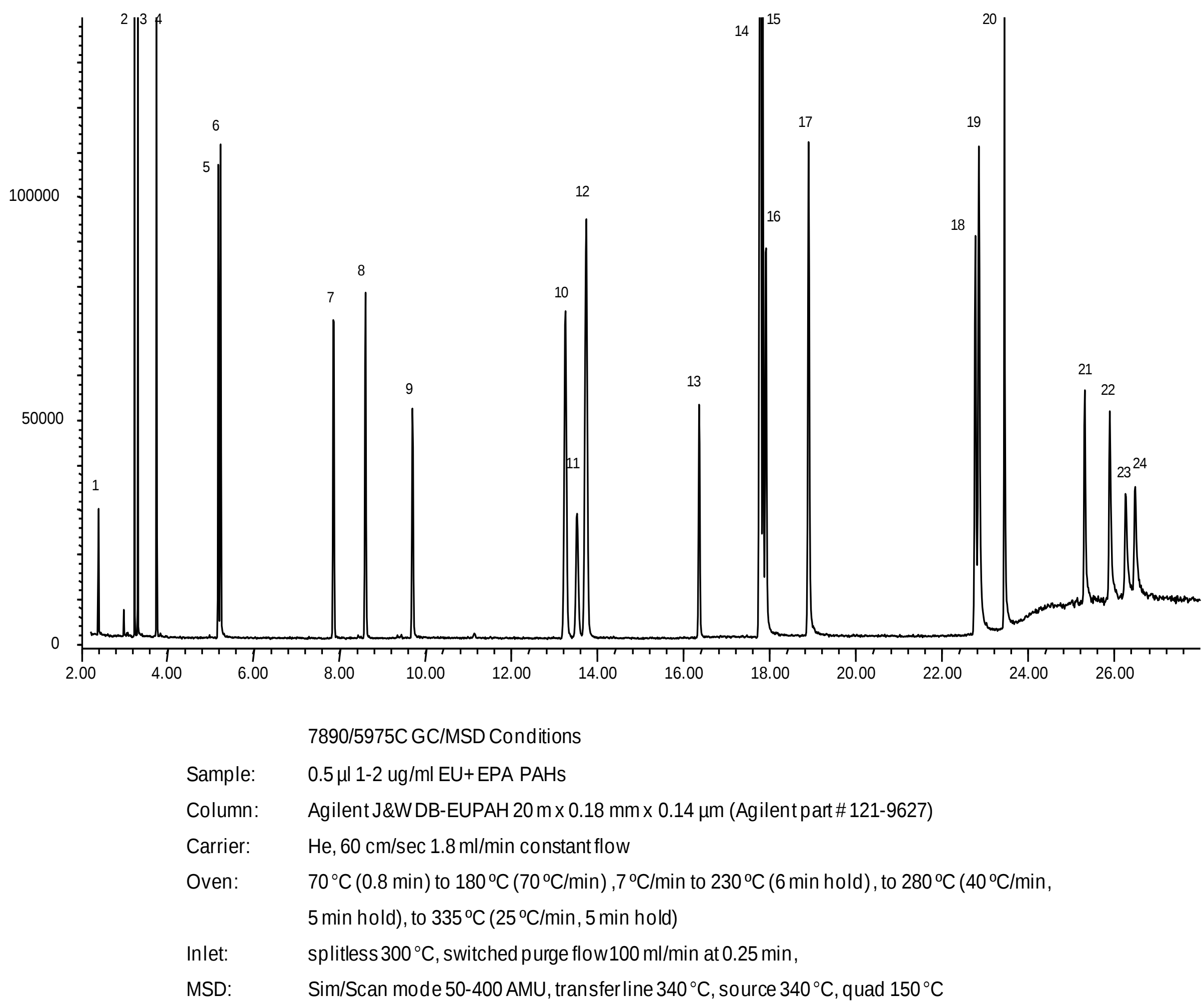
EU 15+1 and US-EPA PAHs

Peak #	Component	CAS #	MW	EU 15+1	EPA
1	Naphthalene	91-20-3	128		X
2	Acenaphthylene	208-96-8	152		X
3	Acenaphthene	83-32-9	154		X
4	Fluorene	86-73-7	166		X
5	Phenanthrene	85-01-8	178		X
6	Anthracene	120-12-7	178		X
7	Fluoranthene	206-44-0	202		X
8	Pyrene	129-00-0	202		X
9	Benzo[c]fluorene	205-12-9	216	X	
10	Benzo[a]anthracene	56-55-3	228	X	X
11	Cyclopenta[c,d]pyrene	27208-37-3	226	X	
12	Chrysene	218-01-9	228	X	X
13	5-Methylchrysene	3697-24-3	242	X	
14	Benzo[b]fluoranthene	205-99-2	252	X	X
15	Benzo[k]fluoranthene	207-08-9	252	X	X
