

Index

- ABS** (acrylo-butadiene-styrene), 250
Acetal resins, 250
Addition polymerisation, 245
Adhesives, 353, 356
Age-hardening, 235
Ageing of plastics, 332
Air-hardening steels, 206, 209
Allotropy, 44-45, 136
Alloy cast irons, 222
Alloys, 118-134
Alloy steels, 202-216; elements in, 207
Aluminium alloys, 231-236; precipitation hardening of, 234
Aluminium bronze, 230
Amorphous: solids, 54; state, 46, 50
Anisotropy, 287
Annealing, 89; of steel castings, 182; process-, 181; spheroidising-, 181
Anode, 315
Antimony, in bearing metals, 241
Arc-welding processes, 358-360
Atom, 2
Atomic: bomb, 397; mass number, 11, 389; nucleus, 9; pile, 398; structure, 4-17; weight, 11
Austempering, 199
Austenite, 173; transformations, 174-178, 181-199
Austenitic: cast irons, 219; steels, 203, 214
- Bainite, 188-190
Bakelite, 244, 256
Ball-bearing steels, 210
Bearing: bronzes, 242; metals, 240-242; plastics, 305; sintered alloys, 242
Beryllium, 299; bronze, 230; oxide, 279, 280
Binary alloys, 119
Bismuth-cadmium alloys, 155
Blow moulding, 106
Body-centred cubic, 44
Borides, 303
Boron, 299; carbide, 279, 300; in glass, 282
Bragg's Law, 39
Brass, 224-227; compositions of, 232; free-cutting, 224; high-tensile, 232
Bravais lattice, 35-36
Brazing, 357; solders, 357
'Brightray', 238
Brinell test, 65
Brittle fracture, 335, 340
Bronze: aluminium bronze, 230; phosphor bronze, 230; tin bronze, 224, 228-232
Bronze welding, 358
Butt welding, 361
- Calendering, 107
Carbides, 303; stability of, 204
Carbon, 20; compounds, 20-25; fibres, 287-289
Case-hardening of steel, 200
Casein plastics, 256
Casting: die-, 100; ingot-, 95; investment-, 99; of ceramics, 101; of plastics, 101; processes, 95-102; sand-, 98; shell-mould-, 98
Cast iron, 216-222; alloy, 222; compositions of, 219; malleable, 221, 222; microstructures of, 218-221; properties of, 218, 219; spheroidal-graphite, 218; varieties and uses of, 219; welding of, 365
Cast structures, 50, 416
Cathode, 315
Cellulose, 296; acetate, 251; acetyl/butyrate, 251; nitrate, 251
Cement, 305
Cemented carbides, 301, 303
Cementite, 173
Ceramics, 273-281; corrosion of, 333; electrical properties, 281; hardness, 279; melting points, 280; strength, 279; structures, 274-278
Cermets, 297, 301, 303
CFRP, 300
Charpy test, 66-68
Chill crystals, 50, 51
'Chromidium', 219
Chromium: in cast iron, 219, 222; in steels, 171, 213-215
Cleavage planes, 71
Close-packed hexagonal, 41-43
Cobalt: in high-speed steels, 211; in magnets, 380, 381
Coercive force, 379
Coherent precipitation, 129, 235
Coinage alloys, 232
Coining, 110
Cold: forging, 110; rolling, 108; welding, 362; working, 71, 108
Cold-setting plastics, 255
Composite: bearings, 304; materials, 296-309
Compression moulding, 116
Concrete, 306; pre-stressed, 308; reinforced, 307
Condensation polymerisation, 254
Conductivity, electrical, 368-376; of aluminium, 231; of copper, 223
Constructional steels, 206, 209
Co-polymer, 248
Copper, 223; alloys of, 149, 159, 224-231; conductivity of, 223; in cast irons, 222; in white metals, 242
Coring, 123, 153
'Corronel', 238
Corrosion, 310-330; crevice-, 327-328; dry-, 310; electrolytic (galvanic), 312; protection from, 329-330; -resistance, 206; sacrificial, 321
Cottrell atmospheres, 127

