



Featured Application: 231 Pain Management and Drugs of Abuse Compounds in under 10 Minutes by LC-MS/MS

Big Pain Assays Aren't a Big Pain with the Raptor Biphenyl LC Column

- 231 compounds, 40+ isobars, 10 drug classes, 22 ESI- compounds in 10 minutes with 1 column.
- A Raptor SPP LC column with time-tested Restek Biphenyl selectivity is the most versatile, multiclass-capable LC column available.
- Achieve excellent separation of critical isobars with no tailing peaks.
- Run fast and reliable high-throughput LC-MS/MS analyses with increased sensitivity using simple mobile phases.

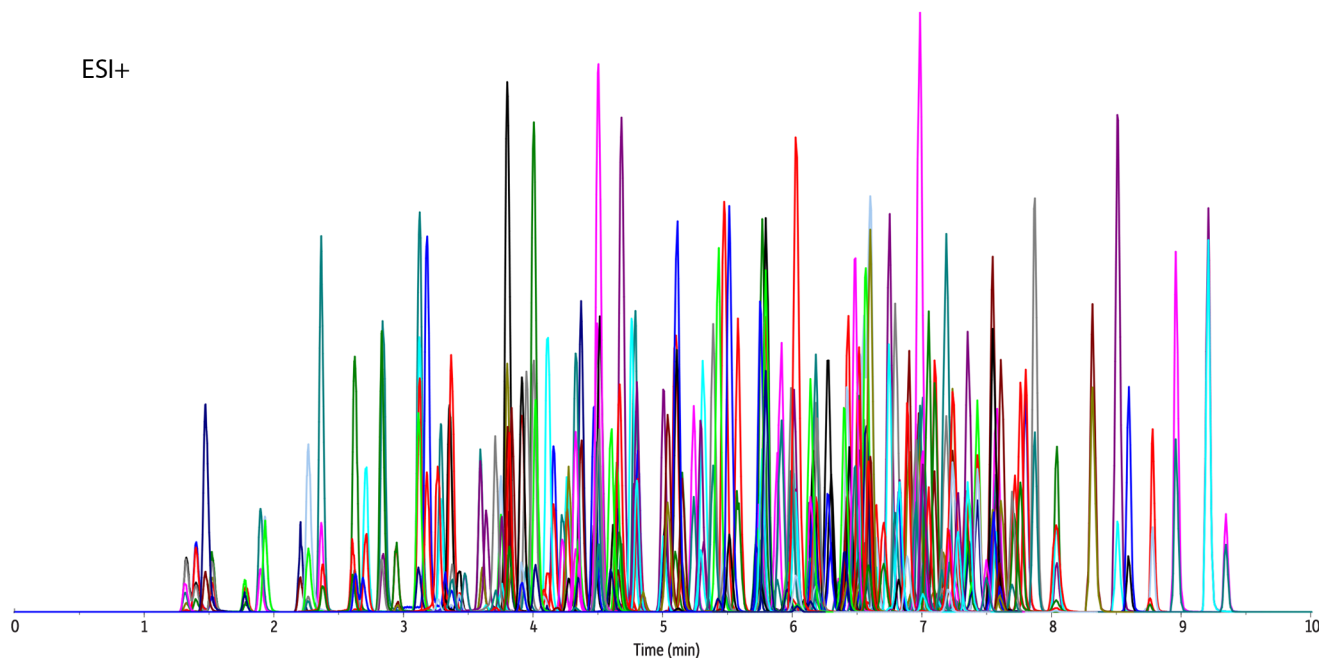
The use of pain management drugs is steadily increasing. As a result, hospital and reference labs are seeing an increase in patient samples that must be screened for a wide variety of pain management drugs to prevent drug abuse and to ensure patient safety and adherence to their medication regimen. Therapeutic drug monitoring can be challenging due to the low cutoff levels, potential matrix interferences, and isobaric drug compounds. To address these challenges, many drug testing facilities are turning to liquid chromatography coupled with mass spectrometry (LC-MS/MS) for its increased speed, sensitivity, and specificity.

