<table>
<thead>
<tr>
<th>Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-2-1 location principle, 875 (online, Ch 40)</td>
</tr>
<tr>
<td>3D printing (see additive manufacturing)</td>
</tr>
<tr>
<td>5S, 245</td>
</tr>
<tr>
<td>ablation, 300</td>
</tr>
<tr>
<td>abrasive grain size, 607</td>
</tr>
<tr>
<td>abrasive hardness, 606</td>
</tr>
<tr>
<td>abrasive jet machining (AJM), 629, 658</td>
</tr>
<tr>
<td>(online, Ch 30)</td>
</tr>
<tr>
<td>abrasive machining, 604–605</td>
</tr>
<tr>
<td>abrasive media, 714–715</td>
</tr>
<tr>
<td>abrasive water-jet cutting (AWC), 627</td>
</tr>
<tr>
<td>abrasives, 162, 606</td>
</tr>
<tr>
<td>acceptable quality level (AQL), 250</td>
</tr>
<tr>
<td>accounting, 896–897 (online, Ch 41)</td>
</tr>
<tr>
<td>accuracy, 195, 232–233</td>
</tr>
<tr>
<td>acceptable quality level (AQL), 250</td>
</tr>
<tr>
<td>accounting, 896–897 (online, Ch 41)</td>
</tr>
<tr>
<td>accuracy, 195, 232–233</td>
</tr>
<tr>
<td>account system, CNC, 561</td>
</tr>
<tr>
<td>adaptive control (A/C), 573, 763</td>
</tr>
<tr>
<td>additive manufacturing, 15–16, 296, 730–731</td>
</tr>
<tr>
<td>ceramics, 433, 738, 742</td>
</tr>
<tr>
<td>composites, 738, 742</td>
</tr>
<tr>
<td>dimensional precision, 734</td>
</tr>
<tr>
<td>economics, 748</td>
</tr>
<tr>
<td>investment casting patterns, 738</td>
</tr>
<tr>
<td>metal, 743</td>
</tr>
<tr>
<td>properties, 746–747</td>
</tr>
<tr>
<td>supports, 731, 734</td>
</tr>
<tr>
<td>processes, 730–748</td>
</tr>
<tr>
<td>address system, CNC, 361</td>
</tr>
<tr>
<td>adhesive bond strength, 861</td>
</tr>
<tr>
<td>adhesive bonding, 434, 856</td>
</tr>
<tr>
<td>adhesive costs, 862</td>
</tr>
<tr>
<td>adhesive selection, 860</td>
</tr>
<tr>
<td>adhesives, 856–869</td>
</tr>
<tr>
<td>plastic joining, 868</td>
</tr>
<tr>
<td>polymeric, 154, 430</td>
</tr>
<tr>
<td>structural, 154</td>
</tr>
<tr>
<td>advanced ceramics, 164</td>
</tr>
<tr>
<td>AFS permeability number, 281</td>
</tr>
<tr>
<td>age hardening (see precipitation hardening)</td>
</tr>
<tr>
<td>aging, 81–82, 86, 109</td>
</tr>
<tr>
<td>agricultural applications, 9, 175, 274</td>
</tr>
<tr>
<td>air carbon arc cutting (AAC), 810</td>
</tr>
<tr>
<td>air gage, 215</td>
</tr>
<tr>
<td>air-bend dies, 396</td>
</tr>
<tr>
<td>AISI (see American Iron and Steel Institute)</td>
</tr>
<tr>
<td>AISI stainless steels, 113–115</td>
</tr>
<tr>
<td>AISI steels, H grades, 107</td>
</tr>
<tr>
<td>AISI-SE: steel identification system, 106–107</td>
</tr>
<tr>
<td>Al clad, 132, 168, 726</td>
</tr>
<tr>
<td>alkaline cleaning, 717</td>
</tr>
<tr>
<td>alkyds, 719</td>
</tr>
<tr>
<td>allotropic, 54</td>
</tr>
<tr>
<td>allowance, 195, 198, 271</td>
</tr>
<tr>
<td>allowances, casting pattern (see pattern allowances)</td>
</tr>
<tr>
<td>alloy steel, 105</td>
</tr>
<tr>
<td>alloy, constructional alloys, 108</td>
</tr>
<tr>
<td>alpha ferrite (see ferrite)</td>
</tr>
<tr>
<td>alternating current welding, 798</td>
</tr>
<tr>
<td>alternative fuel applications, 156, 178</td>
</tr>
<tr>
<td>alumina, 162, 168, 164</td>
</tr>
<tr>
<td>aluminum, 129–135</td>
</tr>
<tr>
<td>aluminum bronze, 128</td>
</tr>
<tr>
<td>aluminum casting alloys, 133</td>
</tr>
<tr>
<td>aluminum classification system, 131</td>
</tr>
<tr>
<td>aluminum cost, 129</td>