- Coulomb: force, 33; Law, 13
 Covalent bond, 18–20
 Cracks: detection of, 404–407; formation of, 338
 Creep, 341–346; in metals, 341; in plastics, 269;
 -resistance, 345; -stress, 343
 Crevice corrosion, 327–328
 Critical: cooling rate, 193; mass, 397
 Cross-linking, 254
 Crystal: boundaries, 84; imperfections, 74; struc-
 ture, 32, 41
 Crystallisation: of metals, 45–51; of polymers, 259
 Crystallites, 259
 Cupro-nickel, 230
- Deep-drawing, 109
 Deformation, 69–93; of polymers, 91
 Degree of freedom, 142
 Dendrite, 48; dendritic growth, 48
 Depth of hardening, 194, 195
 Devitrification, 282
 Diamond, structure of, 52
 Diamond pyramid hardness, 65
 Die-casting, 100; alloys, 237, 240
 Dies, steels for, 210
 Diffusion, 125–127
 Dipole, 26; moments, 26
 Dislocation, 75, 339; climb, 87; edge-, 76; jog, 88;
 screw-, 78; theory, 76–88
 Dispersion: forces, 27; hardening, 298, 302
 Drawing processes, 108
 Drop forging, 102
 Dry corrosion, 310
 Ductile fracture, 335
 Ductility, 56, 61
 Duralumin, 234, 237
 Dynamic testing, 414
- Einstein's Equation, 15, 395
 Elastic: deformation, 58, 69; limit, 63; modulus,
 see Young's Modulus
 Elastomer, 289
 Electrical: conductivity, 366, 368; properties, 41,
 366; resistance, 238, 367
 Electric-arc welding, 358–359
 Electrochemical series, 313
 Electrode potential, 313
 Electrolyte, 316
 Electrolytic corrosion, 312–330
 Electron, 2; beam welding, 360; 'cloud', 70, 366;
 compounds, 133; microscope, 430; shells, 8;
 spins, 7
 Electro-slag welding, 359
 Electrovalent bond, 18, 30–33
 Elongation, per cent, 61
 Embossing, 111
 Endurance limit, 347
 'Energy gap', 368
 'Engineering stress', 63
 Epoxy resins, 257
 Equi-axed crystals, 50, 51
 Equilibrium diagrams, 145–171; construction of,
 149
 Erichsen test, 68
- Etching: macrosections, 105; microsections, 422
 Eutectic, 119, 154–159; point, 154, 158
 Eutectoid, 159; point, 205
 Expanded plastics, 271
 Explosion: forming, 113; welding, 363
 Extrusion, 105, 115; impact-, 110
- Face-centred cubic, 43–44
 Fatigue, 346–349; fracture, 348; limit, 347
 Ferrite, 173
 Ferromagnetism, 377
 Fibre, 103–105; carbon-, 287–289, 299; materials,
 299; reinforced plastics, 298–301
 Fick's Laws, 125, 152
 Fictive temperature, 281
 Fillers, 270
 Flame hardening, 201
 Flash welding, 362
 Flow lines, 103–105
 Fluorescent tests, 405
 Foamed plastics, 271
 Forging, 102; drop-, 102
 Fracture, 335–341
 Frank-Reed source, 80
 Free-cutting brass, 224
 Friction welding, 362
 Furnaces, melting, 95, 96
 Fusion welding, 358–360
- Galvanic: corrosion, 313–322; protection, 330
 Gamma (γ) radiography, 410
 Gas-shielded arc welding, 359
 Gas welding, 358
 Gauge length (tensile test pieces), 61
 Germanium, 368
 Giant molecules, 52
 Glass, 281–287; fibre, 285; heat-treatment of, 286;
 mechanical properties of, 284; reinforced com-
 posites, 282, 299; transition temperature, 261,
 281
 Glues, 356
 Grain: boundaries, 50; growth, 90, 204; refine-
 ment, 205, 207; size, 90
 Graphite, 53, 173
 Griffith's Crack Theory, 337
 GRP, 282, 299, 300
 Gunmetal, 230, 232
 Gutta-percha, 291
- Hardenability, 194
 Hardening: flame-, 201; induction-, 201; of steel,
 196; surface-, 199
 Hardness, 64; measurement of, 64–66
