Index

A
additives
gear oil formulation, 404–406
lubricating greases, 467–469
metalworking and machining fluids, 519–528
air-fuel ratio, 300
air intake temperature control, 302
aldehydes, 278
ambient air quality standards, 280
analytical tests, gear lubricants, 407–408
anti-icing agents, 327
anti-wear agents, lubricants, 21
antistatic agents, 332
application-based formulations, metalworking and machining fluids, 529–530
approval process
lubricant additives, 211
lubricant testing, 531–532
automatic transmission fluids, 365–368
automotive aftermarket, lubricating greases, 484–485
automotive gear oils, 393–396

B
base fluids
gear oil formulation, 402–404
lubricating greases, 463–467
metalworking and machining fluids, 500–505, 518
base oil properties, mineral base oils, 42–46
bearing lubrication, 482–484
bevel gears, 382
biocides, 331–332
biodegradability, lubricants, 595–598
biodegradable grease, 496
biodiesel, 311
biological (natural) base stocks, 92–99
composition of natural oils and structural modifications, 97–99
manufacture and processing, 95
melting point/pour point, 94
oxidative stability, 94
Blue Sky emissions standards, 292
brake fluids, 378–380

C
California emissions standards, 286–288
carbon monoxide, 277
carboxylate esters, synthetic base stocks, 54–61
cetane improvers, 329
chassis grease, 495
chemical tests, 531
chemistry, lubricating greases, 463–469
classification
combustion engine lubricants, 216
lubricating greases, 446, 480
metalworking and machining fluids, 500–517
cleanliness agents, 325–327
combustion chamber
deposit buildup, 301
design, 302
combustion engine lubricants, 212–272
classifications, 216
emissions control, 256–259
gear oil classification based on end-use, 229–245
gear types, 213–215
European standards, 222–228
extended service, 260–267
formulating engine oils, 249–255
formulation examples, 268–269
fuel economy, 256
Indian standards, 229
Japanese standards, 229
lubricant-related causes of engine malfunction, 246
operation mode, 213–215
railroad diesel engine oil concentrates, 270–272
rating of engine parts, 247–248
specifications, 216
trends on new standards, 217
U.S. standards, 218–221
combustion modifiers, 330
composition
lubricating greases, 448–463
metalworking and machining fluids, 518–519
natural oils and structural modifications, 97–99
transmission fluid, 370–373
compression ratio, 302
compressor and refrigeration oils, 424–432
condition-monitoring, hydraulic fluids, 364
conservation, lubricants, 585–587
continuously variable transmissions, 373–376
lubricants, 376–378
controlled auto-ignition combustion, 302
coolant temperature effect, 302
corrosion
inhibitors, 331
protection, 477–478
criteria for suitable base stocks, lubricant additives, 103

demulsifiers, 331
lubricant additives, 181–184
deposit control additives, 325–327
deposit formation, 322–325
desirable properties, lubricating greases, 471–480
detergents
lubricant additives, 137–148
in lubricants, 21
diagnostics, gear failure, 385
diesel combustion, 307–308
diesel emissions standards, 288–292

