

INDEX

- Acenaphthalene, 171
Acetaldehyde, 185, 236
Acetate esters, 175
Acetic
 acid, 73, 182, 184
 anhydride, 178
Acetone, 73, 76, 84, 143, 152, 185
Acetonitrile, 127, 184
Acetyl, 65
Acetylene, 29, 127, 160–161, 257–258
Acid-base, 117, 141
Acidity, 111
Acids, 28, 56, 174, 179. *See also specific types of acids*
Acid standard mix, 233
Acid-wash, 23
Acrolein, 181, 185, 248
Acrylate, 105
Acrylic acids, 175, 235
Acrylonitrile, 23, 178, 181, 184, 248
Acrylonitrile-divinylbenzene copolymers, 28
Adsorbents, 2, 6, 15, 22–31, 34
Adsorption
 capillary columns, 101–102, 190
 column performance and, 117
 column preparation and, 56
 gas-liquid, 204
 irreversible, 120
Advanced Separation Technologies, Inc., 156
AED, 97
Agilent Technologies, 12, 110, 135–139, 172
Aircraft industry, 201. *See also Jet fuel*
Air-filtration system, 197
Alcohol retarder column, 268
Alcohols, 29–31, 40–41, 61, 82–83, 85–86, 134, 158, 161, 174–175, 184–185, 236–237, 270
Aldehydes, 30, 40, 117, 134, 161, 185
Aldrin, 186
Aliphatic(s), 24, 31, 65, 158, 185, 238, 241
Alkali metal, 24–25
Alkaloids, 247
Alkanes, 33–35, 40, 117, 120, 161
Alkyds, 174
Alkyl, 156, 158, 272–273
Alltech, 135–139
Allyl chloride, 184
Alprazolam, 61
Alumina, 2, 6, 24, 134, 158, 161
Aluminum
 characteristics of, 101, 105
 -clad capillary column, 106–107, 113
 column, 3–4
 oxide-KCl, 158
 oxide-sodium sulfate, 158
 tubing, 56
Amantadine, 60
Ambient temperature, 29, 32, 192, 212
American Association of Official Analytical Chemists (AOAC), 10
American Laboratory, 13
American Society for Testing and Materials (ASTM)
 column selection, 172
 selection guidelines, 265
 suggested capillary column dimensions, 174–178
 simulated distillation, 201
 test method, 138
Amides, 30
Amiloxate, 60
Amine(s), 28–31, 101, 110, 119, 139, 158, 161, 185, 238–239
Amino
 acids, 158, 239
 alcohols, 158
Aminoethanol compounds, 185
Aminophenol, 76
Amitraz, 62
Ammonia, 24, 29–30, 241
Amobarbital sodium, 84
Ampicillin sodium, 62

- Amyl
 acetate, 143
 alcohol, 176
 nitrite, 62
 Amylene hydrate, 62
 Analysis time
 characteristics of, 50–51
 diameter and, 163–164, 168–170
 film thickness, 163–164, 169
 heated column jacket, 226
 high-speed gas chromatography, 218–219
 megabore columns, 166
 resolution, 167–168
 temperature programming and, 213–214
Analytical Chemistry, Fundamental Reviews, 11–12
 Anhydrous lactose, 62
 Aniline, 76
 Anion, size of, 25
 Anion-cation effects, of adsorbents, 24
 Anisoles, 264
 Annealing, 103
 Antek Instruments, 211
 Anthracene, 171
 Anticonvulsant drugs, 246
 Antidepressants, 246
 Antimicrobial agents, 62
 Apiezon, 5, 16, 34, 38
 Aqueous solutions, 147
 Argon, 28–29, 52, 161, 261
 Aroclors, 240
 Aromatic(s), 23–24, 27, 40, 102, 150, 158, 174, 177–178, 180, 184–185, 241–242, 247
 Atmospheric conditions, significance of, 105
 Atovaquone, 62
 ATR-IR spectrum scan, 27
 Atropine sulfate, 62, 69
 Attenuated total reflectance (ATR), 26–27
 Automotive industry, 201
 Autosamplers, 8
 Availability, 41
 Azelaic acid, 186
 Azobenzene, 62
 Azo compounds, 145–146

 Back-biting, 195
 Baclofen, 62
 Bacterial acid standard, 236
 Ballistic temperature programming, 212
 Band spacing, 33, 172
 Bandwidth, significance of, 97–99, 211
 Barbiturate/barbituric acid assay, 60, 247
 Barium halides, 25
 Base neutrals, 251. *See also* Acid-base

 Based-deactivated columns, 115
 Belladonna extract, 63
 Benzaldehyde, 126
 Benzene(s), 25, 27, 40, 126, 143, 176–178, 185
 Benzidines, 180–181, 186
 Benzocaine, 63
 Benzoic acid, 119
 Benzoquinoline, 5
 Benzyl
 alcohol, 63, 152
 amine, 118
 diphenyl, 5
 salicylate, 119
 Bicyclics, 158
 Bile acid, 236
 Biodiesel fuel, 107
 Biphenyl, 185
 Birth certificate, 119
 Bis(2-ethylhexyl), 5, 36–37
 Bisabolol, 65
 Biscyanopropylsiloxane, 137
 Bleed
 capillary column, 194–195
 film thickness and, 164
 ions, 150
 sources of, generally, 187
 Blood alcohol analysis, 139, 236
 Boiling
 point, 25, 32, 164, 169–170, 174, 176
 range, 175, 178, 200–201, 211
 Bonding, weak, 24. *See also specific types of bonds*
 Boron, 102
 Borosilicate, 95, 115
 Bourbon, 236
 Broadening, 119, 123, 218
 Bromotrifluoromethane, 184
 Brompheniramine, 63
 Büchner funnel, 55
 Bupivacaine, 63
 Butabarbital, 63
 Butadienes, 160–161, 174, 184
 Butanediol, 117–118, 120
 Butanes, 63, 159–161, 260
 Butanethiol, 185
 Butanol, 40, 143, 152
 Butanone, 143, 185
 Butene, 160
 Butorphanol tartrate, 63
 Butyl
 acetate, 143, 152
 alcohol, 63
 benzene, 242

- cellosolve, 143
- characteristics of, 158
- ether, 185
- maleate, 5
- peroxide, 178
- phenols, 264
- Butylated hydroxyanisole, 63
- Butyryl, 65