As shown in the analysis below, Restek's Raptor Biphenyl column is ideal for developing successful LC-MS/MS pain medication screening methodologies. With its exceptionally high retention and unique selectivity, 231 multiclass drug compounds and metabolites—including over 40 isobars—can be analyzed in just 10 minutes. In addition, separate panels have been optimized on the Raptor Biphenyl column specifically for opioids, antianxiety drugs, barbiturates, NSAIDs and analgesics, antidepressants, antiepileptics, antipsychotics, hallucinogens, and stimulants for use during confirmation and quantitative analyses.

For more information on Restek's "Big Pain" analysis, visit www.restek.com/bigpain

Raptor
LC Columns

ESI+

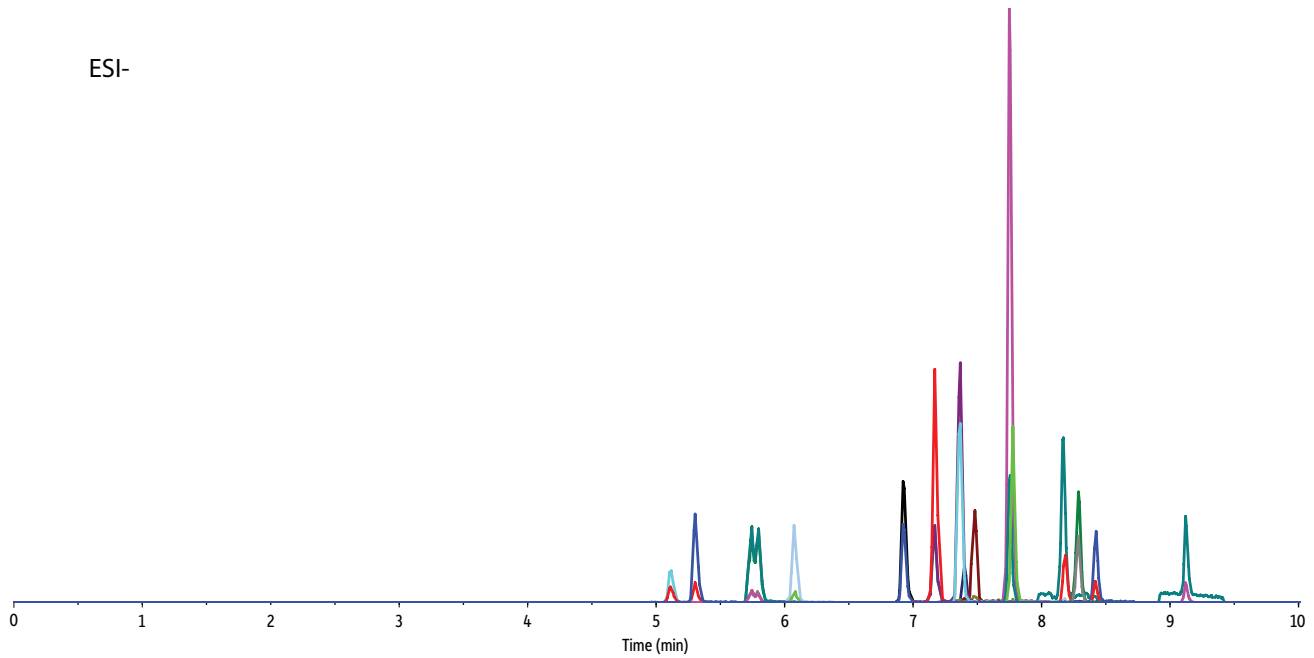


RESTEK

Pure Chromatography

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ESI-



LC_CF0621

Multiclass Drug Panel on Raptor Biphenyl by LC-MS/MS

Peaks	tr (min)	Conc. (ng/mL)	Precursor Ion	Product Ion	Product Ion	Peaks	tr (min)	Conc. (ng/mL)	Precursor Ion	Product Ion	Product Ion
1. <i>trans</i> -3-Hydroxycotinine	1.32	25	193.1	80.0	134.0	41. Diethylpropion	3.80	25	206.2	105.1	100.1
2. Norcotinine	1.33	25	163.1	80.1	118.1	42. Mephedrone	3.80	25	178.2	145.0	160.1
3. Nicotine	1.40	25	163.2	130.1	117.1	43. 2-Oxo-3-hydroxy-LSD	3.82	25	356.3	237.0	222.0
4. BZP	1.47	25	177.2	91.1	65.1	44. <i>o</i> -Desmethylvenlafaxine	3.84	25	264.1	58.1	107.0
5. Anabasin	1.53	25	163.2	120.1	80.1	45. 6-β-Naltrexol	3.91	25	344.3	326.1	308.1
6. Noroxymorphone	1.78	25	288.1	270.1	212.9	46. Tapentadol-β-D-glucuronide	3.91	25	398.3	222.1	107.0
7. Lisdexamfetamine	1.79	25	264.2	84.1	91.0	47. 7-Aminonitrazepam	3.95	25	252.2	121.1	94.2
8. Phenelzine sulfate	1.90	25	137.2	105.1	77.1	48. MDEA	4.00	25	208.1	163.0	105.2
9. Acetaminophen	1.93	100	152.2	93.0	65.0	49. <i>m</i> -Hydroxybenzoylecgonine	4.02	25	306.1	168.1	121.0
10. Pregabalin	2.21	25	160.2	142.1	55.0	50. Lamotrigine	4.09	25	256.0	211.1	145.0
11. Cotinine	2.27	25	177.2	80.0	98.1	51. Ritalinic acid	4.11	25	220.1	84.1	56.2
12. Morphine	2.27	25	286.2	152.1	165.0	52. N-Desmethyltapentadol	4.16	25	208.1	121.2	107.1
13. (+)-Ephedrine	2.37	25	166.2	148.1	115.0	53. Norbuprenorphine glucuronide	4.18	25	590.5	414.3	165.0
