

Index

- Acidizing, 549–551
- Acoustic emission technique, 142–144
- Aircraft structures
 - failure modes, 469–473
 - flap control unit bolt, 472–473
 - landing gear steel pin, 515–516
 - turning tube, 470–471
 - wing panel, 471–472
- Alloys, oxidation of, 59–63
- Aluminum and aluminum alloys, 227–236
 - corrosion behavior, 228–236, 383, 465–469, 480–483
 - in freshwater, 232
 - in seawater, 232
 - in soils, 232–233
- Anodic protection, 106
- Atmospheric corrosion testing, 117–119
- Austenitic iron *See* Iron
- Austenitic steel, 219
- Barrier coatings *See* Coatings, protective
- Bridges, Suspension, 473–476
- Carbon steel *See* Steel
- Cast iron *See* Iron
- Cathodic protection, 100–105, 461–465, 478–480
- Cavitation *See* Corrosion; Mechanically assisted corrosion
- Cells, electrochemical *See* Electrochemical cells
- Ceramics, 297–300
 - corrosion testing of, 122
 - failure analysis, 172–173
- Chiller tubes, 486–489
- Cleaning processes, 95
- Coatings, protective, 90–100
 - barrier, 91–92
 - inhibitive primers, 94
 - organic zinc-rich primers, 93–94
 - sacrificial, 92–93
- Cobalt alloys, 259–263
- Compressed air cylinders, 465–469
- Concentration polarization *See* Polarization, concentration
- Condensers, 509–515
- Cooling water system, 483–485
- Copper and copper alloys, 236–244
 - corrosion, 237–244
 - atmospheric, 237–238
 - biofouling, 242
 - dealloying, 241
 - flow-induced, 243
 - in aqueous media, 238–240
 - in chemical environments, 242
 - in piping, 501–504
 - pitting, 241
 - soil, 238
 - stress-corrosion cracking, 242–243
- Corrosion
 - anaerobic, 387
 - behavior, 333–336
 - causes, early accounts, 3
 - cavitation, 402–403
 - computer applications, 319–326
 - costs, 12–14
 - design factors, 67–75
 - detection and monitoring, 125–150
 - economics, 311–317
 - fatigue, 395, 411–423

- Corrosion (continued)**
- forms, 331–459
 - fretting *See* Mechanically assisted corrosion
 - galvanic *See* Galvanic corrosion
 - general, 340–343
 - graphitic, 373–374
 - high temperature, 54–59, 373, 489–492
 - history, 3–12
 - impact, 12–17
 - in drilling and well stimulation, 549–551
 - inhibitors *See* Inhibitors
 - inspection methods *See* Inspection methods
 - localized *See* Localized corrosion
 - management, 317–319
 - mechanically assisted *See* Mechanically assisted corrosion
 - media, 332–333
 - aqueous, 332
 - atmospheric, 332
 - process, 332–333
 - underground, 332
 - microbiologically influenced *See* Microbiologically influenced corrosion
 - morphology, 338–339
 - oxidation, 54–59
 - prediction, 320
 - published data, 339
 - radiographic detection, 129–134
 - rates, 33–45
 - reactions, 20–22, 331–333
 - replication microscopy assessment, 129
 - stress corrosion cracking *See* Stress corrosion cracking
 - testing, 109–125, 134–16
 - finite element analysis, 145–149
 - liquid penetrant method, 134
 - magnetic particle testing, 135–136
 - other nondestructive methods, 145–150
 - ultrasonic inspection method, 137–139
 - visual examination, 127, 154–155
 - types and modes, 337–338
 - underground, 547–549
- Cracking** *See* Copper and copper alloys; Environmentally induced cracking; Hydrogen induced cracking; Stress corrosion cracking; Weldments
- Cracking failure case studies**, 492–500
- Crankshaft failure**, 492–495
- Crevice corrosion** *See* Corrosion
- Cupronickel**, 486–489
- Curtain wall**, 480–483
- Daniel cell**, 22–23
- Dhar (Delhi) pillar**, 3, 10
- Depreciation**, 313–317
- Discounted cash flow**, 311–313
- Drilling operations**, 549–551
- Drive shaft failure**, 495–497, 499–500
- Duplex stainless steels** *See* Steel
- Dynamic electrochemical processes**, 33–45
- EAC** *See* Environmentally induced cracking
- ECORR**, 325
- Eddy current inspection method**, 136–137
- Electrochemical cells**, 22–28
- Electrochemical impedance spectroscopy**, 369
- Electrochemical noise technologies**, 369
- Electrochemical processes**
- dynamic, 33–46
- Electrochemical potential noise**, 53
- Electrode potentials**, 23–28
- Embrittlement**
- hydrogen embrittlement, 433, 442–445
 - liquid and solid metal-induced, 525–528
- Environmentally induced cracking**, 423–452
- testing for, 111–117
- Erosion-corrosion** *See also* Mechanically assisted corrosion
- prevention, 401–402
- Failure analysis**, 150–173, 318–319, 505–509
- fracture mechanics in, 159–161
- Fatigue** 395, 411–423
- crack initiation and propagation, 416–419
 - failure, 492–497
 - prevention, 420
 - testing, 420–423
- Finite element analysis**, 145–149
- Fracture**, 505–509
- Fretting corrosion** *See* Mechanically assisted corrosion
- Fuel storage tanks**, 391
- Galvanic corrosion**, 344–354, 543–547
- prevention, 352–354
 - testing, 119–120
- Galvanic series in seawater**, 28
- Generators, Steam**, 529–532
- Hazard analysis**
- checklist, 189–190
- Hazard identification**, 181–182
- High temperature corrosion** *See* Corrosion
- HSAB principle**, 87–88
- Hydrogen induced cracking**, 437–438, 516–525
- Hygiene plan**, 193–194
- Impressed current protection**, 105–106
- Inhibitive primers** *See* Coatings, protective

