

# SEPARATOR™

VESTEC  
CORPORATION



# The Solution to LC-EI from the Dedicated LC-MS People

Since Vestec invented Thermospray™ LC-MS, it has become a practical technique in more than 400 laboratories. We remain the source for innovations in LC-MS—Vestec people are committed to developing product advances that make complex liquid chromatography tasks routine.

Our latest example of this commitment is the Vestec SEPARATOR™. We integrated our Dedicated Model 201 with the Vestec SEPARATOR—and made LC-EI a routine but highly sensitive analytical tool. Using a combination of uniquely designed hardware, this system interfaces liquid chromatography to electron ionization mass spectrometry. The SEPARATOR optimizes sample throughput and guarantees superior data reproducibility for LC-EI, with the added benefit of allowing the operator to also do Thermospray LC-MS on the same instrument with a "flick of a switch."

**The SEPARATOR ...  
a simple, straightforward  
design that makes LC-EI routine  
and cost-efficient**

## Why and How It Works

The SEPARATOR allows an essentially solvent-free sample to be introduced into the mass spectrometer, optimizing information over a broad range of applications. The SEPARATOR in its simplest form is shown in *Figure 1*. It comes complete with our Universal Interface™ with a vaporizer/nebulizer chamber, a diffusion cell, flow controllers and associated electronics; a pumping system; and a two-stage momentum separator.

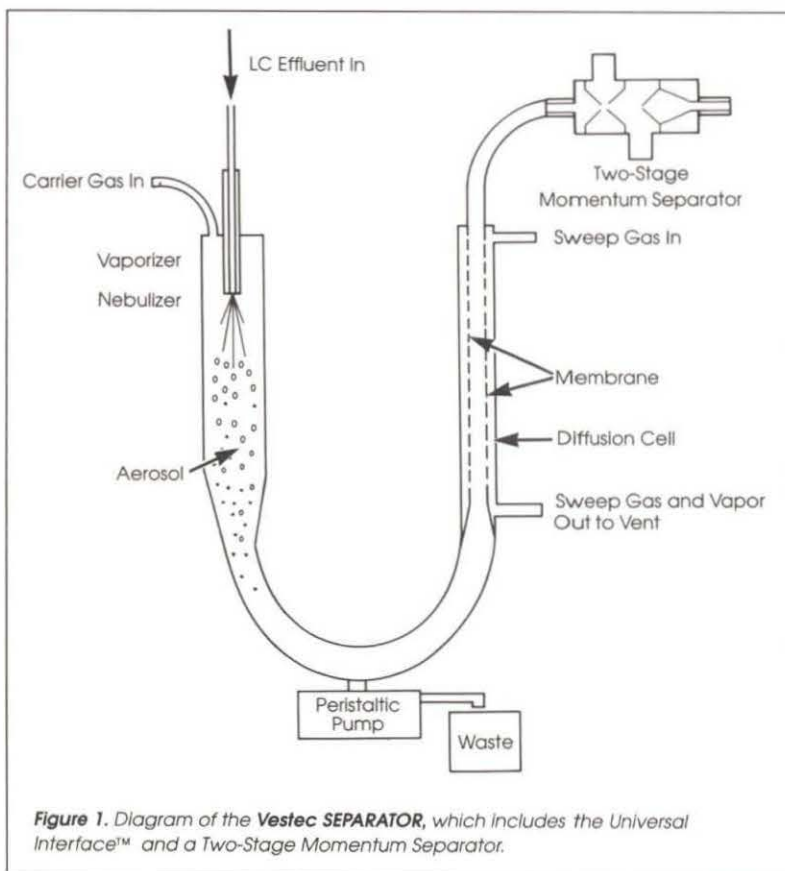
In operation, it uses a Vestec replaceable-tip vaporizer to vaporize/nebulize the HPLC effluent at flow rates of up to 2 mls/min. The aerosol that is formed consists of solvent vapor and unvaporized sample particles. Together with an inert carrier gas, the aerosol passes through a countercurrent flow gas diffusion cell, where most of the solvent is removed.