</tr>
<tr>
<td>aluminum foam, 135</td>
</tr>
<tr>
<td>aluminum oxide (see also, alumina), 606</td>
</tr>
<tr>
<td>aluminum oxide cutting tools, 482</td>
</tr>
<tr>
<td>aluminum properties, 129, 132, 134</td>
</tr>
<tr>
<td>aluminum temper designation, 131</td>
</tr>
<tr>
<td>aluminum, precipitation-hardenable, 131</td>
</tr>
<tr>
<td>American Armory System, 910, 912 (online, Ch 42)</td>
</tr>
<tr>
<td>American Iron and Steel Institute (AISI), 106–107, 113</td>
</tr>
<tr>
<td>American National Standards Institute (ANSI), 198</td>
</tr>
<tr>
<td>American Society for Mechanical Engineers (ASME), 188</td>
</tr>
<tr>
<td>American Society for Testing and Materials (ASTM), 108</td>
</tr>
<tr>
<td>American Welding Society (AWS), 780</td>
</tr>
<tr>
<td>amorphous condition, 113, 142, 149, 160, 320</td>
</tr>
<tr>
<td>arithmetic average (AA), 706</td>
</tr>
<tr>
<td>arm plate, 170, 172</td>
</tr>
<tr>
<td>artificial intelligence (AI), 764</td>
</tr>
<tr>
<td>artificially aging materials, 82</td>
</tr>
<tr>
<td>anneal, 92–93</td>
</tr>
<tr>
<td>annealing, 93</td>
</tr>
<tr>
<td>anneal, stress-relief, 79</td>
</tr>
<tr>
<td>annealing (glass), 431</td>
</tr>
<tr>
<td>anodizing, color, 133, 724</td>
</tr>
<tr>
<td>antimicrobial properties, 125, 153</td>
</tr>
<tr>
<td>Antifio process, 293</td>
</tr>
<tr>
<td>antioxidants, 153</td>
</tr>
<tr>
<td>arbor milling and tooling, 529–528</td>
</tr>
<tr>
<td>arc welding, 810</td>
</tr>
<tr>
<td>arc welding, 797</td>
</tr>
<tr>
<td>arc-filtering, 564–566</td>
</tr>
<tr>
<td>arithmetic average (AA), 706</td>
</tr>
<tr>
<td>armor plate, 170, 172</td>
</tr>
<tr>
<td>artificial intelligence (AI), 764</td>
</tr>
<tr>
<td>artificially aging materials, 82</td>
</tr>
<tr>
<td>assembly jigs, 887 (online, Ch 40)</td>
</tr>
<tr>
<td>assembly robots, 770</td>
</tr>
<tr>
<td>assignable causes and variation, 232–233</td>
</tr>
<tr>
<td>ASTM grain size number, 56</td>
</tr>
<tr>
<td>ASTM International, 48</td>
</tr>
<tr>
<td>ASTM Standard, 119</td>
</tr>
<tr>
<td>atomic bonding, 51</td>
</tr>
<tr>
<td>attributes, 192</td>
</tr>
<tr>
<td>attrition, 606</td>
</tr>
<tr>
<td>austenitizing, 93</td>
</tr>
<tr>
<td>austempering, 92–93</td>
</tr>
<tr>
<td>austenite, 72, 78, 83, 85</td>
</tr>
<tr>
<td>autoclave (composite fabrication), 438</td>
</tr>
<tr>
<td>automated guided vehicles (AGVs), 19, 761</td>
</tr>
<tr>
<td>automatic pallet changers, 574</td>
</tr>
<tr>
<td>automatic storage and retrieval systems (AS/RSs), 19</td>
</tr>
<tr>
<td>automatic tool changers, 564, 574</td>
</tr>
<tr>
<td>automotive applications, 15–16, 296, 730–731</td>
</tr>
<tr>
<td>automotive materials and selection, 186</td>
</tr>
<tr>
<td>autonomination, 250, 911–914 (online, Ch 42)</td>
</tr>
<tr>
<td>autowelding, 34</td>
</tr>
<tr>
<td>babbit, 142</td>
</tr>
<tr>
<td>back rake angle, 458, 485</td>
</tr>
<tr>
<td>backlash, 239</td>
</tr>
<tr>
<td>backward extrusion, 377</td>
</tr>
<tr>
<td>banana, 83, 85</td>
</tr>
<tr>
<td>Bakelite (PF), 148, 152</td>
</tr>
<tr>
<td>ball leadscrew, 561, 564</td>
</tr>
<tr>
<td>bamboo, 169</td>
</tr>
<tr>
<td>bandsaw, 582, 585–589</td>
</tr>
<tr>
<td>bar drawing, 374–375</td>
</tr>
<tr>
<td>bar folder, 394</td>
</tr>
<tr>
<td>barrel finishing, 713</td>
</tr>
<tr>
