

Index

- Ablation, 417
- Abrasives, 330
- Absolute temperature, 10, 12
- Activation energy, 200
- Adiabatic change, 21
- Adiabatic lapse rate, 379
- Adiabatic softening, 288
- Adhesion, 239, 243, 246, 250
 - viscous, 225
- Adhesive friction, 333
- Adsorption, 246
- Age-hardening, 293
- Ageing, 70
- Airfoil, 401
- Airy stress function, 136
- Alloys, 57, 291
- Andrade creep law, 296
- Andrade viscosity formula, 205
- Anelasticity, 178
- Angle,
 - of repose, 315
 - of shear, 123
- Ångstrom, 3
- Anharmonic vibrations, 187
- Anisotropy, 102, 112
- Annealing, 70
- Anticlastic bending, 130
- Aperiodic motion, 173
- Archimedes' principle, 378
- Atomic mass, 3, 46
- Atomic weight, 3
- Attenuation of waves, 158
- Autofrettage, 312
- Avogadro's number, 3
- Basal plane, 67
- Bauschinger effect, 305
- Beams,
 - elastic, 124
 - plastic, 307
- Bearings, sliding, 225, 334
- Bend planes, 267
- Bending waves, 161
- Bernoulli's equation, 381
- Biharmonic equation, 136
- Binding energy, 36, 37, 70
- Bingham equation, 213
- Blue brittleness, 367
- Body forces, 105
- Body-centred cubic lattice, 66, 83
- Boiling points, 4, 34
- Boltzmann's constant, 12, 38
- Boundary layer theory, 404
- Boundaries, dislocation, 267
- Bowden-Tabor theory of friction, 332
- Boyle's law, 11
- Bravais lattice, 62
- Brinell hardness, 329
- Brittle fracture, 225, 342, 349, 356, 361, 367
- Brownian motion, 19, 211
- Buckling, 90, 132, 337
- Built-in beams, 127
- Bulk modulus, 92, 111
- Buoyancy, 378
- Burgers vector, 74, 149, 266, 391
- Caesium chloride, structure of, 66
- Canal waves, 410

Cantilever beams, 127
 Capillary equilibrium, 240
 Capillary waves, 410
 Carbides, 52, 56
 Cauchy elastic relations, 112
 Cauchy-Riemann equations, 398
 Cavitation,
 in grain boundaries, 258
 in liquids, 43, 393
 Cementite, 80
 Centre of symmetry, 61
 Characteristic temperature, 185
 Charles' law, 11
 Charpy notch test, 357
 Chemisorption, 248
 Circulation, 388
 Classical vibrations, 184
 Clausius' specific heat relation, 21
 Clay, 213
 Cleavage, 350
 Climb, dislocation, 75, 285
 Close-packed hexagonal structure, 66
 Coefficient,
 of diffusion, 27, 179, 201
 of thermal expansion, 4, 102
 of work-hardening, 297
 Coffin-Tavernelli fatigue formula, 370
 Cohesionless soils, 318
 Coiled springs, 130
 Cold-working, 286
 Collapse load, 303
 Colloids, 211
 Compatible deformation, 103, 135, 309
 Concentration of strain and stress, 145,
 153, 324, 343, 371
 Conchoidal fracture, 349
 Condensation, 32
 coefficient of, 247
 Conduction, thermal, 24, 189
 Conservative forces, 116
 Considère's construction, 290
 Constrained plastic deformation, 304, 327
 Contact forces, 105
 Convection, 29, 379, 385
 Co-ordination number, 65
 Copolymers, 214
 Corrosion fatigue, 371
 Couette viscosity, 221
 Coulomb's yield criterion, 315
 Covalent bond, 53

The Mechanical Properties of Matter

Crack,
 elastic, 151, 345
 grain boundary, 260
 temperature of arrest of, 357
 velocity of, 349
 Creep, 173, 203, 256, 295, 336
 Creep buckling, 337
 Creep fracture, 352, 355
 Creep-resistance, 296, 298
 Critical damping, 173
 Critical temperature, 33, 34
 Cross-linking, 88, 211, 216
 Cross-slip, 275
 Crystal growth, 254
 Crystalline state, 43
 Crystallization, 76, 78, 210, 218
 Cup-and-cone fracture, 324

