Index

100% relative humidity testing, 733

A
Abradants, 616
  falling abrasive test, 616–617
Abrasion resistance
  abradants, 616
  falling abrasive test, 616–617
  abrasive blast methods
    air jet erosion tester and micro-abrader, 617
    gravel projecting machine, 618
  comparison of abrasion testers, 621
  correlation with end-use performance, 615–616
  mechanism of abrasion, 616
  methods using rotating abrasive wheels
    Taber® Abraser, 618–619
    Taber® grit feeder attachment, 619
  methods using rotating disks
    Schiefer Abrasion testing machine, 618
  PEI Abrasion Tester, 622–623
  rain or water erosion, 622
  relationship to other physical properties, 615
    hardness, elasticity, and tensile strength, 615
Sand on Wheel Tester, 623
  test method precision, comparison, 621
  tests based on linear motion, 619
    oscillating sand tester, 620–621
    RCA abrasion wear tester, 620
    Taber® Large Linear Abraser, 620
    Taber® Linear Abraser, 620
    Taber® Reciprocating Abraser, 620
  tests for mar abrasion resistance
    balanced beam tester, 621
    Coin Mar Test, 622
    Fingernail Test, 622
    Multi-Finger Scratch Tester (5-Finger Scratch
    Tester), 622
    Nanoscratching, 622
    Paperclip Mar Test, 622
    Taber® Shear/Scratch Test, 621
Abrasion scrubbing & washability tester, 735
Abrasion testers
  comparison of, 621
Abrajet blast methods
  air jet erosion tester and micro-abrader, 617
  gravel projecting machine, 618
Absorption, 592
Accelerated mechanical exposure, 734
Accelerated weathering, 715–716
  accelerated weathering devices
    carbon arc and xenon arc, 722–723
    fluorescent UV/condensation, 723
    fluorescent UV-salt fog, 723
    fresnel reflector, 723–724
    electromagnetic spectrum, 716
    elements of weathering, 716
    light, 716–721
  moisture, 721–722
  oxygen, 722
  temperature, 722
  enclosed carbon arc, 717
  fluorescent UV lamps, 718–720
  lamp stability, 720
  metal halide, 720
  open-flame carbon arc, 717–718
  spectra of light, 717
  ultrafast weathering, 724
  xenon arc, 718
Acceleration due to gravity (g), 378
Acetone, 153
Acetone cyanohydrin, 50
Acetoxy cure system, 114
Achromatic, 592
Acid catalysts, 77
Acid resistance
  and acid etch resistance, 727
  testing paints for, 253
Acid spot test, 253
Acid wash color, 177
Acid-base adhesion, 603
Acid-functional acrylics cross-linked with epoxy
  resins, 53–54
Acidity, 177
Acids and anhydrides used in alkyd manufacture, 67
Acylated polyurethanes, 108
Acrylate-terminated polyurethanes, 108
Acrylic emulsion polymers, 49, 56
  acrylic emulsion maintenance coatings, 60
  acrylic emulsions for architectural coatings, 56–60
  acrylic emulsions for industrial coatings, 61
  acrylic emulsions for traffic coatings, 60–61
  effect of particle structure and morphology on
    properties of latex films, 61–64
  exterior coatings applications, 58–60
  interior coatings applications, 57–58
  physical chemistry of, 56
  as property modifier for poly(vinyl acetate)
    architectural coatings, 60
  versus water-based coatings, 61
  waterborne paints based on, 60
Acrylic hetero-polymer, 64
Acrylic latexes (see Acrylic emulsion polymers; Acrylic
  emulsion polymers)
Acrylic modified alkyd, 41
Acrylic monomers, 50
Acrylic polymers as coatings binders, 49–50
  acrylic emulsion polymers, 56
    acrylic emulsion maintenance coatings, 60
    acrylic emulsions for architectural coatings, 56–60
    acrylic emulsions for industrial coatings, 61
    acrylic emulsions for traffic coatings, 60–61
    effect of particle structure and morphology on
      properties of latex films, 61–64

Copyright © 2012 by ASTM International www.astm.org
use of acrylic polymers as property modifier for poly(vinyl acetate) architectural coatings, 60
acrylic monomers, 50
acrylic solution polymers
thermoplastic resins, 51–53
thermosetting acrylic resins, 53–56
methacrylates, 50–51
Acrylic polymers cross-linked with amino resins, 54–55
Acrylic resins (see Acrylic solution polymers)
Acrylic solution polymers, 49, 53
cross-linked with aliphatic isocyanates, 56
Acrylic/epoxy coatings/enamels, 54
disadvantages, 54
Acrylics, 51
Active-8, 40
Active solvents, 156–157
Acyclic dimer acid, 98
Addition cure system, 114
Additive mixing of lights, 553
Adhesion, 601
acid-base adhesion, 603
aerospace and aircraft coatings, 743–744
chemical adhesion, 603
combination of phenomena, 603
diffusion theory, 602
effects of substrates
additional chemistry, 603–604
electrostatic adhesion, 603
fracture theory, 601–602
mechanical adhesion, 603
practical adhesion, 604–605
direct tensile testing, 608–611
mechanized tape test, 607–608
peel adhesion testing on plastic substrates, 605–606
procedural problems, 607
scrap adhesion testing, 611–612
tape controversy, 607
tape test, 605
test methods, 605
weak boundary layer theory, 602
wetting-contact theory, 602
work of adhesion, 601
Adsorption of gases, 400
Adsorption of solutes onto pigments, 400
Aerobes, 313
Aerosol beam generator and detection mechanism, 402
“Aerosol Coating” section, 14
Aerosol coatings regulations (ARB), 14
Aerospace and aircraft coatings, 739
adhesion, 743–744
analytical methods for aircraft paint components, 740
cleanability, 748
cleaning procedure, 749
corrosion inhibition, 746
density, 740
drying time, 742
film thickness, 742
fineness of grind and coarse particles, 740
flash point, 741
Pensky–Martens, 741
pot life, 741–742
setaflash, 741
tag, 741
flexibility, 744–745
fluid resistance, 747–748
hardness and mar resistance, 745–746
heat resistance, 748
optical properties, 742–743
preparation of soil, 749
preparation of the control formula cleaner, 749
solid and volatile concentration/content, 740
chemical analysis, 740–741
pigment concentration, 740
total solids content, 740
volatile concentration, 740
storage stability, 741
accelerated conditions, 741
long-term evaluation, 741
strippability, 748
viscosity, 739
Alcohols, 154–155
properties of, 155
Aliphatic hydrocarbons, 149–150
properties of, 150
Aliphatic isocyanates, 109
Alkali and detergent resistance, 727
Alkali resistance test, apparatus for, 728
Alkalinity, 177–178
Alkali-swellable/soluble emulsions (ASEs), 356–357
Alkyd copolymers, 125
Alkyd resins, 66
classification, 68
description of unmodified, 69
modification of, 94
properties related to oil length, 69
raw materials used to manufacture, 66
Alkyd-oil house paint, 41
Alkyds, 65
alkyd resin classification, 68
higher solids alkyd resins, 68–69
history, 65
manufacture, 66
fusion process, 66
solvent reflux process, 66
physical properties, 67
acid value, 68
color, 68
density, 68
drying properties, 68
flash point, 68
hydroxyl value, 68
nonvolatile content, 68
viscosity, 67–68
and polyesters, 65–70
raw materials used to manufacture alkyd resins, 66
saturated polyesters, 70
silicone-modified polyesters, 70
conventional types, 70
higher-solids types of polyesters, 70
synthesis, processing, and manufacture, 65–66
acids and anhydrides used in, 67
monobasic fatty acid or triglyceride oil, 65
polybasic organic acid/anhydride, 65
polyhydric alcohol, 65
polyhydric alcohols used in, 67
vegetable oils used in, 66, 67
water-reducible alkyd resins, 69–70
Alkyl phenol ethoxylate (APEO), 320
Allen-Bradely sonic sifter, 395
Allophanate, urethane chemistry, 104
ALPHA, 139
Alpine air-jet sieve, 396
Alternative drier compounds, 39
Alumina trihydrate, 247
Alumino hydrate, 246
Aluminum beverage can production in various countries, 771
Aluminum flakes, photomicrographs of two different types of, 274
Aluminum pigments
grade classification, 251–252
properties, 250–251
AM monomer, 55
American Architectural Manufacturers Association, 945
American Association of State and Transportation Officials (AASHTO), 23
American Association of State Highway & Transportation Officials, 945
American Institute of Architects, 945
American National Standards Institute, 945
American Oil Chemists’ Society (AOCS), 32
Amide, urethane chemistry, 105
Amine blocking agents, 77
Amino resins, 72
applications, 72–73
conventional solids versus high-solids, 73
environmental/toxicity, 79
history, 72
kinetics of methylolation reactions, 73
physical properties, 76
surface tension, 76
viscosity, 76
reactions of aminos in coatings
cure reactions, 76–77
degradation and weathering, 77–78
end uses of amino resins, 78
synthesis of amino resins
analysis/analytical methods, 74–76
reactions of synthesis, 73
structure/property variations, 73–74
Amino/aminoplast resins, 72
Amino-based crosslinked coatings, 77
Aminoethylpiperazine, 97, 99
Aminos in coatings, reactions of
cure reactions, 76–77
degradation and weathering, 77–78
end uses of amino resins, 78
Amphoteric surfactant, 321
Anaerobes, 313
Analogue coating thickness gages, 522
Aniline point, 158
Aniline point apparatus, 158
Anionic emulsions, 25
Anionic surfactants, 321
Annual Book of ASTM Standards, 22, 947
Anti-corrosion pigments, 284
Anti-corrosion protection of metal mechanisms for, 294
Anti-corrosion protection of metal, two mechanisms for, 294
Antimicrobial agents, mode of action of, 315
agents that chelate metals, 315
agents that react with nucleophilic groups, 315
formaldehyde-releasing agents, 315
AOCS Ca 2c-25 (Reapproved 1997), 36
AOCS Cd 7-58 (reapproved 1997), 36
AOCS Ce 5b-89 (reapproved 1997), 36
AOCS S 2-64 (Revised 2003), 36
AOCS Tc 1a-64 (Reapproved 1997), 36
AOCS Td 1a-64 (Revised 2000), 36
AOCS Te 2a-64 (Reapproved 1997), 36
AOCS test methods for industrial oils and derivatives, 36
AOCS Tg 1-64 (Reapproved 1997), 36
AOCS Th 1a-64 (Revised 2005), 36
AOCS Tk1a-64 (Reapproved 1997), 36
AOCS Tm 1a-64 (Revised 2003), 36
AOCS Tm 1a-64, 36
AOCS To 1b-64 (Revised 2003), 36
AOCS Tp 1a-64 (Revised 2003), 36
AOCS Tt 1a-64 (Reapproved 1997), 36
Apatites, 294
“APHA Color,” 174
API gravity, 171
API Manual of Petroleum Measurement Standards, 173
API RP 5L2, 788
API RP 5L7, 788
Apparent density, 377
Applicator frame/step gap applicator, 509
Aqueous acrylic/ melamine coil coatings enamel over aluminum and galvanized steel, properties of, 62
Architectural coatings, 751
appearance properties, 760
application properties
anti-sag resistance, 755
application foam, 757
applied hiding power, 757
applied spread rate, 756–757
applying uniform paint films for testing, 757–759
leveling, 755
open time, 759
rheology effects on application, 755
spatter resistance, 757
touch up, 759–760
architectural coating categories, 751
dry film performance properties, 760–764
film-formation proper
drying times, 753–754
holdout, 754
penetration, 754–755
porosity, 754
film-formation properties, 753
properties of liquid coatings, 751
colorant compatibility, 753
density, 752
fineness of dispersion, 753
stability, 753
viscosity, 752–753
Volatile Organic Contents (VOC), 753
substrates, 751–752
Aromatic hydrocarbons, 150–151
nonaromatic hydrocarbons in, 178
properties of, 151
Aromatic naphthas, 151
Artificial bitumens, 19–20
Artists' paints
film properties
adhesion, 767
bleeding, 767
block resistance, 768
chemical resistance, 768
flexibility, 768
gloss, 768
lightfastness, 768–769
yellowing, 769
safety and compliance, 769
Volatile Organic Compounds (VOC), 769
shelf stability, 765
appearance, 765
color change, 766
consistency, 766
flocculation, 766
freeze-thaw stability, 766
package integrity, 766
seeding, 766
settling, 766
spoilage/putrefaction, 766–767
viscosity changes, 767
testing of artists' paints, 765
working properties, 767

ASATM E20, 403
Asbeck-Van Loo method of determining CPVC, 307
Asphalt, 19
ASTM standard terminology, 19
specifications and test methods for, 23
Asphalt cutbacks, 22
Asphalt emulsions, 21
Association of Industrial Metallizers, Coaters and Laminators (AIMCAL), 132
Associative polymer thickening in aqueous media, depiction of, 346
Associative thickeners, 344
Associative TRMS (ATRMS), 356, 361
hydrophobe modified ASEs (HASE), 358–359
hydrophobe modified cellulosics (HMC), 359–360
hydrophobe modified nonionic synthetics (HMNS), 356–358
relative polymer architecture, 359
ASTM F695-01(2009), 680
ASTM D2137, 502
ASTM D2794-93, 642

ASTM D4449, 560
ASTM D5950, 141
ASTM A394, 133
ASTM A740, 133
ASTM A896, 133
ASTM A123/A123M, 133
ASTM A641/A641M, 133
ASTM A653/A653M, 133
ASTM A854/A854M, 133
ASTM B117, 295, 728, 746
ASTM B200, 132
ASTM B456, 132
ASTM B488, 132
ASTM B533, 612
ASTM B545, 132
ASTM B571, 612
ASTM B579, 132
ASTM B605, 132
ASTM B633, 132
ASTM B634, 132
ASTM B650, 132
ASTM B679, 132
ASTM B700, 132
ASTM B734, 132
ASTM B766, 132
ASTM B840, 132
ASTM B841, 132
ASTM B842, 132
ASTM B852, 133
ASTM B866, 133
ASTM B867, 132
ASTM B874, 132
ASTM B875, 132
ASTM B905, 607
ASTM B537-70 (1992), 691
ASTM B117-07a, 24
ASTM C148, 84
ASTM C217, 621
ASTM C282, 84
ASTM C283, 84
ASTM C285, 84
ASTM C346, 84
ASTM C372, 82, 83
ASTM C374, 84
ASTM C385, 84
ASTM C424, 82, 83
ASTM C448, 622
ASTM C536, 84
ASTM C537, 84
ASTM C538, 84
ASTM C539, 84
ASTM C554, 82, 83
ASTM C556, 82, 83
ASTM C584, 83
ASTM C609, 83
ASTM C614, 84
ASTM C633, 612
ASTM C650, 82, 83
ASTM C675, 85
ASTM C676, 85
ASTM C703, 84
ASTM C724, 85
ASTM C735, 85
ASTM C738, 82, 83
ASTM C743, 84
ASTM C756, 84
ASTM C777, 85
ASTM C813, 465
ASTM C824, 85
ASTM C839, 84
ASTM C872, 84
ASTM C895, 82, 83
ASTM C927, 85
ASTM C1027, 83
ASTM C1028-07e1, 680
ASTM C1028-07e1, 680
ASTM D4, 788
ASTM D4-86(2004), 19, 23
ASTM D5, 788
ASTM D16, 375, 592
ASTM D235, 179
ASTM D255-70, 25
ASTM D279, 768
ASTM D281, 241, 300, 302
ASTM D282, 596
ASTM D287, 172
ASTM D305, 213
ASTM D312-00(2006), 23
ASTM D323, 160
ASTM D344, 587, 757
ASTM D365, 548
ASTM D387, 213
ASTM D402-08, 24
ASTM D412, 116, 624, 633
ASTM D445, 142, 159
ASTM D449-03(2008), 23
ASTM D450-07, 23
ASTM D465-05, 99
ASTM D1218, 141, 175
ASTM D1227-95(2007), 25
ASTM D1259, 68
ASTM D1259-06, 99
ASTM D1296, 141, 175
ASTM D1298, 172
ASTM D1308, 725, 727, 761, 768
ASTM D1319, 177
ASTM D1328-86, 25
ASTM D1343, 30
ASTM D1347, 387
ASTM D1364, 142
ASTM D1436, 677
ASTM D1439, 387
ASTM D1474, 44, 501
ASTM D1475, 68, 142, 385, 739
ASTM D1475-98(2008), 24
ASTM D1476, 180
ASTM D1492, 179
ASTM D1500, 548
ASTM D1505, 386
ASTM D1506, 213
ASTM D1509, 213
ASTM D1510, 213
ASTM D1511, 213
ASTM D1512, 213
ASTM D1513, 213
ASTM D1535, 766
ASTM D1540, 725
ASTM D1540-82, 25
ASTM D1542-60, 25
ASTM D1544, 68, 548
ASTM D1544-04, 99
ASTM D1545, 67, 74, 159
ASTM D1555, 173
ASTM D1562, 30
ASTM D1613, 177
ASTM D1614, 177
ASTM D1617, 141, 177
ASTM D1619, 213
ASTM D1640, 68, 528, 742
ASTM D1640-03(2009), 24
ASTM D1644-01(2006), 24
ASTM D1647, 727
ASTM D1653, 747
ASTM D1654, 732
ASTM D1654-08, 24
ASTM D1669-07, 23
ASTM D1670-04, 23
ASTM D1676, 501
ASTM D1686, 548
ASTM D1695, 30, 351
ASTM D1722, 180
ASTM D1729, 551
ASTM D1730, 732
ASTM D1734, 508, 732
ASTM D1735
ASTM D1735-08, 729
ASTM D1738, 587
ASTM D1849, 741
ASTM D1849-95(2008), 24
ASTM D1856-09, 23
ASTM D1879, 955
ASTM D1894-08, 680
ASTM D1925, 547
ASTM D1955, 36
ASTM D1968, 766
ASTM D2042-09, 23
ASTM D2047-99, 680
ASTM D2064-91, 767
ASTM D2124, 120
ASTM D2134, 501
ASTM D2192, 177
ASTM D2196, 349, 423, 739, 767
ASTM D2196-05, 99
ASTM D2197, 611, 621, 745
ASTM D2201, 133
ASTM D2240, 116, 745
ASTM D2243, 337, 741
ASTM D2243-95(2008), 24
ASTM D2244, 596, 743
ASTM D2247, 729, 747, 785
ASTM D2247-02, 24
ASTM D2251, 133
ASTM D2268, 176
ASTM D2288, 116
ASTM D2306, 176
ASTM D2318-98(2008), 23
ASTM D2320, 386
ASTM D2320-98(2008), 23
ASTM D2354, 333
ASTM D2360, 178
ASTM D2369, 74, 740
ASTM D2369-07, 24
ASTM D2370, 517, 624, 633, 642
ASTM D2370-98(2002), 24
ASTM D2372, 740
ASTM D2394-83, 680
ASTM D2414, 213
ASTM D2415, 788
ASTM D2415-98(2008), 23
ASTM D2416-84(2004), 23
ASTM D2486, 619
ASTM D2486-06, 761
ASTM D2521-76(2008), 23
ASTM D2569-97(2002), 25
ASTM D2578, 465
ASTM D2614, 587
ASTM D2616, 551
ASTM D2621, 120
ASTM D2671, 501
ASTM D2697, 386, 387, 740
ASTM D2698, 740
ASTM D2710, 179
ASTM D2714—94, 680
ASTM D2745, 594
ASTM D2746-07, 23
ASTM D2792, 726
ASTM D2794, 502, 641
ASTM D2804, 176, 740
ASTM D2805, 587, 588, 743
ASTM D2823-05, 25
ASTM D2824-06, 25
ASTM D2825, 677
ASTM D2832-92(2005), 24
ASTM D2849, 140
ASTM D2879, 140, 160
ASTM D2929, 30
ASTM D2935, 173
ASTM D2939-03, 25
ASTM D2962-97(2007), 23
ASTM D2963-78, 25
ASTM D2965, 381
ASTM D3009, 176
ASTM D3023, 725
ASTM D3037, 213
ASTM D3053, 213
ASTM D3054, 176
ASTM D3104-99(2005), 24
ASTM D3105-08, 24
ASTM D3108-07, 680
ASTM D3132, 160
ASTM D3143, 788
ASTM D3170, 618
ASTM D3170-03(2007), 24
ASTM D3257, 176
ASTM D3260, 727
ASTM D3265, 213, 596
ASTM D3278, 68, 141, 168, 741
ASTM D3313, 213
ASTM D3329, 176
ASTM D3335, 740
ASTM D3359, 605, 607, 743, 760, 768
ASTM D3359-09, 24
ASTM D3360, 397
ASTM D3363, 43, 501, 745
ASTM D3412, 678
ASTM D3412-07, 680
ASTM D3423-84(2003), 25
ASTM D3424, 766
ASTM D3432, 740
ASTM D3447, 176
ASTM D3459, 734
ASTM D3461-97(2007), 23
ASTM D3465, 141, 143
ASTM D3493, 213
ASTM D3505, 173, 385
ASTM D3539, 161
ASTM D3545, 176
ASTM D3718, 740
ASTM D3719, 337
ASTM D3730, 510, 612, 766
ASTM D3730-10, 752
ASTM D3732, 955
ASTM D3742, 176
ASTM D3760, 176
ASTM D3793, 337
ASTM D3793-06, 755
ASTM D3797, 176
ASTM D3798, 176
ASTM D3805-85, 25
ASTM D3825, 465
ASTM D3849, 213
ASTM D3893, 176
ASTM D3934, 170