- Caffeine, 82
- Cages, capillary, 116–117
- Calcium, 101
- Calibration
 - curve, 201
 - qualitative standard, 266
 - SIMDIS blend, 265
- Calmus oil, 127
- Camphorated phenol, 63–64
- Cannabinoids, 245
- Capacity
 - capillary column performance, 131, 161, 164–165
 - fused-silica capillary columns, 166
 - high-speed gas chromatography, 218
 - megabore columns, 168–169
- Capillary column
 - bleed, 194–195
 - conditioning, 192–194
 - economic statistics, 10
 - efficiency, 117, 119, 170–171
 - fatigue, 200
 - ferrule materials and fittings, 190–191, 194
 - ideal, 119
 - gas chromatography, *see* Capillary column gas chromatography
 - guard columns, 196–200
 - installation, 190–191
 - overview of, 27, 279
 - performance, test mixtures for monitoring, 117–119
 - preparation of, 59
 - regeneration, 200
 - reinstallation, 119
 - retention gap, 196–200
 - selection factors, *see* Capillary column selection guidelines
 - separation number, 50
 - stationary phase, 34–35, 41
 - technology, *see* Capillary column technology
 - tool kit, 195
- Capillary column gas chromatography
 - achievements, chronology of, 95–98
 - column installation and care, 186–200
 - column selection, 159–178
 - historical perspectives, 2, 94, 97
 - noteworthy events in, 97
 - overview of, 4–5, 94
 - packed column chromatography compared with, 98–100
 - performance of, 122–132
 - separation, 50, 95
 - significance and impact of, 94–95
 - specialty columns, 153–159
 - stationary-phase selection for, 132–153
 - technology, *see* Capillary column technology
 - USP/NF descriptions, 60–90
- Capillary column selection guidelines
 - diameter, 159–163
 - film thickness, 159, 164
 - length, 159, 164–165
 - significance of, 8–9
- Capillary column technology
 - aluminum-clad fused-silica, 106
 - computer modeling, stationary phase, 204
 - fused-silica, 100–106, 110–122
 - fused-silica-lined stainless steel, 106–110
 - glass, 100–103
 - materials, 100
 - multidimensional gas chromatography, 201–202
 - simulated distillation, 200–202
- Capillary electrochromatography (CEC), 104
- Capillary electrophoresis (CE), 104
- Capillary liquid chromatography (LC), 104
- Capital equipment investments, 8
- Capric/caproic/caprylic acid, 83
- Caprylocaproyls, 63
- Carbamazepine, 63
- Carbitol, 152
- CarboBlack, 23
- Carbomer, 63
- Carbon
 - dioxide, 29–30, 52, 161, 256, 273
 - disulfide, 184
 - graphitized, *see* Graphitized carbon
 - molecular sieves, 28
 - monoxide, 28, 63
 - PLOT, 161
 - tetrachloride, 143
 - vitreous, 105
- Carbonates, 24
- Carbonyl analytes, 29
- Carbopack, 23
- Carborane, 37
- Carbosphere, 28
- Carbowax, 5, 16, 35–38, 41–43, 112, 114, 120, 141, 148
- Carboxen, 161

- Carboxylic acids, 158
- Carrier gas
- capillary column gas vs. packed column chromatography, 99–100
 - chromatographic methods, 60–90
 - flow rates, 58, 123
 - high-purity, 192
 - high-speed gas chromatography, 220–221
 - linear velocity, 127–130
 - nature of, 123, 129
 - packed column preparation, 59
 - purifiers, 178, 187
 - selection, 52–53
 - types of, 124–126
 - viscosity, 127–129
 - volume of, 129
- CA Selects*, 12
- Castor oil, 63
- Cefoxitin sodium, 63
- Celanese ester, 5
- Cellaburate, 65
- Cellosolve, 152
- Cetostearyl alcohol, 65
- Cetyl alcohol, 65
- Chain branching, 25
- Chamomile, 65
- Charcoal, 24
- Charge distribution, 134
- Chemical
- bonding phase, 6, 142–149
 - stability, 32, 140
- Chemical Abstracts Service, 12
- Chemisorption research, 25–26
- Cherry brandy, 236
- Chiraldex capillary columns, 156, 158
- Chiral stationary phases
- characteristics of, 153, 155
 - cyclodextrins, 155–156
 - immobilization of, 149–150
- Chirasil-Val, 155–156
- Chlordane, 176, 186, 223
- Chlorhexidine gluconate, 65
- Chlorides, 24–25
- Chlorinated
- diphenyl ether, 186
 - hydrocarbons, 182, 250, 254
 - solvents, 244
 - terphenyl, 186
- Chlorine, 101
- Chlorobenzene, 143
- Chloroethylamine hydrochloride, 73
- Chloroform, 143, 197
- Chloro-1,1,2-trifluoroethylmethyl ether, 27
- Chlorophenol, 66, 117
- Chlorophenoxyacid, 179
- Chloroprene, 184
- Chloroxyleneol, 65
- Chlorpheniramine maleate, 65, 79
- Cholesterol, 274–275
- Cholesteryl esters, 276
- Choline chloride, 65
- Chromatographic performance
- carrier gas, 124–129
 - coating efficiency, 132
 - flow rate, 126–127
 - Golay equation vs. van Deemter expression, 122–124
 - linear velocity, 125–129
 - phase ratio, 129–132
 - viscosity, 1227–129
- Chromatography Forum*, 13
- Chromosorb, 23–24, 28, 33–34
- Chrompack, 12, 135–139
- Chrysene, 171
- Cilastatin sodium, 65
- Cinnamics, 119
- cis*-Hydrindane, 40
- Clavulanate potassium, 65
- Clean rooms, 103
- Clindamycin palmitate hydrochloride, 65
- Clioquinol, 65
- Clofibrate, 66
- Coating(s)
- capillary gas vs. packed column chromatography, 99
 - efficiency of, 132
 - fused-silica capillary columns, 103, 105, 122, 133
 - PLOT columns, 156
 - static, capillary columns, 116
- Cocoa butter, 66
- Codeine, 72, 85
- Cod liver oil, 66
- Coelution, 28
- Colchicine, 66
- Colestipol hydrochloride, 66
- Column, *see* Capillary column; Packed column
- central role of, 6–8
 - historical perspectives, 1–6
 - information resources, 11–14
 - selection, *see* Column selection
 - technology, advances in, 6–8
 - tubing, historical perspectives, 6–7
- Column selection
- selection guidelines, 277–280
 - importance of, 8–9
 - by specifications, 172–187
- Combustion, 102

- Comprehensive two-dimensional GC (C2DGC), 202
- Computer assistance
 applications, generally, 40, 165, 201, 203
 database services, as information resource, 12
 oven temperature control, 214–217
 programs, types of, 6
- Conditioning, packed columns, 58–59
- Connectors, capillary columns, 195–200
- Contamination, sources of, 32, 200
- Convachlor, 5
- Convection ovens, 210–211, 218–219, 228
- Convoil, 5
- Copper
 characteristics of, 101
 tubing, 56
- Corn silage, 234
- Corrosion, fused-silica columns, 105
- Creosote, 244–245
- Cresol, 185
- Cross-linked/cross-linking
 capillary columns, 141–149
 characteristics of, 6
 chemical bonding and, 149
 cyanopolysiloxane, 38
 fused-silica capillary columns, 120, 122
 megabore columns, 167
- Cryogenic applications, 153, 163, 210
- Current Contents*, 12
- Cyanopropyl, 37–38, 41–43, 134–136, 147, 149, 156
- Cyclic amines, 158
- Cyclic isomeric hydrocarbons with increasing degrees of unsaturation (CIHDUs), 26
- Cyclic siloxanes, 115
- Cyclodextrins, 155–157
- Cyclohexanes, 174, 177
- Cyclohexanol, 143
- Cyclohexanone, 152
- Cyclomethicone, 67
- Cycloparaffin, 42
- Cyclopentadiene, 185
- Cyclopropane, 160
- Cycloprololamine, 65
- Cyclosporine, 67
- Data system, 8
- DB-ProSteel, 110
- DC
 high-vacuum grease, 5
 silicone oil, 5
- Deactivation
 capillary columns, 106, 110
 fused-silica capillary columns, 103, 119–120
- packing columns, 56
- silanol procedures, for fused-silica capillary columns, 110–116
- Debye induction forces, 33
- Decane, 35, 118–119, 121
- Decomposition, 32, 56
- Decylamine, 117, 118
- Degradation, 105, 114, 193
- Dehydrocondensation, 112
- Dehydroesterone, 67
- Demeton, 186
- Denaturants/denaturation, 176–177, 236
- Desflurane, 67
- Desoximetasone, 67
- Detector(s), *see specific types of detectors*
 capillary columns, 97
 chromatographic methods, 60–90
 column dimensions for EPA methods, 180–183
 design, advances in, 8
 significance of, 9
- Dexamethasone, 67–68, 79
- Dexbrompheniramine maleate, 68
- Dexchlorpheniramine maleate, 68
- Dexpanthenol, 68
- Dexsil, 37, 151
- Dextran, 68
- Diacetone alcohol, 43
- Dialkyl, 158
- Diameter, capillary columns, 10, 124, 128–132, 153, 156, 160–164, 167–172, 194, 280
- Diaphragms, in gas purifiers, 187
- Diastereoisomer, 74
- Diatomite supports, 15–22
- Diazomethane, 185
- Dibasic acids, 235
- Dibenzyl ether, 5
- Dibromo
 difluoromethane, 184
 methane, 179
 -3-cyclopropane, 179
- Dibutyl
 phosphate, 186
 phthalate, 68, 186
 sebacate, 68
- Dicarboxylic acid, 36
- Dichloro
 benzaldehyde, 72–73
 benzene, 143
 benzhidine, 186
 difluoromethane, 68, 184
 ethane, 143
 ethylene, 143
 ethyl ether, 184
 fluoromethane, 185