16	Benzo[j]fluoranthene	205-82-3	252	X	
17	Benzo[a]pyrene	50-32-8	252	X	X
18	Indeno[1,2,3-cd]pyrene	193-39-5	276	X	X
19	Dibenzo[a,h]anthracene	53-70-3	278	X	X
20	Benzo[g,h,i]perylene	191-24-2	276	X	X
21	Dibenzo[a,l]pyrene	191-30-0	302	X	
22	Dibenzo[a,e]pyrene	192-65-4	302	X	
23	Dibenzo[a,i]pyrene	189-55-9	302	X	
24	Dibenzo[a,h]pyrene	189-64-0	302	X	

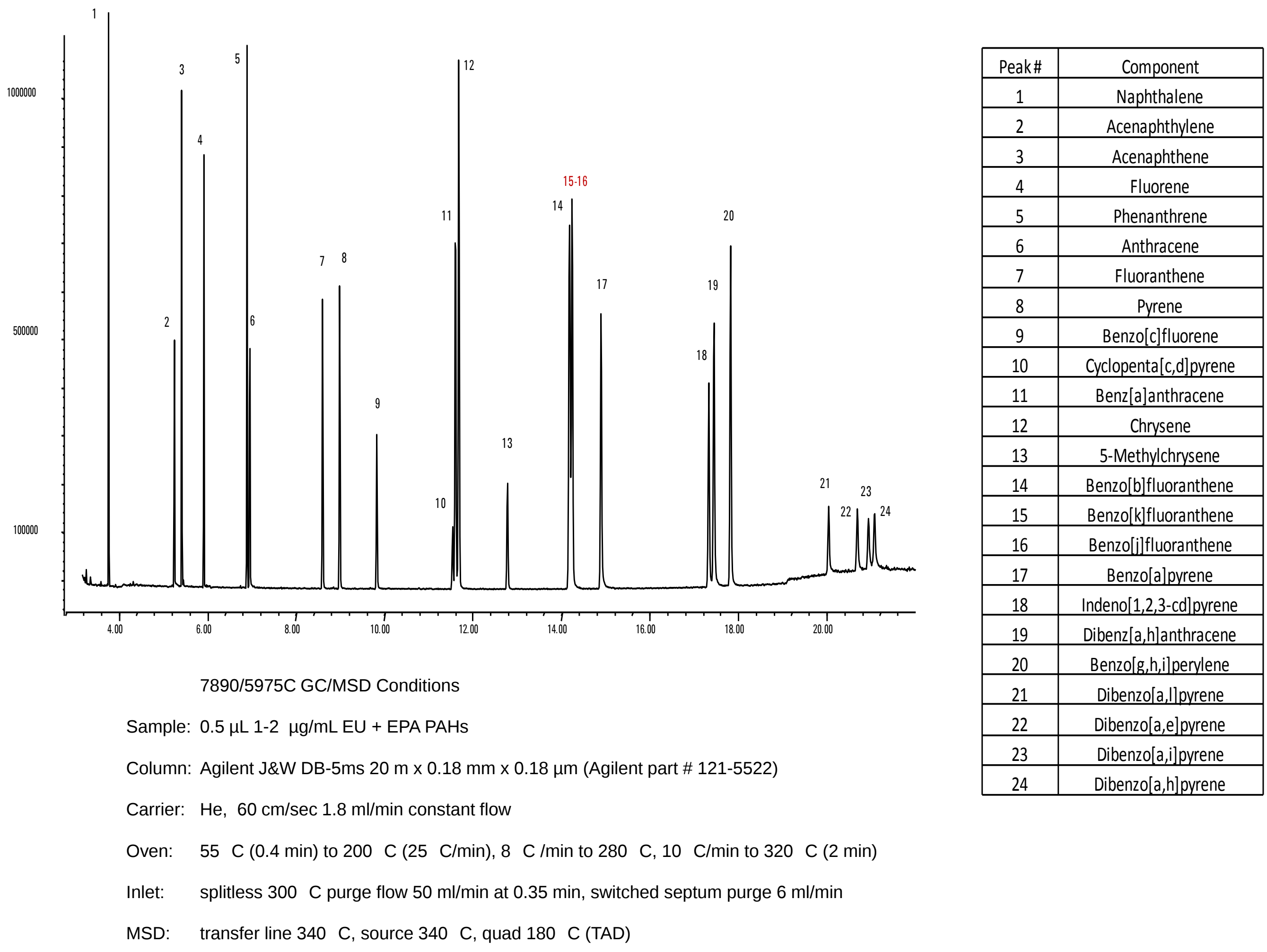
Table 1. Regulated PAH compounds shown in plain text are included only in the US-EPA set, compounds in *Italic* are included only in the EU 15+1 list, and the compounds in **bold** are included in **both the US-EPA and EU 15+1 lists**.