14. Oxymorphone	2.38	25	302.1	227.2	198.2	54. Zonisamide	4.23	25	212.9	132.1	77.1
15. Hydromorphone	2.61	25	286.2	184.9	156.9	55. mCPP	4.26	25	197.1	154.0	118.1
16. Amphetamine	2.63	25	136.2	91.0	65.1	56. Norketamine	4.28	25	224.1	125.0	89.1
17. DMAA	2.65	25	116.1	57.1	99.2	57. Nalbuphine	4.33	25	358.2	340.1	115.0
18. Gabapentin	2.71	25	172.2	154.0	137.1	58. Norfentanyl	4.33	25	233.1	84.1	55.0
19. Methylephedrine	2.83	25	180.2	162.0	115.1	59. (+/-)-Hydroxybupropion	4.35	25	256.0	130.2	166.0
20. Levetiracetam	2.84	25	171.1	125.9	69.2	60. Tapentadol	4.37	25	222.1	107.1	121.0
21. Desmethyloanzapine	2.94	25	299.1	256.1	198.0	61. Lacosamide	4.47	25	251.5	91.1	108.1
22. Norcodeine	2.96	25	286.1	151.9	115.0	62. Dextrorphan	4.50	25	258.2	157.0	201.2
23. Olanzapine	3.12	25	313.2	256.1	198.1	63. Levorphanol	4.50	25	258.2	156.8	199.2
24. Methamphetamine	3.13	25	150.3	91.1	119.0	64. 7-Hydroxyquetiapine	4.51	25	400.3	269.0	208.0
25. MDA	3.18	25	180.1	163.1	105.2	65. Molindone	4.51	25	277.2	100.1	70.2
26. (-)-Naloxone	3.27	25	328.3	310.1	212.3	66. Tramadol	4.52	25	264.2	58.0	77.1
27. Phentermine	3.29	25	150.2	91.1	133.1	67. Zolpidem phenyl-4-carboxylic acid	4.60	25	338.2	265.1	219.0
28. Noroxycodone	3.32	25	302.1	227.0	197.9	68. Felbamate	4.62	25	239.1	117.1	177.8
29. Methylone	3.36	25	208.1	160.1	132.1	69. N-Desmethyl- <i>cis</i> -tramadol	4.65	25	250.2	44.0	232.1
30. <i>O</i> -Desmethyl- <i>cis</i> -tramadol	3.37	25	250.1	58.0	42.0	70. Ketamine	4.66	25	238.1	125.1	89.1
31. (-)-Dihydrocodeine	3.38	25	302.2	199.0	128.2	71. Benzoylecgonine	4.67	25	290.1	168.1	77.1
32. Norhydrocodone	3.43	25	286.1	199.0	128.2	72. Methylphenidate	4.68	25	234.1	84.1	56.1
33. Codeine	3.43	25	300.2	152.0	165.1	73. Normeperidine	4.76	25	234.1	160.2	91.0
34. 6-Acetylmorphine	3.47	25	328.2	165.0	211.0	74. Meprobamate	4.79	25	219.1	158.2	97.0
35. MDMA	3.60	25	194.2	163.0	135.1	75. Meperidine	4.80	25	248.1	220.1	174.1
36. Desomorphine	3.61	25	272.1	152.1	165.0	76. Bupropion	4.81	25	240.0	184.1	130.2
37. Oxycodone	3.64	25	316.2	298.0	169.0	77. Heroin	4.85	25	370.4	328.2	164.9
38. Naltrexone	3.71	25	342.2	324.0	267.0	78. Cocaine	5.01	25	304.2	182.0	77.1
39. Levamisole	3.75	25	205.1	178.0	91.1	79. 7-Aminoclonazepam	5.02	25	286.1	121.2	250.1
40. Hydrocodone	3.76	25	300.1	199.0	128.0	80. Zopiclone	5.04	25	389.2	245.0	217.2