- Dichloro (*Continued*)
 propane, 184
 Dicumyl peroxide, 147–148
 Dicyanoallyl, 43
 Dicyclohexylamine, 117–118
 Dieldrin, 223
 Dienes, 161
 Diepoxide, 38
 Diesel fuel, 227
 Diethanolamine, 118
 Diethylene, 5, 36–37, 43, 68, 118
 Differential flow, 203
 Diffusion
 coefficient, 122–123
 eddy, 15, 52
 packed column separation, 52–53
 Diffusivity, 33, 140
 Diflouroethane, 184
 Diglycerol, 5, 34
 Dihydroequilin, 66–67
 Dihydrostreptomycin sulfate, 79
 Dihydrotachysterol, 69
 Dihydroxyaluminum, 69
 Diisodecyl, 2, 5, 37
 Dimensions, EPA methods, 180–183
 Dimethylacetamide, 185
 Dimethyls, 5, 16, 36–38, 41–42, 56, 69, 83, 111,
 117–120, 135, 140, 143–144, 158, 161,
 185, 220
 Dimethylenedialine, 186
 Dinonyl, 2, 5
 Dioctyl phthalates, 2, 5
 Diols, 158
 Dioxane, 40, 80–81, 88, 143, 184
 Dioxins, 139
 DIPE, 176
 Diphenoxylate hydrochloride, 69
 Diphenyls, 23, 135, 144
 Dipoles, 24, 33, 40, 134, 141
 Dipropionyl, 158
 Dipropylene glycol monomethyl ether, 176
 Disilazanes, 115
 Disinfection, 179, 182
 Dispersion, 33, 141
 Distillation, 139, 200–202
 Distilled water, 103
 Distribution coefficient, 129
 Disulfides, 274
 Divinylbenzene, 29, 38, 161
 DMP, 121
 Dodecane, 35, 118, 121
 Donor-acceptor interactions, 33, 141
 Doxorubicin hydrochloride, 69
 Doxylamine succinate, 69–70
 Drinking water, 172, 180–182
 DryLab software, 214–215
 Dust, 116
 Dyphylline, 70
 Earth, siliceous, 23
 ECD, 180–183, 189, 195, 203
 Echothiophate iodide, 70
 Eddy diffusion, 15, 52
 Efficiency
 capillary columns, 117, 119, 170–171
 packed columns, 15, 46–47, 50–51
 separation, 119
 utilization of theoretical (UTE), 132
 EGDMA polymer, 29
 Eicosane, 118
 ELCD, 180, 183
 Electron(s)
 density, 25
 donors, 101, 103
 -releasing groups, 25
 -withdrawing groups, 25
 Electronic advances, 8
 Electronic pressure-controlled injection, 97
 Elution, 24, 39, 45, 211
 Embaphase silicone oil, 5
 Enantiomers, 155
 Endosulfan, 223
 Endrin, 186, 223
 Enflurane, 70
 Engine fuel, 176, 178
 Ethylene glycols, 178
 Environmental analysis, 11
 Environmental Protection Agency (EPA)
 column dimensions, 180–183
 column selection, 172
 method number designations, 179
 methods, generally, 153, 244, 250–251
 series, 167, 170
 Enzacamene, 70
 EPC, 223
 Epichlorhydrin, 184
 EPN, 186
 Epoxides, 158
 Equilin, 67
 Esters, 30, 40–41, 158, 184
 Estradiol, 66–67
 Estrogens, 66
 Estrone, 67
 ETBE, 176
 Ethanes, 159–161
 Ethanol, 40, 60, 143, 152, 177
 Ethchlorvynol, 70
 Ethers, 30, 40–41, 70

- Ethoxyethanol, 68, 143
 Ethoxyethyl acetate, 143
 Ethyls, 16, 66, 70–71, 83, , 80, 119, 126, 143, 152, 176–177, 184–186, 241, 269
 Ethylenes, 5, 38, 68, 77, 80–81, 160–161, 184–186, 252, 255, 257–258
 Ethylhexanoic acid, 65, 117–118
 Etodolac, 71
 Eucalyptol, 71, 118
 Eutectic mixtures, inorganic, 5
 Evaporation, 55, 116
 Explosives, 139, 179
 Extracolumn effects, 119
 Extrapolation, 35
- Fast capillary columns, 164–165
 Fast chromatography, 217–228
 Fast data acquisition systems, 97
 Fast gas chromatography, 7, 11
 Fatigue, 186, 200
 Fatty acid(s)
 characteristics of, 30, 40, 53, 56, 60, 66, 85, 117, 174–175, 177
 free, *see* Free fatty acids (FFA)
 methyl esters (FAMES), 139, 174, 252–253
 volatile, 233
- Feedback, fused-silica columns, 103
 Fenoldopam mesylate, 71
 Ferrule materials and fittings
 capillary columns, 187, 190–191, 194, 197, 200
 quick-connect, 196
 for packed columns, 57
- Filling columns, 53
 Film, generally
 liquid-phase, 53
 stability, 144
 thickness, *see* Film thickness
- Film thickness
 capillary columns, 129–130, 153, 159, 161, 163, 195
 fundamental resolution equation, 167–172
 megabore columns, 166
 stationary phase, 280
- Filtrate, in packed column preparation, 55
 Fingerprinting chromatograms, 165
 Fittings
 ferrule, *see* Ferrule materials and fittings
 glass wool plugs and, 56–57
 overtightening, 56
- Flame ionization detection (FID), 9, 116, 127, 132, 142, 156, 159, 177, 180–183, 186, 190, 191, 213
 Flammable materials, 187
- Flash gas chromatography, 223–224
 Flavors, 139
 Flexibility, 2
 Flexible input requirement standard technology (FIRST), 217
 Flow rate, 6, 52–53, 58, 123, 126–127. *See also* Differential flow; Stop-flow operation
 Fludarabine phosphate, 71
 Fludeoxyglucose, 71
 Fluocinonide, 71
 Fluoranthrene, 171
 Fluorene, 5, 171
 Fluticasone propionate, 71
 Food and flavor volatiles, 40, 139
 Forced-air convection oven, 210–211, 228
 Formaldehyde, 29–30, 161, 185, 256
 Formalin solution, 256
 Fourier transform infrared spectroscopy (FTIR), 97
 FPD, 183
 Fragrances, 139
 Free acids, 253
 Free fatty acid (FFA) phase, 38, 43, 233–234
 Free-radical cross-linking, 133, 141, 145–147
 Freon, 254
 Fritted metal plugs, 15, 57
 Fuel oil, 167
 Functional groups, 33, 41, 112, 134, 140, 156, 195
 Furans, 139, 158
 Furaral, 185
 Furfuryl alcohol, 185
 Fused-silica capillary columns
 aluminum-clad, 106–107
 characteristics of, 1–2, 4, 6–7, 100–106, 190–191
 drawing process, 103–104
 extrusion of, 103–106
 historical perspectives, 9, 97
 impurities in, typical, 101
 mechanical properties of, 102
 physical properties of, 102
 PLOT columns and, 156
 polyimide-clad, 113
 popularity of, 100
 preparation of, 110–122
 proposed structure of, 100–101
 stainless steel, 113
 synthetic, 101
 tubing, 105, 109
 Fused-silica packed columns, 27, 60
- Gadodiamide, 71
 Gadoversetamide, 71