Copyright © 2009 by ASTM International
www.astm.org
diesel engines
  design and operating variables, 311–313
  emissions control, 305–322
  diesel fuel properties, 308–311
  diesel ignition improvers, 329
  diesel particulate filter, 291
  dispersants
    lubricant additives, 121–136
    in lubricants, 21
  displacement per cylinder, 302
  disposal
    lubricants and environment, 599–600
    lubricating greases, 486
  drag reducers, 332
  dyes and markers, 332–333
  E
  emerging engine technologies, 303–305
  emissions
    engine design effect, 300–305
    engine performance and, 279–280
    gasoline properties versus, 296
    in internal combustion engine, 273–333
  emissions control
    combustion engine lubricants, 256–259
    via after-treatment, 313–314
    via engine design changes, 314–322
  emissions standards, 281–295
    European Union, 293–296
    U.S., 281–293
  emulsifiers, lubricant additives, 181–184
  end-use classification, metalworking and machining
    fluids, 506–517
  engine oil classification based on end-use, combustion
    engine lubricants, 229–245
  engines
    design effect, emissions, 300–305
    performance and emissions, 279–280
    speed, 301
    types, combustion engine lubricants, 213–215
  environment
    lubricant additives, 209
    lubricants and, 591–593, 599
    lubricating greases, 486
  European standards, combustion engine
    lubricants, 222–228
  European Union emissions standards, 293–296
  evaporative emissions standards, 292
  exhaust back pressure, 301
  exhaust emissions, 274–278
  exhaust gas recirculation, 302–303
  extended service, combustion engine lubricants, 260–267
  extreme-pressure additives in lubricants, 21
  extreme-pressure greases, 495
  F
  failure, gear, 386
  film-forming agents, lubricants, 149–180
  flow improvers, 330
  fluid-based formulations, metalworking and machining
    fluids, 529–530
  fluid formulations and testing, metalworking
    and machining fluids, 529
  fluidizers, 327
  foam inhibitors, 331
    in lubricants, 22
  food processing, lubricating greases, 485
  formulated gasoline, 299
  formulating
    engine oils, 249–255
    hydraulic fluids, 361–363
  formulation examples, 363–364
  combustion engine lubricants, 268–269
  gear lubricants, 408–409
  hydraulic fluids, 363–364, 378–381
  industrial lubricants, 442
  metalworking and machining fluids, 529–530
  transmission fluids, 378–381
  friction and lubrication, 3
  friction modifiers in lubricants, 21
  fuel additives, 322–333
  fuel economy, combustion engine lubricants, 256
  full-scale testing, lubricants, 573–575
  G
  gas cans emissions control program, 293
  gas to liquid technology, mineral base oils, 46
  gasoline benzene control program, 292–293
  gasoline engines
    emissions control, 296–304
    standards, 283–288
  gasoline properties versus emissions, 296
  gear failure, 385–390
    cause of failure, 386
    diagnostics, 385
    modes, 385
  gear lubricants, 382–409
    analytical tests, 407–408
    formulation examples, 408–409
    lubricating greases, 484
    methods, 391
    performance tests, 408
    physical tests, 407
    selection, 393–401, 406–407
    tests, 407–408
  gear oil formulation, 402–405
    additives, 404–406
    base fluids, 402–404
  gears
    diagnostics, 385–386
    metallurgy, 383–384
    types, 382–383
    ground level ozone, 278
  H
  handling, lubricating greases, 486
heat resistance, lubricating greases, 476
helical bevel gears, 382
helical gears, 382
humidity effect, 302
hybrid vehicles, 303–304
hydraulic fluids, 333–363
        condition-monitoring, 364
        formulating, 361–363
        formulation examples, 363–364, 378–381
types, 349–361
hydrocarbon analysis, mineral base oils, 41
hydrocracking, mineral base oils, 37
hydrogen cracking, mineral base oils, 37

I

ideal air air-fuel mixture, 279
ignition timing, 301
in-service lubricant analysis, 558–573
Indian standards, combustion engine lubricants, 229
industrial applications, industrial lubricants, 432–438
industrial gear oils, 396–397
industrial hydraulic fluids, 335–349
industrial lubricants, 410–442
        compressor and refrigeration oils, 424–432
        formulation examples, 442
        industrial applications, 432–438
        machine tool lubricants, 438–439
        mining industry, 439–440
        synthetic fluids, 440–442
turbine, 411–424
industry trends, lubricating greases, 496
intake manifold pressure, 301
inter-grease compatibility, lubricating greases, 481–482