ASTM D3941, 169
ASTM D3960, 338
ASTM D3960-05, 24, 101
ASTM D3964, 550
ASTM D4017, 740
ASTM D4045, 180
ASTM D4052, 142, 386
ASTM D4060, 616, 618, 621, 745, 789
ASTM D4061, 538
ASTM D4062, 349
ASTM D4065, 628
ASTM D4072-98(2008), 24
ASTM D4092, 624
ASTM D4103-90(2009), 680
ASTM D4122, 213
ASTM D4138, 519
ASTM D4141, 284
ASTM D4141-07, 764
ASTM D4144, 955
ASTM D4145, 612, 640
ASTM D4146, 282, 612, 641
ASTM D4209, 30
ASTM D4212, 739
ASTM D4213, 619
ASTM D4213-08, 761
ASTM D4236, 766
ASTM D4273, 129
ASTM D4274, 68, 129
ASTM D4366, 501
ASTM D4367, 178
ASTM D4368, 120
ASTM D4400, 349, 436, 508
ASTM D4402-06, 23
ASTM D4414, 514, 517
ASTM D4414-95, 756
ASTM D4446, 731
ASTM D4479-07, 25
ASTM D4492, 176
ASTM D4527, 213
ASTM D4534, 178
ASTM D4541, 609–610, 611, 781
interlaboratory data, 610
ASTM D4558, 729, 733, 785
ASTM D4587-05, 764
ASTM D4616-95(2008), 24
ASTM D4662, 129
ASTM D4707, 758
ASTM D4707-09, 757
ASTM D4708, 506, 627, 642
ASTM D4746-98(2008), 24
ASTM D4752, 501, 632, 727
ASTM D4773, 176
ASTM D4799-08, 23
ASTM D4820, 213
ASTM D4821, 213
ASTM D4838, 593, 767
ASTM D4875, 129
ASTM D4883, 387
ASTM D4890, 129
ASTM D4892, 387
ASTM D4892-89(2009), 24
ASTM D4893-94(2004), 24
ASTM D3320-00(2004)e1, 25
ASTM D3359-09e2, 760
ASTM D3468-99(2006)e1, 25
ASTM D4715-98(2008)e1, 24
ASTM D4866-88(2003)e1, 25
ASTM dispersion gage and scraper, 409
ASTM E11, 393
ASTM E96, 732
ASTM E161, 394
ASTM E167, 561
ASTM E170, 955
ASTM E179, 596
ASTM E201, 173
ASTM E202, 176
ASTM E260, 176
ASTM E276, 394
ASTM E284, 214, 274, 558, 596
ASTM E300, 141
ASTM E303-93(2008), 680
ASTM E308, 174, 766
ASTM E355, 176
ASTM E430, 561, 563
ASTM E446, 176
ASTM E510, 678
ASTM E595, 115
ASTM E670-09, 680
ASTM E707-90(1996), 680
ASTM E805, 537, 596
ASTM E808, 538
ASTM E809, 538
ASTM E810, 538
ASTM E811, 538
ASTM E991, 538
ASTM E1100, 176
ASTM E1147, 335
ASTM E1164, 537, 549, 550, 596
ASTM E1247, 538
ASTM E1331, 537, 549, 550
ASTM E1336, 549
ASTM E1341, 549
ASTM E1345, 537, 550, 596
ASTM E1347, 537, 596, 743
ASTM E1348, 537, 549, 550
ASTM E1349, 537, 549, 550
ASTM E1455, 549
ASTM E1499, 551
ASTM E1501, 538
ASTM E1640, 629
ASTM E1696, 538
ASTM E1709, 538
ASTM E1710, 538
ASTM E1773, 133
ASTM E1809, 538
ASTM E1899, 30
ASTM E2030, 539
ASTM E2072, 539
ASTM E2073, 539
ASTM E2152, 538
ASTM E2153, 538
ASTM E2175, 274
ASTM E2176, 538
ASTM E2177, 538
ASTM E2214, 537, 550
ASTM E2301, 538
ASTM E2302, 538
ASTM E2366, 538
ASTM E2367, 538
ASTM E2501, 538
ASTM E2539, 277
ASTM E2540, 538
ASTM E2630, 538
ASTM E2729, 539
ASTM E108-07a, 23
ASTM E96/E96M-05, 23
ASTM E102/E102M-93(2009), 23
ASTM E609-05, 680
ASTM F692, 613
ASTM F732-00(2006), 680
ASTM F735, 621
ASTM F923, 538
ASTM F1044, 613
ASTM F1147, 613
ASTM F1677, 680
ASTM F1677-96, 679
ASTM F1679, 680
ASTM F1679-00, 679
ASTM F1842, 613
ASTM G1, 728
ASTM G6, 789
ASTM G6-07, 24
ASTM G10, 789
ASTM G14, 641
ASTM G17, 788
ASTM G24, 284
ASTM G40-99, 680
ASTM G50-76, 691
ASTM G56, 623
ASTM G65-04(2010), 680
ASTM G77-98, 680
ASTM G85, 746
ASTM G99-05(2010), 680
ASTM G115, 678
ASTM G115-10, 677, 680
ASTM G123, 678
ASTM G151, 716
ASTM G152, 722
ASTM G153, 722
ASTM G154, 723
ASTM G155, 722, 729, 747
ASTM G133-05(2010), 680
ASTM G143-03(2009), 680
ASTM Gage, 411
ASTM International, 945
ASTM (3M-710), 607
ASTM Method D446 and D2162, 444
ASTM practices, preparation, specifications, and test
method for galvanized materials/structures/surfaces, 133
ASTM specification for electrode-H posited coatings of
various metals, 132
ASTM Standards on Chromatography, 176
ASTM standards on reflectance and transmittance
measurements, 537
ASTM Test Method for Particle Size Distribution of
Alumina, 241
ASTM test standards, 249
ASTM Type III polyurethane coatings, 109
ASTM WK3833, 538
ASTM WK19806, 538
ASTMD1725, 159
Atmospheric corrosion of metals, 689–690
Atmospheric pollutants, 3
Attapulgite clay, 362–363
Attenuated total reflection (ATR), 32
Automated curve-fitting approaches, 463
Automatic mullers, 595
Automatic thin-film evaporometer, 163
“Auxochromes,” 216
AWWA C210, 788
AWWA C214, 788
AWWA C215, 788
AWWA C217, 788
Azam method, 301, 302
Azo condensation yellows
structures, 228
Azo-based oranges, 227–230
B
B117, 298
Bactericides, fungicides, and algicides, 313
analysis and neutralization of microbicides, 318
factors impacting efficacy of some common microbicides, 318
groups of microorganisms related to biocidal efficacy, 314
methods for determination of microbicide efficacy, 318–319
microbial problems
dry-film preservation, 314
in-can preservation, 313–314
mode of action of microbicides, 315
mode of action of some antimicrobial agents, 315
agents that chelate metals, 315
agents that react with nucleophilic groups, 315
formaldehyde-releasing agents, 315
regulatory issues, 319
strategies for minimizing resistant strains, 315–316
Baked liquid coatings, 90
Balanced beam tester, 621
Balanced-beam scrape adhesion tester, 614
Barium sulfate, 245, 246
coatings performance, 245
physical properties, 245
Barytes (see Barium sulfate)
Battelle chemical resistance cell, 727
Bentonite clay
macro-structure of, 291
Bentonite/montmorillonite clay—swelling, 360–361
Benzene, 178
Benzene content, 178
Benimidazole based reds, 221
structure of, 221
Benimidazole oranges, 229
Benimidazole yellows, 226
properties of, 227
Benzoguanamine-based amino resins, 78
Bisphenol A/epichlorohydrin, 53
application properties for white enamel based on acid functional acrylic resin cross-linked with, 54
Bitumen-modified waterproofing membranes, 22
Bitumens, 19 (see also Asphalt)
ASTM standard terminology, 19
history and background of, 19–20
Bituminous coatings
automotive under-body rust proofing, 20
bitumens, history and background of, 19–20
coating types, 20
coatings for paving, 22
roof coatings, 20–22
specialty paints and coatings, 20
waterproofing membranes, 22
identification of bituminous materials, 22
tests on bituminous materials, 22–23
resin modified, 25
tests and specifications for coatings, 24
resin modified bituminous coatings, 25
solvent-thinned or cut-back coatings, 24
withdrawn specifications and test methods, 25
Bituminous materials
identification of, 22
standard specifications and standard test methods for, 23
tests on, 22–23
Biuret, urethane chemistry, 105
Black pigments, 204
carbon blacks (class 1), 204–214
black tinted coatings, 211
carbon black optical function, 204–208
carbon black parameters affecting optical function, 208–210
effect of dispersion quality, 210–211
measuring appearance properties of carbon black coatings, 211–213
selecting grade of carbon black for coloring, 211
carbonaceous pigments (class 2), 204
bone blacks, 204
mineral blacks, 204
classification of, 205
iron oxide blacks (class 3), 204
Bleed test, 232
Bleister fluid, 649
Blistered coatings, systematic chemical analysis of osmotic blister fluids and, 649–650
determination of electrical conductivity and pH, 651–652
GC/MS analysis by low temperature thermal extraction/desorption (TE/GC/MS), 650–651
GC/MS high temperature pyrolysis (PYRO/GC/MS), 651
Blooming/blushing, 283
Blues, pigments
  iron blue, 236
  ultramarine blue, 236

Bodying and flattening agents, metallic soaps as, 38
BON Maroon, structure of, 217
BON Red, 217
Bone blacks, 204
BPA diglycidyl ether (BADGE), 91
BPA epoxy resins, 87–88
  idealized structure of, 88
  properties of, 88
Brightness, 592
British Standards Institution, 589, 945
Broad spectrum, 313
Brominated epoxy resins, 89
Bromine index, 179
Brookfield CAP 2000 Viscometer, 443–444
Brookfield Digital Viscometer Model KU-1, 441
Brookfield DV Series Rheometers, 443
Brookfield KU-1 Krebs viscometer, 348
Brookfield synchro-lectric, 443
Brookfield viscometers, 443–444
Browns
  natural iron oxides, 238
  synthetic brown oxides, 238
Brunauer-Emmett-Teller (BET) Method, 400
Brushouts, 573
BS 388: Specification for Aluminum Pigments, 253
Bulk density, 381
Bulk process, vinyl polymers for coatings, 119
Buoyancy-hydrometers, 382
Burgers creep experiment, 430
Burgers model, 430
Burgers model stress relaxation, 430
Butyl alcohols, 155

C
CAB 381, Flexible cloth lacquers made from, 30
CAB esters, 27
CaBER Rheometer (Capillary Breakup Extensional Rheometer), 431
Cadmium mercury orange, 237
Cadmium orange, 237
Cadmium sulfide yellow, 237
Cadmium zinc yellow, 236–237
Calcium borosilicate, 247
Calcium carbonate, 242, 246
  coatings performance, 242–243
  physical properties, 242
Calcium carbonate (CaCO₃), 201
Can coatings, 770
  can coating industry, 771
  can production process, 771
  description of can industry, 770–777
  three-piece can production process, 773
  two-piece can production process, 772
Canadian General Standards Board, (CGSB) 1-GP-71, 589
Capillary forces, 437
Capillary rise method, 463
Capillary viscometers, 444–445
Capillary waves, 461
in radiation curing (RC) systems, 30
repeating unit in, 28
selector guide for graphic arts applications, 30
testing of, 30–31
types of, 27
typical properties, 28
Cellulose esters of organic acids, 27
applications for cellulose esters in coatings, 29–30
cellulose esters as film formers, modifiers, or additives, 29
compliant coatings, 30
factors affecting performance of cellulose esters in coatings, 27–29
testing of cellulose esters, 30–31
types of cellulose esters, 27
Cementitious linings, 708
Centrifugal sedimentation, 396–397
disk centrifuge, 397
relationship of disk and probe of disk centrifuge sampling, 398
rotating cell holder centrifuge, 398
Centrifuge, reference cells used in, 399
Ceramic coatings, 81
casting application, 85–86
glass enamels, 84
testing of glass enamels, 85
glazes, 81
applications for glazes, 81
lead-containing glazes, 82
leadless glazes, 81–82
satin and matte glazes, 82
testing of glazes, 82
porcelain enamels, 82
cover coat enamels, 84
ground coat enamels, 82
testing of porcelain enamels, 84
refractory coatings, 85
testing of, 85
Ceramic glazes
test methods for, 83
in weight percent, 82
Ceramic jet black, 240
Ceramic Jet black-stronger, 240
Ceramic pigments, 239, 294
 ceramic pigments used in organic paints, 239–241
 inorganic anti-corrosion pigments, 294
testing of ceramic pigments, 241
Certified Product Data Sheets (CPDS), 11
Chain balance and Mohr Westphal balance, 383
Chain-stopped alkyd, 41
Chalking of paint coating, 287
Channel process, 205
Characterizing article size and distribution, 389–390
considerations in sampling techniques, 391
sampling techniques and equipment, 393
theoretical considerations of variance in sampling, 391–393
“electrical resistance zone sensing,” 390
history of particle-size analysis, 390
importance of particle-size analysis, 390–391
particle characterization methodologies, 390
particle characterization methodology, 393
adsorption of gases, 400
chromatography: Angstrom particle sizing, 403–404
definitions of particle size and shape, 408–409
direct microscopic measurement using visual light microscopes and electron microscopes, 403
drawdown techniques for texture and oversize, 409–411
individual particle sensing by light blocking and electrical resistance, 401–403
light attenuation and scattering techniques, 404–408
particle size by sedimentation, 395–398
particle size by sieving, 393–395
particle size from surface area employing both gases and liquids, 398–400
permeation through packed powders, 401
separation and collection: particle size by Elutriation, 411–412
“perfect” sample, 392
role of particle-size reference test material, 412
Chemical adhesion, 603
Chemical resistance
 acid resistance and acid etch resistance, 727
alkali and detergent resistance, 727
Battelle chemical resistance cell, 727
humidity exposure, 729
photochemical weathering, 729
 cyclic testing, 729–730
salt fog test, 728
solvent/fuel resistance, 726
 Battelle chemical resistance cell, 726
Bratt conductivity cell for chemical resistance, 726–727
resistance, 727
solvent rub resistance, 727
sources of stains, 726
staining, 725
staining from household chemicals, 725
staining in the transportation industry, 725
staining resistance of furniture finishes, 725
staining from household chemicals, 726
water and moisture resistance, 728
China Association for Standardization, 945
Chloride process pigments, 192
Chlorinated hydrocarbons, 155
 properties of, 156
Chlorinated solvents, 167
Chlorofluorocarbons (CFC), 12
Cholesteric liquid crystal-optical properties, 268
Chroma, 592
Chromalflair® interference flake, 276
Chromate conversion coatings, 707
Chromate-based compounds, 284–285
 inorganic anti-corrosion pigments, 284–285
Chromate-free conversion coatings, 707
Chromatic paints, 593–594
Chromaticity Diagram, 592
Chromatography: Angstrom particle sizing, 403–404
Chrome green, 237–238
Chrome orange, 237
Chrome yellow, 236
Chrome-doped rutile, 240
Chromium oxide green, 238
“Chromogen,” 216
“Chromophore,” 216
Chute splitting, 393
CIE (see International Commission on Illumination (Commission Internationale de l’Eclairage, CIE))
CIE76, 279
CIE 45/0 bidirectional viewing, 549
CIE 1976 L*, a*, b* (CIE LAB) space, 544
CIE 1976 L*, u*, v* (CIE LUV) Space, 544
CIE 1931 standard colorimetric system, 592
CIE 1931 x, y chromaticity diagram, 543
CIE LUV Space, 544
CIE standard illuminants A, relative spectral power distributions of, 542
CIE standard observers, 541–544
CIE standard sources and illuminants, 541–542
CIE Whiteness Index and Tint, coefficients for equations for, 547
CIEDE2000, 552
CIELAB, 544