- Gamma radiation, 144–148
- Gas, *see specific gases*
 - analyses, 9–10
 - delivery, 187
 - generators, 186–188
 - lines, 56
 - purifiers, 187
- Gas chromatographic columns
 - central role played by, 6–8
 - evolution of, 1–6
 - ideal, 46
 - information resources, 11–13
 - selection and care, justification for, 8–11
 - size of, 1, 10
 - test mixtures in evaluation, 118
 - trends in, 9–10
- Gas chromatography, historical perspectives, 5
- Gas chromatography-mass spectroscopy (GC-MS) systems, 11, 97, 132, 161, 187, 195
- Gas-liquid chromatography (GLC), 11, 24, 203
- Gas-liquid mechanisms, 30
- Gas-liquid-solid chromatography (GLSC), 24
- Gasoline, 174–177, 241, 265, 267
- Gas-solid
 - adsorption mechanisms, 32
 - chromatography (GSC), 2, 10, 24–25
 - mechanisms, 30
 - packed columns, 11
- GC-SOS (Gas Chromatography Simulation and Optimization Software), 216–217
- GC Racer, 226–228
- Gels
 - silica, 2, 6, 24, 28
 - sol-gel, 116, 150–152
- Geminal silanols, 102
- General elution problem, 211
- Generators, *see* Gas generators
- Gentamicin sulfate, 71
- Geraniol, 119
- Glass
 - beads, 15
 - capillary columns, *see* Glass capillary columns
 - chemical inertness, 56
 - coiled column, 57
 - drawing machines, 27
 - to-glass connections, 57
 - historical perspectives, 9
 - to-metal connections, 57
 - packed columns, 3, 55–56
 - wool/wool plugs, 15, 56–57
- Glass capillary columns
 - characteristics of, 2, 98
 - composition, approximate, 101
 - development of, 95–96, 98, 100, 133
- Gluteraldehyde, 185
- Glycerin, 71
- Glycerol, 5, 34
- Glyceryl, 72
- Glycidol, 184
- Glycidyl, 158
- Glycols, 28–30, 152
- Golay, Marcel, 94
- Golay equation, 122–124
- Gold, 72, 105
- Gonadorelin hydrochloride, 72
- Gradient elution HPLC, 215
- Grapefruit oil, 253
- Graphite (G) columns, 57
- Graphite ferrules, 187, 190
- Graphite-Vespel composite ferrules, 187, 190
- Graphitized carbon, 15, 23, 28, 30–31, 158
- Grease, removal of, 56
- Grob mixture, 120, 122
- Grob procedure, 119
- Guaiifensein, 72, 86
- Guanabenz acetate, 72
- Guard columns, 115, 196–200
- Haloacetic acids, 179
- Haloalkanes, 158
- Halocarbons, 179, 247
- Halocarboxylic acid esters, 158
- Halocycloalkanes, 158
- Haloepihydrins, 158
- Haloethers, 179, 250
- Halogenated
 - aromatic hydrocarbons, 27
 - hydrocarbons, 175, 184
 - organics, 180
- Halogens, 25, 56
- Hastelloy tubing, 56
- HayeSep, 23, 28–29, 38
- Hdyroxy citronellal, 119
- Headspace samples, 8, 127, 175, 180
- Heat, *see* Temperature
 - of adsorption process, 25–26
 - transfer, 106
- Heated column jacket, 223–228
- Height equivalent to a theoretical plate (HETP), 46, 53, 125
- Helium, 52, 125, 127–128, 170–171
- Heptachlor, 176, 223
- Heptadecane, 118
- Heptane, 174
- Herbicides, 40, 179, 183
- Heterocyclics, 158, 239

- Hewlett-Packard, 2, 97
- Hexachlorophene, 73
- Hexadecane, 5, 118
- Hexanes, 143, 159
- Hexanol, 119
- Hexanone, 143
- Hexylamine, 118
- High boilers, 2
- High-molecular-weight compounds, 25
- High-performance liquid chromatography (HPLC), 179, 196, 201, 215
- High-pressure materials, 187
- High-resolution
gas chromatography, 95, 178
separations, 9
- High Resolution Chromatography*, 218
- High-speed gas chromatography (HSGC)
column jackets, 223–228
overview of, 6, 11, 217–219
resistivity heated columns, 223–228
selectivity tuning, 219–223
- High-throughput sample, 6
- Historical perspectives, 1–10, 132–134
- Homosalate, 73
- Hot/cold spots, 1
- HTS phenyl polycarborane-siloxane, 154
- Hydrazines, 30
- Hydrocarbons
aromatic, 27, 40, 174, 177, 180
capillary column chromatography, 134, 154,
161, 176–177, 179, 186–187, 200–201,
210, 244, 250, 254–260, 262, 271
chlorinated, 182, 250, 254
halogenated, 27, 175, 184
linear isomeric, 26
packed columns chromatography, 30, 43,
70
saturated, 158
unsaturated, 40, 257–260
- Hydrochloride, 60, 63
- Hydrocortisone, 65, 73
- Hydrofluoric acid, 103
- Hydrogen
bonding, 102–103, 117, 120, 141
characteristics of, 28, 52, 125, 127–128,
170–171
chloride, 56
generator, 188
sulfide, 29–30, 272
- Hydrolysis, 134, 144
- Hydroxyl groups, 103, 114, 158
- Hydroxyoctamethyltetrasiloxane, 112
- Hyoscyamine, 73
- Hypromellose, 73
- Ideal gas chromatographic column, 46
- Ifosfamide, 73
- Igepal, 37
- Imipenem, 73
- Immobilization
cyclodextrins, 156
polyethylene glycol, 147–148
polysiloxanes, 147, 149–150
stationary phase, 142
- Indinavir sulfate, 73
- Indomethacin sodium, 73
- Induction, 33
- Industrial solvents, 151–152, 269–270
- Inertness, 2, 56, 117, 169
- Information resources
professional journals, 11
reading recommendations, 11, 212
web sites, 172–173, 227
- Infrared laser beams, 103
- Infrared spectroscopy, 26
- In-house preparation, 53–54
- Injection(s)
advances in, 7–8
ancillary techniques, 169
capillary columns, 97
direct, 163, 175, 180
dual-valve, 218
large volume, 97, 169, 210
on-column, 161
split/split-less, 161, 213
- Inlet discrimination, 97, 106
- Inlet liner, 119
- In-line gas purifiers, 186
- Inorganic packing, 26–27
- Insecticides, 60
- In situ polymerization, 156
- Installation preparations, capillary columns,
190–191
- Integra-Guard Column, 200
- Integrators, 97
- Internet resources, 12–13
- Iodixanol, 73
- Iodobutane, 40
- Iohexol, 73–74
- Iopromide, 74
- Ioxilan, 74
- Iron, 101
- Irradiation, cross-linking and, 147–148
- Irreversible chemisorption, 26
- Isoamyl, 35, 40, 143
- Isobutane, 159–161
- Isobutanol, 143
- Isobutyl acetate, 143
- Isocyanates, 186