J

Japanese standards, combustion engine lubricants, 229

L

light-duty vehicle cold temperature emissions
        standards, 292
liquid lubricants versus lubricating greases, 444–445
load-carrying capacity, lubricating greases, 478–480
load or power level, 301
low-temperature operability additives, 330
lubricant additives, 100–211
        approval process, 211
        criteria for suitable base stocks, 103
desirable properties, 103
detergents, 137–148
dispersants, 121–136
emulsifiers and demulsifiers, 181–184
environmental impact, 209
film-forming agents, 149–180
new additives, 210
oxidation inhibitors, 110–120
performance additives, 104–211
polymeric additives, 185–205
stabilizers/deposit control agents, 105–109
lubricant base stocks, mineral base oils, 32–41
lubricant classifications, 20
lubricant-related causes of engine malfunction, 246
lubricant selection criteria, 19
lubricant testing, 531–578
        approval process, 531–532
        full-scale testing, 573–575
        in-service lubricant analysis, 558–573
        mechanical or tribological tests, 554–558
        new product introduction, 531–532
        physical and analytical tests, 532–554
        quality testing, 575–578
lubricants
        composition, 20–22
        continuously variable transmissions, 376–378
types, 19
lubricants and environment, 579–600
        biodegradability, 595–598
        conservation, 585–587
disposal issues, 599–600
environmental compatibility, 591–593
environmentally acceptable lubricants, 599
lubricant deterioration in service, 579–583
oil reconditioning, 588–591
re-recycling, 589
reclamation, 589
standardized testing, 593–595
toxicity, 598–599
used oil, 583–585
used oil recycling, 587–588
lubricating greases, 443–496
        additives, 467–469
        automotive aftermarket, 484–485
        base fluids, 463–467
        bearing lubrication, 482–484
        chemistry, 463–469
corrosion protection, 477–478
desirable properties, 471–480
development history, 445–446
disposal, 486
environmentally compatible, 486
food processing, 485
gear lubrication, 484
handling, 486
heat resistance, 476
industry trends, 496
inter-grease compatibility, 481–482
versus liquid lubricant, 444–445
load-carrying capacity, 478–480
manufacture, 469–471
market, 447–448
modern grease characteristics, 480–481
nonsoap, 459–463
oxidation stability, 476
rheological stability, 476
rheological properties, 472–476
selection, 482
soap, 448–459
specialty, 492–496
steel mills, 485
storage, 485–486
storage stability, 476
testing, 486–492
textiles, 485
water sensitivity, 477
lubrication, 1–22
friction and, 3
market, 1
metalworking and machining fluids, 499
lubricity agents, 328–329

M

machine tool lubricants, industrial lubricants, 438–439
manufacture
biological (natural) base stocks, 95
lubricating greases, 469–471
market, lubricating greases, 447–448
mechanical or tribological tests, 554–558
melting point/pour point, biological (natural) base stocks, 94
metal deactivators, 333
metalworking and machining fluids, 497–530
additives composition, 519–528
application-based formulations, 529–530
base fluid classification, 500–505
base fluid composition, 518
classification, 500–517
composition, 518–519
end-use classification, 506–517
fluid-based formulations, 529–530
fluid formulations and testing, 529
formulation examples, 529–530
lubrication, 499
viscosity, 500
methods, gear lubrication, 391
mineral base oil manufacture, 34
mineral base oils, 23–46
base oil properties, 42–46
effects of sulfur and nitrogen compounds, 42
gas to liquid technology, 46
hydrocarbon analysis, 41
hydrocracking, 37
hydrogen cracking, 37
lubricant base stocks, 32–41
mineral base oil manufacture, 34
naphthenic base oils, 33
oil field and refinery chemicals, 24–27
oxidation properties, 42
paraffinic base oils, 33
petroleum composition, 23–27
petroleum refining, 28–31
refinery process chemicals, 31
refinery processes, 28–31
mineral oils mixed with solids, 495
mining industry, industrial lubricants, 439–440
modern grease characteristics, 480–481

N

naphthenic base oils, mineral base oils, 33
new additives, lubricant additives, 210
new product introduction, lubricant testing, 531–532
nitrogen oxides, 277–278
nonsoap lubricating greases, 459–463