D'Alembert's paradox, 397, 399, 416
 Dalton's law, 10
 Damping, 172, 177
 de Broglie's relation, 206
 Debye's specific heat formula, 186
 Defects in crystals, 68
 Degrees of freedom, 17
 Delayed elasticity, 217
 Dendrites, 76
 Density,
 of dislocations, 269
 of elements, 4
 Detergency, 239
 Deviatoric strain and stress, 100, 108, 317
 Devitrification, 208
 Diamond, 66
 Diffusion, 24, 27, 200
 Dilatation, 100, 222
 Dimensional analysis, 226
 Dipoles,
 dislocation, 149, 277
 fluid, 396
 Direction cosines, 96
 Discontinuous fracture, 354
 Discontinuous streamlines, 393
 Dislocation,
 elastic, 103, 146
 glide, 266, 307
 structure of, 72
 Dislocation boundaries, 150, 267
 Dislocation climb, 75, 285
 Dislocation dipole, 149, 277

- Dislocation fracture, 352, 360, 374
Dislocation pile-up, 152
Dispersion, wave, 158, 162, 409
Dispersion-hardening, 293, 299
Dissociation energy, 36
Drag, 400, 403
Ductile fracture, 322
Ductile–brittle transition, 356
Dulong–Petit law, 184
Dynamical viscosity, 26, 196
- Easy glide, 284
Eddy, 394, 407
Edge dislocation, 72, 147, 267
Effusion of gases, 11
Eigenfunctions, 175
Einstein,
 diffusion formula of, 228
 specific heat formula of, 186
 viscosity formula of, 212
Elastic after-effect, 217
Elastic beams, 124
Elastic constants, 4, 85, 110, 112, 115
Elastic design, 306
Elastic dislocation, 103, 146
Elastic hysteresis, 88
Elastic instability, 90
Elastic limit, 87, 287
Elastic resilience, 116, 131
Elastic stability, 131
Elastic stress concentration, 153
Elastic vibrations, 171
Elastic wave velocity, 159
Electron, 46
Electron conductivity in metals, 191
Electron spin, 50
Electron-pair bond, 54
Electron-volt, 47
Electropositive and electronegative elements, 50
Encastré beams, 127
Endurance, fatigue, 369
Energy,
 activation, 200
 adsorption, 247
 diffusion, 200
 dislocation, 148
 dissociation, 36
 elastic, 116
 interfacial, 237
 quantum of, 18, 48
 vacancy, 70
Energy level, 49
Enthalpy, 38, 414
Entropy, 38, 83, 414
 surface, 233
 vibrational, 187
Equation of continuity, 222, 384
Equation of state, 10, 39, 41, 384
Equipartition of energy, 17
Equipotential lines, 396, 398
Equivoluminal waves, 160
Euler,
 buckling formula of, 133
 fluid equations of, 385, 395
Eutectics, 79, 294
Extended dislocation, 272
Extrusions, fatigue, 372
- Face-centred cubic lattice, 62, 66, 83
Fatigue,
 static, 346
 thermal, 103
Fatigue failure, 305, 311
Fatigue strength, 369
Fatty acids, 249
Ferrite, 80
Fibres, 89, 235, 295, 347
Fibrous fracture, 323
Field-ion microscopy, 2
Fisher, Hart and Pry hardening, 293
Flexural rigidity, 126
Flexural vibrations, 176
Flexural waves, 161
Fluctuations, 20
Fluidity, 195
 grain boundary, 259
Fluidized beds, 213
Foams, 240
Forced vibrations, 173
Form resistance, 403
Four-point loading, 125
Fracture,
 of adhesives, 225
 brittle, 225, 342, 349, 356, 361, 367
 ductile, 322
 grain boundary, 258, 260
Fracture toughness, 363
Frank–Read dislocation source, 279
Free electrons, 55, 273

Free energy, 39, 83
 Free streamlines, 393
 Free volume, 44, 202
 Free vortex, 390
 Freezing, 77
 Friction, 39, 315
 Bowden–Tabor theory of, 332
 internal, 177
 Friction hill, 335
 Froth flotation, 250

Gas constant, 12
 Gels, 211
 Gemstones, 330
 General yielding, 307
 Gibbs' adsorption theory, 246
 Glass,
 transition temperature of, 208
 viscosity of, 197
 Glassy polymers, 218
 Glide, plastic, 265
 Graham's law, 11
 Grain boundaries, 75, 77, 150, 256, 259, 362
 Grain growth, 240
 Gravity waves, 410
 Griffith cracks, 345
 Group wave velocity, 162, 409
 Growth of crystals, 254
 Grüneisen's constant, 188