- Isoflurane, 74
 Isofluorophate, 74
 Isomeric alcohols, 237
 Isomers, 161
 Isomyl acetate, 35
 Isooctane, 174
 Isopentane, 160
 Isophorone, 152, 179, 182, 185
 Isopropyls, 69, 73–76, 83–84, 87–88, 126, 143, 175
 Isosorbide, 74
 Isothermal
 conditions, 57, 164
 operations, 211–212
 separations, 128, 167
 Isotretinoin, 74
 Ivermectin, 74

 J&W, 12, 134–139
 Jet fuel, 95, 167
 Junction-point pressure, high-speed gas chromatography, 220–221

 Keesom orientation forces, 33
 Kelvin temperature, 39
 Kerosene, 267
 Ketones, 30, 40–41, 101, 158, 179, 184, 269
 Ketosteroids, 276
 Kovats Retention Index, 34–35, 39–40, 117
 Kraft pulp mill stack gases, 273
 KRS-5 crystal, 27

 Labetalol hydrochloride, 74–75
 Lactic acid, 234
 Lactones, 158
 Lamivudine, 75
 Lanolin, 75
 Lauric acid, 83
 Lead, 185
 Lemon oil analysis, 153, 155, 214, 254
 Length of column, significance of, 159, 164–165, 170, 280
 Lewis acids, 101, 103, 117
 Limonene, 119
 Lindane, 74, 186
 Linear
 amines, 158
 isomeric hydrocarbons with increasing degrees of unsaturation (LIHIDUs), 26
 profile, in temperature programming, 212–213
 velocity, 6, 47, 52, 122, 125–126
 Line voltage, 210
 Linoleic acid, 83
 Linolenic acid, 83

 Liquid
 chromatography (LC), 11–13
 extraction, 181–183
 phases, 2–3, 32
 Literature resources, 11–12
 Lithium, 101
 Loading, 33, 53, 160
 Log adjusted retention, 35
 London dispersion forces, 33
 Longitudinal diffusion, 52–53, 122–123
 Losartan, 74
 Low-molecular-weight, 52, 175
 Low resolution mass spectrometry, 177
 Low thermal mass (LTM), 227–228
 Low vapor pressure, 32
 Lubricants, industrial-grade, 34

 McReynolds and Rohrschneider Classifications, 34–35, 40–44
 McReynolds constants, 133, 140, 204
 Mafenide acetate, 74
 Magnesium, 74, 101
 Malathion, 75, 186
 Maleate, 63
 Mangafodipir trisodium, 75
 Manganese, 101
 Manufacturers, comparison of columns, 134–140
 Mapp gases, 257
 Mass spectrometry (MS), 9, 97, 150, 190
 Mass transfer, 53, 123
 Mecamylamine hydrochloride, 75
 Megabore columns, 165–169
 Melting points, 24
 Menthol, 63, 75, 85
 Meperidine hydrochloride, 76
 Mepivacaine hydrochloride, 76
 Meradimate, 76
 Mercaptans, 272–274
 Meropenem, 76
 Mesalamine, 76
 Mesh support, advantages of, 52
 Mesityl oxide, 143
 Metadone hydrochloride, 76
 Metal(s), *see specific types of metals*
 alkoxide, 150
 capillary columns, 95–96, 110
 -clad capillary columns, 113, 210
 columns, characteristics of, 1
 ferrule systems, 187
 ions, 111
 oxides, 26, 101
 packed column, 56–57
 -to-metal connections, 57

- Metaproterenol sulfate, 76
Methane, 28, 127, 159–161, 262
Methanol, 56, 76, 84, 143, 185, 258, 268–269
Methohexital sodium, 76
Methoxyethanol, 68, 73, 81
Methoxyflurane, 76
Methyl(s), 36–37, 40, 43, 54, 74, 76, 83–84, 89, 110–111, 117, 119, 136, 140–141, 143, 147–148, 152, 169–171, 174–176, 184–185, 235–236, 253–254
Methylal, 184
Methylated acids, 235
Methylcyclohexanone, 185
Methylene chloride, 76, 116, 119, 127, 143, 184, 243
Methoxyethanol, 143
Metoxychlor, 223
Mevinphos, 185
Mibolerone, 76
Miconazole nitrate, 77
Microcrystalline wax, 267
Microextraction, 180
Microparticulates, 116
Microprocessors, 211
Microwave ovens, 211
Mineral spirits, 174
Mitoxantrone hydrochloride, 77
Mixed-phase packed columns, 220
Mixed phenols, 263
Mobile phase, 44, 53, 129
Modified van Deemter equation, 51
Modulators, multidimensional gas chromatography, 202–203
Molecular, generally
 diffusion, 52–53
 geometry, 28, 30
 sieves, 28, 134, 158, 161
 simulation studies, 11
 weights, 32–33, 38, 41, 52, 106, 141, 150, 175, 201
Monomethyl ether, 81
Monopentaerythritol, 174
Morizine hydrochloride, 77
Motor oil, 177
MSD, 180–183
MTBE, 176
Multidimensional gas chromatography, 201–203
Multilinear profiles, temperature programming, 213–214
Multiple-path effect, 52
MXT columns, 106, 111
Myristic acid, 83
Myristyl alcohol, 77
Naftifine hydrochloride, 77
Naltrexone hydrochloride, 77
Naphthalene, 118, 121, 171
Naphthas, 184, 267
Naphthylamines, 186
National Formulary, 59–90
National Institute for Occupational Safety and Health (NIOSH)
 column dimensions, 184–186
 column specifications, 172
Natural gas, 262
Nearest-neighbor technique, 41
Neopentyl glycol succinate, 5, 37
Nickel
 -chromium alloy, 56
 tubing, 56
Nicotine, 77, 176, 245
Nitrates, 25
Nitriles, 30, 40–41, 161
Nitroaromatics, 179, 182
Nitrobenzenes, 184
Nitro compounds, 161
Nitro-containing compounds, 142
Nitroethane, 185
Nitrogen, 24, 28–29, 52, 56, 125, 127–128, 158, 170–171, 179, 188, 200, 252, 261, 271
Nitroglycerine, 185
Nitromethane, 40, 185
Nitroparaffins, 30
Nitropropane, 40, 143, 185
Nitrosamines, 179, 181, 185, 249
Nitroterephthalic acid, 38, 43
Nitrous oxide, 272
Noble gases, 161
Nomenclature codes, USP, 36–39, 135–139
Nonanal, 117–118
Nonane, 119
Nonequilibrium, packed column gas chromatography, 53
Nonoxynol, 37, 77
Nonylamine, 118
Nonylphenoxypoly(ethylene-oxy)ethanol, 5, 37
Norgestimate, 77
North Sea, Oseberg, 266
NPD, 181, 183, 190, 195, 203
Nu-Check-Prep ester mixture, 89–90
Nujol, 5, 34
Ocetanethioll, 185
Occupational Safety and Health Administration (OSHA), column specifications, 172–173, 243
Octadecane, 118
Octamethylcyclotetrasiloxane (OMCTS), 27, 112