color difference, 551, 552
Clay stabilized emulsions, 25
Clay thickeners, 360
Clean air act
and amendments
EPA regulatory definition of VOC, 4–5
metrics for defining “negligible photochemical reactivity,” 5–6
ozone standard, 6–7
photochemical smog, 3–4
VOC and ozone formation, 6
VOC definition, 4
amendments of 1990, 9
identification based on VOC I emissions, 8
title III—air toxics program, 10–11
title I—ozone control in atmosphere, 9–10
title VII—enforcement, 12
title VI—stratospheric ozone protection, 12
title V—state operating permit program, 11–12
and ozone standard, 7
Clean Air Act of 1970, 320
Cleanability
aerospace and aircraft coatings, 748
Cleaning and pretreatment of substrates for coating, 465–466
Cleaning procedure
aerospace and aircraft coatings, 749
Clear plastic film, 577
CMC, 354
Coal tar, 20
specifications and test methods for, 23–24
Coalescence, 332
Coalescing aids, 332, 337
AFM images of high Tg acrylic latex with coalescent levels of (A) 5 phr and (B) 10 phr; 334
chemical names and structures of, 336
distribution in latex paint, 335
film formation, 332
guidelines for incorporating coalescing aids, 336
history, 332
impact of coalescing aid concentration on MFFT of typical latex, 334
impact of VOC regulations on coalescing aids, 338
influence of coalescing aids on paint properties, 336
block resistance, 337
color development, 337
exterior durability, 337
freeze-thaw stability, 337
gloss, 337
rheology, 337
scrub resistance, 336–337
wetting and defoaming, 337
low VOC coalescing aids, 338–339
performance evaluation of coalescing aids
coalescing efficiency, 334–335
evaporation rate, 335
hydrolytic stability, 335
odor, 335–336
water solubility, 335
physical properties and partitioning characteristics of, 336
reducing VOC through resin modification, 339
reformulating to reduce VOC, 338
relative humidity on evaporation rate of water at 25°C, 335
requirements for effective coalescing aids, 333
structures and properties of common coalescing aids, 336
U.S. AIM VOC regulations, 338
water soluble coalescing aid in paint, 335
Coating application, 85–86
certain defects and, 283
Coating characterization methods, 283–284
Coating components, effect of, 662
binder, 665
pigmentation, 662–664
solvents, 664–665
Coating defects, 465
Coating films, 131
Coating performance, basic properties affecting, 637–638
Coating processes, rheological components of, 417
Coating resins, plasticizers and their compatibility with, 144
Coating surfactants, 321
Coating thickness gage with hall effect probe, 523
Coating types, 20
coatings for paving, 22
diversity, 199
roof coatings, 20–22
specialty paints and coatings, 20
waterproofing membranes, 22
Coatings
aminos reactions in
cure reactions, 76–77
degradation and weathering, 77–78
end uses of amino resins, 78
asphaltic or bituminous coatings, 20
cellulose esters in
applications for, 29–30
factors affecting performance of, 27–29
compliant, 30
defects, application and, 463
drier levels in, 40
electrodeposition, 90–91
epoxy materials used in, 88–89
first phenolic resin based, 93
high solids, solvent borne, 90
industry, prior to 1960s, 3
oil furnace black color grades for, 212
and overlayers for corrosion control, 692–694

performance
barium sulfate, 245
calcium carbonate, 242–243
feldspar and nepheline syenite, 245
kaolin, 243
mica, 244
silica, 244
wollastonite, 245
performance dimensions, 199–200
dispersibility, 200
durability, 199
gloss, 199–200
undertone, 200
performance expectations of, 341
phenolic resins in
coatings based on phenolic resins, 93
coatings based on polymer alloys with phenolic resins, 93–94
polyamide resins reaction in, 100–101
polymeric films available for, 131
specfic applications, product designs, 200
tests and specifications, 24
tests and specifications for, 24
resin modified bituminous coatings, 25
solvent-thinned or cut-back coatings, 24
waterborne, 91–92
Coatings and Composites Coordinated Rule (CCCR), 9
Coatings failures, analysis of, 830–832
coating system, 832
Cobalt blue, 240
Cobalt chromite blue, 240
Cobalt phosphate violet, 240
Cobalt-zinc blue, 240
Code of Federal Regulations (CFR), 14
Coefficient of friction, 679
Cohesive energy density for aromatic hydrocarbons, 478
Coin mar Test, 622
Cold crack resistance tests, 642–643
Cole method for CPVC, 307
Color and light, 535–555
Color by diffraction, 262
Color collections, 546
Color constancy and metamerism, 540–541
Color difference evaluation for color control, 551
color tolerance, 553
color-difference calculations, 551–553
Color matching, 555
instrumental and computer-aided color matching, 555
visual color matching, 555
Color measurement, changes in structure spectrum compared to changes in, 566–567
Color metrics, 279–280
Color mixing
additive mixing of lights, 553
pigment mixing, 554
subtractive mixing in transparent films, 553
Color order systems, 544
color collections, 546
DIN system, 545–546
Munsell system, 544–545
NCS, 546
OSA-UCS system, 546
single-number color scales, 546
whiteness and tint indices, 546
yellow indices, 546
Color Pigments Manufacturers Association (CPMA), 215
Color space
arrangement of hue, lightness, and chroma axes in usual cylindrical representation of, 540
arrangement of lightness, redness-greenness, and yellowness-blueness axes in the usual opponent-color representation of, 540
Color tolerance, 553
Color-difference calculations, 551–553
Colored inorganic pigments, 235
Colored lights, additive mixing of, 554
Colored pigments
inorganic
blues, 236
browns, 238
classification of pigments by color, 234
greens, 237–238
oranges, 237
reds, 234–235
violets, 235–236
yellows, 236–237
organic, 215
benzimidazolone based reds, 221
blues, 223–224
classification of pigments by chemistry, 216
disazo condensation reds, 221–223
high performance reds, 219–220
international nomenclature—colour index (C. I.) system, 215–216
oranges, 227–230
perylene reds, 220–221
reds, 216–219
testing of pigments for use in coatings, 230–233
yellows, 224–227
pigments in HP, role of, 572–573
Colorimetry and CIE system, 541
CIE standard observers, 541–544
CIE standard sources and illuminants, 541–542
uniform color spaces, 544
Color-matching booths, 536
Color-matching functions of the CIE 1931 standard observer, 542
Colour Index International, 592
Commercial “conventional organic” thickeners for waterborne coatings, 352
Commercial instruments, 550–551
Comparison of different extender pigments
comparative performance in coatings, 248–249
physical properties, 247–248
Compatibility, 145
Compliant coatings, 30
Cone and quartering, 393
Conical Mandrel bend tester, 639
Conical Mandrel tester, 785
Conical Mandrel tests, 639
Considerations in sampling techniques, 391
Constant Depth Gage, 411
Contact angle goniometer, 462
Contact angle measurements, 460–463
Contamination of water-based paints and coatings, problems, 314
Continuous flow method, 400
Continuously Closed-Cup Flash Point, 170
Contrast design and visual sensitivity, 573
Controlled condensation apparatus, 734
Controlled condensation testing, 733–734
“Controlled-stress” rheometer, 425
Conventional (non-associative) polymer thickening in aqueous media, 354
Conventional solids and high-solids amino resins
analysis/analytical methods, 74
combining ratios, 75
free formaldehyde, 75–76
size exclusion, high-performance liquid chromatography, and mass spectrometry, 75
solids content, 74
solvent tolerance, 74–75
viscosity measurement, 74
structure/property variations, 73–74
Conventional thickeners, 344
Conventional TRMS (CTRMs), 350–351
alkali-swellable/soluble emulsions (ASEs), 356–357
cellulosic polysaccharide thickeners, 351–354
fermentation biopolymer polysaccharide, 355
galactomannan polysaccharide thickeners, 354
Conversion coatings, 706
chromate conversion coatings, 707
chromate-free conversion coatings, 707
phosphate conversion coatings, 706–707
Copolymeric glycols, 109
Copolymerization of vinyl acrylate, methyl methacrylate, and methacrylic acid, 57
Copper phthalocyanine, 223, 224
Copper phthalocyanine blue, 223–224
Copper phthalocyanine green, 230
Corrosion
aggressivity/corrosiveness, 283
definition, 697
forms of, 700, 702
depiction of, 702
Corrosion cell, 699
Corrosion cell/galvanic cell, 283
Corrosion failures in protective paint coatings, 284
Corrosion in aqueous solutions, 687–689
Corrosion inhibiting mechanism of acrylate-epoxy-silane superprimer, 292
Corrosion inhibition, aerospace and aircraft coatings, 746
Corrosion of thin metal films and microstructures, 690–692
Corrosion products, 283
Cottonseed oil, 34
Coulter principle, 403
Cover coat enamels, 84
“Cracked” asphalts, 20
specifications and test methods for, 23–24
Cracking, 204
Cracking (of coating), 283
CRC handbook of solubility parameters and other cohesive parameters, 160
Crevice corrosion, 703
Critical micelle concentration (CMC), 324, 346, 455
Critical pigment volume concentration (CPVC), 300, 388, 391
calculated from oil absorption data, useful equations based upon, 305–307
calculation of, 305
cole method for, 307
determining
Asbeck–Van Loo method of determining CPVC, 307
cole method for CPVC, 307
Pierce-Holsworth method for CPVC, 308–309
“Crossover” rheological behavior, 435
Cryptometers, assessment of, 575
Crystalline dicyandiamide (Dicy), 389
Crystalline silica, 244
Cupping tests, 640
Cure, 497
copyright of, 497–498
cure measurement, 500–501
hardness, 501–502
impedance measurements, 502–503
solvent rubs, 501
curing mechanisms
emulsions and latexes, 498
lacquers, 498
oxidative crosslinking, 498
reactive crosslinking, 498–500
Curing agents, 89–90
Curtain coating, 464
Cycle testing, 734
Cycloaliphatic epoxides, 130–131
and their physical properties, 130
Cycloaliphatic phenol, 130
Cycloalkanes, cohesive energy density for cycloalkanes, 478
Cyclohexane
properties of, 151
Cylindrical mandrel bend tester, 639
Cylindrical Mandrel bend tests, 639–640

D
D16, 298
D34, 248, 298
D49, 298
D50, 298
D81, 298
D95, 253
D153, 248
D185, 248, 253
D235, 253
D267, 253
D281, 248
gardner needle thickness gage, 518
micrometers and dial gages, 517–518
microscope for film thickness, 519–520
Dry film thickness (nondestructive methods), 520
electronic coating thickness gages, 521–523
permanent magnet thickness gages, 520–521
Dry powder cast-iron enameling, 86
Dry-film preservation, 314
microbicides used for, 317
Dry-Hard-Time, 41
Drying efficiency, testing of, 40–44
Drying oils, 32–36
AOCS test methods for industrial oils and derivatives, 36
fatty acids in, 33
by iodine value, classification of, 33
physical characteristics of, 35
solidification or polymerization of, 36
unsaturated fatty acids found in, 34
weight percentage of, residues in, 34
urethane modified, 105
Drying time, 528
aerospace and aircraft coatings, 742
mechanical devices, 530–531
preparations of specimens, 528
test methods, 528–530
Drymax, 40
Dry-powder pulse jet disperser, 402
Dry-Through-Time, 41
Dry-To-Recoat, 41
Dry-To-Touch-Time, 41
Du Nouy Ring, 459–460
dual microprocessor electromagnetic coating thickness gage, 523
Dullness measurement, instrument for, 565
Durability, 197
Durability and stress development, 669–670
Dust-Free-Time, 40
Dynamic mechanical analysis (DMA)
determination of cross-link density, 630–632
instruments and methods used for DMA, 628–629
interpretation of plots, 629–630
plots for clearcoat prepared from ACR and etherified MF resin, 6329
Dynamic mechanical and tensile properties, 624
determination of tensile properties
description of SSA, 633
interpretation of stress-strain curves, 633–634
relationship to other mechanical properties, 634–635
DMA
determination of cross-link density, 630–632
instruments and methods used for DMA, 628–629
interpretation of plots, 629–630
dynamic properties, definitions of, 624–626
preparation of free film samples, 627–628
relationship to other mechanical properties, 632
tensile properties, definitions of, 626–627
tensile versus shear tests, 624
Dynamic Mechanical Thermal Analyzer (DMTA), 638
Dynamic properties of liquid surfaces, 457–458
Dynamic surface tension (DST), 457
methods, 460
“Dynamic uniaxial extensional viscosity” (DUEV), 344
Effect pigments, 256
color contribution from each layer of optical stack, 261
by CVD, 265
dependence of interference color on oxide layer thickness, 260
development of new substrates, 263–265
developments in manufacturing, 265–266
dielectric substrate pigments principle of color flop, 261
diffraction, 261–263, 266–267
effect of increasing refractive index on light, 258
functionality, 268–269
history, 256–257
incident white light and resulting spectral distribution from diffraction grating, 262
influence on substrate/surface smoothness on reflectivity, 258
intensity distribution from Fabry-Pérot filter with different reflectivities, 260
interaction of light rays with various phase lengths, 259
phase relationship between interfering light rays, 258
phase shift of $\gamma/2$ of sine wave, 259
reflectivity and thin film interference, 257–261
refractive index for materials used in, 258
technologies, graphic illustration of various, 270
testing, 269
thin film interference pigment flake cross section, 261
unsupported (non-substrate) effect materials, 267–268
by VVD, 265
Effects of aging and weathering, 642–643
Efficacy, 313
Efflux devices (orifice flow), 440
Efflux rheometers, 442
Eilers, dispersion relative viscosity data of, 433
Elastic liquids (viscoelasticity), 426
Elastomeric silicone coatings, 113
Electrical coatings, 116
“Electrical resistance zone sensing,” 390
Electrical resistivity/conductivity, metallic pigments, 254
Electrically driven drawdown device, 510
Electrochemical corrosion, 698–700
Electrode-H posited coatings of various metals, ASTM specification for, 132
Electrodeposition coatings, 90–91
Electroless plating, 132
INDEX
Falling Needle Viscometer® data, 444
Falling sand abraser, 617
Falling-needle viscometer, 444
Fastness, 232
Fastness tests, 232
Federal Environmental Laws Administered by U.S. Environmental Protection Agency, 4
Federal Specification: TT-P-320D Pigment, Aluminum Powder and Paste for Paint, 253
Federal test method for dry opacity, 576
Federal Test Method Standard 141C, Method 4061.2: Drying Time, 529
Federal Test Method Standard (FTMS) 141 method 3022.1, 741
Federal Test Method Std. 141, 589
“Feeder” driers, 39
Feldspar and nepheline syenite, 245
coatings performance, 245
properties, 245
Feldspars, 245, 246
Fell Equation, use of, 576
Felvation, 411
Feret’s diameter, 408
Fermentation biopolymer polysaccharide, 355
Filiform corrosion, 283
Film casting, drawdown bars for, 508
Film casting techniques
dry coatings on substrates, 507–508
free films, 505–507
wet films for testing, 508
Film formation, 333
minimum film forming temperature apparatus, 334
rheology and, 434
Film formers, modifiers, or additives, cellulose esters as, 29
Film porosity index, calculation of, 305–306
Film preparation for coating tests, 505
equipment for film preparation
dip coating, 512
drawdown bars, 508–510
spin coating, 512
spray outs, 511–512
Wire-Wound Rods, 510–511
film casting techniques
dry coatings on substrates, 507–508
free films, 505–507
wet films for testing, 508
test requirements of films, 505
tips on practice of art, 512
Film thickness
aerospace and aircraft coatings, 742
hiding power, 570
of material to be tested, recommended, 529
Film thickness, measurement of, 514
data management, 525–526
dry film thickness (destructive methods), 517
gardner carbonyl drill thickness gage, 518
gardner gage stand, 518
gardner micro-depth gage, 518–519
gardner needle thickness gage, 518
micrometers and dial gages, 517–518
microscope for film thickness, 519–520
dry film thickness (nondestructive methods), 520
electronic coating thickness gages, 521–523
permanent magnet thickness gages, 520–521
effects of surface finish, curvature, and substrate composition, 523
curvature, 524–525
substrate composition, 525
substrate thickness, 525
surface finish, 523–524
statistics in film thickness measurement, 525
uncured powder coating thickness to predict final film thickness, 526
using ultrasonics, 526
wet film thickness, 514
inmont wet film gage (wet film wheel), 514
needle micrometer, 517
notch gage (wet film comb), 515–517
Pfund wet film gage, 514–515
X-ray fluorescence (XRF), 526–527
principle of XRF measurement, 527
Finding regulatory information
EPA sources, 14–15
Fineness of grind and coarse particles
aerospace and aircraft coatings, 740
Fineness -of-dispersion gages, 410–411
Fingernail Test, 622
Fish oil, 35
Flake guide, 277–278
Flake-containing paint film, 273
Flame spray coatings, 85, 86
Flash point, 141, 166, 741
Pensky–Martens, 741
pot life, 741–742
setaflash, 741
tag, 741
Flattening agents and bodying, metallic soaps as, 38
Flection, 410
Flexibility, 744–745
Flexibility and toughness
basic properties affecting coating performance, 637–638
interpretation, 637
measurements
cold crack resistance tests, 642–643
conical Mandrel tests, 639
cupping tests, 640
cylindrical Mandrel bend tests, 639–640
effects of aging and weathering, 642–643
forming tests, 641
impact resistance tests, 641–642
Mandrel Bend Tests, 638–639
T-bend tests, 640
testing of free films, 642
techniques for measuring basic viscoelastic properties
Dynamic Mechanical Thermal Analyzer (DMTA), 638
humidity, 638
strain rate, 638
temperature, 638
Tensile Testing, 638
Thermal Mechanical Analyzer (TMA), 638
Flexible packaging, 125
Film casting knife—Micrometers adjust blade clearance, 509
Flocculative mechanisms, thickening mechanisms, 345–346
depletion flocculation, 346
Fluid density, 445
Fluid resistance, aerospace and aircraft coatings, 747–748
Fluorescence, 538–539
Fluorescent illuminants, 541
Fluorescent Indicator Adsorption (FIA), 177
Fluorescent sources, 535–536
Fluorocarbon surfactants, 322
“Foam killers,” 329
Foams, 328
Ford bath immersion test, 732
Ford cup viscosity data, 441
Formal HP methods, 587–590
Formaldehyde, 72, 75, 79
Forming tests, 641
Fracture theory, 601–602
Free binder, calculation of, 307
Free film samples, preparation of, 627–628
Free films, 505–507
Free formaldehyde, 75–76
French Standards Association (AFNOR), 589–590
Friction and slip resistance, 673
concepts of friction, 673–677
determination of the coefficient of friction (COF), 678–679
friction for various coatings, coefficients of, 678
kinetic friction, coefficients of, 677
lubricants, 681–682
sensor materials, 680–681
sliding friction, ranges of coefficient, 677
slipperiness, 677–678
static friction, coefficient of, 675, 676
triboelectric series for number of widely used polymers, 678
Friction force, 679
Fumed silica (pyrogenic silica), 363
Furnace process blacks, 206
Fusion process, metallic soaps, 38