<td>baton-passing zone, 916 (online, Ch 42)</td>
</tr>
<tr>
<td>bearings, 320</td>
</tr>
<tr>
<td>belt sanding, 716</td>
</tr>
<tr>
<td>bending, 748</td>
</tr>
<tr>
<td>bending design, 394–396</td>
</tr>
<tr>
<td>bending test, 33</td>
</tr>
<tr>
<td>benzene rings, 149</td>
</tr>
<tr>
<td>beryllium, 142</td>
</tr>
<tr>
<td>beryllium, 374</td>
</tr>
<tr>
<td>Bessemer process, 102</td>
</tr>
<tr>
<td>bevel protractor, 202, 212</td>
</tr>
<tr>
<td>bill of materials, 906 (online, Ch 41)</td>
</tr>
<tr>
<td>billet, 359</td>
</tr>
<tr>
<td>bimetals, composite, 434</td>
</tr>
<tr>
<td>binders, powder metallurgy 323</td>
</tr>
<tr>
<td>binders, sand mold, 283</td>
</tr>
<tr>
<td>biocompatible, 138, 165</td>
</tr>
<tr>
<td>biodegradable plastics, 156–157</td>
</tr>
<tr>
<td>biomedical applications, 160, 163, 320, 735</td>
</tr>
<tr>
<td>bioplastics, 157</td>
</tr>
<tr>
<td>bismuth, 105, 129</td>
</tr>
<tr>
<td>Black-Huang model for shear strain, 463–464</td>
</tr>
<tr>
<td>blank coating, 727</td>
</tr>
<tr>
<td>blanking, 387–392</td>
</tr>
<tr>
<td>blanking finishing, 383</td>
</tr>
<tr>
<td>blast cleaning, 300, 713</td>
</tr>
<tr>
<td>blast furnace, 313</td>
</tr>
<tr>
<td>blocking (forging), 363</td>
</tr>
<tr>
<td>bloom, 359</td>
</tr>
<tr>
<td>blow molding, 420</td>
</tr>
<tr>
<td>blowout, 373</td>
</tr>
<tr>
<td>blows, 282</td>
</tr>
<tr>
<td>BMW, 945 (online, Ch 43)</td>
</tr>
<tr>
<td>body-centered tetragonal (BCT) structure, 83</td>
</tr>
<tr>
<td>body-centered-cubic structure (BCC), 55, 58</td>
</tr>
<tr>
<td>bolster, 413</td>
</tr>
<tr>
<td>bolt manufacture, 366</td>
</tr>
<tr>
<td>bond strength, metallic, 53</td>
</tr>
<tr>
<td>bonded product (abrasive particles), 604</td>
</tr>
<tr>
<td>borescope, 220</td>
</tr>
</tbody>
</table>
defects, 266, 268, 282, 316
design considerations, 271
finishing, 316
furnaces, 312–313
inspection, 316
metals, 277
mold preparation, 283
mold sand properties, 280
process selection, 316–317
solidification (see solidification shrinkage)
finishing operations, 261
surface roughness, 710
cause-and-effect diagram, 245, 247–249
cavitation, 718
C-C-T diagram (see continuous-cooling transformation diagram)
cementation, 433
cemented carbide cutting tool inserts, 479
cemented carbides, 168
cemented tungsten carbide, 163
cemenitite, 72–73, 75, 78
center drill, 542, 544
centering, 679
centerless grinding, 620
centers, 506, 515–515
centrifugal casting, 310–312
Ceracon process, 329
ceramic brazing, 453
ceramic component design, 433–434
ceramic composites, 140
ceramic cutting tools, 482
ceramic fiber, 169
ceramic injection molding, 432
ceramic matrix composites, 441
ceramic mold casting, 293
ceramic soldering, 453
ceramic-ceramic composites, 160
ceramic-matrix composites (CMCs), 171
ceramics, 160
ceramics machining, 433
ceramics,
crystal structure, 160
joining, 433, 868–869
piezoelectric, 162
cermets, 160, 163, 482–483
chamfering, 727
chance causes, 232–233
changeover, 944 (online, Ch 43)
chevy, 292
Charpy test, 39, 475
chase method (see rabbit-chase method)
chatter, 455, 461, 465, 526
check sheet, 245–247, 249
check, 292
chemical ablation, 673 (online, Ch 30)
chemical bath deposition (CBD), 646
(online, Ch 29)
chemical blanking, 660 (online, Ch 30)
chemical cleaning, 717