- Inhibitors, 80–90
 anodic, 82
 cathodic, 81
 hard, 87–88
 selection of, 88
 soft, 87–88
 testing, 122–125
 types, 88–90
- Inspection methods
 Eddy current, 136–137
 laser, 128
 microfractography, 159
 metallographic examination, 156–158
 non-destructive examination, 126–127
 thermal, 149–150
 ultrasonic, 137–139
 visual, 127, 154–155
- Iron
 austenitic, 202
 ductile, 202
 gray cast, 201–202
 high-silicon cast, 202
 nickel cast, 202
 white cast, 201
- Landing gear steel pin, 515–516
- Lead and lead alloys, 263–270
 uses, 270
- Liquid penetrant testing method, 134
- Localized corrosion, 355–370, 545–547
 crevice, 360–361
 filiform, 361–362
 galvanostatic methods, 366
 pitting, 355–359, 362–366
 potentiostatic methods, 366
 poultice, 359
 prevention, 366–367
 testing and evaluating, 367–370
- Low-alloy steels *See Steel*
- Macroscopic examination *See Visual examination*
- Magnesium and magnesium alloys, 270–281
 corrosion, 271–281
- Magnetic particle testing, 135–136
- Marine environments, 207–208
- Martensitic stainless steels *See Steel*
- Materials, 201–309
 life prediction analysis of, 75–79
- Mechanical properties, 162–164
- Mechanically assisted corrosion, 393–423
 wear, 393–410
 abrasive, 394–395
 adhesive, 395
 cavitation, 402–405
- chemical, 396–397
 electric-arc-induced, 398
 erosion-corrosion, 398–400
 erosive, 395–396
 fatigue wear and corrosion, 395, 411–423
 fretting, 405–410
 galling stress, 410
 galvanic effect, 400–401
 impact, 395–396
 impacting bubbles, 403–404
 oxidative, 397–398
 percussive, 396
 prevention, 405, 489–492
 turbulence, 400
 water droplet impingement erosion, 401
- Metallographic examination, 156–158
- Metallurgically influenced corrosion, 370–384
 aluminum alloys, 383
 aqueous media, 371
 dealloying, 373–376
 dealuminification, 374
 dezincification, 373
 defects and inclusions, 372
 exfoliation, 377–378
 grain boundaries, 371–372
 intergranular, 376–382
 nickel-based alloys, 383–384
 passivation, 372–373
 pitting, 372–373, 381 *See also Pitting*
 weldment corrosion, 378–383
- Microbiologically influenced corrosion, 384–393
 anaerobic corrosion, 387
 biofilms, 388
 corrosion mechanisms, 388–390
 environments, 384–385
 freshwater environments, 385
 gases and corrosive processes, 390
 growth and metabolism, 384
Hormoconis resinae, 391
 industries affected, 385
 marine environments, 385
 microbiological impacts and testing, 391–392
 materials, 390–391
 organic and inorganic acids, 390
 prevention, 392–393
 sulfate-reducing bacteria, 386–387
 sulfides, 390
Thiobacillus, 387–388, 391
- Microfractography, 159
- Nernst equation, 21
- Nickel and nickel alloys, 244–255
 corrosion resistance, 383–384