The resulting dry aerosol is then transmitted to the mass spectrometer using a two-stage momentum separator, where the concentration of particles relative to the solvent vapor and carrier gas is significantly increased.

## Simple to Operate

A technician can begin operating the system with minimal training. After initial setup, sample throughput and data collection can continue uninterrupted because no in-process tuning or adjustments are required.

Typical results illustrating the sensitivity of the interface and its ability to deal with gradient elution chromatography involving aqueous mobile phases can be seen in *Figure 2* and *Table I*.



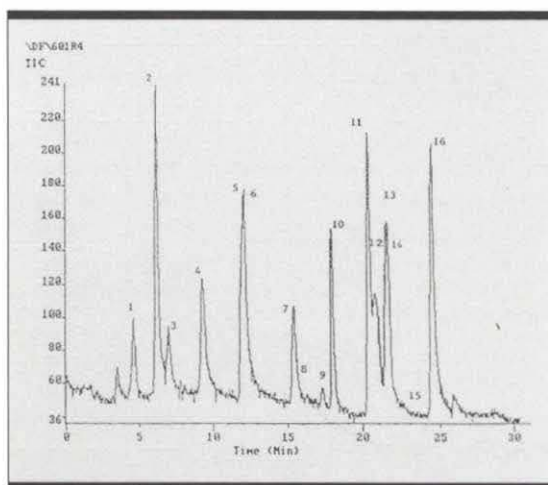
**Figure 1.** Diagram of the Vestec SEPARATOR, which includes the Universal Interface™ and a Two-Stage Momentum Separator.

\*Thermospray, SEPARATOR and Universal Interface are patented products of Vestec Corp.

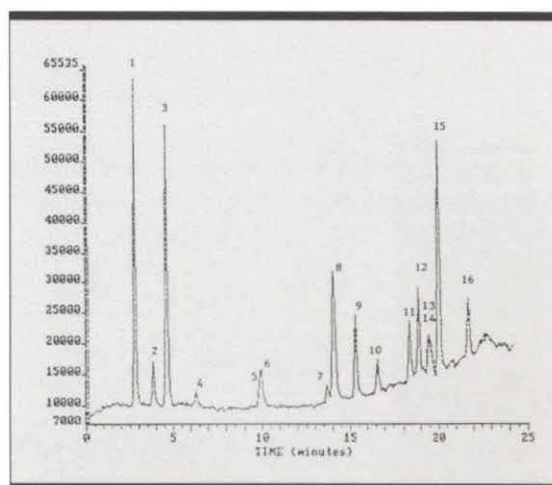
Thermospray and SEPARATOR are trademarks of Vestec Corp.

**Table III 16 Compounds in EPA Test Mixture**

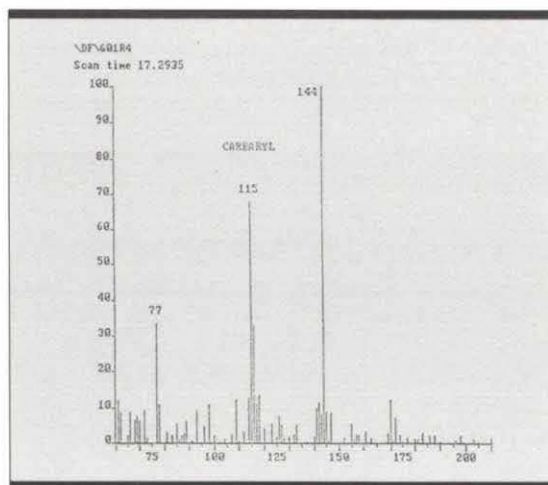
	MW
1. Ethylene Thiourea	102
2. Aldicarb	222
3. Methomyl	162
4. p-Chlorophenyl Thiourea	186
5. Benzidine	184
6. N(1-Naphthyl) Thiourea	202
7. 3,3'-Dimethoxybenzidine	244
8. Carbofuran	221
9. Carbaryl	201
10. Diuron	232
11. Siduron	232
12. Methiocarb	225
13. 3,3'-Dichlorobenzidine	252
14. Linuron	248
15. Mexacarbate	222
16. Rotenone	394