G
G85, 298
G90, 298
G113, 298
Galvanic corrosion, 702
cathodic protection by sacrificial anode, 702
galvanic series in seawater flowing at 13 FTPS, 701
galvanized steel cross-section, photomicrograph of, 708
impressed current cathodic protection, 702–703
Gardner carboloy drill thickness gage, 518
Gardner contrast HP board, 573
Gardner gage stand, 518
Gardner micro-depth gage, 518–519
Gardner needle thickness gage, 518
Gardner–Coleman method, 302
Gardner-Coleman test, 302
Gardner-Holdt bubble tubes, 442
Gas chromatographic (GC) techniques, 140
Gas evolution test for metallic coatings, 254
Gas state
particles of matter in solid state, 379
Gas-liquid chromatography (GLC), 175
Gassing test, metallic pigments, 254
Gellan gum, 355
German Standards Institute (DIN), 590
Glass and porcelain enamels, 708
Glass enamels, 84
test methods for, 85
testing of, 85
Glass panels, 578
Glaze 2 is sanitary-ware glaze, 81
Glazes, 81
applications for glazes, 81
lead-containing glazes, 82
leadless glazes, 81–82
satin and matte glazes, 82
testing of glazes, 82
Gloss, 336, 558
appearance changes with structure size, 561
aspects of gloss and their definition, 558
directionality, 559
distinctness-of-image, 558–559
haze, 558
sheen, 558
specular gloss, 558
waviness, 559
block diagram depicting relationships of various appearance characteristics, 559
carbon blacks (class 1), 209–210
coalescing aids, 337
coatings, performance dimensions, 199–200
contrast sensitivity of our eyes is highest, 562
DOI measurement, instrument for, 565
dullness measurement, instrument for, 565
instrumental measurement techniques
changes in structure spectrum compared to changes in color measurement, 566–567
goniophotometry, 561
measurement of distinctness-of-image, 563
measurement of reflection haze, 561
measurement of waviness (orange peel), 563–566
specular gloss measurement, 560–561
Landolt Rings, 561
modern miniature glossmeter, 563
observer focuses on image of reflected object, 559
observer focuses on the illuminated surface of object, 559
original surface with high amount of long-, shortand microstructures, 565
positions of source and receptor for three geometries, 563
reflected light flux distribution from semigloss surface, 560
schematic diagram of gloss meter, 562
specular gloss is dependent on refractive index, 565
structure spectrum helps to understand appearance of surface finishes, 565
structure spectrum with reduced short waves, 566
structure spectrums of original surface and first improvement step, 566
surface appearance is dominated by short waves after longer waves were reduced, 566
very brilliant surface with a low amount of short waves makes long waves very apparent, 567
visual gloss evaluation, 559–560
development of documentary standard, 560
use of landolt rings to visually analyze distinctness of image, 560
visual evaluation of orange peel, 560
Glycol ethers., 153
properties of, 154
Glycol ethers., 336
Glycoluril resins, 78
GM 9504P, 729
Gold bronze properties, 251
Gold bronze pigments, 251
Gold bronze pigments
grade classification, 252
Gonioapparent colors, 273–274
croma shifts observed in strong interference colors, 277
color angle, 277
color difference for specimens containing interference pigments with reflective inner layer, 279
summary of ANOVA results, 278
color difference measurement for quality control of colors containing interference flake, 278–279
color metrics, 279–280
conventions for designating measurement geometry, 274
diagram of aspecular angles, 274
far-aspecular angle, 275
measurement of, 272
measurement of colors containing interference flake, 276–278
measurement of metallic color and color difference, 274–276
mid-aspecular angle, 275
near-aspecular angle, 275
side-tone scattering of light, 275
standardization of, 280
Gonioappearance, 272, 537
Goniochromatism, 274
Goniophotometer, 564
Goniophotometry, 561
Goniorspectrophotometer, 272, 276, 549
Gooden-Smith apparatus for surface area, 401
Gooden-Smith method, 401
GOST 5494: Aluminum Pigments, 253
Granular pigments and their relation to surface properties, 392
Graphite, 288
inorganic anti-corrosion pigments, 288
Gravel projecting machine, 618
Gravimetric adsorption apparatus, 400
Gravimetric method, 400
Gravity sedimentation, 396–397
hydrometer method, 396
radioactivity method, 397
Green pigments
hiding power, 569
bending of a light ray by refraction, 571
CR, 569–570
early photometric HP methods, 575
  federal test method for dry opacity, 576
  Fell Equation, use of, 576
  Hanstock method, 576
  New York Paint Club (NYPC) method, 576
  Pfund precision cryptometer, 575–576
  Van Eyken–Anderson method, 576
early visual HP methods
  brushouts, 573
  contrast design and visual sensitivity, 573
  hallet hidimeter, 575
  Pfund cryptometers, 574–575
  relative dry HP—Krebs Method, 574
factors affecting white HP, 586
  crystal and particle size, 586
  film porosity, 587
  pigment concentration, 586–587
  pigment dispersion, 586
film thickness, 570
formal HP methods, 587–590
HP methodology
  film application, 576–577
  photometric measurements, 577
  SR (or film thickness) determination, 577
incomplete hiding, 569
K-M two-constant theory, 578–579
  calculation of HP from tinting data, 584–585
  determination of relative HP of untinted white paints from tinting data, 585
  Judd Graph (information included for historical purposes), 580–581
K-M HP method, 579–580
K-M HP results, 583–584
Mitton graph and table, 581–583
scattering coefficient and scattering power, 579
theoretical problems and practical considerations, 584
light absorption, 569
light scattering, 569
light-scattering behavior of pigmented film, 572
microvoids for white HP, 587
opacity, 569
photometric HP end-point, 571
refractive index and relative HP
  of some extender pigments, 572
  of some white hiding pigments, 572
role of pigments in HP
  binders and pigments, 571
  colored pigments, 572–573
  extender pigments, 572
  refractive index, 571–572
  white hiding pigments, 572
  white pigments, 571
of some colored pigments measured with Pfund cryptometer, 574
SR, 570
test substrates, 569
test substrates, currently used, 577
  clear plastic film, 577
  glass panels, 578
  painted metal panels, 578
  paperboard charts, 577
visual HP end-point, 571
visual observations of contrast, 570
High solids, solvent borne coatings, 90
High solids alkyd, 41
Higher solids alkyd resins, 68–69
types and end uses, 70
High-shear capillary rheometry, 445
High-solids coating resins, 72
Hildebrand parameters, 471
HLB ranges and surfactant applications, 324
Homolytic fragmentation type photoinitiators, examples, 952
Homopolymer, 63
Homopolymerization of phenolic resole resins, 96
Hot dip galvanizing, 132
Hot-dip galvanizing, 708
HP methodology
  film application, 576–577
  photometric measurements, 577
  SR (or film thickness) determination, 577
Hues, 592
Humidity, 638
Humidity cabinet, 733
Humidity exposure, 729
Hutto-Davis method, 401
Hydrated chromium oxide green, 238
Hydrocarbon solvents, 149–152
Hydrocarbons, processes that produce, 3–4
Hydrogen abstraction type photoinitiators, examples, 952
Hydrogen bonding solubility parameter, calculation of, 480
Hydrogen damage, 706
Hydrometer and meniscus detail, 172
Hydrometer methods, 172
Hydrometers, 382
Hydrometer–Sugar with Brix scale and enclosed thermometer, 382
Hydrophobe modified ASEs (HASE), 358–359
  HEASE (subclass of HASE), 358
  HEURASE (subclass of HASE), 359
Hydrophobe modified cellulose (HMC), 359–360
Hydrophobe modified nonionic synthetics (HMNS), 356–358
  HEAT (subclass of HMNS), 358
  HEET (subclass of HMNS), 358
  HEUR (subclass of HMNS), 356–357
  HEUUR (subclass of HMNS), 358
Hydrophobic silica, 364
Hydrophobic silicas, 362
Hydroxyethyl cellulose (HEC), 351, 353
Hydroxyl functionality, 55
Hydroxyl-functional acrylics, 55
Hydroxypropyl guar (HPG), 354
Hysteresis, 446
Hysteresis effects, 457
ICI cone and plate viscometer, 444
ICI cone/plate high shear viscometer for determination of HSV, 350
ICI rotothinner, 441
Illuminant metamerism, 540
Illuminating and sensing geometry, example of, 274
Illuminator, 548
Imidazoline structure, 100
Immersion testing, 732
Impact resistance tests, 641–642
In-can preservation, 313–314
microbicides used for, 316
Incandescent sources, 535
Incomplete hiding, 569
Indanthrone blue, 224
Individual particle sensing by light blocking and electrical resistance, 401–403
Industrial color measurement
commercial instruments, 550–551
instruments using eye as detector, 547–548
selection and calibration of instruments, 550
spectrocolorimeters, 549
spectrophotometers, 548–549
spectroradiometers, 549
tristimulus (filter) colorimeters, 549–550
Industrial maintenance coatings, testing of, 778
infrared spectra of an epoxy (top) and vinyl latex, 780
multinotch applicator used to evaluate sag resistance, 780
portable adhesion tester, 781
stormer viscometer used to obtain viscosity of coatings, 779
testing of applied coatings, 781–786
testing of liquid coatings, 778
Infinite-shear viscosity, 419
Infrared spectroscopy (FTIR), 142
Ink, pigments for, 200
Inks and overprint coatings, 125
Inmont gage (Interchemical) wet film, 515
Inmont wet film gage (wet film wheel), 514
Inorganic anti-corrosion pigments, 284
ceramic pigments, 294
chromate-based compounds, 284–285
graphite, 288
inorganic oxoanionic inhibitors, 289
ion-exchange pigments, 289–290
iron oxides, 287–288
magnesium-rich primer, 287
metal flake pigments, 293–294
needle-shaped anti-corrosion pigments, 292
pigments for “smart” anti-corrosion coatings, 291–292
protective coatings and, 282–283
silicate-based pigments with non-isometric particles, 288
spinel-type pigments, 293
super primers, 290–291
titanates, 288–289
titanium dioxide (TiO₂), 288
zinc ferrites, 287
zinc oxide-containing systems, 285–286
zinc phosphate, 286–287
zinc-rich paints, 285
Inorganic based thickeners and rheology modifiers for WB and SB coatings, 364
Inorganic colored pigments
blues, 236
browns, 238
classification of pigments by color, 234
greens, 237–238
oranges, 237
reds, 234–235
violets, 235–236
yellows, 236–237
Inorganic for waterborne and solventborne coating, 362
Inorganic oxoanionic inhibitors, 289
inorganic anti-corrosion pigments, 289
Inorganic thickeners for aqueous and solvent-borne coatings, 360
clay thickeners, 360–363
synthetic silicas, 363–364
thicker blends, 365
Instrument for reflection haze measurement, 564
Instrumental and computer-aided color matching, 555
Instruments using eye as detector, 547–548
Intergranular corrosion, 704
“Interim Guidance on Control of Volatile Organic Compounds in Ozone State Implementation Plans,” 6
Interior of gravelometer, 618
International Commission on Illumination (Commission Internationale de l’Éclairage, CIE), 279, 541, 592
Intrinsic viscosity, 432
Ion-exchange pigments
ion-exchange pigments, 289–290
Iron blue, 236
Iron oxide blacks (class 3), 204
Iron oxide reds, 234
Iron oxide yellows, 237
Iron oxides, 287–288
inorganic anti-corrosion pigments, 287–288
ISCC-NBS System, 545
ISO 1247: Aluminum Pigments, 253
ISO 2814, 589
ISO 4624, 610
ISO 6504-1, 589
ISO 6504-3, 589
ISO 1522 Paints and Varnishes—Pendulum Damping Test, 44
ISO 4624 test assemblies, 611
ISO Standard 9117, Paints and Varnishes—Pendulum Damping Test, 44
J
JASO M610, 729
K
Kaolin, 243, 246
coatings performance, 243
physical properties, 243
Karl Fischer reagent method, 180
Kauri-butanol value, 157
Kelvin-Voigt creep experiment, 429
Kelvin-Voigt model, 429
Ketimine, 90
Ketones, 89, 153
  properties of, 153
  purity of, 177
Kinetic coefficient of friction, 679
K-M two-constant theory, 578–579
  calculation of HP from tinting data, 584–585
  determination of relative HP of untinted white paints from tinting data, 585
  Judd Graph (information included for historical purposes), 580–581
  K-M HP method, 579–580
  K-M HP results, 583–584
  Mitton graph and table, 581–583
  scattering coefficient and scattering power, 579
  theoretical problems and practical considerations, 584
Knoop and Pfund hardness, 501
Kraft Temperature, 326
Krebs diamond-stripe HP chart, 573
Krebs type viscometer, digital, 348
  “Krebs units” (KU), 441
Krieger–Dougherty model, 433