chemical conversion coating, 722
chemical engineer, 11
chemical flux cutting (FOC), 796
chemical machining (CHM), 659 (online, Ch 30)
chemical milling, 658–662 (online, Ch 30)
chemical vapor deposition (CVD), 472, 480, 486–
488; 643–644 (online, Ch 29)
chill bars, 118
chill zone, 263
chills, 270
China, 22
chip breaker, 486
chip formation, shear angle and forces, 458–462
chip groove, 480, 486
chip load (see also, feed per tooth), 526
chip removal, 20, 877 (online, Ch 40)
chip thickness ratio, 460
chip-forming process, limitations, 657
(online, Ch 30)
chips, 15
chok (casing gating system), 267
chromium plate, 724
chuck, 881 (online, Ch 40)
chuck, lathe, 515–516, 881 (online, Ch 40)
Chvornov’s Rule, 263–264, 269
clad materials, 167–168
cladding, 434, 718, 726, 830, 840
clamps, 887 (online, Ch 40)
clay, 161
clean rooms, 653 (online, Ch 29)
clearance fit (see also, fits), 195
climb milling, 525–526
closed-die forging (see impression-die forging)
closed-loop automation, 756
closed-loop control, 564
closed-loop machine, 561
closed-loop manufacturing resource planning (MRP II), 907 (online, Ch 41)
closed-molding process, 439
close-packed plane, 55
CNC
command words, 564
feedback control, 756
history, 558, 756
interpolation, 564, 571–572
motion types, 564
precision and accuracy, 574
programming, 567, 569
sawing centers, 585
setup, 567
toolpath, 758
coalescence, 779
coated abrasives, 623–624
coated cutting tools, 475
coated product (abrasive particles), 604
coated-carbide tools, 480
coating, 718
coatings, ceramic, 163
coatings, polymer, 155
cobalt, 139
cobalt-bonded tungsten carbide, 165
co-extrusion, 374
cohesiveness, 81
cohesiveness (mold sand), 280
coining, 331, 381, 397
co-injection molding, 422
cold forming, 376–379
cold heading, 736–737
cold rolling, 359
cold saw, 582
cold shuts, 266
cold treatment, 93
cold welding (CW), 824
cold working, 376–379
collapsibility (expendable-mold), 280
collet, 516–517
coloring of metals, 722
combination center drill and countersink, 542, 544
compactibility (mold sand), 281–282
companywide quality control (CWQC), 232, 244
competition, 10–11
complex shapes, 334–335, 422
composite adhesives, 858
composite braiding, 440
composite defects, 173
molybdenum, 105, 140, 374
monel, 128, 139
monomers, 146
mounted abrasive wheels and points, 623
MRP II (see closed-loop manufacturing resource planning)
MRR (see metal removal rate)
MTM (methods-time-measurement), 901
(multiple-variable analysis, 232, 245, 249
nano and microelectromechanical systems (see MEMS)
Nano steels, 110
nanocrystals, 632 (online, Ch 29)
nanomanufacturing, 632 (online, Ch 29)
nano-scale metrology, 653–654 (online, Ch 29)
nanotechnology, 632 (online, Ch 29)
nanotubes, carbon, 143
naturally aging materials, 82
necking (tensile test), 30
necking (turning), 500
neoprene, 158, 429
net shape parts, 369–370
neutral axis, 393
nibbling, 390
nicrome, 139
nickel silvers, 128
nickel-based alloys, 139
nickel based superalloy, 351
niobium, 140
nitinol, 139
nitriding, 95, 97
nitrocarburizing, 95
no-bake cores and molding, 291, 287, 300
nominal, 196, 232, 234, 246
noncutting tools, 8
nondestructive testing and inspection, 218–229
nonferrous metals and alloys, 124–144
nonmagnetic characteristics, 114
nonmetallic materials, 27, 146