 'Hastelloy', 238
 Heat-resisting: alloys, 216, 238; steels, 216, 312
 Heat-treatment: of aluminium alloys, 234; of
 steels, 181–199, 212
 Hexagonal close-packed, see Close-packed hex-
 agonal
 High-speed steels, 211; hardening of, 212
 High-temperature alloys, 214, 216, 238
 Homologous series, 23
 Hooke's Law, 58

- Hot: pressing, 102; rolling, 105; working processes, 102–107
- Hume-Rothery, 122
- Hydrogen: bomb, 401; bond (bridge), 28
- Hyper-, hypo-eutectoid, 177
- Impact tests, 66–68
- Induction: hardening, 201; welding, 362
- Ingot: casting, 95; structures, 50
- Inhibitors, 325
- Injection moulding, 116
- Inspection of welds, 403
- Insulators (electrical), 372
- Intermediate phases, 131–134, 167–168
- Intermetallic compounds, 132, 167
- Internal defects, detection of, 408–414
- Interstitial: compounds, 134; solid solutions, 121
- Iron, 136, 172; -carbon diagram, 174
- Isomerism, 23
- Isothermal: transformations, 190; treatments, 198
- Isotopes, 11, 12, 391, 394, 396, 399
- Izod test, 66–68
- Jominy test, 194–195
- Kinetic Theory of Matter, 45
- Laminates, 258
- Laser welding, 360
- Lattice, 33–35
- Laves phases, 132
- Layer structures, 53
- Lead: alloys of, 166; in brass, 224
- Lever Rule, 147
- Lignin, 296
- Limiting creep stress, 343
- Limit of proportionality, 63
- Liquidus, 150
- Lost-wax process, *see* Casting, investment
- Lower critical temperature, 175
- Machinability, 181, 224
- Magnesium: alloys of, 167, 236; oxide, 274
- Magnetic: domains, 378; dust tests, 406; hysteresis, 379; permeability, 382
- Magnetism, 376–382
- Malleability, 56, 60
- Malleable cast irons, 222
- Marageing steels, 208
- Marsh machine, 81
- Martempering, 198
- Martensite, 185, 187
- 'Mass defect', 15
- Mass effect (of heat treatment), 194
- 'Mazak', 240
- Mechanical: properties, 56–67; testing, 56–67
- Melamine formaldehyde, 256
- Melting point (of polymers), 260
- Mer, 245
- Metallic-arc welding, 359
- Metallic bond, 40–41, 366–368
- Methane, 21
- Micelles, 54
- Microscope, 426; care of, 430; electron-, 430; magnification, 427; objectives, 427
- Microsections: etching of, 422; preparation of, 420; selection of, 419
- MIG process, 359
- Miller indices, 36–38
- Miscibility, 120
- 'Modification' (of aluminium-silicon alloys), 231
- Modulus, Young's, 58
- Moh's Scale, 64
- Molecule, 18–29
- Molecular crystals, 54
- Molybdenum: boride, 303; in high-speed steels, 211, 212; in steels, 204, 207, 208, 209
- Monel Metal, 232
- Monomer, 245
- Mortar, 306
- Nailing, 350
- Neutron, 3, 12, 331
- Nickel: alloys of, 168, 238, 240; in aluminium alloys, 237; in cast irons, 222; in steels, 202–206; 'silvers', 230
- 'Nimonic' alloys, 238
- Niobium, in steels, 204, 213
- 'Ni-resist', 219
- Nitriding, 200; advantages of, 200; steels, 200
- Noble gases, 19
- Nodular cast iron, *see* Spheroidal-graphite cast iron
- Non-coherent precipitates, 131
- Non-destructive testing, 403–417; applications, 416
- Normalising, 182
- Novolak, 254
- Nuclear: binding force, 12; binding energy, 15; energy, 15, 395, 398; fission, 16, 395–400; fusion, 401; reactions, 392–400; stability, 386
- Nucleon, 13, 386
- Nylon, 250
- Objectives, microscope, 427
- Oil-less bearings, 115, 135
- Oil-quenching, 193
- Orbital, atomic, 6