Peaks	tr (min)	Conc. (ng/mL)	Precursor Ion	Product Ion	Product Ion	Peaks	tr (min)	Conc. (ng/mL)	Precursor Ion	Product Ion	Product Ion
81. N-Desmethylmirtazapine	5.10	25	252.1	195.1	209.2	157. N-Desmethylflunitrazepam	6.80	25	300.1	254.1	198.1
82. Norcocaine	5.11	25	290.1	168.0	136.1	158. Lorazepam	6.82	25	321.1	275.0	229.0
83. Phenobarbital*	5.11	500	230.9	187.8	85.0	159. Mesoridazine	6.83	25	387.2	126.1	98.2
84. Buprenorphine glucuronide	5.12	25	644.3	468.2	55.1	160. Tiagabine	6.89	25	376.2	246.8	111.1
85. MDPV	5.15	25	276.2	135.1	126.1	161. Ketorolac	6.90	25	256.1	104.9	77.0
86. Venlafaxine	5.15	25	278.4	260.4	121.2	162. Chlorpromazine	6.91	25	320.1	58.1	86.1
87. Milnacipran	5.24	25	247.2	100.1	129.1	163. Loxoprofen*	6.93	200	245.0	83.2	80.9
88. Pentazocine	5.29	25	286.2	218.1	69.2	164. Clomipramine	6.95	25	315.3	86.0	58.0
89. Mirtazapine	5.31	25	266.1	195.1	72.1	165. Oxazepam	6.96	25	287.1	241.2	268.8
90. Butalbital*	5.31	500	223.0	180.0	84.9	166. Methadone	6.98	25	310.2	264.9	105.1
91. Norbuprenorphine	5.35	50	414.3	152.2	165.2	167. Sertraline	6.98	25	306.2	158.9	275.1
92. LSD	5.39	25	324.3	223.1	208.0	168. Dehydro aripiprazole	7.01	25	446.2	285.0	98.1
93. Butorphanol	5.43	25	328.3	310.3	131.2	169. Clonazepam	7.01	25	316.1	270.0	214.1
94. Fosphenytoin	5.43	25	363.1	265.9	207.8	170. Nitrazepam	7.01	25	282.1	235.9	180.1
95. Topiramate	5.44	25	340.2	264.2	223.9	171. Lornoxicam	7.02	100	373.1	121.1	95.0
96. Cocaehtylene	5.48	25	318.2	196.1	82.0	172. 25I-NBOMe	7.05	25	428.1	121.2	91.1
97. Clozapine	5.48	25	328.2	271.1	193.1	173. Salsalate*	7.05	100	256.8	136.8	92.9
98. 9-Hydroxyrisperidone	5.51	25	427.3	207.1	110.2	174. Desalkylflurazepam	7.09	25	289.0	140.1	104.0
99. Acetyl fentanyl	5.58	25	323.3	188.0	105.0	175. Tolmetin	7.10	25	258.1	119.1	91.0
100. Didesmethyl citalopram HCl	5.73	25	297.1	261.9	109.1	176. α -Hydroxytriazolam	7.12	25	359.1	330.9	175.9
101. 7-Aminoflunitrazepam	5.75	25	284.1	135.0	227.1	177. Fluphenazine	7.16	25	438.3	171.1	143.2
102. Amobarbital*	5.75	500	225.0	182.0	84.8	178. 2-Hydroxyethylflurazepam	7.16	25	333.1	211.1	109.0
103. Zolpidem	5.76	25	308.2	235.2	218.9	179. Ketoprofen*	7.17	100	253.0	209.0	-
104. N-Desmethylcitalopram	5.77	25	311.1	262.1	109.1	180. Naproxen*	7.17	200	229.0	168.9	184.9