non-sparking metals, 128, 129
non-traditional machining (NTM) processes, 658 (online, Ch 30)
normal distribution, 196, 235–236, 239
normalizing, 78–79
notching, 387, 390
notch-sensitive material, 40
nucleation and growth, 56
NURBS interpolation, 564
nylon, 150, 426
oblique machining, 454, 458
offset yield strength, 30
offsets, CNC, 568
Ohno, Taiichi, 578, 777, 910–911 (online, Ch 42)
one-piece flow, 911 (online, Ch 42)
open-die hammer forging, 361
open-hearth process, 102
open-loop automation, 561, 562, 752, 756
operation, 5, 6
operations sheet, 899–902 (online, Ch 41)
operator, 6
optical comparator, 205
optical flats, 206
optical properties, 48
orbital forging, 365–366
orbital forming, 381
oriented plastics, 153–154
orthogonal machining, 457
OSHA, 112
Oshre process (spray forming), 329, 411
overaged material, 82
oxidation, IC manufacture, 650 (online, Ch 29)
oxides, 265, 713
oxyfuel gas welding (OFW), 792–794
oxygen arc welding (OAC), 810
oxygen torch cutting processes, 795
packaging, 6, 20, 425–426, 377, 398
paint application methods, 719
painting robots, 771
paints, 719
pallet changers, 761
parallelism, 200
Pareto chart, 245, 248–249
parison, 420
part home, 567
part reference zero (PRZ), 560, 567
particulate composites, 168
parting (turning), 450, 500, 503
parting line, 261–262, 271
pattern, 261–262, 270, 277–278
pattern allowances, 270
pattern, additive manufacturing, 744
patternmaker’s contraction, 268
patterns, match-plate, 279
pearlite, 73, 79, 83
peck drilling, 568
peening, 382, 787, 865–866
penetration (casting defect), 266, 282
percent elongation, 31
percent reduction in area, 31
perforating, 390
peripheral milling, 522
permanent mold casting, 263, 303
permeability, 280–281, 332, 334
personnel department, 897 (online, Ch 41)
phases, 65
phase transformation strengthening, 80
phenol, 148
phenolics, 152, 421
phosphate coatings, 722
phosphor bronze, 127
photonics, 152, 421
photochemical blanking, 660 (online, Ch 30)
photochemical machining (PCIM), 658–660
(online, Ch 30)
photoluminescence, 658 (online, Ch 29)
photoresists, 635–636 (online, Ch 29)
physical properties, 27, 48
physical vapor deposition (PVD), 475, 477, 486–488, 642 (online, Ch 29), 726
pick-and-place machine, 769
pickling, 350, 359, 718, 842, 851
piece rate, 917 (online, Ch 42)
piercing, 379
piezoelectric (sheet processes), 387, 389–392
piezoelectric applications, 162, 223, 227, 647 and 654 (online, Ch 29)
pig iron, 102, 313
pipe, 356
pipe applications, 824
pipe threads, 681
planing, 596–600
planing machines, 599
planing workholding, 600
plant, 9
plant engineering, 897 and 904 (online, Ch 41)
plasma arc cutting (PAC), 658, 675, (online, Ch 30); 796, 810
plasma arc welding (PAW), 807–808
plasma etching, 639 (online, Ch 29)
plasma-enhanced CVD (PECVD), 645 (online, Ch 29)
plaster casting, 294
plaster molding, 293, 300
plastic adhesives, 154
plastic assembly, 427
plastic casting, 419
plastic deformation, 29, 57, 60, 149
plastic design for fabrication, 427
plastic finishing, 427–429
plastic injection molding, 308
plastic machining, 426
plastic mold material, 420
plastic molding cycle times, 421, 423
plasticity, 53
plasticizers, 153
plastics, 146
plating processes, 723–726
plowing, abrasive, 608
plug gage, 213