- Oxidation, 311
- Oxy-acetylene welding, 358
- Partial solid solubility, 159–163
- Particle: hardening, 298; hardened composites, 301
- Pauli's Exclusion Principle, 7, 8, 366
- Pearlite, 177
- Penetrant tests, 404
- Periodic Classification (Table), 7, 10, 18
- Peritectic reactions, 163–166
- Permanent magnet alloys, 380
- Permeability (μ), 382
- 'Perspex', 250
- Phase: definition of, 119, 136; diagrams, 141–171; equilibrium, 136–171; Rule, 142
- Phenol formaldehyde, 254, 256, 356
- Phosphor bronze, 230, 232

- Pipe, in ingots, 97
 Planck's Constant, 6
 Plasma-arc welding, 360
 Plastic deformation (strain), 60, 70, 71-87
 Plastics, 244-272; foams, 271; properties of, 259-269; shaping of, 106-107, 115-117; structures and compositions of, 247, 249-253, 256, 259
 Plasticisers, 270
 Platinum-silver alloys, 163
 Plutonium, 400
 Poisson's Ratio, 293
 Polar bonds, 33
 Polyamides, 250
 Polyesters, 250, 257
 Polyethylene, 24, 245, 247, 249
 Polyethylene terephthalate, 250
 Polyisoprene, 292
 Polymerisation, 245
 Polymers, 244-272; mechanical properties of, 263
 Polymethyl methacrylate (PMM), 247, 250
 Polymorphism, 45, 172
 Polypropylene, 249
 Polystyrene, 247, 249
 Polytetrafluoroethylene (PTFE), 247, 250
 Polythene, 24, 245, 247, 249
 Polyurethanes, 251, 257
 Polyvinyl: acetate, 247, 249; chloride, 247, 249
 Polyvinylidene chloride, 247, 250
 Portevin's Rules, 147
 Portland cement, 306
 Pourbaix diagrams, 323
 Powder metallurgy, 114, 134
 Precipitation: from a solid solution, 129; hardening, 123, 208, 230, 234, 236, 237, 238
 Pressing, 102, 111
 Pressure: die-casting, 100; welding, 360-363
 Process annealing, 181
 Projection welding, 361
 Proof stress, 63
 Protection of metallic surfaces, 320
 Proton, 3
 Pseudo-binary diagram, 171
 PTFE, *see* Polytetrafluoroethylene
- Quantum shells, 7
 Quench cracks, 193
 Quenching of: aluminium alloys, 235; steels, 179, 193, 196, 210-211, 213
- Radiation: alpha (α)-, 384; beta (β)-, 384; gamma (γ)-, 385; damage, 331-332; detection of, 386
 Radioactive: decay, 389; series, 388, 391
 Radioactivity, 383; artificial-, 393
 Radiography, 408-413
 Recrystallisation, 89; temperature, 89
 Reduction: chemical, 311; in area, 62
 Relative atomic mass, *see* Atomic mass
 Relief of stress, 87, 89
 Remanence, 379
 Resistance alloys, 238
 Resolving power (of lenses), 428
 Riveted joints, design of, 350
- Riser, 98
 Rockwell Hardness, 66
 Rolling, 105, 108; mills, 105, 108
 Rubber pressing, 111
 Rubbers, 289-295; mechanical properties of, 293; structures of, 290; synthetic, 293
 Ruling section, 194
 Runner, 98
- Sacrificial corrosion, 321
 Sand casting, 98
 Scission, 332
 Screws, 350; steel for, 180
 Seam-welding, 361
 Season cracking, 326
 Secondary: hardening, 213; solid solutions, 132
 Segregation: major, 97; minor, 97
 Semi-conductors, 368, 372-376
 Shell-moulding, 98
 Shrinkage cavities, 49
 Side branching, 255
 Silicates, 275-280
 Silicon, 368; in cast iron, 216-218
 Silicon-aluminium alloys, 231
 Silicon carbide, 279, 300
 Silicones, 257
 Silver: alloys of, 159, 163; solders, 357
 Sintered: aluminium powder (SAP), 302, 304; bearings, 114, 242, 305; carbides, 301, 303
 Sintering, 114
 Size factor, 132
 Slip, 69; bands, 71, 72; planes, 70