- Octane, 35
 Octanol, 117–118, 121
 Octanone, 117–118, 121
 Octinoxate, 77
 Octisalate, 77
 Octocrylene, 78
 Octonone, 118
 Octyl(s), 78, 118
 Octyne, 40
 Ofloxacin, 78
 Oil, *see specific types of oils*
 products, 110, 174
 removal of, 56
 spills, 177
 Oleate FAMES, 253
 Olefens, 40, 158
 Olefins, 41, 102, 161
 On-column injection, 97, 106, 116
 Open-tubular columns, 2, 27, 47, 49–50, 94
 Operating temperature, stationary phases, 32–33
 Optima Delta 3, 39
 Orange oil analysis, 254
 Ordinary diffusion, 52–53
 Organic
 compounds, 177
 solvents, 175
 volatiles, 40
 Organochlorine, 60, 177
 Organophosphorus insecticides, 60
 Orientation, 33
 Oven design/geometries, 210. *See also*
 Convection oven; Microwave oven; Oven
 temperature control
 Oven temperature control
 computer assistance, role in optimizing
 separations, 214–217
 fast/high-speed chromatography, 217–228
 profiles for programmed-temperature gas
 chromatography, 212–214
 subambient, 228
 temperature programming, advantage over
 isothermal operation, 211–212
 thermal performance variables, electronic
 considerations, 210–211
 Overload of column, 163
 Oxandrolone, 78
 Oxidation, 55, 134, 145
 Oxide formation, 56
 Oxycodone hydrochloride, 78–79
 Oxydipropionitrile, 5
 Oxygen
 characteristics of, 24, 28–29, 102, 127, 141,
 161
 -sensitive detectors, 190
 Oxygenates, 178
 Oxygenation, 177
 Ozone, 145
 Packed column, *see* Packed column gas
 chromatography
 bleed, 58
 dimensions, selection of, 6
 efficiency, 15, 46–47, 50–51
 evaluation of, *see* Packed column evaluation
 preparation of, *see* Packed column preparation
 separation, *see* Packed column separations,
 optimization strategies
Packed Column Application Guide, The, 59
 Packed column gas chromatography
 adsorbents for, 15, 22–31
 capillary column gas chromatography
 compared with, 98–100
 characteristics of, 2–3, 15, 279
 column preparation, 53–59
 historical perspectives, 10
 liquid phase, 5
 methodologies, *United States Pharmacopeia*
 and *National Formulary*, 59–90
 PLOT columns and, 156
 required plate number, 48–50
 selection guide, 232–276
 separation, *see* Packed column separations
 solid supports for, 15–22, 54–55
 stationary phase, 15, 32–53
 USP/NF descriptions, 60–90
 Packed column preparation
 coating methods, 55
 column care, 58–59
 conditioning columns, 58–59
 filling columns, 57–58
 glass wool plugs and column fittings, 56–57
 overview of, 53, 55
 tubing, materials and dimensions, 55–56
 Packed column separations, optimization
 strategies
 diffusion, molecular, longitudinal, or ordinary,
 52–53
 eddy diffusion term, 52
 Packing
 material, 1–2
 retainers, 15
 Padimate, 79
 Paints, 174
 Palmitic acid, 75, 83
 Palmitoleic acid, 83
 Pancake format, 4
 Paraffin, 5, 161
 Parallel chromatograms, 129

- Parathion, 186
 Paroxetine hydrochloride, 79
 Particle size, 15
 Particulate matter, 2, 196
 Partitioning, 49
p-bonding, 101–102
 Peak deformations, types of, 119–120
 Peanut oil, 253
 Penicillin G procaine, 79
 Pentachloroethane, 185
 Pentachlorophenol, 166
 Pentadecane, 118
 Pentaerithritol, 174, 276
 Pentane, 159–160
 Pentanol, 268
 Pentanone, 40
 Peppermint oil, 98, 106, 111
 Perflubron, 79
 Perflutren, 79
 Peripheral
 devices, 8
 sampling, 212
 Perkin-Elmer gas-liquid chromatographic
 columns, 16, 135–139
 Permanent gases, 56, 134, 161, 210, 261–262
 Permeability, 50
 Permeation tubes, 56
 Permethlated *B*-cyclodextrin, 137
 Permethy, 158
 Peroxides, 145–147, 178
 Pesticides, 40, 75, 83–84, 177, 179, 183, 249,
 251, 263
 Petrolatum hydrocarbon grease, 38
 Petroleum/petroleum industry, 23, 106, 164,
 174, 176, 178, 201
 Pharmaceuticals, 40
 Phase-height augmentation technology (PHAT),
 166
 Phase ratio, 170
 Phenanthrene, 171
 Phendimetrazine tartrate, 80
 Phenobarbital, 169
 Phenols, 56, 174, 179, 181, 185, 248, 251,
 263–264
 Phenomenex, 12, 135–139
 Phenoxy, 183
 Phenoxyethanol, 80
 Phenyl(s), 10, 36–38, 41–43, 80, 107, 134,
 136–137, 141, 150–152
 Phenylene phase, 150
 Phenytoin sodium, 80
 Pheromones, 264
 Phthalate esters, 179
 Phosphoric acid, 30, 56
 Phosphorus, 179
 Photomicrographs, 16
 Phthalates, 2, 179, 181, 248–249
 Physical adsorption research, 25–26
 PID, 180–183
 Pigtail configuration, 3
 Piperidine, 36
 Piperdylpropane, 36
 Plant sterols, 275
 Plate
 height, 47
 number, 48–50, 164
 theory, 44
 Plumbing lines, 56
 Pluriisocyanate reagents, 148
 Pneumatics, 8
 Polar, generally
 columns, 132
 functional groups, 140–141
 polyethylene glycols (PEGs), 6
 properties, types of, 278
 stationary phase, 33, 132
 Polarization, 28
 Poloxamer, 80
 Polyamides, 36, 105
 Polyaromatic hydrocarbons (PAHs), 171
 Polyarylene, 133–134
 Polycarbophil, 80
 Polychlorinated
 biphenyls (PCBs), 9–11, 40, 151, 174–175,
 178, 183
 dibenzodioxin (PCDD), 11
 furan (PCDF0), 11
 Polychlorobenzenes, 186
 Polychlorobiphenyl, 186
 Polydimethylpolysiloxane, 141, 145
 Polyesters, 5
 Polyethylene, 5
 Polyethylene
 glycol (PEG), 6, 10–11, 16, 23, 36–39, 41, 43,
 81, 87, 112, 114, 134, 136, 140–142,
 220
 oxide, 81
 imines, 148
 Polyhydrosiloxanes, 114
 Polyimide (PI), 38, 57, 105, 190
 Polyimide-clad fused-silica capillary columns,
 113
 Polymer(s)
 chain, 150
 porous, 27–28, 158
 Polymeric
 adsorbents, 8
 stationary-phase composition, 141

- Polymethylsilicones, 149
Polynuclear aromatic hydrocarbons, 179, 182, 186, 250
Polyoxyl ethyl ether, 81
Polyphenyl ether, 5
Polyphenylenes, 5, 16, 134
Polypyrrone, 115
Polysilarylene, 150
Polysiloxanes, 6, 39, 41, 44, 112–113, 133, 140–141
Polysilphenylene, 133, 150
PONA analysis, 139
Porabond column, 162
Porapak, 23, 28–29, 156
Porous-layer open-tubular (PLOT) column, 2, 11, 156–161, 210, 279
Portable gas chromatographs, 106
Potassium, 101
Potassium hydroxide (KOH), 40
Pressure
 controller, 219
 programmed, 50
 regulator, 130
 vapor, 32
Primidone, 81
Procyclidine hydrochloride, 81
ProezGC, 215–216
Professional journals, as information resource, 11
Programmed Temperature Gas Chromatography (Harris/Habgood), 212
Propadiene, 160–161
Propane, 159–160, 258, 260
Propanediol, 119
Propanol, 143, 152
Propionic acids, 235
Propionyl, 158
Propofol, 81
Propoxyphenes, 82
Propyls, 126, 143
Propylenes, 5, 26, 80, 82, 86, 152, 160–161, 176, 178, 184, 258, 260
Propyne, 160
Protective coatings, fused-silica columns, 103, 105
Proton-acceptor/donor capabilities, 40
Psychotropic drugs, 246
Psyllium hemicellulose, 82
Purge and trap sampling, 153, 164, 180–181, 210, 212
Pygeum, 82
Pyramids, chromatographic, 131
Pyran, 158
Pyrene, 171
Pyrethroid insecticides, 60
Pyridine, 24, 40, 84, 118, 185
Pyrolyzers, 8