O

octane improvers, 327–328
odor, exhaust, 278–279
oil field and refinery chemicals, mineral base oils, 24–27
oil reconditioning, lubricants and environment, 588–591
on-board diagnostics, 303
operation mode, combustion engine lubricants, 213–215
oxidation inhibitors
lubricant additives, 110–120
in lubricants, 21
oxidation inhibitors/stabilizers, 333
oxidation properties, mineral base oils, 42
oxidation stability
biological (natural) base stocks, 94
lubricating greases, 476

P

paraffinic base oils, 33
particulate matter, 278
performance additives, lubricant additives, 104–211
performance tests, gear lubricants, 408
petroleum
composition, 23–27
refining, 28–31
petroleum base stocks versus synthetic base fluids, 76–91
physical and analytical tests, lubricant testing, 532–554
physical tests, 531
gear lubricants, 407
pitting, 389
poly(alkylene glycols), synthetic base stocks, 62–66
polymeric additives, lubricant additives, 185–205
pour point depressants in lubricants, 22
power steering fluids, 381
power transmission fluids, 368–370
PuriNOx technology, 311

Q

quality testing, lubricant testing, 575–578

R

railroad diesel engine oil concentrates, combustion engine lubricants, 270–272
rating of engine parts, combustion engine lubricants, 247–248
re-recycling lubricants and environment, 589
reclamation, lubricants and environment, 589
refinery process chemicals, mineral base oils, 31
refined lubricant additives, 185–205
refined diesel fuel, 310–311
refined gasoline, 299–300
refrigeration oils, industrial lubricants, 424–432
rheological properties, lubricating greases, 472–476
roll neck greases, 495–496
rust and corrosion inhibitors in lubricants, 21

S

selection
gear lubricants, 406–407
gear lubrication, 393–401
lubricating greases, 482
shock absorber fluids, 380–381
smoke suppressants, 330
soap lubricating greases, 448–459
soot, 278
spalling, 389
specialty lubricating greases, 492–496
specifications, combustion engine lubricants, 216
spur gears, 382
stabilizers/deposit control agents, lubricant additives, 105–109
standardized testing, lubricants and environment, 593–595
standards
ambient air quality, 280
Blue Sky emissions, 292
California emissions, 286–288
combustion engine lubricants, 218–221
diesel emissions, 288–292
emissions, 281–295
European, 222–228
European Union, 293–296
evaporative emissions, 292
gasoline engines, 283–288
Indian, 229
Japanese, 229
light-duty vehicle cold temperature emissions, 292
trends, 217
U.S., 281–293
steel mills, lubricating greases, 485
storage
lubricating greases, 485–486
stability, lubricating greases, 476
stroke-to-bore ratio, 302
sulfur and nitrogen compounds effects, mineral base oils, 42
sulfur dioxide, 278
surface temperature, 301–302
surface-to-volume ratio, 302
synthetic base fluids versus petroleum base stocks, 76–91
synthetic base stocks, 47–91
carboxylate esters, 54–61
versus petroleum base stocks, 76–91
poly(alkylene glycols), 62–66
synthetic hydrocarbon (SHC) polymers, 47–53
synthetic fluids, industrial lubricants, 440–442
synthetic hydrocarbon (SHC) polymers, 47–53

testing
gear lubricants, 407–408
lubricating greases, 486–492
transmission fluid, 370–373
textiles, lubricating greases, 485
toxicity, 583
lubricants and environment, 598–599
track roller lubricants, 495
tractor hydraulic fluids, 335
transmission fluids, 364–378
automatic, 365–368
composition and testing, 370–373
formulation examples, 378–381
power, 368–370
trends on new standards, combustion engine lubricants, 217
turbine, industrial lubricants, 411–424
turbo-charging, 303

U
unburned hydrocarbons, 276–277
U.S. standards
combustion engine lubricants, 218–221
emissions, 281–293
used oil recycling, 587–588

V
valve overlap, 301
viscosity
metalworking and machining fluids, 500
modifiers in lubricants, 22
and wear, 8–18

W
water sensitivity, lubricating greases, 477
wax modifiers, 330
wear, viscosity and, 8–18
worm gears, 382–383