Example Chromatograms

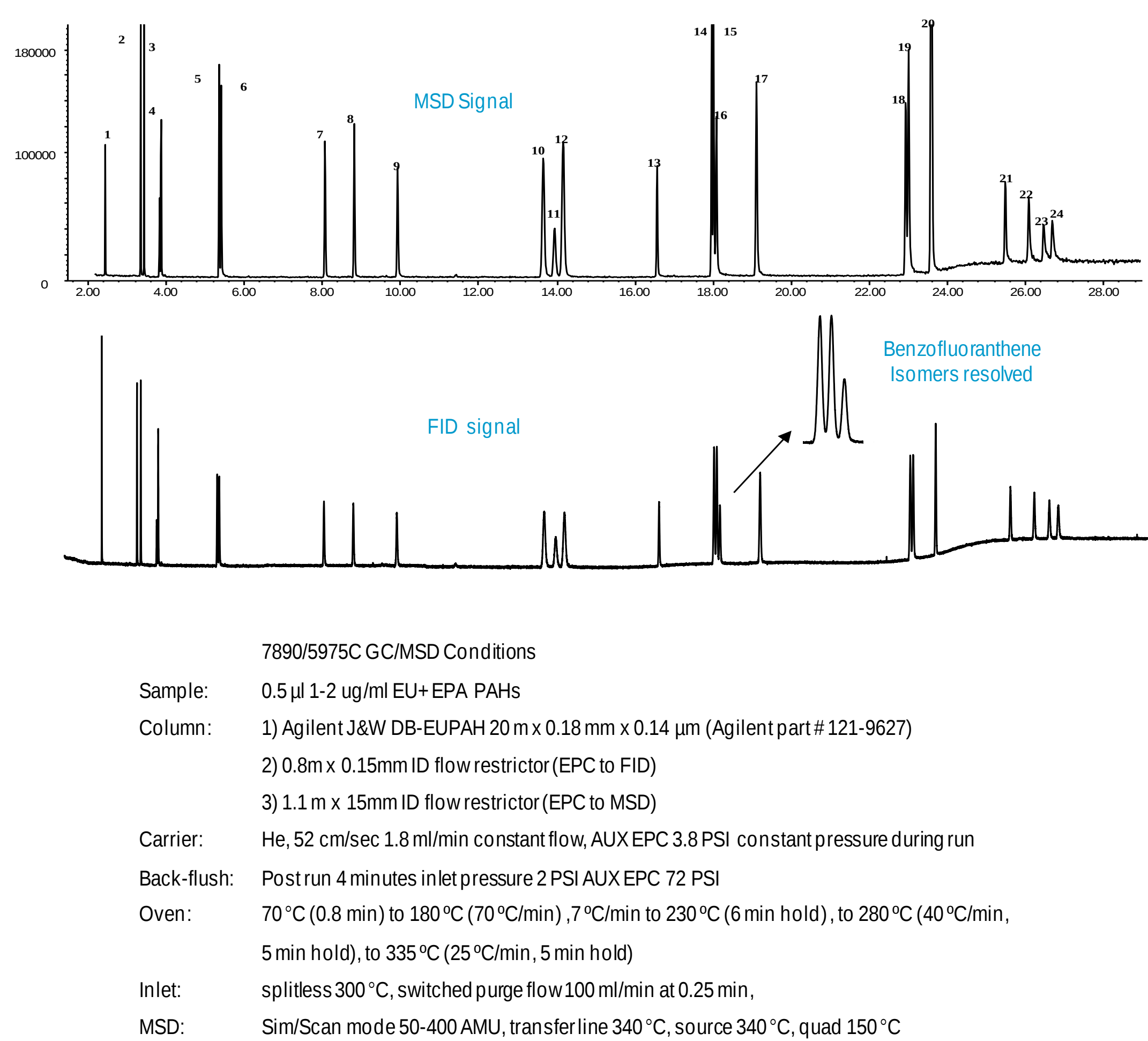
European Union 15+1 and US-EPA PAH Separation Agilent J&W DB-EUPAH 20m x 0.18mm x 0.14µm