- Oil and gas wells, 549–551
 Oil storage tank, 536–541
 Organic zinc-rich primers *See* Coatings, protective
 Paint types, 96–99
 Pipe clamp joint connector failure, 497–499
 Pipe, Copper, 501–504
 Pipe, Welded, 519–523
 Pipes, Water, 547–549
 Pitting, 355–359, 362–366, 486–489, 538–541 *See also* Corrosion
 electrochemical studies, 364–366
 cyclic potentiodynamic polarization method, 364–366
 Polarization
 concentration, 46–53
 Polymeric materials, 300–305
 failure analysis of, 169–171
 in corrosion control, 302–305
 testing of, 120–121
 Pourbaix diagrams, 28–33
 Poultice corrosion *See* Corrosion
 Pressure vessels, 177–179
 Primers, inhibitive *See* Coatings, protective
 Protection
 Anodic, *See* Anodic protection
 Impressed current *See* Impressed current protection
 Protective coatings *See* Coatings, protective
 Radiographic methods, 129
 Refractories, Corrosion testing of, 122
 Refractories and ceramics, 297–300
 Regulations and specifications, 177–180
 Replication microscopy, 129–134
 Residual stress
 x-ray diffraction, 161–162
 Risk assessment, 191–192
 Rock bolts, 504–509
 Rust
 electrochemical process involved in, 26–27
 Sacrificial coatings *See* Coatings, protective
 Safety, 181–198
 at design stage, 197–198
 audits, 183–188
 in corrosion laboratory, 192
 in field plant inspection, 198
 in storage and transport, 198
 nonionizing radiation sources, 196–197
 radiation sources, 194–196
 Scanning reference electrode technique, 369–370
 Software programs, 323–325
 Soils, 210–214
 Sprinkler systems, 501–504
 Stainless steel *See* Steel
 Standard potential series, 25
 Standards, 177–180
 Steel, 202–227
 carbon, 202–213, 529–532, 541–547
 corrosion in fresh waters, 204–207
 corrosion in seawater, 207–210
 corrosion in soils, 210–214
 in concrete, 478–480, 533–536
 low-alloy, 202–213
 pin, 515–516
 stainless, 214–227, 380–383
 austenitic, 219
 biological corrosion, 382
 composition, 215
 corrosion in boiling acids, 217–218
 corrosion rates of Fe-Cr alloys, 216
 duplex, 219–224
 knife-line attack, 382
 martensitic, 224–227
 rebar, 533–536
 tubing corrosion, 509–515
 Stress corrosion cracking, 424–452
 accelerating ions, 434
 active-passive behavior, 430
 alloy/liquid interface, 432–433
 carbon steel, 529–532
 electrode potential and crack growth, 431
 environmentally induced cracking, 439–445
 hydrides, 433
 hydrogen embrittlement, 433, 442–445
 hydrogen induced blistering, 435–437
 inhibitors, 431
 key factors, 425–428
 material parameters, 428
 mechanisms, 442
 morphology, 425
 nitrate, 529–532
 potential-pH diagram, 428–430
 prevention, 449–452
 environmental considerations, 449–450
 metallurgical considerations, 450
 hydrogen damage, 450–451
 surface treatments, 450
 propagation models, 445–449
 sulfide stress cracking, 435
 testing, 451–452
 Sulphate-reducing bacteria *See*
 Microbiologically influenced corrosion
 Surface preparation, 95 *See also* Cleaning processes

- Tanks, 536–547
oil storage, 536–541
carbon steel, 541–547
- Testing *See* Corrosion
- Thermal methods of inspection *See* Inspection methods
- Thermodynamics, 18–20
- Tie rods (Bridge), 473–476
- Tin and tin plate, 292–297
aqueous corrosion, 293
corrosion of tin plate, 296–297
- Titanium and titanium alloys, 255–259
galvanic corrosion, 259
resistance to chemical environments, 257–258
resistance to waters, 257
- Ultrasonic inspection method, 137–139
- Visual examination, 127, 154–155
- Water
electrochemical reactions involved in, 29–30
- Water systems corrosion, 476–478, 483–485, 486–489
- Water mains, 461–465, 547–549
- Wear *See* Mechanically assisted corrosion
- Wear-related failures, 164–169
- Weldments, 378–383
aluminum alloys, 383
carbon steels, 378–379
corrosion prevention, 383
filler metal, 380
grooving, 379
knife-line attack, 382
pitting, 381
sensitization, 380–382
stainless steels, 380–382
biological corrosion, 382
stress-corrosion cracking, 379–381
unmixed zones, 380
weld metal overlay, 489–492
- X-ray diffraction, 161–162
- Zinc and zinc alloys, 282–290
corrosion, atmospheric, 282–285, 289
corrosion in aqueous media, 285–287
corrosion in concrete, 288–289
corrosion in soils, 287
corrosion of painted materials, 287–288
- Zirconium and zirconium alloys, 291–292
corrosion in acids and alkalis, 292, 295