105. Isocarboxazid	5.77	25	232.0	91.1	65.2	181. EMDP	7.19	25	264.2	235.2	220.3
106. Pentobarbital*	5.79	500	225.0	182.0	84.9	182. Aripiprazole	7.20	25	448.2	285.0	176.1
107. Escitalopram	5.80	25	325.3	109.1	261.9	183. Perphenazine	7.22	25	404.2	171.1	143.2
108. Citalopram	5.80	25	325.2	109.1	262.0	184. Etoricoxib	7.24	25	359.2	280.0	279.2
109. Diphenhydramine	5.80	25	256.1	167.0	152.1	185. Methaqualone	7.24	25	251.1	91.1	132.2
110. Desmethyldoxepin	5.88	25	266.1	107.1	115.0	186. α -Hydroxyalprazolam	7.25	25	325.1	297.0	216.2
111. Exogabine	5.91	25	304.0	230.1	109.1	187. Trifluoperazine	7.28	25	408.2	141.2	113.1
112. Doxepin	5.96	25	280.1	107.2	77.1	188. Piroxicam	7.34	25	332.1	95.2	78.1
113. Haloperidol	5.96	25	377.2	123.0	95.1	189. Ibuprofen*	7.34	200	205.0	160.9	-
114. Fluvoxamine	5.97	25	319.3	71.1	257.8	190. Prochlorperazine	7.36	25	374.1	141.0	113.1
115. Trazodone	5.99	25	372.3	176.1	148.0	191. Etodolac*	7.36	50	286.0	241.9	212.0
116. Norfluoxetine	6.01	25	296.3	134.3	104.9	192. Nordiazepam	7.37	25	271.0	139.9	208.0
117. Fentanyl	6.02	25	337.3	188.0	105.1	193. Phenazepam	7.39	25	349.1	206.2	179.0
118. Oxcarbazepine	6.02	25	253.1	180.0	208.1	194. Fenoprofen*	7.40	200	240.9	92.8	-
119. Risperidone	6.03	25	411.2	191.0	110.1	195. Zaleplon	7.43	25	306.1	264.0	236.0
120. Buprenorphine	6.04	50	468.3	55.1	414.2	196. Clobazam	7.43	25	301.0	259.1	224.0
121. Fluoxetine	6.05	25	310.1	148.0	115.1	197. Flurbiprofen*	7.48	200	243.0	199.0	196.8
122. Secobarbital*	6.08	500	237.0	193.9	84.8	198. Thiothixene	7.50	25	444.2	221.2	235.0
123. Phenytoin	6.12	25	253.0	103.9	181.7	199. Flunitrazepam	7.55	25	314.2	267.9	239.1
124. Carisoprodol	6.13	25	261.1	176.0	62.0	200. Meloxicam	7.55	25	352.1	115.0	141.0
125. Flurazepam	6.14	25	388.2	315.2	183.0	201. Triazolam	7.58	25	343.1	307.9	315.0
126. Chlordiazepoxide	6.14	25	300.1	282.0	227.0	202. Estazolam	7.58	25	295.1	266.9	205.1
127. Dextromethorphan	6.16	25	272.2	215.1	170.9	203. Celecoxib	7.60	25	382.2	362.0	300.1
128. PCP	6.18	25	244.2	86.1	159.1	204. Parecoxib	7.60	25	371.2	234.0	165.1
129. Tenoxicam	6.18	25	338.1	121.0	95.0	205. Temazepam	7.61	25	301.1	255.1	282.9
130. Buspirone	6.20	25	386.3	122.1	95.0	206. Sulindac	7.70	25	357.2	233.1	248.0