plumbing applications, 155, 175, 274, 432
plunge-cut grinding, 618
plywood, 167
point millng, 566, 568
point-to-point positioning, 563
Poisson’s ratio, 57
poka-aoke, 9, 245, 250–252, 256; 911, 940–941
(online, Ch 42); 952–953 (online, Ch 43)
polarization, 54
polyamides, 152, 423
poly carbonate (PC), 149, 150, 152
poly crystalline cubic boron nitride (PCBN) tools, 484
poly crystalline diamond (PCD) tools, 166, 483
polyester, 152, 421, 426
polyether ether ketone (PEEK), 170, 420
polyethylene (PE), 149, 152–152, 154, 420
polyethylene terephthalate (PET), 148, 149, 152, 156,
poly lactic acid (PLA), 157
polymer, 146
polymer crystallization, 149
polymerization, 146
polymer-matrix composites, 170–171
polymers, photocurable, 734
polymides, 152
polymorphic, 54
polypropylene (PP), 149, 152, 156
polystyrene (PS), 149, 152, 298
polyurethane (PUR), 149, 152, 158, 423
polyurethane foam, 297
polyvinyl chloride (PVC), 54, 149, 152, 156, 420
polyurethane (PVA), 29
population, 234
porcelain, 160–161
porcelain enamel, 163, 726
porosity, 260, 262, 265, 307
porous parts, 334
post processing, 571, 731
powder coating, 720–722
powder manufacture, 321
powder metallurgy, 163, 320
powder metallurgy (P/M), 163, 320
powder metallurgy (P/M), cutting tool applications, 477
powder metallurgy design, 149
powder metallurgy forging, 320, 330
powder metallurgy products and properties, 332–335
powder metallurgy, gears, 700
progressive dies, 392–393
programmable automation (see soft automation), products, 9
production scheduling, 905 (online, Ch 41)
production rate (PR), 911, 924, 941 (online, Ch 42)
production planning, 901 and 905 (online, Ch 41)
production leveling, 913 (online, Ch 42)
production control in lean manufacturing, 930–
production and inventory control, lean
production, 4
product variety (see also, model variety), 21
production, 4
production and inventory control, 905 (online, Ch 41), 911 (online, Ch 42)
production and inventory control, lean production, 907 (online, Ch 41)
production control in lean manufacturing, 930–932 (online, Ch 42)
production leveling, 913 (online, Ch 42)
production planning, 901 and 905 (online, Ch 41)
production rate (PR), 911, 924, 941 (online, Ch 42)
production scheduling, 905 (online, Ch 41)
production smoothing (see production leveling)
products, 9
profit, 896–897 (online, Ch 41)
programmable automation (see soft automation), progressive dies, 392–393
project shop, 11–12
projection welding (RPW), 822
proof testing, 218
properties selection, 182
proportional limit, 28
prototype, 181, 730, 743
pulforming, 437
pul broach, 590
pull method, 916 (online, Ch 42)
pulsed plasma arc cutting, 811
pulsed spray transfer (GMAW-S), 802
pulsed-current ECM (PECM), 665 (online, Ch 30)
pultrusion, 436
punch and die construction, 390–392
punching force, 391
purchasing, 905 (online, Ch 41)
push broach, 592
quality, 21
quality circles, 253
quality control (QC), 232
quality engineering, 897 and 904–905
quality tools, 246–249, 256
quench cracking, 89–92, 105
quench distortion, 89, 90–92
quench residual stresses, 90–91
quench-and-temper, 86–87, 120
quenching, 81
quenching medium, 89–90
quenching, design for, 90
quill, 506
R and R study, 244
R chart (see also, control chart), 241, 951
R (arithmetic roughness average), 706