L
Lab roller mill, 506
Lab spin coating device, 512
Laboratory miniature media mills, 595
Laboratory roller mill, 595
Lacquers, 498
  “Lake,” 215
Lake Michigan Air Directors Consortium (LADCO), 12
Lampblack process, 205
Landolt Rings, 561
Large body center, vast distance to, 378
Large-particle system, layout for, 406
Latent solvents, 157
Latex binding power index, calculation of, 306–307
Latex paints, 332
Lead chromates pigments, 235
Lead-containing glazes, 82
Leadless glazes, 81–82
Leafling grades aluminum pigments, 251
Leveling, 437
Licanic, 34
Light, color and, 535
  color difference evaluation for color control, 551
    color tolerance, 553
    color-difference calculations, 551–553
  color matching, 555
    instrumental and computer-aided color matching, 555
    visual color matching, 555
  color mixing
    additive mixing of lights, 553
    pigment mixing, 554
    subtractive mixing in transparent films, 553
  color order systems, 544
    color collections, 546
    DIN system, 545–546
    Munsell system, 544–545
NCS, 546
OSA-UCS system, 546
  single-number color scales, 546
  whiteness and tint indices, 546
  yellow indices, 546
  colorimetry and CIE system, 541
    CIE standard observers, 541–544
    CIE standard sources and illuminants, 541–542
    uniform color spaces, 544
  eye
    color constancy and metamerism, 540–541
    perception, 539
    variables of perceived color, 539–540
    the visual system, 539
  industrial color measurement
    commercial instruments, 550–551
    instruments using eye as detector, 547–548
    selection and calibration of instruments, 550
    spectroradiometers, 549
    spectrophotometers, 548–549
    spectroradiometers, 549
    tristimulus (filter) colorimeters, 549–550
light sources, 535–536
  color-matching booths, 536
  fluorescent sources, 535–536
  incandescent sources, 535
  natural and artificial daylight, 535
  other sources, 536
reflection and transmission
  fluorescence, 538–539
  goniopappearance, 537
  opaque, transparent, and translucent films, 536
  phosphorescence, 539
  retroreflection, 536
Light absorption, 207, 569
Light attenuation and scattering techniques, 404–408
  “Light fastness,” 217
Light scattering, 186, 207, 569
Light sources, 535–536
  color-matching booths, 536
  fluorescent sources, 535–536
  incandescent sources, 535
  natural and artificial daylight, 535
  other sources, 536
Lightness, 592
d-Limonene, 152
Linear motion, tests based on, 619
  oscillating sand tester, 620–621
  RCA abrasion wear tester, 620
  Taber® Large Linear Abraser; 620
  Taber® Linear Abraser, 620
  Taber® Reciprocating Abraser, 620
Linear viscoelastic regime (LVER), 447
Linoleic, 34
Linolenic, 34
Linseed oil, 34, 41, 301
  properties of, 309
Linkpin bicapillary pycnometer, 173
Linkpin-type pycnometer, 173
Liquid crystal polymeric effect pigments (LCPs), 267
Liquid paint driers
  specifications for, 44
testing of, 44
typical requirements of, 42–43
Liquid pycnometers, 383
Liquids
defining equation for, 454
densities of liquids—methods of determination, 382–383
displacement—fluid external media, 383
displacement-known volume devices-fluid internal media, 383–386
with entrapped air, 385
particles of matter in solid state, 379
Lithol reds, 217
Lithol rubine red, 217
Locust bean gum (LBG), 354
Long oil alkyd-air dry, 41
"Lower flammable limit"/"lower explosive limit" (LEL), 166
Lubricants, examples of, 682
Luminance, 592
Lydersen group constants, 478
M
Machine sieving, 394–395
Macrodispersion, 211
Macrofoams, 328
MACT Hammer, 11
Magne-gage, 520
Magnesium-rich primer, 287
inorganic anti-corrosion pigments, 287
Magnetic coating pull-off thickness gage, 521
Magnetic recording media, 125–126
Magnetic reluctance coating thickness gage, 521
Magnetic reluctance gage, 521
Maintenance and marine finishes, 125
Mandrel Bend Tests, 638–639
Manganese violet, 236
Manganese-doped rutile, 240
Manganophosphate violet, 240
Manual Krebs type viscometer Sag bars, 348
Manual Pensky-Martens closed-cup flash point tester, 169
Manual small-scale (Setafl ash) flash point tester, 170
Manual tag closed-cup flash point tester, 168
Mar abrasion resistance, tests for
balanced beam tester, 621
Coin Mar Test, 622
Fingernail Test, 622
Multi-Finger Scratch Tester (5-Finger Scratch Tester), 622
Nanoscratching, 622
Paperclip Mar Test, 622
Taber® Shear/Scratch Test, 621
Mark-Houwink equation, 52
Martin's diameter, 408
Mass color and tinting strength of pigments, 591
laboratory miniature media mills, 595
laboratory roller mill, 595
mixing time of liquid colors, 595–596
pull glass mill, 595
pigment concentration, 595
pigment dispersion, 594
pigment dispersion techniques, 595
automatic mullers, 595
spatula and hand mullers, 595
tinting strength, 593
chromatic paints, 593–594
white paints, 594
Material, 377
Material safety data sheet (MSDS), 3, 101
Materials and coatings, miscellaneous, 128–134
Matte glazes, 82
Maximum achievable control technology (MACT) standards, 9
Maximum bubble pressure methods, 461
modified static surface tension measurements, 461
Maxwell model for viscoelastic liquid behavior, 428
McArdle-Robertson evaporation index, 164
Measurement of film thickness, 514
Measurement of waviness (orange peel), 563–566
Mechanical adhesion, 603
Mechanized tape test, 607–608
Medium oil alkyd-air dry, 41
Medium oil alkyd-bake, 41
Melamine, 499
Melamine resins, 73, 78
Mercury cadmium red, 235
Metal analysis by EDTA titration, 44
Metal corrosion, types of, 697
advantages and limitations of principal coating resins, 710–712
advantages and limitations of zinc-rich coatings, 712
cathodic protection of a pipeline using impressed current, 703
cathodic protection of buried pipeline using anodes, 703
cementitious linings, 708
chemical concept of electron flow, 700
conversion coatings, 706
chromate conversion coatings, 707
chromate-free conversion coatings, 707
phosphate conversion coatings, 706–707
corrosion, definition, 697
corrosion cell, 699
crevise corrosion, 703
depiction of cavitation, 705
dry cell battery, 699
electrochemical corrosion, 698–700
electromotive force series, 701
electroplating, 708–709
erosion-corrosion, 704–705
extractive metallurgy in reverse, 697–698
forms of corrosion, 700, 702
depiction of, 702
galvanic corrosion, 702
cathodic protection by sacrificial anode, 702
impressed current cathodic protection, 702–703
galvanic series in seawater flowing at 13 FTPS, 701
glass and porcelain enamels, 708
hot-dip galvanizing, 708
hydrogen damage, 706
intergranular corrosion, 704
metallurgy in reverse, 698
metals in order of energy required for conversion from their ores, 698
paints, coatings, and linings, 712–713
photomicrograph of galvanized steel cross-section, 708
pitting corrosion, 703–704
microbiologically influenced corrosion, 704
rubber linings, 709
selective leaching, 704
stress corrosion, 705–706
thermal spray coatings, 709
uniform corrosion, 701
use of protective overlays to prevent corrosion prevention with protective overlayers, 706
Metal flake pigments, 293–294
inorganic anti-corrosion pigments, 293–294
Metal oxides pigments, 235
Metallic coatings, 131–133
Metallic color measurement, E2194 angles for, 276
Metallic pigments, 250
formulation and application guidelines, 252
economics of use, 253
market applications, 252–253
grade classification
aluminum pigments, 251–252
gold bronze pigments, 252
nickel powder and flake, 252
zinc pigment, 252
history and manufacturing methods, 250
properties, 250
aluminum, 250–251
gold bronze, 251
nickel, 251
stainless steel flake, 251
zinc pigment, 251
testing
ASTM test methods, 253
test methods and specifications, 253–255
Metallic soaps, 38
as bodying and fl atting agents, 38
coatings applications of, 39
Metallized azo reds, 216–217
structure of, 216
Metallized azo yellows, 226
Metallurgy in reverse, 698
Metals in order of energy required for conversion from their ores, 698
Methacrylamide sulfate, 50
Methacrylates, 50
Methacrylic acid, 51
Methacrylic acid, copolymerization of, 57
Methanol, 155
Method 14.1, Visual Hiding at a Specified SR, 589
Method 14.2, SR Determined at Full Visual Hiding (for Quick-Drying Coatings), 589
Method 14.7, CR on Black and White Glass Panels at a Given SR or Dry Film Thickness, 589
Method 4121, CR at a Specified SR, 589
Monofunctional epoxies, 89
Monoarylide yellows, 224–226
Monocyclic dimer acid, 98
Monocyclic dimer acid, 98
Monofunctional epoxies, 89
Molybdate orange, 234
Molybdate orange, 234
Munsell Book of Color, 545
Munsell Color System, 593
Munsell system, 544–545
N
NACE RP0394, 789
NACE RP T-10D, 788
Nanoscratching, 622
Naphthenate, 40
Naphthenic hydrocarbons, 151
Naphthol reds, 218
  generic structure and key to, 219
Narrow spectrum, 313
National ambient air quality standards (NAAQS), 6
National Bureau of Standards (NBS), 389
National Emission Standards for Hazardous Air Pollutants (NESHAP), 9, 10, 11
National Institute of Standards and Technology (NIST), 389
National Lead Company method, 301
National Rules for Consumer Products, 9
Natural and artificial daylight, 535
NCS, 546
Needle micrometer, 517
Needle-shaped anti-corrosion pigments, 292
  inorganic anti-corrosion pigments, 292
Negligible photochemical reactivity, 5–6
Neodecanoate, 40
Nepheline syenite, 245, 246
Neutralization with triethylamine (TEA), 107
New Source Performance Standards (NSPS), 7
“New Source Review” (NSR), 11
New York Paint Club (NYPC)
  level test blade, 510
  method, HP, 576
Newtonian fluids, 418
NF-T30-075, SR at a CR (CR) of 0.98, 590
NF-T30-076, SR at Complete Visual Hiding, 590
Nickel
  properties, 251
Nickel powder and flake
  grade classification, 252
Nickel-doped rutile, 240
Nitrate hydrocarbons, 155–156
Nitrogen, oxides of (NOx), 6
Nonaromatic hydrocarbons in aromatics, 178
Noncontact ultrasonic coating thickness gage for uncured powder coatings, 526
Non-ionic emulsions, 25
Nonionic surfactant, 321–322
Nonleafing grades aluminum pigments, 251
Non-metallized azo reds, 217–219
Non-newtonian behavior, types of, 418
  flow curve seen for unstable (flocculating) dispersions, 421
  shear-dependent viscosity, 418–421
  shear-thinning fluids, 421
  superimposed on equilibrium flow curve, 421
Non-Newtonian fluids, 418
Nonreactive emulsions, 61
Nonvolatile residue, 178
Notch Gage for uncured powder thickness measurement, 526
Notch gage (wet film comb), 515–517
NPIRI Grindometer, 411
Nutra ADR 10 %, 40
Nutra LTD 18 %, 40