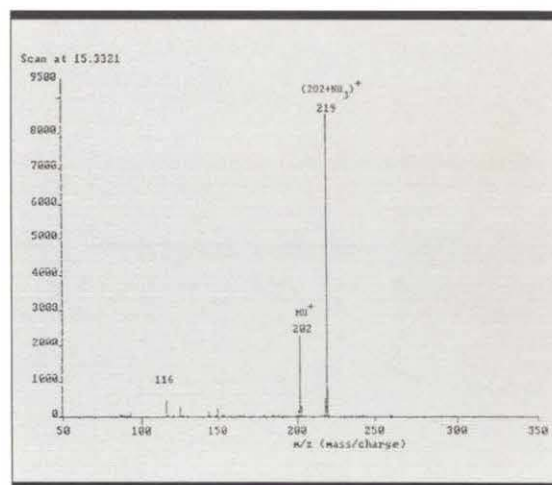
**Figure 5a.** Total ion chromatogram using the Vestec SEPARATOR and EI for 16 compounds from EPA test mixture listed in Table III.



**Figure 5b.** Total ion chromatogram of EPA test mixture using Thermospray positive ion discharge ionization and gradient reverse phase HPLC.



**Figure 6.** Electron ionization spectrum of carbaryl.



**Figure 7.** Positive ion discharge ionization spectrum of carbaryl using the Vestec Dedicated Model 201.

## Enhancing Thermospray with the SEPARATOR

Thermospray, either alone or in combination with filament-aided or discharge ionization, is now the most widely used LC-MS interface. It's an ionization method in its own right and gives molecular weight information. This is ideal for applications such as the determination of peak purity or quantitation, but further information is required for unambiguous structural confirmation.

For this application, the Vestec SEPARATOR represents a relatively inexpensive yet equally powerful alternative to the more time-, labor- and cost-intensive mass spectrometry techniques, such as MS/MS, traditionally employed in acquiring this information.

## Performance That Counts

Thermospray and EI are illustrated by the chromatograms given in Figure 5a and Figure 5b. The 16 compounds and the molecular weights for the compounds analyzed are listed in Table III.

Figures 5a & b show the total ion current trace obtained from a mixture of 16 pesticides analyzed using (a) electron ionization and (b) Thermospray and the Vestec SEPARATOR. Differences in relative response between the two techniques are apparent. An examination of the spectra from carbaryl shows that

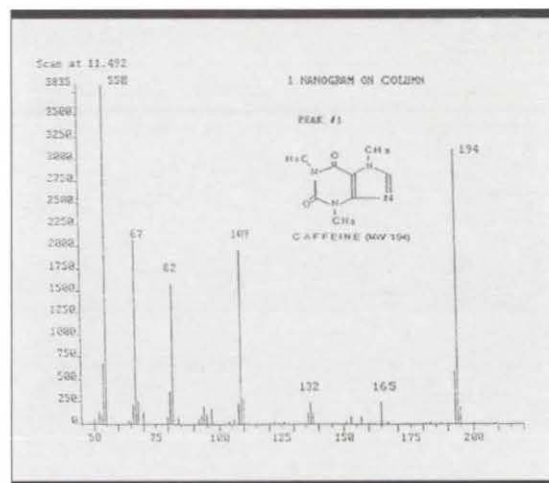


Figure 4. Electron ionization spectrum of 1 ng of caffeine. HPLC peak #1 from gradient reverse phase conditions.

molecular weight information is absent in the EI spectrum but readily available from the Thermospray data. The NBS spectrum of carbaryl compares nicely with that obtained using the Vestec SEPARATOR. The electron ionization spectrum of carbaryl, which is peak 9, at retention time 17.29 minutes, is given in Figure 6. The Thermospray spectrum of this compound, eluting at 15.32 minutes, is shown in Figure 7.