rabbit-chase assembly, 910, 916–918
rack, 693
radial cutting force, 454
radiation-curing adhesives, 859
radio frequency (RF) identification, 952
radio frequency (RF) welding, 868
radioactive tracers, 220
radiographic inspection, 224–225, 316
rake angle, 485–485
rake angle, abrasive machining, 608
ram EDM, 669 (online, Ch 30)
rapid product deployment, 914 (online, Ch 42)
rapid prototyping (RP) (see additive manufacturing)
rapid thermal annealing, 649 (online, Ch 29)
rapid tooling, 730, 743
rapid traverse motion, 566
rapid-solidification processing (RSP), 138
rate of deformation, 44
rate-sensitive materials, 345
rayons, 426
reaction injection molding, 423, 440
reaction sintering, 433
reactive ion etching (RIE), 640 (online, Ch 29)
reaming, 505, 554–556
recrystallization temperature, 347
recrystallization, 61, 79, 80, 347
recyclability, 129
recyclability, 102, 109
recycled glass, 163
recycling, 1, 102, 155–156
refinery, 9
refractoriness (mold sand), 280
refractory materials, 140–141, 161

Index
rubber-die forming (see Guerin process)
rule of 10, 201, 233, 244
run chart, 234, 245–246
runners, 261–262, 277–278, 422
runout, 200
rupture, 46
sales forecast, 895 (online, Ch 41)
sample range, 243
sample size, 240, 243
sampling, 234, 239–240, 243, 251, 950–951
sand blasting, 713
sand casting, 263, 277
sand slinger, 283
sandwich structures, 435
saw blades, 582–583
sawing, 581
saws, types, 581–585
scaling laws, 632 (online, Ch 29)
scanning electron microscope (SEM), 229, 653–654
scanning probe microscopy, 653–654
scanning tunneling microscope (STM), 654
SCARA robots, 766
scarf joints, 845
scatter diagram, 245, 248
scleroscope test, 36–38
scrap iron, 102
scrap reduction, 336
screen printing, 646 (online, Ch 29), 659
screw dislocation, 59
screw machine, 509
screw thread (see thread)
sealing, 20
seam welding (see resistance seam welding)
seamed pipe, 411
seam ing, 398
seamless tubing, 379
season cracking, 127
secondary bonds, 53
segregation, 78
selective deposition lamination (SDL), 742
selective laser melting (SLM), 738
self-exicted vibration, 466
self-inspection, 253, 952 (online, Ch 43)
semiconductors, 647 (online, Ch 29)
semiconductors, intrinsic, 63
semiconductors, n-type, 63, 649 (online, Ch 29)
semiconductors, p-type, 63, 649 (online, Ch 29)
semisolid casting, 309
sensitivity, 636 (online, Ch 29) (see also, sensitization)
screw, 252
sequence of operations, 8
service industries, 1
service production system (SPS), 4–5
services, 1, 4
setup, 874, 884–885 (online, Ch 40)
set up (see also, tooling sheet), 567
shaped-tube electrolytic machining (STEM), 658, 665 (online, Ch 30)
shape-memory, 139
shaping, 596–599
shaving, 390
Shaw process, 294
shear forming, 400
shear loading, 27
shear strain, 27
shear strain, machining, 462–463
shear stress, 27
shear velocity, 461
shearing, 15, 341, 387
shearing clearance, 387
shearing force, 389, 391
sheet, 341, 359
sheet bending, 392
sheet metal forming design, 410
sheet metal processes, 387–412
sheet metal properties, 409
sheet rolling defects, 398–399
sheet-forming, 355
shelf life, 20
shell molding, 287–300
shiel ded metal arc cutting (SMAC), 810
shiel ded metal arc welding (SMAW), 798–800
Shingo, Shigeo, 952 (online, Ch 43)
shop equations, machining, 452