131. Quetiapine	6.28	25	384.2	253.0	221.2	207. Alprazolam	7.72	25	309.1	280.9	204.9
132. Norpropoxyphene	6.29	25	326.4	252.0	91.1	208. Flufenamic acid*	7.75	50	279.9	236.1	176.2
133. Propoxyphene	6.30	25	340.3	265.9	58.1	209. Thioridazine	7.76	25	371.2	126.1	98.1
134. Asenapine	6.35	25	286.2	165.1	229.1	210. Diclofenac*	7.78	100	293.9	249.8	-
135. Ziprasidone	6.40	25	413.2	194.1	130.0	211. Nabumetone	7.80	25	229.1	171.1	128.1
136. Protriptyline	6.42	25	264.1	191.1	165.2	212. Oxaprozin	7.87	25	294.1	103.0	234.2
137. Promazine	6.42	25	285.1	58.0	86.0	213. HU-211	8.03	25	387.3	155.9	128.1
138. Midazolam	6.43	25	326.2	291.1	248.9	214. JWH-200	8.04	25	385.3	155.0	127.1
139. Desipramine	6.43	25	267.1	72.1	193.1	215. Diazepam	8.04	25	285.1	192.9	153.9
140. Amoxapine	6.44	25	314.2	271.0	193.1	216. Mefenamic acid	8.04	25	242.1	224.1	-
141. Sufentanil	6.48	25	387.2	238.1	111.1	217. Tolfenamic acid*	8.17	50	259.9	215.8	-
142. Imipramine	6.51	25	281.1	86.2	58.1	218. Meclofenamic acid*	8.18	200	293.9	257.8	177.7
143. Paroxetine	6.51	25	330.2	192.2	70.1	219. (+/-)-CP 47,497*	8.27	200	317.1	245.1	159.0
144. Loxapine	6.52	25	328.1	271.1	193.0	220. Indomethacin*	8.29	50	356.0	311.8	296.9
145. Maprotiline	6.52	25	278.1	250.2	191.0	221. Perampanel	8.32	25	350.2	219.1	247.1
146. Duloxetine	6.52	25	298.1	154.1	188.2	222. (+/-)-CP 47,497 C8 homologue*	8.42	200	331.1	259.0	159.1
147. Metaxalone	6.52	25	222.1	161.1	77.1	223. 11-Nor-9-carboxy-delta-9-THC*	8.44	25	343.0	298.9	244.8
148. Carbamazepine	6.55	10	237.1	194.1	165.0	224. Prazepam	8.51	25	325.2	271.0	139.9
149. Cyclobenzaprine	6.56	25	276.2	215.0	189.0	225. XLR-11	8.60	25	330.3	125.2	144.0
150. EDDP	6.57	25	278.2	234.3	249.2	226. Δ^9 -THC	8.76	25	315.2	193.0	123.2
151. Nortriptyline	6.58	25	264.1	91.1	115.2	227. UR-144	8.78	25	312.3	125.1	214.1
152. Mitragnyne	6.59	25	399.3	174.2	159.0	228. JWH-250	8.96	25	336.3	120.9	91.1
153. Eslicarbazepine	6.60	25	297.2	194.0	237.1	229. THCA-A*	9.12	25	357.1	312.9	245.0
154. Amitriptyline	6.65	25	278.1	91.1	202.1	230. JWH-073	9.21	25	328.2	155.0	127.1
155. α -Hydroxymidazolam	6.70	25	342.2	324.1	202.9	231. JWH-018	9.35	25	342.3	127.1	155.1
156. Trimipramine	6.75	25	295.2	100.2	58.2						