## Interfacing the SEPARATOR to Your Lab's MS

Your chromatography laboratory can use the Vestec SEPARATOR to perform LC-EI on any existing mass spectrometer, whether quadrupole or magnetic sector. Our 1700 Series interfaces include the complete HPLC System and the SEPARATOR, packaged in a two-bay roll-about cart. It may be ordered with Thermospray or electron ionization interfaces or with both. The 700 Series interfaces are available in floor-standing or benchtop cabinets.

## Put Vestec's SEPARATOR technology to work for you.

The Vestec SEPARATOR is a unique product that turns your mass spectrometer into the ultimate chromatography detector. Its ability to perform complex analyses quickly and easily reflects our commitment to placing LC-MS in the hands of the scientist solving today's real-world problems. Contact us for more information on how Vestec really makes LC-MS work for you.

Table II Performance Characteristics of the Vestec SEPARATOR

1. Sample Transfer Efficiency	0.7 ± 0.2
2. Solvent Transfer Efficiency	< 10 <sup>-6</sup>
3. Linearity	Excellent
4. Sensitivity	Same as GC-MS
5. Dependence on Flow Rate	None
6. Dependence on Solvent Composition	Negligible
7. Loss in Chromatographic Fidelity	Negligible
8. Quality of EI Spectra	Library Searchable
9. Compatibility with EI Instruments	All (including benchtops)
10. Compatibility with LC Separations	All (except nonvolatile buffers)
11. Critical Adjustments	None

Table I Summary of Results

Peak #	Compound Name	R.T. (min)	MW	m/z	LOD (ng)	LOQ (ng)
1	Caffeine	11.4	194	194	0.05	0.2
2	4,4'-Diaminophenyl Ether	13.0	200	200	0.2	1
3	Benzidine	13.4	184	184	0.1	1
4	Strychnine	14.1	334	334	2	50
5	4,4'-Methylenebis (Aniline)	14.5	198	198	0.2	1
6	Cycloheximide	15.0	281	126	5	25
7	Cyclophosphamide	15.1	260	211	1	25
8	3,3'-Dimethoxybenzidine	16.2	244	244	0.3	1
9	4,4'-Thiobis (Aniline)	17.2	216	216	0.3	1
10	Auramine O	19.5	267	267	0.3	1
11	Warfarin	20.4	308	131	1	25
12	3,3'-Dichlorobenzidine	21.5	252	252	0.2	1
13	Methylenebis (O-Chloroaniline)	21.9	266	131	0.3	1
14	Michler's Ketone	23.1	268	268	0.05	0.5
15	Rotenone	23.3	394	192	0.3	1
16	Tetrachlorobisphenol A	24.6	364	351	5	100
17	Malachite Green	25.2	364	330	0.3	1
18	Tetrabromobisphenol A	25.9	540	529	50	500

LOD limits of detection defined as signal level approximately 3X noise at the major ion or ions monitored.

LOQ limits of quantitation defined as estimate of minimum sample required to provide spectrum of sufficient quality to allow unambiguous compound identification and reliable quantitation.

### Uncompromised Sensitivity

Efficient solvent removal and high sample transfer efficiencies provide uncompromised sensitivities. The compounds in the mixture shown in Figure 2, representing a wide range of chemical classes, give EI spectra at the 1 nanogram level. The spectra from 1 ng of caffeine and Michler's ketone injected on the column, shown in Figure 3 and Figure 4, are essentially identical to those in the NBS library. See Table II for a summary of performance characteristics of the Vestec SEPARATOR.