Q-type PLOT, 161
Quadrex, 135–139
Quartz tubing, 101
Quinapril hydrochloride, 82
Quinoline-brucine, 5

Rapeseed oil mixture, 252–253
Rapid
 analysis, 218–219
 heating and cooling, 224, 227–228
 screening, 164–165
Reactive compounds, 56
Reagent vapors, 146
Reference gas oil, 265
Regeneration, capillary columns, 200
Relative retention data, 35
Relative volatility, 32, 49–50
Reoplex, 5
Residual solvents, 139
Resistance, packed column gas chromatography, 53
Resoflex, 5
Resolution
 capillary columns, 163–165, 167–172
 high-speed gas chromatography, 221
 packed columns, 47–48, 50–51, 53–54
 temperature programming and, 213–214
Resorcinol, 82
Restek, 52, 227
Retention
 capillary columns, 164, 167–169, 196–200
 factor, 123–124, 172–173
 high-speed gas chromatography, 218
 index, 35
 multidimensional chromatography systems, 203
 temperature programming and, 211, 214
 time, *see* Retention time
Retention time
 fused-silica capillary columns, 119
 high-speed gas chromatography, 222
 linear velocity and, 126
 packed columns, analysis time and, 50
Revalidation, on capillary columns, 9
Reversible chemisorption, 26
Rimantadine hydrochloride, 83
Rosemary oil, chiral analysis, 153, 155
Rt-QPLOT column, 159
Rumen fluid, 234
RVM Scientific, 227

- Saccharin, 83
 Salsalate, 83
 Salts, inorganic, 15, 24–27
 Sampling methods, 212. *See also* Purge and trap sampling
 Saturated compounds, 158
 Saw palmetto extract, 83
 Scanning electron micrographs (SEMs), 106, 109, 166
SciFinder Scholar, 11
 Scopolamine hydrobromide, 84
 Scotch whiskey, 236
 Scott mix, 256–257, 261
 Seals/sealing, 57, 196
 Secobarbital sodium, 84
 Selection, stationary-phase
 comparison of manufacturers, 134–140
 chemical bonding, 149
 cross-linked *vs.* chemically bonded phase, 142–149
 historical perspectives, 132–134
 MS-grade phases *vs.* polysilarylene or polysilphenylene phases, 150
 phenylpolycarborane-siloxane phases, 151–152
 polyethylene glycol phases, 141–142
 polysiloxane phases, 140–141
 sol-gel stationary phase, 150–151
 requirements for, 132
 Selectivity
 enantiomeric, 156
 fused-silica capillary columns, 120
 high-speed gas chromatography, 220
 significance of, 2, 5, 172
 in stationary phase, 32–34
 Semivolatiles organic compounds, 179, 181
 Sensitive detectors, 10
 Separation
 capillary columns, 50, 95
 efficiency, 119
 enantiomeric, 153, 156
 EPA series, 153
 factor, 32
 high-resolution, 9–10
 isomeric, 128, 167
 number, 50
 optimizing using computer software, 214–216
 packed columns, 50, 52–53
 stationary phase, 34
 thermodynamics and, 50
 Sewage effluents, 233
 SGE, 135–139, 172
 Sigma-Aldrich, 12
 Silanol groups, 114–115, 117, 167
 Silarylene, 97
 Silarylene-siloxane groups, 141
 Silcoport, 23
 SilcoSmooth tubing, 56
 Silcosteel deactivation process, 56
 Silica/silica gel, 2, 6, 24, 28
 Silicons, 103, 112, 115
 Silicones, 5, 16, 105
 Siloxanes, 103, 134. *See also* Polysiloxanes
 Silphenylene, 97
 Siltek process, 115
 SilTite metal ferrules, 187, 190
 Silver nitrate, 26
 Silyl hydride groups, 114
 Silylation chemistries, 1, 56
 SIMDIS calibration blend, 265
Sim Dist, 201
 Simulated distillation, 200–201
 Siphenylene(arylene), 149
 Size exclusion HPLC, 201
 Slurry, 55
 Soap-bubble meter, 126
 Soda-lime borosilicate glasses, 101
 Sodium, 84, 101, 161
 Softening, 56
 Sol-gel method, 116, 150–151
 SolGel-WAX, 151–152
 Solid support, 34, 54–55, 58–59
 Solid waste, EPA specifications, 172, 180–182
 Solubility, differential, 32
 Solute diffusivity, 41
 Solute-stationary phase interactions, 141
 Solvent(s)
 characteristics of, 161, 268–270
 resistance, 144
 rinse kit, 201
 Sonication, 181–183
 Sorbates, 24
 Sorbent solids, 24
 Sorbitol, 5, 36
 Soxhlet extraction, 181–183
 Special gas chromatographic techniques
 computer modeling of stationary phases, 203
 multidimensional gas chromatography, 201–203
 simulated distillation, 200–201
 Specialty columns
 chiral stationary phases, 153, 155–156
 EPA methods, 153
 gas-solid adsorption capillary columns, 156–160
 Spectinomycin hydrochloride, 84
 Split injection, 125, 190
 Squalane, 5, 35
 Stabilwax, 37–38