Hardness, 188, 270, 293, 329
 Heat,
 of sublimation, 36
 of vaporization, 36
 Heat pumps, 23
 Heisenberg principle, 48
 Helium, superfluidity of, 206
 Hencky's plastic relations, 326
 Heterogeneous equilibrium, 33
 Heterogeneous nucleation, 253
 Homopolar bond, 51
 Hooke's law, 85, 110, 136
 Hoop stress, 122
 Hot-shortness, 79, 238, 260
 Hot-working, 279
 Hydrogen, electronic structure of, 47, 54
 Hydrophobic sols, 250
 Hydrostatic stress, 42, 108, 362

Hydrostatics, 378
 Hypersonic flow, 417
 Hysteresis, 88, 180

Ideal fluid, 380, 388
 Ideal plasticity, 198, 275
 Ideal shear strength, 271
 Ideal tensile strength, 42, 234
 Impact, 163, 357
 Imperfect dislocations, 74, 267
 Imperfect frames, 121
 Incremental collapse, 305
 Indentation hardness, 329
 Induced drag, 404
 Inert gases, 50
 Infinitesimal strain, 96
 Instability, 90, 288, 394
 Interatomic forces, 35, 51, 91, 234
 Interfacial energy, 237
 Intermetallic compounds, 57
 Intermolecular forces, 35, 42
 Internal energy, 38
 Internal friction, 177, 315
 Internal stresses, 103
 Interstitial defects, 68
 Interstitial diffusion, 200
 Interstitial solutions, 68
 Intrusions, fatigue, 372
 Ionic bond, 51, 91
 Ionic crystals, 52
 Ionization, 49, 50
 Irreversible changes, 39
 Irrotational elastic waves, 159
 Irrotational flow, 383, 388
 Isotactic polymers, 215
 Isothermal change, 21
 Isotopes, 11, 46

Jets, 393
 Joffé effect, 346
 Jogs, 277
 Joule–Thomson effect, 36

Kelvin's equation of droplet equilibrium, 251
 Kinematic viscosity, 26, 385
 Kinetic heating, 416
 Kink bands, 267
 Knudsen gases, 29, 419
 Kutta–Joukowsky theorem, 401

- Lambda point in helium, 206
Lamé's elastic constants, 113
Laminar flow, 26, 219, 402
Landau's superfluidity theory, 206
Langmuir isotherm, 247
Laplace equation, 395
Lattice, 61
Lattice defects, 68
Law of resolved shear stress, 270
Layer crystals, 53
Lever rule of heterogeneous equilibrium, 34
Lévy–Mises plasticity equations, 317
Lift, 400
Limit analysis, 309
Limit of proportionality, 287
Line tension of dislocation, 280
Linear damping, 180
Linear elasticity, 86
Liquid, tensile strength of, 42
Liquid state, 33
Logarithmic creep, 296
Logarithmic decrement, 172, 178
Longitudinal waves, 159
Long-range order, 43
Loschmidt's number, 3
Love waves, 161
Lubrication, 225, 250
Lüders band, 170, 218, 281
Ludwik–Davidenkov–Orowan fracture condition, 358
Lyophilic and lyophobic sols, 211
- Mach number, 412, 419
Machining, 323
Magnetohydrodynamics, 386
Magnus effect, 400
Martensite, 292
Maxwell–Boltzmann law, 14, 185, 191, 200
Mean free path, 23, 189
Melting, 4, 187
Meniscus, 33, 240
Metal fatigue, 371
Metallic bond, 51, 55, 249, 273
Metallic conductivity, 191
Metallography, 75
Metastability, 41
Mixing length, turbulent flow, 407
Modes of vibration, 182
- Modulus,
of elastic resilience, 116
of elasticity, 111, 113
of rupture, 343
Modulus defect, 179
Mohr's circle construction, 100, 316
Mohs hardness, 330
Mole, 3
Molecular substances, 55
Molecular weights, 3
Moment of area, 124, 125
Monomers, 214
Multiple connectivity, 104, 390
- Nabarro–Herring creep, 204
Natural vibrations, 175
Necking, 170, 287, 322
Negative thermal expansion, 188
Network polymers, 216
Neutral surface in bending, 124
Neutron, 46
Newton's law,
of mechanics, 9, 156
of viscous flow, 26, 196, 338
Nitrides, 52, 56
Nominal strain and stress, 87, 93, 169, 286
Non-Newtonian flow, 198, 298
Notch effect, 235, 328, 343, 355, 364, 371
Nucleation, 41, 253
- Octahedral planes, 67
Order, 43, 60
Orowan strength formula, 293
Orowan–Irwin fracture formula, 355
Osmotic pressure, 38
- Partial dislocation, 74, 267
Partial pressure, 10
Pastes, 213
Pauli principle, 50
Pearlite, 80, 294
Peierls–Nabarro force, 272
Pellini crack test, 357
Perfect dislocation, 73, 266
Perfect elasticity, 85
Perfect frames, 121
Perfect gases, 10, 32
Petch's yield formula, 282