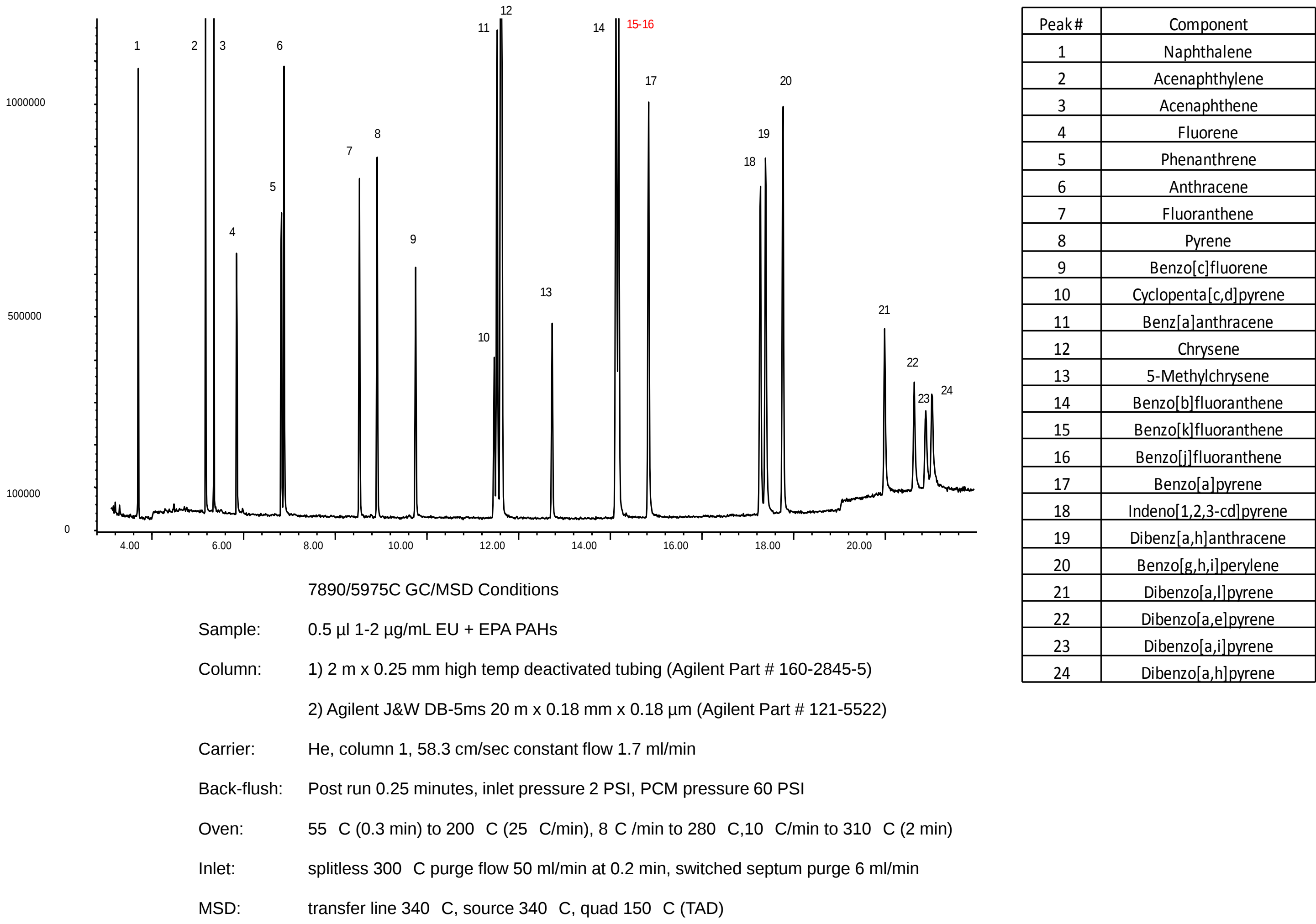
European Union 15+1 and US-EPA PAH Separation Agilent J&W DB-5ms 20m x 0.18mm x 0.18µm