* Analyzed using negative polarity.

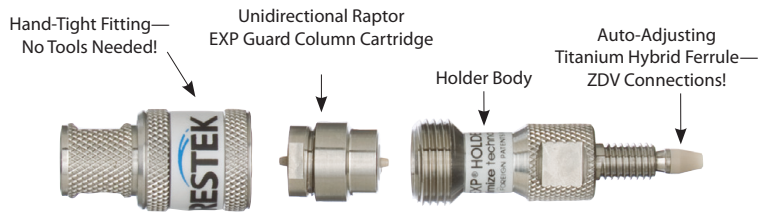
Column: Raptor Biphenyl (cat.# 9309A12); Dimensions: 100 mm x 2.1 mm ID; Particle Size: 2.7 μ m; Guard Column: Raptor Biphenyl EXP guard column cartridge 5 mm, 2.1 mm ID, 2.7 μ m (cat.# 9309A0252); Temp.: 30 $^{\circ}$ C; **Sample:** Diluent: Water; Inj. Vol.: 5 μ L; **Mobile Phase:** A: Water + 0.1% formic acid + 2 mM ammonium formate; B: Methanol + 0.1% formic acid + 2 mM ammonium formate; **Gradient (%B):** 0.00 min (5%), 9.00 min (100%), 10.00 min (100%), 10.01 min (5%), 12.00 min (5%), **Flow:** 0.6 mL/min; **Detector:** MS/MS; Ion Mode: ESI+/ESI-; Mode: Scheduled MRM; **Instrument:** UHPLC; **Notes:** 1. Positive and negative polarity data were collected simultaneously from a single injection. 2. Ibuprofen, fosphenytoin, and topiramate degrade quickly in solution. 3. Levorphanol and dextrophanol are enantiomers and are not resolved. 4. Escitalopram is a pure enantiomer and citalopram is a racemic mixture of both enantiomers. These compounds are not resolved. 5. DMAA consists of 4 stereoisomers, 2 of which are partially resolved. 6. Doxepin and desmethyldoxepin consist of a mixture of *cis/trans* isomers. The isomers are fully resolved and the retention time identifies the main isomer component. 7. Lornoxicam, meloxicam, etodolac, oxaprozin, indomethacin, and mefenamic acid can be detected by positive or negative polarity. The polarity chosen in this chromatogram provides optimal response.

Raptor Biphenyl LC Columns (USP L11)



Description	cat.#
2.7 μm Columns	
100 mm, 2.1 mm ID	9309A12

Raptor EXP Guard Cartridges



Protect your investment and extend the life of our already-rugged LC columns and change guard column cartridges by hand without breaking fluid connections—no tools needed!

EXP Direct Connect Holder

Description	qty.	cat.#
EXP Direct Connect Holder for EXP Guard Cartridges (includes hex-head fitting & 2 ferrules)	ea.	25808

Maximum holder pressure: 20,000 psi (1,400 bar)

Raptor EXP Guard Column Cartridges

Description	Particle Size	qty.	5 x 2.1 mm
			cat.#
Raptor Biphenyl EXP Guard Column Cartridge	2.7 μm	3-pk.	9309A0252

Maximum cartridge pressure: 600 bar/8,700 psi (2.7 μm) or 400 bar/5,800 psi (5 μm).