shop floor control, 774
short-circuit transfer (GMAW-S), 798, 802
short blasting, 713
short peening, 711
shot peening, residual stress, 712
shrink fits, 864
shrinkage allowance, 270
shrinkage porosity, 307, 309
shrinkage, casting (see solidification shrinkage) silacon, 164
Sievert’s law, 265
sigma phase, 115
sigma prime, 234
silica, 163
silicon, 74
silicon bronze, 128
silicon carbide, 162, 164–165, 168, 606
silicon nitride, 164–165
silicon wafer, 648 (online, Ch 29)
silicone, 152, 429–430, 857
silicone adhesives, 857
silicone rubber, 158
silk screening, 646 (online, Ch 29)
simple cubic structure, 54–55
single-piece flow (SPF), 232, 911 (online, Ch 42)
sinter bonding, ceramics, 869
sinter brazing, 327
sinter hardening, 327
sintered carbide cutting tool inserts, 479
sintering, 97
sintering, ceramics, 430, 432
sintering, powder metallurgy, 321, 326–327
Six Sigma methodology, 233, 245, 253, 256, 951
size dimensions, 873 (online, Ch 40)
sizing, 380
skelp, 411
skin-dried mold, 286
skin-rolled, 359
slab, 359
slab milling, 451, 523, 528
slag, 102–103, 265, 314, 798
slip, 58
slippage theory of deformation, 58–59
slitting, 389
slot die coating, 646 (online, Ch 29)
slush casting, 306
smart materials, 143
SMED (single-minute exchange of dies), 883
smooth ing (see production leveling)
S-N curve, 40–41
snagging, 612
snap fits, 865, 868
snap gage, 214
Society of Automotive Engineers (SAE), 106, 121, 188
Society of Manufacturing Engineers (SME), 188
sodium chloride, 66
sodium silicate, 287
soft automation, 755
solder, 142
soldering, 850–853
soldering, thermal effects, 786
son gel processing, 432
solid solution, 62
solidification modeling, 274
solidification process, 260
solidification shrinkage, 260, 262, 267–268
solid-solution hardening, 80
solid-solution strengthening, 80
solid-state welding, 434, 817
sodium line, 68
sodium temperature, 263
solubility, 68, 81
solve, 69
solution deposition, 646 (online, Ch 29)
solution treatment, 81
solvent cleaning, 717
solvent welding, 868
solvus line, 68
source inspection, 252, 256, 952 (online, Ch 43)
sources of variability, 233
spade drill, 545
spark-plasma sintering, 328, 433
SPC (see statistical process control)
specific energy, 455–456, 262
specific heat, 48
specific horsepower, 454–455
specific horsepower of materials, 456, 462
specific horsepower, milling, 524
specification limits, 234, 246
speeds, bandsawing, 585
speeds, drilling, 537, 546
spheroidization, 79
spin coating, 636 and 646 (online, Ch 29)
spin welding, 867
spindle speed, drilling, 537–538
milling, 523–524
turning, 499
spindle, lathe, 506
spinneret, 426
spinning, 400, 426
split nut, 506, 682
spoilage, 20
sporting goods applications, 138, 150, 152, 157,
169, 171, 174, 296, 423, 425, 430, 434, 725
spot facing, 554
spot weldable metals, 821
spot welding, 806
spray deposition, 411
spray forming, 329, 411
spray transfer (GMAW-ST), 798, 802
springback, 349, 394, 396–397
sprue, 261–262, 266–267, 277–278, 284, 422
sputter etching, 639–640 (online, Ch 29)
sputtering, PVD, 642–643 (online, Ch 29), 726
square head, 202
squeeze casting, 309
stability, 201, 244
stabilizers, 153
stainless steels, 113–115
austenitic, 114–115
cast, 115
duplex, 115
ferritic, 114–115
free-machining, 115
martensitic, 114–115
Index