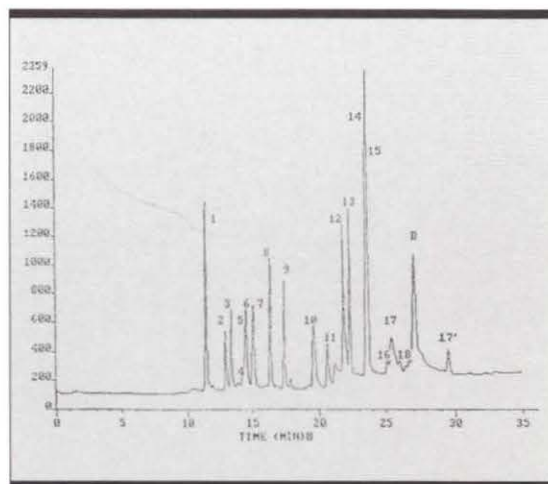


Figure 2. Gradient HPLC total ion chromatogram of approximately 250 ng each of 18 components using reversed phase conditions and electron ionization mass spectrometry.

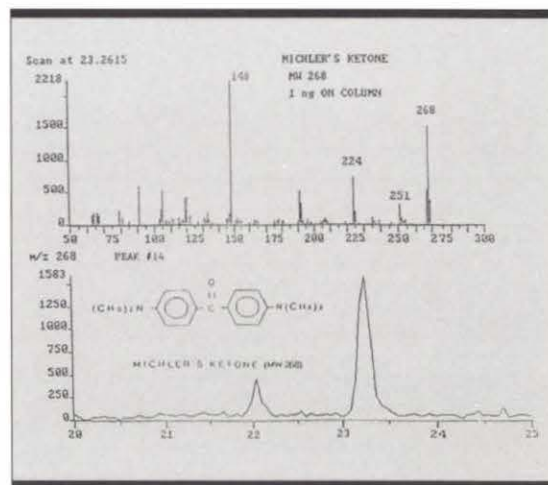
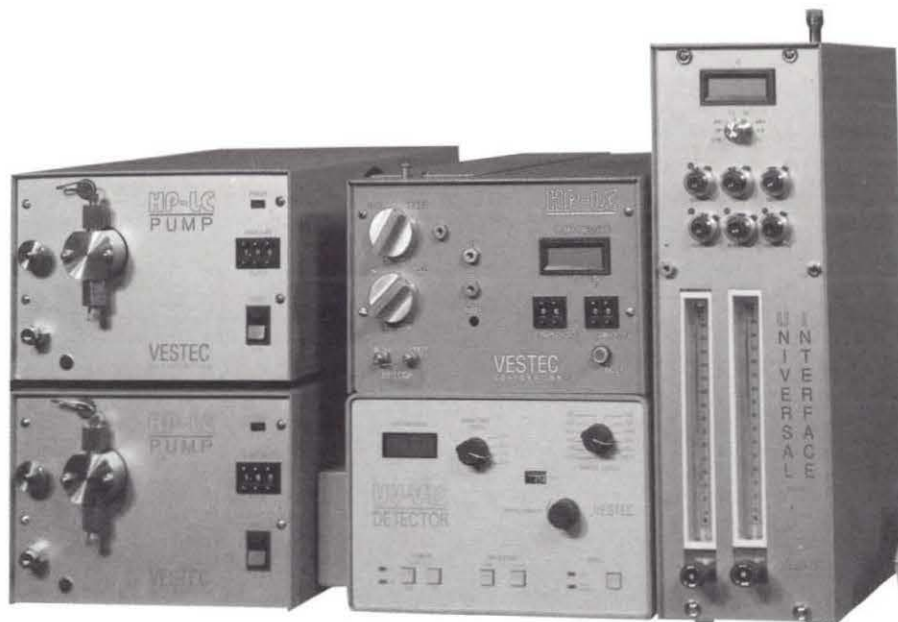


Figure 3. Electron ionization spectrum of 1 ng of Michler's ketone injected on column and a single ion chromatogram at m/z 260 the parent peak.



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