O
  Object, 377
  Obstructed-flow devices, 442

Occupational Exposure to Hazardous Chemicals in Laboratories, 3
Occupational Safety and Health Administration (OSHA), 79
Octoate, 40
Odor, 175
Oil absorption, 231–232
  calculation, 302
  values, 302
Oil absorption of pigments, 300
  critical pigment volume, 303–305
  useful equations based upon CPVC calculated from oil absorption data, 305–307
  determining CPVC
    Asbeck–Van Loo method of determining CPVC, 307
    cole method for CPVC, 307
    Pierce-Holsworth method for CPVC, 308–309
  mechanism, 300
  methods for determining oil absorption, 300
  characterization of dispersions at oil absorption point, 302–303
  Gardner–Coleman method, 302
  plasticizer absorption by pigments, 303
  Rowland-Stieg simplification of ASTM D281, 302
  spatula rub-out method, 300–302
Oil absorption studies, characteristics of pastes from, 303
Oil-in-water (O/W) emulsions, 21
Oil-modified polyesters (see Alkyds)
Oil-modified urethane, 41
Oil/petroleum asphalts, 19–20
  specifications and test methods for, 23–24
Oiticica oil, 34
Olefins, 178
Olefins content, 178–179
Oleic, 34
Oleoresinous varnish, 41
Opacity, 569
Opaque, transparent, and translucent films, 536
Operating permit program, 11
Optical properties, aerospace and aircraft coatings, 742–743
Optically variable pigments (OVPs), 264
Optimal scattering performance, 190
Oranges
  cadmium mercury orange, 237
  cadmium orange, 237
  chrome orange, 237
  colored pigments, 227–230
  orange pigments of significance in coatings industry, 229
  properties of, 231
  structures of, 231
Orchard equation, 438
Organic coating, applications of surface energetics to coating defects, 465
  coatings application and defects, 463
  curtain coating, 464
  dip coating, 463–464
  electrostatic spray, 464
  powder coating, 464–465
Organic coating system, protection against corrosion, 283
Organic coatings, stress phenomena in durability and stress development, 669–670
effect of coating components, 662
binder, 665
pigmentation, 662–664
solvents, 664–665
interdependence of stresses, 657–658
origins of stress in organic coatings, 655
film formation, 655–656
variation of relative humidity, 657
variation of temperature, 656–657
stress and physical aging, 661–662
stress measurement, 658
mono-layer systems, 659–660
stress versus adhesion and cohesion, 666–669
Organic coatings on plastics, pull strength for, 610
Organic (colored) pigments, 215
benzimidazolone based reds, 221
blues, 223–224
classification of pigments by chemistry, 216
disazo condensation reds, 221–223
high performance reds, 219–220
international nomenclature—colour index (C. I.) system, 215–216
oranges, 227–230
perylene reds, 220–221
reds, 216–219
testing of pigments for use in coatings, 230–233
yellows, 224–227
Organic paint, components of, 282
Organic polyelectrolyte dispersants, 328
Organic TRMs for solvent borne coatings, 365
castor oil derivatives (castor waxes), 365
modified polyurea, 365–367
overbased calcium sulfonate, 365
polyamides, 365
thickeners for “solventborne” coatings, 366
for waterborne coatings with conventional and associative analogs and their acronyms, 357
Organoclays, 362, 363
Organosol, 124
primers, 124
Orthonitroaniline orange, 227
OSA-UCS system, 546
Oscillating jet, 461
Oscillating sand tester, 620–621
Oscillatory shear, 447–448
Osmotic activity in paint films, 644–645
case histories of osmotic activity paint failures, 652–654
chemistry of osmotic process, 646–647
conductivity meter requiring only one drop of blister fluid, 651
factors causing variation in osmotic activity in paint film, 647–649
fragment pattern collected by mass spectrometer, 653
GC/MS response from thermal extraction of blister fluid collected from bottom of barge, 653
ideal analytical instrument configuration for identifying source of, 650
osmosis in paint films, 646
oven of gas chromatograph housing quartz capillary column, 650
pH indicating paper strip is used to determine pH of blister solution, 651
systematic chemical analysis of osmotic blister fluids and blistered coatings, 649–650
determination of electrical conductivity and pH, 651–652
GC/MS analysis by low temperature thermal extraction/desorption (TE/GC/MS), 650–651
GC/MS high temperature pyrolysis (PYRO/GC/MS), 651
Osmotic blisters, 645
in ballast tank, 645
large, 648
in potable water tank, 645
OTC (Ozone Transport Commission), 338
Overbased calcium sulfonate, 365
OVP manufacturing process, 266
Oxidative crosslinking, 498
Oxidative drying and function of driers, theory of, 38–39
Oxime cure system, 114
Oxygenated solvents, 149
Oxygenated solvents, 152–155, 155
Ozone formation, controlling alternative concept, 13
reactivity concept, historical perspective, 13
in atmosphere, 9–10
Ozone formation, VOC and, 6
Ozone standard, 6–7
EPAs “concentration based” form, 6
nitrogen dioxide, 7
Ozone Transport Commission (OTC), 12
P
Pack cementation, 132
Paint, analysis of characterization and chemical analysis, 817–826
forensic paint analysis, 827–828
general testing, 814–815
sampling, 813–814
separation of solids and volatile content, 815–817
trace analysis, 826–827
Paint and coating film preservation, problems, 314
Paint and coating industry
microbicides used in, 318
Paint application, shear forces of, 190
Paint binders and polymers, list of suppliers and trademarks for, 488
Paint coating, blistering of, 283
Paint films
spectrophotometric curves of two highly metameric, 541
stress-strain curves of some, 391
Paint Inspection Gage, 519
Paint monitoring, 294–295
concept of, 294–295
Paint volume solids, 387
analytical determination of paint volume solids, 387
critical pigment volumes, 388
theoretical calculations of paint volume solids, 387
Painted metal panels, 578
Painting or brush coating, 115
Paints, coatings, and linings, 712–713
Paliocrom®, 265
Pall glass mill, 595
Paper, pigments for, 200
Paperboard charts, 577
Paperclip Mar Test, 622
Para reds, 218
structure of, 218
Partial solubility parameters
group contributions to, 475
methods and problems in determination of,
472–474
Particle
definitions, 191
term “casual contact” in, 190
system measuring both large and small, 407
Particle characterization methodologies, 390, 393
adsorption of gases, 400
chromatography: Angstrom particle sizing, 403–404
definitions of particle size and shape, 408–409
direct microscopic measurement using visual light
microscopes and electron microscopes, 403
drawdown techniques for texture and oversize,
409–411
individual particle sensing by light blocking and
electrical resistance, 401–403
light attenuation and scattering techniques,
404–408
particle size by sedimentation, 395–3989
particle size by sieving, 393–395
particle size from surface area employing both gasses
and liquids, 398–400
permeation through packed powders, 401
separation and collection: particle size by Elutriation,
411–412
Particle size
analysis, 191
control, 191
definitions of, 408
determination of sugar-sand mixture as function of
sampling techniques, 393
distributions
of commercial TiO₂, pigments, 191
of pigment grades, 190
instrument for determining particle size in real time,
399
scattering of radiation in near infrared region of
spectrum, 405
Particle-size analysis
history of, 390
importance of, 390–391
metallic pigments, 253
Particle-size reference test material, role of, 412
Particle-sizing methods, comparison of, 409
Parylene, 134
Parylene coatings, 134
Pavement marking materials, 799
field evaluation of marking materials, 804–805
material testing, 800–804
types of pavement marking materials, 799–800
Paving sealers, 25
Payne permeability cup, 732
Pearlescent, 273
Peel adhesion testing on plastic substrates, 605–606
Peeling, 285
PEI Abrasion Tester, 622–623
Pencil hardness, 501
Penetration into powder, rate of, 463
Pensky-Martens flash point test cup and cover
assembly, 170
Pensky-Martens—ASTM D93, 168
Perceived color, variables of, 539–540
Perfect white, 543
Permanent magnet thickness gages, 520–521
Permeability cups, 732, 786
Permeation, 381
permeation through packed powders, 401
Perovskite structure, 288
Perovskite structure AB₅O₉, 289
Peroxide-cured silicones, 114
Pertinent ASTM test standards, 249
Pearlyne reds, 220–221
structure of, 221
Pfund black-and-white cryptometer, 575
Pfund cryptometers, 574–575
diagram of early model of, 573
Pfund cryptometer, 510
Pfund film gage, 516
Pfund Hardness Number (PFN), 501
Pfund precision cryptometer, 575–576
Pfund wet film gage, 514–515
Pfund gage schematic, 515
PH measurement, metallic pigments, 254
Phase shift, 427
Phenolic novolak structure, 95
Phenolic resin
and epoxy resin, reaction, 95
products, testing of, 96
Phenolic resole resins
homopolymerization of, 96
Phenolic resole structure, 96
Phenolic starting materials, 95
Phenolics, 93, 500
first phenolic resin based coatings, 93
phenolic resin chemistry, 94–95
acid catalysis, 95
base catalysis, 95–96
raw materials, 95
phenolic resins as photo-imagable coating, 94
phenolic resins in coatings
coatings based on phenolic resins, 93
coatings based on polymer alloys with phenolic
resins, 93–94
testing of phenolic resin products, 96
Phenoxy, 133–134, 134
Phosphate conversion coatings, 706–707
Phospho-molybdate pigments, 289
Phosphorescence, 539
Photochemical smog, 3–4
Photochemical weathering, 729
  cyclic testing, 729–730
Photo-imagable coating, phenolic resins as, 94
Photoinitiator, 951
Photometric HP end-point, 571
Photometric HP methods, 575
Phthalocyanine greens, proposed structures for, 232
Pierce-Holsworth method for CPVC, 308
pigment volume concentration calculated by, 308
Pierce-Holsworth method for CPVC, 308–309
Pigment Blue 27, 235
Pigment Blue 27, C. I. Number 77510, 236
Pigment Blue 28, 235
Pigment Blue 29, 235
Pigment Blue 29, C. I. Number 77007, 236
Pigment Brown 6, 235
Pigment Brown 6, C. I. Number 77491, 77492, 77499, 238
Pigment Brown 7, 235
Pigment Brown 11, 238
Pigment concentration, 595
Pigment dispersion, 595
Pigment dispersion process, 328
automatic mullers, 595
spatula and hand mullers, 595
Pigment Green 15, C. I. Number 77520, 77601, 77603, 237
Pigment Green 17, 235
Pigment Green 17, C. I. Number 77288, 238
Pigment Green 18, 235
Pigment Green 18, C. I. Number 77289, 238
Pigment mixing, 554
Pigment Orange 20, 235
Pigment Orange 20, C. I. Number 77202, 237
Pigment Orange 21, 235
Pigment Orange 21, C. I. Number 77601, 237
Pigment Orange 23, C. I. Number 77201, 237
Pigment Orange 46, C. I. Number 15602, 227
Pigment Orange 60, C. I. Number 11782, 229
Pigment Orange 62, C. I. Number 11775, 229
Pigment packing factors, 307
  comparison, 308
  and oil absorption test, 308
Pigment Red 101, 235
Pigment Red 101, C. I. Number 77491, 234
Pigment Red 102, 235
Pigment Red 104, 235
Pigment Red 104, C. I. Number 77605, 234
Pigment Red 108, 235
Pigment Red 108, C. I. Number 77202 and 77196, 235
Pigment Red 113, C. I. Number 77201, 235
Pigment red 214, structure of, 222
Pigment red 224, structure of, 221
Pigment red 242, structure of, 222
Pigment red 257, structure of, 223
Pigment Violet 15, C. I. Number 77007, 235
Pigment Violet 16, 235
Pigment volume concentration (PVC), 303
Pigment volume relationships, 368
Pigment Yellow 32, C. I. Number 77839, 236
Pigment Yellow 34, 235
Pigment Yellow 34, C. I. Number 77600 and 77603, 236
Pigment Yellow 35, 235
Pigment Yellow 35, C. I. Number 77205, 236–237
Pigment Yellow 36, C. I. Number 77955, 236
Pigment Yellow 37, 235
Pigment Yellow 37, C. I. Number 77199, 237
Pigment Yellow 42, 235
Pigment Yellow 42, C. I. Number 77492, 237
Pigment Yellow 43, 235
Pigment Yellow 45, 235
Pigment Yellow 65, C. I. Number 11740, 225
Pigment Yellow 73, 225
Pigment Yellow 73, C. I. Number 11738, 225
Pigment Yellow 74, C. I. Number 11741, 225
Pigment Yellow 75, C. I. Number 11770, 225
Pigment Yellow 97, C. I. Number 11767, 225
Pigment Yellow 98, C. I. Number 11727, 225
Pigment Yellow 116, C. I. Number 11790, 225
Pigment Yellow 184, 235
Pigment Yellow 184, C. I. Number 771740, 237
Pigmentation, Vinyl copolymer coatings, 123
Pigments, 187, 215
  black (see Black pigments)
ceramic (see Ceramic pigments)
  characteristics, 189
  commodity composition, 191–193
  elemental analysis, 193
  packing measures, 194
  and performance, 188–189
  phase analysis, 190
  pigment packing, 193–194
  pigment particle size, 190–191
  pigment surface, 193
  surface analyses, 193
classification complications, requirements, 200
color measurement, 194–195
colored (see Colored pigments)
colored inorganic, 235
compatibility, 199
contaminants, 194
cost of hiding, 187
dispersing, 196–197
durability control, 197
durability testing, 198
effect (see Effect pigments)
effects on gloss, 198–199
  gloss measurement, 199
effects on paint film durability, 197
extender (see Extender pigments)
hazards, 195
hiding power of paint films, 196
high density as disadvantage, 187
high refractive index, 187
inorganic anti-corrosion (see Inorganic anti-corrosion pigments)
inorganic colored (see Inorganic colored pigments)
metal flake, 293–294
metallic (see Metallic pigments)
needle-shaped anti-corrosion (see Needle-shaped anti-corrosion pigments)
oil absorption of, 300
performance, 195
dispersibility, 196–197
hiding and opacity, 195
measurement of dispersibility, 197
measurements of light scattering, 195–196
products for industries other than coatings, 200
protective coatings and inorganic anti-corrosion, 282–283
reflectance of white, gray, and black paints, 195
scattering by spheres of rutile in polymer, 187
silica shells from encapsulated, 198
for “smart” anti-corrosion coatings, 291–292
spinel-type, 293
trace analyses, 194
white (see White pigments)

Pigments in HP, role of
binders and pigments, 571
colored pigments, 572–573
extender pigments, 572
refractive index, 571–572
white hiding pigments, 572
white pigments, 571

Pigments-inhibitors, environmentally friendly paints and, 295–296

Pine oil, 152

Ping-pong balls coated with solid and metallic color paints, 273

Pipeline coatings, 787
external coatings for repair and rehabilitation, 788–789
factory or plant applied products, 789–791
internal pipe coatings, 788
market, 787
product development, comparative testing, and quality control, 787

Pitting corrosion, 703–704
microbiologically influenced corrosion, 704

Plastic (yield) behavior, 424
Plasticizer absorption by pigments, 303
Plasticizer absorption for some typical pigments, 304
Plasticizers, 122–123, 139
compatible with solution vinyl chloride-based copolymers, 123
extenders, 139
family/performance grid, 140
methods of identification, 142
chlorine, 143
gas chromatography, 143
infrared spectrophotometry, 142
instrumental methods, 142
isolation of plasticizers, 142
liquid chromatography, 143
nitrogen, 143
phosphorous, 143
phthalates, 143–145
qualitative methods, 143
sulfur, 143
performance properties
compatibility, 145
low-temperature properties, 145
permanence, 145
physical and chemical properties
acidity, 139
color, 139–140
copper corrosion, 140
density and specific gravity, 142
distillation range, 140–141
ester value, 141
flash point, 141
pour point, 141
refractive index, 141
residual odor, 141
sampling, 141
typical properties, 142
viscosity, 142
water, 142

prepared with and 2-ethylhexyl (2-EH)/i-nonyl (iso-N) alcohols, physical properties of, 143
and their compatibility with coating resins, 144

Plastics, pigments for, 200

Plastisol, 124
primers, 124

Platinum-cobalt color, 174
versus Saybolt color, 174

Polar solubility parameter, calculation of, 479–480

Polyamide resins, 97, 98
in coatings, reaction of, 100
reaction with epoxy resin, 100

Polyamide structure, 100

Polyamides, 89, 97, 365
acids, 97
amines, 97
chemical properties, 98–99
everly history, 97
environmental/toxicity considerations, 101
physical properties, 99–100
reaction of polyamide resins in coatings, 100–101
synthesis of polyamides, 98

Polyaniline (PANI) layer, 288, 292

Poly(1,4-butanediol adipate) polyester polyl, 128

Polycarbodiimide, urethane chemistry, 105

Polycyclic dimer acid, 99

Poly-(ε-caprolactone polyls) (PCP), 128

Polyfunctional amines, 109

Poly(glycol adipates) (PEA), 128

Polyhydroxyethers, 133–134

Polymer melt and solution rheology, 432

Poly-(n-alkyl methacrylates), specific volume-temperature relations for, 51

Polyols, 128–130

Poly-(propylene oxide) polyls (PPO), 128

Polyhydric alcohols used in alkyd manufacture, 67

Polyhydroxylethers, 133–134

Polymer melt and solution rheology, 432

Polymer morphologies, cross sectional representations of, 63

Polymerization, 118–119

Polymer melts, viscosity of, 432

Poly-(n-alkyl methacrylates), specific volume-temperature relations for, 51

Polyols, 128–130

Poly-(propylene oxide) polyls (PPO), 128

Polysulfide coatings, 133

Polysulfides, 133

Poly(tetramethylene oxide) polyls, 129

Polyurethane coatings, 102–104

ASTM classification
type I, one-package prereacted, 102
type I polyurethanes, 105
type II, one-package moisture cured, 102–103
type II polyurethanes, 105
type III, one-package heat cured, 103
type III polyurethanes, 106
type IV, two-package catalyst, 103
type IV polyurethanes, 106
type V, two-package polyol, 103
type V polyurethanes, 106
type VI, one-package, nonreactive lacquer, 103
type VI polyurethanes, 106
waterborne polyurethane coatings, 103

chemistry and reactions
basic urethane chemistry, 104–105
powder coatings, 108
radiation-curable coatings, 108
waterborne polyurethane coatings, 106–107
interpenetrating polymer network (IPN) coatings, 104
markets, 110
polyurethane powder coatings, 104
raw materials
additives, 109–110
catalysts, 109
isocyanates, 108–109
six ASTM conventional type, 105–106
six ASTM conventional type polyurethane coatings, 105–106
two-package polyurea and poly (urethane-urea) coatings, 103
Polyurethane end uses, examples of, 109
Polyurethane powder coatings, 104
Polyurethanes, 102
Poly(vinyl chloride) latex, 126
Porcelain enamels, 82
cover coat enamels, 84
ground coat enamels, 82
test methods for, 84
testing of porcelain enamels, 84
in weight percent, 83
Portable adhesion tester, 610
Portable adhesion tester, 781
Post-polymerization process, vinyl polymers for coatings, 119
Powder coating, 464–465, 957
Powder coatings, 108, 126
HP and scattering coefficient values, 583
Power law fluid, gravity drainage of, 436
Practical adhesion, 604–605
direct tensile testing, 608–611
mechanized tape test, 607–608
peel adhesion testing on plastic substrates, 605–606
procedural problems, 607
scrape adhesion testing, 611–612
tape controversy, 607
tape test, 605
test methods, 605
Practical aspects of yield behavior, 426
Precipitated coatings, 296
Precipitated silica, 363
Prevention of metal corrosion with protective overlayers, 687
atmospheric corrosion of metals, 689–690
corrosion and overlayers for corrosion control, 692–694
corrosion in aqueous solutions, 687–689
corrosion of thin metal films and microstructures, 690–692
multilayer “sandwich” arrays, 692
simulations of galvanic interactions in multilayer arrays, 692
thin film materials for magnetic, optical, metal conductor lines and microelectronic contacts, 691
Print-Free-Time, 41
Procedural problems, 607
Programmable lab spray applicator, 511
Propylene glycol monophenyl ether, 336
Protective coatings and inorganic anti-corrosion pigments, 282–283
certain defects and coating application, 283
casting characterization methods, 283–284
concept of paint monitoring, 294–295
environmentally friendly paints and pigments-inhibitors, 295–296
inorganic anti-corrosion pigments, 284
ceramic pigments, 294
chromate-based compounds, 284–285
graphite, 288
inorganic oxoanion inhibitors, 289
ion-exchange pigments, 289–290
iron oxides, 287–288
magnesium-rich primer, 287
metal flake pigments, 293–294
needle-shaped anti-corrosion pigments, 292
pigments for “smart” anti-corrosion coatings, 291–292
silicate-based pigments with non-isometric particles, 288
spinel-type pigments, 293
super primers, 290–291
titanates, 288–289
titania dioxide (TiO2), 288
titanium dioxide, 287
zinc ferrites, 287
zinc oxide-containing systems, 285–286
zinc phosphate, 286–287
zinc-rich paints, 285
mechanisms for anti-corrosion protection of metal, 294
smart coatings, 295
surface preparation, 283
Protective overlays to prevent corrosion, use of corrosion prevention with protective overlayers, 706
Pseudoplastic, 421
Pseudoplastic behavior, 418
PVD generated flakes aluminum pigments, 251
Pycnometer, 172
Pycnometer methods, 172–173
Pyrazoloquinazolone, generic structure of, 223
Pyrazoloquinazolone, generic structure of, 223
Pyrazoloquinazolone, generic structure of, 223
Pyrolo-pyrrole, 418
Pyrolo-pyrrole, 418
Q/C instruments, 440
efflux devices (orifice flow), 440
obstructed-flow devices, 442
rising-bubble viscometers, 442
rotational devices, 441
Quinacridone reds, 219–220
  classifications of, 220
  translinear quinacridone showing proposed hydrogen
  bonding mechanism, 219