- Stack gases, 273
- Stainless steel
- capillary columns, 98, 100, 106–110
 - characteristics of, 2–4
 - packed columns, 56
- Stationary phase
- capillary columns, 97, 99–100, 114–116, 120–121, 129–130, 132–153, 195
 - carrier gases and, 125
 - column operation evaluation, 44–52
 - computer modeling, 203
 - fused-silica capillary columns, 120–121
 - graphitized carbons, 28
 - historical perspectives, 6–11
 - Kovats Retention Index, 34–35, 39–40
 - loading, 53
 - McReynolds and Rohrschneider Classifications of, 34–35, 40–44, 203
 - megabore columns, 166–167
 - optimization of packed column separations, 52–53
 - packed columns, 53, 58, 99–100
 - requirements of, 32–35
 - selection, 10, 132–153
 - technology, 2
 - USP designation, 35–39
- Stearic acid, 75, 83–84
- Stearyl alcohol, 84
- Steroids, 274–275
- Sterols, 82
- Stinging nettle, 84
- Stop- operation, high-speed gas chromatography, 221–223
- Storage guidelines, packed column, 59
- Strontium halides, 25
- S-type PLOT, 161
- Styrene, 23, 28–29, 126, 143, 156, 174–176, 269
- Subambient temperature controls, 228
- Subsampling, 202
- Substituents, ortho vs. meta, 25
- Sucralfate, 84
- Sucralose, 85
- Sucrose acetate isobutyrate, 5
- Sufentanil citrate, 85
- Sugars, 158, 271
- Sulfates, 24
- Sulfides, 274
- Sulfur
- characteristics of, 56, 82, 161, 190
 - dioxide, 30, 271
 - gases, 30, 56, 271–274
- Suner oil, 85
- Supelco, 12, 134–139
- Supelcoport, 23
- Support-coated open-tubular column (SCOT), 279
- Support materials, 15–23, 34, 52, 54–55, 58–59
- Surface-stationary phase, 112
- Tailing, 33, 56–57, 98, 111, 119, 191, 197
- TAME, 176
- Tamoxifen citrate, 85
- Tangerine oil analysis, 225–226
- Tapping processes, 1
- TCD cell, 156
- Teflon
- columns, 57
 - supports, 15, 22
 - tubing, 56
- Temperature
- capillary column performance and, 99–100, 130, 192–195
 - carrier gas velocity, 128
 - chemical bonding and, 149–150
 - chromatographic methods, 60–90
 - control, *see* Oven temperature control; Temperature programming
 - fused-silica capillary columns, 112, 120, 133–134
 - gas-liquid chromatography (GLC), 24
 - isothermal column 39
 - packed column chromatography, 50, 59, 99–100
 - programming, *see* Temperature programming
 - selectivity and, 172
 - significance of, 11
 - stationary phase, 35, 53–54
- Temperature programming
- advantages over isothermal operation, 211–212
 - characteristics of, 6–7
 - conditions, 165, 168
 - cool-down rates, 212
 - high-speed, 218–219, 226
 - profiles for, 212–214
- Tenax, 23
- Terazosin hydrochloride, 85
- Terephthalic acid, 37–38
- Terpenes, 158
- Terphenyls, 24, 186
- Terpin hydrate, 85
- Test mixtures, column evaluation
- components of, diagnostic role, 119–122
 - types of, 117–119
- Testosterone cypionate, 85
- Tetrabromoethane, 185
- Tetracaine, 85
- Tetrachlorodibenzofuran, 86
- Tetrachlorodibenzo-*p*-dioxin, 73, 86

- Tetrachloroethane, 143, 184
 Tetrachloromethane, 143
 Tetradecane, 118
 Tetraethoxysilane, 150
 Tetraethylene glycol dimethyl ether, 5, 37
 Tetraethyl pyrophosphate, 185
 Tetrahydrofuran, 143, 184
 Tetramethylbenzenes, 243
 Tetra(methylvinyl)cyclotetrasiloxane, 147
 Tetrahydro-2-furancarboxylic acid, 85
 THEED (tetrahydroxyethylenediamine), 5
 Theophylline, 86
 Theoretical plates, effective number of, 47, 49
 Thermal degradation, 114, 193
 Thermal desorption, 8, 164, 210
 Thermal gradients, 1
 Thermal shock, 59, 212
 Thermal stability, 2, 6–10, 33, 41, 97, 106, 133, 140, 145, 147–148, 195
 Thermedics Detection, 224–225
 Thermodynamic(s)
 adsorbents and, 27
 characteristics of, 24, 204
 gas chromatographic retention index, 25
 separation factor and, 50
 Thick-film columns, 164. *See also* Film thickness
 Thin-film columns, 169
 Thiodipropionitrile (TDPN), 37
 Thiophene, 176
 Three-component systems, 51
 Thymol crystal, 119
 Tiamulin, 86
 Tide detergent, 2, 5, 34
 Tiletamine, 86
 Tilmicosin, 86
 Time management, fast analysis, 10
 Time-of-flight mass spectroscopy (TOFMS), 203
 Titanium, 101
 TMS, 239, 245
 Tocopherols, 86–87
 Tolcapone, 86
 Toluenes, 56, 83, 86, 126, 143, 152, 175, 177–178, 186
 Tollyl groups, 147
 Toroidal geometry, 156
 Total aromatics, 177–178
 Toxicological analysis, 11
 Trace analysis, 98
 Trace water, 30
 Trennzahl number, 117
 Triazolam, 86
 Tributyl citrate, 86
 Trichloroethane, 184
 Trichloroethylene, 143
 Trichlorofluoromethane, 184
 Triclosan, 86
 Tricresyl phosphate, 5
 Tridecane, 118, 121
 Trientine hydrochloride, 87
 Triethyl citrate, 87
 Trifluoroacetyl, 158
 Trifluoroethane, 184
 Trifluoropropyl, 41–43, 36, 134–135, 144–145, 149, 222
 Triglycerides, 107, 164, 276
 Trihalomethanes, 180
 Trimethylbenzenes, 243
 Trimethylsilylating reagent, 115
 Tris(cyanoethoxy)propane, 43, 137
 Triton-X, 5
 Tubing
 capillary columns, 105, 109
 fused-silica columns, 105, 142
 historical perspectives, 6
 packed columns, 55–56
 quartz, 101
 Turpentine, 174, 184
 Two-dimensional gas chromatography (2DGC), 201–203, 218
 TX-XLSulfur packing material, 56
 Tyloxapol, 87

 Ucon oils, 5, 34
 Ultrahigh-purity gases, 186
 Undecane, 118–119, 121
 Undecylenic acid, 66
 U.S. Army Method, 252
 U.S. Department of Labor, Occupational Safety and Health Administration, 173
 U.S. Environmental Protection Agency (EPA), 10
United States Pharmacopeia (USP)
 chromatographic methods, 59–90
 column selection, 172
 Nomenclature, 135–139
 packed column, 10
 solid support designations, 22–23
 Unleaded gasoline, 167
 Unsaturated compounds, 26, 40, 257–260
 Urea, 87
 Urethane prepolymers, 175
 Utilization of theoretical efficiency (UTE), 132
 U-type PLOT, 161

 Vacuum system, 58, 164
 Valeraldehyde, 185
 Validation, capillary columns, 9
 Valine amino acids, 235
 Valproic acid, 87
 Valrubicin, 87

- Valve-based modulators, 202
van Deemter expression, 16, 122–124
van der Waals forces, 32
Vanadium (II), 26
Vanillin, 119
Vaporizer, capillary column chromatography, 97
Vapor pressure, 32, 193
Varian, 12, 135–139
Velocity, 51, 125–130. *See also* Linear, velocity
Vespel/Vespel ferrule, 57, 187, 190
Vibration processes, 1
VICI Gig Harbor Group, 12
Vicinal silanols, 102
Vinyl
 bromide, 184
 chloride, 30, 176, 184, 243
 cyclohexene, 126
 groups, 147
 pyridine, 23, 29
 pyrrolidone, 29
Vinylidene chloride, 30, 184
Viscosity, 32–33, 41, 53, 133, 140, 144
Vitamins, 78, 87
Volatile compounds, 58, 161, 164, 244, 251. *See also* Volatile organic compounds (VOCs)
Volatile organic compounds (VOCs), 24, 30, 110, 138, 161, 179–180
Volatility, impact of, 24, 49–50, 116
Volumetric rate, 126
Vu-Union, 200
Wall-coated open-tubular (WCOT) column, 94, 279
Warfarin sodium, 87
Wastewater, 180–182
Water, 24, 28, 174–175, 272
Water vapor, 103
Wax/wax standard mix, 266, 268
Web sites, as information resource, 172–173, 227
Wetting ability, 32
Whisker-walled columns, 27
Whole milk free acids, 234, 253
Window diagram approach, 220
Wood, chloroform extract, 166
World Wide Web (WWW), *see* Internet resources
Xanthan, 88
Xylazine, 88
Xylene, 119, 126, 143, 152, 175, 177, 269
Xylitol, 88
Xylose, 88
Zeolites, 28
Zileuton, 88
Zinc, 5, 26
Zip Scientific, 227
Zirconium, 101
Zolazepam, 86