 Sodium: chloride, 33; in 'modification', 231
 Soldering, 355
 Solders, 357; silver-, 357
 Solid solutions, 119-131, 149-154; diffusion in, 125, 153
 Solidus, 150
 Solute, 119; 'atmospheres', 127
 Solution, 118-131; treatment of aluminium alloys, 234
 Solvent, 119
 Solvus, 160
 Sorbite, 197
 Space lattice, 33-35
 Specific: modulus of elasticity, 60, 287; strength, 288
- Spheroidal-graphite cast iron, 218
 Spheroidising, 181
 Spinning, 112
 Spot-welding, 361
 Stainless: iron, 214; steels, 213-215, 329
 Steel: compositions, 172, 178-181; heat-treatments of, 181-201; ingots, 95; properties and uses of, 178-181; structures of, 173-189
 Stereoisomerism, 290
 Strain, definition of, 57
 Stress: corrosion, 325; definition of, 57; 'engineering-', 63; relief, 87
 Stress-strain diagrams: 62; of plastics, 267
 Stretch forming, 112
 Structural steels, 179, 180
 Sub-critical annealing, 181

- Submerged-arc welding, 359
 Substitutional solid solutions, 121
 Superconductivity, 370–372
 Surface defects, detection of, 403–407
 Surface hardening of steels, 199
- Tantalum, 168; carbide, 280
 Tarmacadam, 309
 Temper brittleness, 206
 Tempering of steels, 196
 Tensile: strength, 63; tests, 61
 Ternary equilibrium diagrams, 168–170
 Test-pieces, 61; proportional, 61
 Thermal equilibrium diagrams, *see* Equilibrium diagrams
 Thermit welding, 360
 Thermodynamics, 136
 Thermoplastic polymers, 246
 Thermosetting polymers, 248, 254
 Thorium, 388; oxide, 280
 TIG process, 359
 Time/yield stress, 344
 Tin: in bearing metals, 240; in brass, 224; in bronze, 224; in solders, 357
 Titanium, 242; alloys, 242; carbide, 303; in steels, 204, 205, 213
 Tool steels, 180, 208, 210
 Toughness, 66
 Tough-pitch copper, 223
 Transfer moulding, 116
 Transformation rates, retardation of, 193, 205
 Transition temperature, 341
 Troostite, 197
 TTT curves, 188–198
 Tungsten: carbide, 303; in steels, 211, 212
 Twins: annealing, 86; deformation, 85
- Ultimate tensile stress, *see* Tensile strength
 Ultrasonic: testing, 413; welding, 263
 Upper critical temperature, 175
- Uranium, 388, 396–400
 Urea-formaldehyde, 256
- Vacancies (vacant sites), 74
 Vacuum forming, 107
 Valency (valance): band, 368; compounds, 132
 Vanadium: in cast iron, 222; in steels, 204, 207, 211
 Van der Waals forces, 25, 53, 246, 259, 276
 Vickers Diamond Pyramid Hardness, 65
 Vinyl plastics, 246–248
 Viscoelasticity, 92, 264–266
 Visual inspection, 403
 Vulcanisation, 291, 292
- Weld: decay, 213, 329, 364; inspection, 403, 417
 Welding: processes, 357–363; structures, 363–365
 Welding of: alloy steels, 364; aluminium alloys, 365; carbon steels, 364; cast iron, 365; magnesium alloys, 365; plastics, 362; refractory metals, 360; stainless steels, 364
 'Whiskers', 81, 300
 'White' bearing metals, 240–242
 Widmanstätten structure, 182
 Wöhler fatigue test, 346
 Wood, 296; structure of, 296
 Work-hardening, 86
- X-ray analysis, 38–40, 55
 X-radiography, 408
- Y-alloy, 236
 Yield strength, 63
 Young's Modulus of Elasticity, 58
- Zener voltage, 376
 Zinc: alloys, 240; in bronze, 230, 232; in magnesium alloys, 236, 239; protective coating of, 320; sacrificial protection by, 321, 330
 Zirconium: in magnesium alloys, 239; oxide, 280