R
Radiation curing of coatings, 951
Radiation-curable coatings, 108
Radiation-cured polyurethanes, 108
Rain or water erosion, 622
Raleigh scattering effect, 263
Ransburg megohms, 175
Rayleigh theory of light, 263
RCA abrasion wear tester, 620
Reactive crosslinking, 498–500
“Reactive” plasticizers, 145
Reactivity concept, 13
Reactivity policy, shaping future, 14
Reasonably Available Control Technology (RACT), 7
“Recovery” process, 267
Reds, pigments
  cadmium red, 235
  iron oxide reds, 234
  mercury cadmium red, 235
  molybdate orange, 234
Reducible hypervalent transition metals, 296
Reflectance and transmittance measurements, ASTM
  standards on, 537
Reflection and transmission
  fluorescence, 538–539
  goniopappearance, 537
  opaque, transparent, and translucent films, 536
  phosphorescence, 539
  retroreflection, 536
Reflection haze, measurement of, 561
Refractive index, 175
  pigments in HP, role of, 571–572
Refractive index for materials used in effect materials, 258
Refractory coatings, 85
  testing of, 85
Relationship to other physical properties, 615
Relative density, 376
Relative dry HP—Krebs Method, 574
Relative viscosity, 432
Relaxation time and retardation time, 627
Research rheometers /viscometers, 442
  brookfield viscometers, 443–444
  rotational instruments, 442–443
Residual odor, 175
Resin based coatings
  first phenolic, 93
Resin modified bituminous coatings, 25
Resins, advantages and limitations of principal coating,
  710–712
Resoles, 95–96
  with allyl chloride, modification of, 94
Resorcinol diglycidyl ether, 89
Retroreflection, 536
Rhamson gum, 355
Rheology, 416
  and film formation, 434–435
  instrumentation, 440
Rheology and viscometry, 415–416
  capillary viscometers, 444–445
  deformation (strain), 416
  dispersion rheology, 432–434
  extensional rheology, 431
    extensional viscosity in coatings processes, 431
    extensional viscosity measurement, 431
  falling-needle viscometer, 444
  general classification of fluid behavior
    Newtonian fluids, 418
    non-Newtonian fluids, 418
  high -shear capillary rheometry, 445
  ICI cone and plate viscometer, 444
  leveling, 437–439
  measures of, 439–440
  polymer melt and solution rheology, 432
  Q/C instruments, 440
    efflux devices (orifice flow), 440
    obstructed-flow devices, 442
    rising-bubble viscometers, 442
    rotational devices, 441
  research rheometers /viscometers, 442
    brookfield viscometers, 443–444
    rotational instruments, 442–443
  rheology, 416
  rheology and film formation, 434–435
  rheology instrumentation, 440
  rheometry, 445–446
    nonequilibrium flow curve, 446–447
    oscillatory shear, 447–448
    rotational rheometry, 446
  sagging, 435–436
    measures of, 436–437
  shear-thickening fluids, 422
    elastic liquids (viscoelasticity), 426
    mechanism of thixotropy, 423–424
    plastic (yield) behavior, 424
    practical aspects of yield behavior, 426
    static versus dynamic yield, 425
    “thixotropic index” test, 423
    thixotropy test methods, 424
    time-dependent fluids, 422–423
    viscoelastic models, 428–430
    viscoelastic parameters and their measurement,
      426–428
    viscoelasticity and industrial processes, 430–431
    yield stress test methods, 425–426
  strain rate, 416
    modulus, 417–418
    stress, 416–417
  units, 418
  viscosity, 417
  types of non-newtonian behavior, 418
    shear-dependent viscosity, 418–421
    shear-thinning fluids, 421
  Rheology and viscosity, 343
    elongational flow, 343–344
    shear flow, 343
  Rheology modifier, 342
defined, 343

different coating rheology in architectural paints, 347

highshear viscosity (HSV), 342
types of flow in coatings rheology, 344

Rheometry, 445–446

high-shear capillary, 445
nonequilibrium flow curve, 446–447
oscillatory shear, 447–448
rotational rheometry, 446
steady simple shear (equilibrium flow), 446
Rhopaque®, 202
Ricinoleic, 34
Rigid packaging, 124–125
Rising-bubble viscometers, 442
Road oils (see Asphalt cutbacks)
Roller particle-size analyzer, 410, 411
Roof coatings, 20–22, 25

asphalt, 21
Asphalt emulsions, 21
bitumens, 20–21
Roofing emulsions, 21
Ro-tap sieve shaker, 394
Ro-tap testing sieve shaker, 395
Rotary cryptometer, 575
Rotating abrasive wheels, methods using
Taber® Abraser, 618–619
Taber® grit feeder attachment, 619
Rotating cell holder centrifuge, 398
Rotating disks, methods using
Schiefer Abrasion testing machine, 618
Rotational devices, 441
Rotational instruments, 442–443
Rotational rheometers, 446
Rotational rheometry, 446
Rotothinner®, 348
Rowland-Stieg simplification of ASTM D281, 302
Rubber linings, 709
Rule 66-limits of solvent categories in approved mixtures, 4
Rutile pigments, 192

S
Säberg Drill, 519–520
Safflower oil, 34
Sagging, 435–436
measures of, 436–437
Salt fog resistance, 728
Salt fog test, 728
Salt-spray (fog) cabinet, diagram of, 729
Sampling, theoretical considerations of variance in, 391–393
Sampling techniques and equipment, 393
Sand on Wheel Tester, 623
Satin glazes, 82
Saturated polyesters, 70
Saturation, 593
Saybolt color, 174
versus platinum-cobalt scales, 174
SCAQMD (South Coast Air Quality Management District), 338
Scattering, 593
Scattering tinting strength, 593
Schiefer Abrasion testing machine, 618
Schiefer abrasion testing machine, 618
Scoop sampling, 393
Scrape adhesion testing, 611–612
Scrub Abrasion Tester, 619
Sealants, 792
federal specifications, 794
polymers used in sealants, 792–793
test procedures, 793–794
Sedimentation, particle size by, 395–3989
Sedimentation (Stoke’s) E.S.D., 409
Selective leaching, 704
Semi-automatic small-scale (Setaflash) flash point tester, 170
Separation and collection: particle size by Elutriation, 411–412
Sapinolite clay, 363
Sessile drop
dimensions, measurement of, 462–463
direct measurement of contact angle by, 462
Sessile or pendant drop shape methods, 461
Set-To-Touch-Time, 40
Shear flow, rheology and viscosity, 461
Shear thickening, 418
Shear thinning, 418, 421
Shear-thickening fluids, 422
dilatant behavior, 422
electric liquids (viscoelasticity), 426
mechanism of thixotropy, 423–424
plastic (yield) behavior, 424
practical aspects of yield behavior, 426
shear rate or shear stress ramp experiment, 423
static versus dynamic yield, 425
“thixotropic index” test, 423
thixotropy test methods, 424
time-dependent fluids, 422–423
viscoelastic models, 428–430
viscoelastic parameters and their measurement, 426–428
viscoelasticity and industrial processes, 430–431
yield stress test methods, 425–426
Shear-thinning index, 423
Sheen, 558
Short oil alkyd air-dry, 41
Sienna:, 284
Sieving, particle size by, 393–395
Silica, 244, 246
coatings performance, 244
physical properties, 244
Silicate-based pigments with non-isometric particles, 288
inorganic anti-corrosion pigments, 288
Silicone coatings, 113
forms of silicone coatings, 113–115
methods of application, 115
new requirements for silicone coatings, 116–117
specific applications for silicone coatings, 116
testing conditions, 115–116
Silicone elastomeric coating, 114
Silicone elastomeric coatings, 114
Silicone-containing surfactants, 322
Silicone-modified polyesters, 70
conventional types, 70
higher-solids types of polyesters, 70
Single setting lab spray applicator, 511
Single-number color scales, 546
SiO2 flakes, manufacturing process of, 265
Six ASTM conventional type polyurethane coatings, 105–106
Skeletal density, 381
Slip, 85–86
Slip resistance, 679–680
Slipperiness, 677–678
Slumping (plug flow), 435
“Smart” anti-corrosion coatings, pigments, 291–292
Smart coatings, 295
Smectite clays, 362
Smith-Stead method, 301
SNAP (Significant New Alternatives Policy), 12
Soap titration of emulsion particles, 400
Society for Protective Coatings (SSPC), 507
Society of Automotive Engineers standard J1545, 276
Sodium aluminosilicates, 245–247
Solids
apparent density, 387
densities of solids—methods of determination, 386
direct volume measurement by pycnometer, 386
displacement of liquids, 386
displacement—gases, 386–387
particles of matter in solid state, 379
sonic frequency shifts, 387
Solids, liquids, and gases, 379
as concrete materials, 380–381
Solubility, 121–122
Solubility parameter
examples of use of, 489
miscibility of polymers, 490
relations for optimum pigment dispersion stability, 490
solubility relations for polymer mixtures, 490
surface energy/contact angle characterizations, 491
Solubility parameter concept, 52
Solubility parameters, 470
Solubility parameters, 159–160, 470–471
applications, 488–491
calculation of dispersion solubility parameter, 476–479
calculation of hydrogen bonding solubility parameter, 480
calculation of polar solubility parameter, 479–480
Hansen solubility parameters, 471–480
Hansen solubility parameters and environmental stress cracking (ESC), 491–493
Hildebrand parameters, 471
methods and problems in determination of partial solubility parameters, 472–474
solubility parameters for polymers, 480
supplementary calculations and procedures, 480
Solubility parameters for polymers, 480, 486–487
Solubilization, 325–326
Solution coatings, formulation of, 121
Solution process, vinyl polymers for coatings, 119
Solvency, 145
Solvent balance, 157
Solvent borne coatings, high solids, 90
Solvent/fuel resistance, 726
Battelle chemical resistance cell, 726
Bratt conductivity cell for chemical resistance, 726–727
resistance, 727
solvent rub resistance, 727
Solvents
ASTM distillation test methods for, 164
ASTM distillations, 165
ASTM gas chromatography methods for analyzing purity and composition of, 176
classification by chemical type, 149
chlorinated hydrocarbons, 155
hydrocarbon solvents, 149–152
nitrated hydrocarbons, 155–156
oxygenated solvents, 152–155
classification by function, 156
active solvents, 156–157
diluents, 157
latent solvents, 157
solvent balance, 157
classified according to function, 149
electrical resistance of typical commercial, 175
impurities
acid wash color, 177
acidity, 177
alkalinity, 177–178
benzene content, 178
nonaromatic hydrocarbons in aromatics, 178
nonvolatile residue, 178
olefins content, 178–179
sulfur content, 179–180
water solubility, 180
manual apparatus assembly for distillation test, 165
performance requirements
solvency, 157–160
volatility, 160–170
physical properties
density and specific gravity, 171–175
electrical resistivity, 175
odor, 175
refractive index, 175
purity and composition
gas chromatography, 175–176
liquid chromatography, 176–177
purity of esters, 177
purity of ketones, 177
vapor concentration versus temperature, 166
Sonic Sifter, 394
Sources of stains, 726
South Coast Air Quality Management District (SCQAMD), 12
Soybean oil, 34
Spark protection welding blankets, 114
Spatula and hand mullers, 595
Spatula rub-out method, 300–302
Specialty coatings, 25
Specialty organic coatings
parylene coatings, 134
phenoxy, 133–134
polysulfides, 133
Specific gravity, 171, 233 (see also Relative density)
Specific gravity, apparent, 171
Specimen preparation, 732
Spectrocolorimeters, 549
Spectrophotometers, 548–549
Spectrophotometric curves measured on paint films, 537
Spectrophotometric techniques, 404
Spectroradiometers, 549
Spectrum, 313
Specular gloss, 558
Specular gloss measurement, 560–561
Spin coating, 512
Spindle viscometers, digital, 394
Spinel brown, 240
Spinel pigments, 293
Spinel-type pigments
inorganic anti-corrosion pigments, 293
Spin-Line Rheometer (SLR), 431
Spinning rifflers, 393, 394
Spiral wire drawdown applicator, 511
Spray applied coatings, solvent mixtures for, 122
Spray outs, 511–512
Spraying, 85
Spreading rate (SR), 570
and film thickness relationships, 570
SSPC-PS Guide 8.00, 298
St. Louis Gage, 411
Staining, 725
staining from household chemicals, 725
staining in the transportation industry, 725
staining resistance of furniture finishes, 725
Staining from household chemicals, 726
Stainless steel flake
properties, 251
Stains, sources of, 726
“Standard Observer,” 279
Standard surface phenomena testing methods, 466
State Implementation Plans (SIP), 7
California Air Resource Board’s (CARB) for ozone control, 14
State operating permit program, 11–12
Static coefficient of friction, 679
Static surface tension measurements, 459–460
Static versus dynamic yield, 425
Statistics in film thickness measurement, 525
Steady simple shear (equilibrium flow), 446
Steam-distilled wood turpentine, 152
Steric stabilization, 433
Stick-slip, 679
Stokes’ law, 395
Stokes–Smoluchowski–Einstein theory, 420
Stormer viscometer, 348
Stormer ® Viscometer, 441
Straight line recorder., 530
Strain rate, 638
Stress, 416–417
corrosion, 705–706
and physical aging, 661–662
Stress in organic coatings, origins of, 655
film formation, 655–656
variation of relative humidity, 657
variation of temperature, 656–657
Stress measurement, 658
Stress phenomena in organic coatings
coefficients of friction for various coatings used in electronics industry and elsewhere, 678
durability and stress development, 669–670
effect of coating components, 662
binder, 665
pigmentation, 662–664
solvents, 664–665
interdependence of stresses, 657–658
origins of stress in organic coatings, 655
film formation, 655–656
variation of relative humidity, 657
variation of temperature, 656–657
schematic description of stress (S) dependence on time, 656
stress and physical aging, 661–662
stress dependence on time for latex coatings, 656
stress measurement, 658
mono-layer systems, 659–660
stress versus adhesion and cohesion, 666–669
triboelectric series for number of widely used polymers, 678
Stress relaxation, 428
Stress versus adhesion and cohesion, 666–669
Stresses, interdependence of, 657–658
Stress-strain curve for ductile film, hypothetical, 627
Stress-strain curves for various types of coatings, 633
Stress-strain test, 626
Strippability, 748
Strontium yellow, 236
Styrene or vinyl toluene, 53
Substrates, effects of
additional chemistry, 603–604
Subtractive mixing in transparent films, 553
Sulfate wood turpentine, 152
Sulfides and Sulfoselenides pigments, 235
Sulfur by lamp method, 179
Sulfur content, solvents, 179
copper strip corrosion, 179
doctor test, 179
sulfur by lamp method, 179
trace sulfur by gas chromatography and sulfur specific detection, 180
trace sulfur by hydrolysis and colorimetric detection, 179
trace sulfur by oxidative combustion and electrochemical detection, 180
Super primers, 290–291
inorganic anti-corrosion pigments, 290–291
Supercritical carbon dioxide, 156
Supercritical fluids, 156
Superprimer coating system, 291
Supplementary calculations and procedures, 480
Surface area employing both gasses and liquids, particle size from, 398–400
Surface chemistry, 210
Surface Coatings Processes, 10
Surface energetics, 453–454
applications of surface energetics to organic coating defects, 465
coatings application and defects, 463
curtain coating, 464
dip coating, 463–464
electrostatic spray, 464
powder coating, 464–465
capillary rise method of measuring surface tension, 459
cleaning and pretreatment of substrates for coating, 465–466
contact angle in G/L/S system, 456
contact angle measurements, 460–463
drop weight method of measuring surface tension, 459
Du Nouy ring method of measuring surface tension, 459
dynamic properties of liquid surfaces, 457–458
local pressure changes at surface giving surface tension, 454
maximum bubble pressure method of measuring surface tension, 460
measurement of surface tension of liquids, 458–459
dynamic surface tension methods, 460
static surface tension measurements, 459–460
physical property changes in surfactant solution at critical micelle concentration (CMC), 455
possible scenarios for wetting, 456
standard surface phenomena testing methods, 466
surface excess concentration as calculated as difference for bulk concentration, 454
surface thermodynamics
liquid surfaces, 454–455
liquid/solid interfaces, wetting and contact angles, 455–457
surfactant flux and surface excess concentration with regard to liquid surface area, 458
Wilhelmy plate method of measuring surface tension, 460
Surface finish, curvature, and substrate composition, effects of, 523
curvature, 524–525
substrate composition, 525
substrate thickness, 525
surface finish, 523–524
Surface interactions, 381
Surface preparation, 283
Surface profile gages, 524
Surface tension
drop weight method of measuring, 459
Surface tension of liquids, measurement of, 458–459
dynamic surface tension methods, 460
static surface tension measurements, 459–460
Surface tension-driven leveling, 437
Surface thermodynamics
liquid surfaces, 454–455
liquid/solid interfaces, wetting and contact angles, 455–457
Surfactant aggregates, 324
Surfactants, 320
amphoteric and zwitterionic, 321
anionic, 321
applications
coalescent agents, 329
coating defects, 329–330
dispersing agents, 327–328
emulsifiers, 326–327
foaming and antifoaming agents, 328–329
wetting agents, 327
cationic, 321
chemical structure, 320–321
Davies’ HLB group numbers, 323
hydrophilic and hydrophobic groups, classification, 321
hydrophilic and lipophilic moieties of surfactant molecules, 323
hydrophobic groups, 322
Krafft temperature $T_k$ is point at which surfactant solubility equals CMC, 326
nonionic, 321–322
polymerizable surfactants, 322
properties of
cloud point, 326
hydrophilic-lipophilic balance, 322–323
Krafft temperature, 326
micellization, 324–325
surface adsorption, 323–324
solubility in water and its HLB value, 323
surface active molecules with hydrophilic and hydrophobic, 321
Suspension polymerization, 119
Suspension polymerization, vinyl polymers for coatings, 119
Sward hardness, 501
Synthetic acid, 40
Synthetic mica manufacturing process and metal oxide coated mica deposition process, 264
Synthetic resins, 25
Synthetic silicas, 244, 362
Synthetic silicas, versus mica substrates