European Union 15+1 and US-EPA PAH Separation Agilent J&W DB-EUPAH 20m x 0.18mm x 0.18µm with back-flush



European Union 15+1 and US-EPA PAH Separation Agilent J&W DB-5ms 20m x 0.18mm x 0.18µm with back-flush



Results Summary

- DB-EUPAH column resolves combined EU and US-EPA regulated PAHs in under 28 minutes
- DB-5ms column resolves 23 of 24 EU and US-EPA regulated PAHs in under 22 minutes
- Back-flush is available with either approach to minimize deleterious matrix effects

Factors to Consider in Optimizing PAH Analyses

- When benzo[b,j,k]fluoranthene resolution is required choose a DB-EUPAH column.
- When benzo [b,j,k] fluoranthene isomers can be summed choose a DB-5ms column for 27% faster analysis.
- Consider the use of retention gaps and inlet back-flushing to reduce cycle time
- Achieve faster analysis times with no loss of resolution using 0.18 mm ID High Efficiency GC columns.
- Optimize injection volume, temperature, purge time, and solvent focusing on each instrument.
- Minimize inlet and system dwell time with high linear velocities.
- Keep heated zones hot to avoid cold spots

For More Information

To learn more about Agilent J&W GC/MS and Ultra Inert columns – or Agilent products and services – visit us online at www.agilent.com/chem/myGCCcolumns

For the specifics on the applications cited here enter the Agilent Publication (XXXX-XXXXEN) number in the part number field for free display or download of the application note

Pertinent References

Polycyclic Aromatic Hydrocarbon (PAH) Analysis Using an Agilent J&W DB-5ms Ultra Inert Capillary GC Column, Kenneth Lynam and Doris Smith, 5989-9181EN

GC/MS Analysis of European Union (EU) Priority Polycyclic Aromatic Hydrocarbons (PAHs) Using an Agilent J&W DB-EUPAH GC Column with a Column Performance Comparison, Doris Smith and Ken Lynam 5990-4883EN

PAH Analyses with High Efficiency GC Columns: Column Selection and Best Practices, Ken Lynam 5990-5872EN