cross section of, 263
System measuring both large and small particles, 407
T
Taber® Abraser, 618–619
Taber® grit feeder attachment, 619
Taber® Large Linear Abraser, 620
Taber® Linear Abraser, 620
Taber Multi-Finger Scratch Tester, 622
Taber Oscillating Sand Tester, 621
Taber® Reciprocating Abraser, 620
Taber® Shear/Scratch Test, 621, 622
Table sampling, 393
Tack-Free-Times, 40
Tag Closed Cup—ASTM D56, 167
Tag Open Cup—ASTM D1310, 167
Tag open-cup flash point tester, 167
Talc, 243, 246, 288
coatings performance, 243–244
physical properties, 243
Tall oil, 34
Tallates, 40
Tape controversy, 607
Tape test, 605
Tar, ASTM D1079, 20
T-bend tests, 640
Temperature, 638
Tensile properties, 634
  definitions of, 626–627
  determination of
    description of SSA, 633
    interpretation of stress-strain curves, 633–634
    relationship to other mechanical properties, 634–635
Tensile Testing, 638
Tensile versus shear tests, 624
Terpenes, 151–152
  properties of, 152
Test requirements of films, 505
Test substrates, HP, 569
  currently used, 577
    clear plastic film, 577
    glass panels, 578
    painted metal panels, 578
    paperboard charts, 577
Testing of free films, 642
Testing of phenolic resin products, 96
Tetra functional, fully methylated methylol glycolurils, 78
Thermal fatigue, 748
Thermal Mechanical Analyzer (TMA), 638
Thermal spray coatings, 709
Thermoformable coating, 116
Thermoplastic acrylic resins, 51
Thermoplastic acrylic solution polymers, 52
Thermoplastic resins, 51
Thermosetting acrylic resins, 53
  acid-functional acrylias cross-linked with epoxy resins, 53–54
  acrylic polymers cross-linked with amino resins, 54–55
  alternate approach to, 55
  isocyanate-reactive acrylias, 55–56
Thermosetting emulsions, 61
Thickeners, 341–342
  defined, 343
  medium shear viscosity (MSV), 341
  photomicrographs of various dispersed, 365
Thickeners and rheology modifiers (TRMs)
  application properties (HSV), 350
  associative mechanisms, 346–347
  associative TRMS (ATRMS), 356
    hydrophobe modified ASEs (HASE), 358–359
    hydrophobe modified celluloses (HMC), 359–360
    hydrophobe modified nonionic synthetics (HMNS), 356–358
  classification, 344–345
  coating properties controlled, affected, or influenced by, 342
  conventional TRMS (CTRMs), 350–351
    alkali-swellable/soluble emulsions (ASEs), 356–357
    cellulosic polysaccharide thickeners, 351–354
    fermentation biopolymer polysaccharide, 355
    galactomannan polysaccharide thickeners, 354
  functions, 347
    coating consistency MSV, 347–348
    leveling, sag, syneresis, settling (LSV), 348–350
    incorporation of TRMs, 342–343
    inorganic thickeners for aqueous and solvent-borne coatings, 360
      clay thickeners, 360–363
      synthetic silicas, 363–364
      thicker blends, 365
    organic TRMs for solvent borne coatings, 365
      castor oil derivatives (castor waxes), 365
      modified polyurea, 365–367
      overbased calcium sulfonate, 365
      polyamides, 365
  other TRM test methods, 350
  performance expectations of coatings, 341
  rheology and viscosity, 343
    elongational flow, 343–344
    shear flow, 343
  rheology modifiers, 342
  terminology convention, 342
  thickeners, 341–342
  thickening mechanisms, 345
    flocculative mechanisms, 345–346
    hydrodynamic mechanism, 345
  Thickening mechanisms, 345
    for conventional and associative TRMs in aqueous media, 345
    flocculative mechanisms, 345–346
    hydrodynamic mechanism, 345
  Thin-film drawdown for oversize particles, 410
  Thin-film evaporometer, 163
  Thioindigold reds, 222
    structure and key, 222
  "Thixotropic index" test, 423
Thixotropy, 423
    mechanism of, 421, 423–424
    recovery parameter, 424
    step-shear method for thixotropic recovery, 424
    test data comparison, gel coat, 424
    test methods, 424, 439
Thomas Stormer® Rotational Shear Viscometer 348
  Thomas-Stormer® Viscometer Model ET S-1000, 441
  Three-dimensional diffraction grating as in opals, diffraction in, 262
    theory of, 262
  Through-dry tester, 530
  Time-dependent fluids, 422–423
Tint, 593
  Tinting strength, 592, 593
    chromatic paints, 593–594
    white paints, 594
  TiO₂-mica, synthesis of reduced, 257
  Tips on practice of art, 512
Titanate greens and bluegreens, 240
  Titanates, 288
    inorganic anti-corrosion pigments, 288–289
  Titanium dioxide (TiO₂), 288
    aggregate size distribution, 192
    color, 194
    commercial pigment grades, 201
    crystallites, 189–190
    and durability of paint films, 197
    inorganic anti-corrosion pigments, 288 (see also Pigments)
    manufacture of pigments
sulfate processes, 185
waste disposal, 185
pigments, 185 (see also White pigments)
commodity composition, 191–193
encapsulated, 198
particle size distribution of, 191
scattering coefficient of, 196
Tolerance charts, 553
color-tolerance charts, 553
Toluene, 151
Toluene Diisocyanate (TDI), 11
Toluene dilution ratio, 158
Toluidine red, 218
structure of, 218
“Toner,” 215
Tooke inspection gage (paint inspection gage), 519
Torsion pendulum, 502
Total light scattering, 406
Toughness, flexibility and
basic properties affecting coating performance,
interpretation, 637
measurements
cold crack resistance tests, 642–643
conical Mandrel tests, 639
cupping tests, 640
cylindrical Mandrel bend tests, 639–640
effects of aging and weathering, 642–643
forming tests, 641
impact resistance tests, 641–642
Mandrel Bend Tests, 638–639
T-bend tests, 640
testing of free films, 642
techniques for measuring basic viscoelastic properties
Dynamic Mechanical Thermal Analyzer (DMTA), 638
humidity, 638
strain rate, 638
temperature, 638
Tensile Testing, 638
Thermal Mechanical Analyzer (TMA), 638
Traditional test methods, 732
Traffic paint roller, pick time roller, 531
Translinear quinacridone, hydrogen bonding
mechanism, 219
Transmission electron microscopy (TEM), 403
Transparent colorants, subtractive color mixing of, 555
Triboelement, 677
Tribosystem, 677
Trifluoropropylmethyl polysiloxanes, 113
2,2,4-trimethyl-1,3-pentanediol monoisobutyrate, 336
Tris-(alkoxy carbonylamino) triazine (TACT), 78
Tristimulus colorimetry, 174–175
Tristimulus (filter) colorimeters, 549–550
Tristimulus values, 593
Tristimulus values, calculation of, 542
Tung oil, 35
Turpentine, 152
Tuscan red, 284
Typical automatic distillation apparatus, 165
Typical automatic Pensky-Martens closed-cup flash point
tester, 170
Typical automatic tag closed-up flash point tester, 168
Typical salt-spray cabinet, 733

U
U. S. Environmental Protection Agency (EPA), 3
EPA Federal Reference Method 24, 8
Federal Environmental Laws Administered by, 4
promulgating MACT standards, 10
U. S. food and drug administration (FDA) regulations,
121
Ultramarine blue, 236
Ultramarine violet, 236
Umber, 284
Unbalanced magnetron sputtering (UBM), 131
Uncoated pigments, 191
Uncured powder coating thickness to predict final film
thickness, 526
UNICARB™3 process, 156
Uniform color spaces, 544
Uniform corrosion, 701
United States production of beverage cans, 771
United States production of food cans for human and
pet consumption, 773
Universal color language, 545
“Upper flammable limit”/“upper explosive limit” (UEL),
166
Urea, urethane chemistry, 104
Urea compounds, 499
Urea resins, 72, 73
Uretedione/isocyanate dimer, urethane chemistry, 105
Urethane, urethane chemistry, 104
Urethane coatings, 102
Urethane modified drying oils, 105
Urethanes, 500
Uretone-imine, urethane chemistry, 105
U.S. Department of Labor
Occupational Safety and Health Administration
(OSHA), 166
U.S. Department of Transportation (DOT), 166
regulations, 141
U.S. regulatory activities, 12

V
Vacuum, 377
Vacuum plate pulling a vacuum through side nozzle, 506
Vacuum vapor deposition (VVD), 266, 376
Van Eyken–Anderson method, 576
Variable impact tester, 784
Variacrom®, 265
Vat reds, 220
structure of, 220
vegetable oils used in alkyd manufacture, 67
velocity of fluid, vectorial representation of, 404
Venetian-blind effect, 273, 276
Vernonia oil, 35
Vesiculated beads, 202
Vinyl chloride copolymers, 120–121
analysis, 120–121
properties of, 120
solutions, 122
Vinyl chloride monomer, 118
Vinyl chloride-based copolymers  
coatings, applications for, 119–120  
plasticizers compatible with solution, 123

Vinyl coatings, 125  
trends in, 126–127

Vinyl copolymer, 121  
memory effect in, 123  
to various substrates, adhesion of, 121  
viny solution-polymerized copolymers, 121

Vinyl inks, 125

Vinyl lacquer and vinyl thermoset coatings, 125

Vinyl organosols, 124

Vinyl polymers for coatings, 118  
aplications for vinyl chloride-based copolymer  
coatings, 119–120  
bulk process, 119  
emulsion polymerization, 119  
food and drug administration considerations, 120  
formulation of solution coatings, 121  
guidelines for viscosity stable solutions, 123  
major market areas for vinyl copolymer coatings  
dry film printing, 125  
flexible packaging, 125  
inks and overprint coatings, 125  
magnetic recording media, 125–126  
maintenance and marine finishes, 125  
poly(vinyl chloride) latex, 126  
powder coatings, 126  
rigid packaging, 124–125  
trends in vinyl coatings, 126–127  
waterborne vinyl dispersions, 126  
wood finishes, 125  
manufacture, 119  
organosols and plastisols, 124  
primers for, 124  
pigmentation, 123–124  
 plasticizers, 122–123  
 polymerization, 118–119  
 solubility, 121–122  
 solution characteristics, 122  
 solution process, 119  
suspension polymerization, 119  
viny solution-polymerized copolymers, 120–121

Vinyltoluene alkyd, 41

Violets, pigments, 235–236

Viscoelastic models, 428–430

Viscoelastic parameters and their measurement, 426–428

Viscoelastic properties, techniques for measuring basic  
 Dynamic Mechanical Thermal Analyzer (DMTA), 638  
 humidity, 638  
 strain rate, 638  
 temperature, 638  
 Tensile Testing, 638  
 Thermal Mechanical Analyzer (TMA), 638

Viscoelasticity and industrial processes, 430–431

Viscometer, 445

Viscometric flow, 446

Viscosities, solvents  
effect of solvent type on solution viscosity, 159  
 reduction, 159  
of typical commercial solvent, 159  
 Viscosity, 417, 739  
 brookfield and stormer methods, 739–740  
 cup methods (cup viscometers), 739  
 Viscosity reduction, 159  
 Viscosity versus shear rate, 434  
 Viscosity-shear rate curves for simple flow models, 419  
 Visible spectrum, electromagnetic spectrum showing  
 relatively small portion occupied by, 536  
 Visual color matching, 555  
 Visual gloss evaluation, 559–560  
 development of documentary standard, 560  
 use of landolt rings to visually analyze distinctness of  
 image, 560  
 visual evaluation of orange peel, 560

Visual HP end-point, 571

Visual observations of contrast, 570

Visual system, 539

Vitreous coatings, 81

Vitreous (glassy) ceramic coatings, 81

VM&P naphthas, 150

VOC content, determination of  
 EPA federal reference method 24, 8  
 other VOC-related methods and studies, 8–9

VOC emissions from coatings, control of, 7  
 control technique guidelines, 7  
 new source performance standards, 7

VOC emissions from paints and coatings, regulation of  
 aerosol coatings regulations (ARB), 14  
 clean air act amendments of 1990, 9  
 title III—air toxics program, 10–11  
 title I—ozone control in atmosphere, 9–10  
 title VII—enforcement, 12  
 title VI—stratospheric ozone protection, 12  
 title V—state operating permit program, 11–12

Clean Air Act and amendments  
 EPA regulatory definition of VOC, 4–5  
 metrics for defining “negligible photochemical  
 reactivity,” 5–6  
 ozone standard, 6–7  
 photochemical smog, 3–4  
 VOC and ozone formation, 6  
 VOC definition, 4  
 control of VOC emissions from coatings, 7  
 control technique guidelines, 7  
 new source performance standards, 7  
 controlling ozone formation, alternative concept, 13  
 reactivity concept, historical perspective, 13  
 determination of VOC content  
 EPA federal reference method 24, 8  
 other VOC-related methods and studies, 8–9  
 finding regulatory information  
 EPA sources, 14–15  
 prior to 1960s, coatings industry, 3  
 scenario for next decade, 14  
 shaping future reactivity policy, 14  
 U.S. regulatory activities, 12

Void pigments, 185

Void pigments, 202

Volatile organic compounds (VOC), 4  
 definition, 4, 6  
 EPA regulatory definition of, 4–5  
 epoxy coating technologies, reducing, 87
nitr**o**gen, oxides of (NOx), 6
and ozone formation, 6
Volatile organic compounds (VOCs), 333
Volatile organic contents (VOCs), 320
Volatility, solvents, 160
boiling point/distillation range, 163–166
evaporation rate, 160–163
evaporation rates, solvents, 163
   evaporation rate of xylene Neat, 163
relative solvent evaporation rates, 162
solvent vapor pressure versus temperature, 164
vapor pressure, 160
   of commercial solvents, 161
Volume, 377
Volume E.S.D., 409
W
Washability testing, 734–735
Water and moisture resistance, 728
Water and water vapor, effects on coatings of exposure to, 731
Water content, solvents, 180
   heptane miscibility test, 180
   Karl Fischer reagent method, 180
Water coverage, metallic pigments, 253
Water dispersible, 40
Water fog testing, 733
Water repellency, 731
Water resistance, 731
Water solubility, 180
Water soluble coalescing aid in paint, 335
Water vapor transmission rate (WVTR), 747
Water-based alkyls, 41
Waterborne alkyl resin types and end uses, 70
Waterborne alkyls, 70
Waterborne coatings, 91–92
Waterborne polyurethane coatings, 103, 106–107
Waterborne polyurethane dispersions (WPUDs), 103–104
   cationic, 104
Waterborne vinyl dispersions, 126
Water-in-oil (W/O) emulsions, 21
Waterproofing membranes, 22
Waterproofing membranes, 25
Water-reducible alkyd resins, 69–70
Water-reducible/water dispersed polyesters, 70
Water-repellent coatings, 807–810
Water-resistance testing of coatings, 731
   100% relative humidity testing, 733
   abrasion scrubbing & washability tester, 735
   accelerated mechanical exposure, 734
   car wash simulator, 734
   controlled condensation apparatus, 734
   controlled condensation testing, 733–734
   cycle testing, 734
   effects on coatings of exposure to water and water vapor, 731
   evaluation, 732
   ford bath immersion test, 732
   humidity cabinet, 733
   immersion testing, 732
   payne permeability cup, 732
   permeability cups, 732
   specimen preparation, 732
   traditional test methods, 732
typical salt-spray cabinet, 733
washability testing, 734–735
water fog testing, 733
Waviness, gloss, 559
Weak boundary layer theory, 602
Weathering, accelerated, 715–716
   accelerated weathering devices
      carbon arc and xenon arc, 722–723
      fluorescent UV/condensation, 723
      fluorescent UV-salt fog, 723
      fresnel reflector, 723–724
elements of weathering, 716
      light, 716–721
      moisture, 721–722
      oxygen, 722
      temperature, 722
ultrafast weathering, 724
Weathering and environmental exposure, 747
Weight, 378
Welan gum, 355
Wells-Brookfield cone and plate viscometer, 443
Wet film comb schematic, 516
Wet film thickness, 514
   inmont wet film gage (wet film wheel), 514
   needle micrometer, 517
   notch gage (wet film comb), 515–517
   Pfund wet film gage, 514–515
Wet films for testing, 508
Wetting agents, 327
Wetting-contact theory, 602
Wet-treated pigments, 192
White hiding pigments
   pigments in HP, role of, 572
White HP, factors affecting, 586
   crystal and particle size, 586
   film porosity, 587
   pigment concentration, 586–587
   pigment dispersion, 586
White paints, 594
White pigments
   HP and scattering coefficient values, 584
White pigments, 185
   commerce, 185
   function of pigments, 186–187
   high refractive index, 187
   manufacture, 185
   optics and appearance, 186
   pigment characteristics, 189–195
   pigment performance, 195–199
   pigments in HP, role of, 571
   product types, 199–201
   research and development, 186
   scattering by spheres of rutile in polymer, 187
   substance of, 187–188
TIO2 pigments, 188–189
void pigments, 202
Whiteness and tint indices, 546
Wilhelmy plate, 462, 463
Wire-Wound Rods, 510–511
coating thickness obtained from various wire-wound rods, 510
Wollastonite, 288
Wollastonite, 244–245, 246 coatings performance, 245 properties, 245
Wood finishes, 125

X
Xanthan gum, 355
X-ray analysis, 920
X-ray fluorescence, thickness ranges for some common coating materials using, 527
X-ray fluorescence (XRF), 526–527 principle of XRF measurement, 527
X-ray micrographs technique, 411
X-ray scattering, 407–408
XRD peaks of common pigments and extenders for paint, strongest, 927
Xylene, 151

Y
Yellow indices, 546
coefficients of equation for, 547
Yellows, pigments
  bismuth vanadate/molybdate yellow, 237
cadmium sulfide yellow, 237
cadmium zinc yellow, 236–237
chrome yellow, 236
iron oxide yellows, 237
strontium yellow, 236
zinc chromate, 236
Yield stress test methods, 425–426 Young–Laplace equation, 458

X
Zapon Tack Tester, 529
Zinc chromate, 236
Zinc ferrites, 287
  inorganic anti-corrosion pigments, 287
Zinc oxide-containing systems, 285–286
  inorganic anti-corrosion pigments, 285–286
Zinc phosphate, 286–287
  inorganic anti-corrosion pigments, 286–287
Zinc pigment, 251
Zinc tripolyphosphonate (ZTPP), 287
Zinc-rich coatings, advantages and limitations of, 712
Zinc-rich paint (ZRP), corrosion in steel protected by, 286
Zinc-rich paints, 285
  inorganic anti-corrosion pigments, 285