Phase velocity, 162, 409
 Phases, thermodynamic, 34, 45, 252
 Phonons, 189, 206
 Physical adsorption, 248
 Piled-up dislocations, 152
 Pin-jointed frames, 120, 303
 Pitot tube, 381
 Planck's constant, 48
 Plane flow, 397
 Plane strain and stress, 134, 319
 Plane waves, 158
 Plastic collapse, 303, 309
 Plastic constraint, 327, 358
 Plastic design, 306
 Plastic flow, 198, 295
 Plastic hinge, 307
 Plastic moment, 308
 Plastic rupture, 322, 352
 Plastic waves, 170
 Plastic yielding, 213, 264
 Poiseuille flow, 30, 220
 Poisson's ratio, 4, 113, 130, 158, 160
 Polarizability, 52
 Polishing, 331
 Polycrystalline plasticity, 278
 Polygonization, 150, 285
 Polymers, 88, 211, 214
 Prandtl's boundary layer, 404
 Prandtl's method for torsion, 244
 Prandtl–Meyer expansion fan, 418
 Precipitation hardening, 293
 Pressure vessels, 122
 Pressure welding, 332
 Prestressed concrete, 127
 Primary creep, 296
 Primitive lattice cell, 61
 Principal strain, 94, 99
 Principle,
 St. Venant's, 120
 of superposition, 86, 119, 395
 of virtual work, 84
 Prismatic dislocation, 275
 Proof stress, 286
 Proper modes, 175
 Protons, 46
 Punching, 327
 Quantum effects, 18, 48, 206
 Quantum vibrations, 184
 Quenching, 70, 84, 292

The Mechanical Properties of Matter

Radiation, elastic, 168
 Radiation damage, 69
 Random walk, 28, 201
 Rankine state of plastic equilibrium, 318
 Rankine–Hugoniot shock equations, 414
 Rarefaction waves, 413
 Rayleigh waves, 160
 Recrystallization, 259, 286
 Reduced equation of state, 41
 Redundant frames, 121
 Reflection of waves, 164
 Refraction of waves, 417
 Refractories, 52
 Relaxation of stress, 197
 Repeated suffix convention, 93
 Resilience, 116
 Resolution of stress, 106
 Resolved shear stress for glide, 270
 Resonance, 174
 Reverberation, 181
 Reversible changes, 39
 Reynolds number, 402, 412, 419
 Rigid body rotation, 95
 Rigidity of beams, 126, 129
 Ripples,
 on liquid surfaces, 409
 on solid surfaces, 349, 373
 Robertson crack test, 357
 Rockwell hardness, 329
 Rotation, 95, 389
 Rotons, 207
 Rubber, 88, 181, 217
 Rupture, 322, 352
 modulus of, 343
 St. Venant's principle, 120, 143, 150
 Sand-hills, 213, 315
 Schrödinger's equation, 49
 Screw dislocation, 73, 146, 267
 Secondary creep, 296
 Sedimentation, 20
 Seizure, 334
 Self-diffusion, 24, 27, 70, 201
 Self-stress, 103, 143
 Sessile dislocation, 276
 Shafts, torsion, 123
 Shakedown, 305, 311
 Shear crack, 151
 Shear failure, 322
 Shear modulus, 4, 111

- Shear strain, 95
Shear strength, 271, 314
Shear stress, 26, 124
Shocks, 117, 163, 168, 189, 411, 413
Shot-peening, 167
Silicides, 56
Sintering, 204, 256
Size, effect of,
 on fracture, 359, 364
 on nucleation, 252
Skin friction, 404
Sliding bearings, 225, 334
Sliding friction, 333
Slip,
 in crystals, 265
 in grain boundaries, 259
Slip coefficient, 29
Slip lines, plastic, 315, 320
Slurries, 213
Soaps, 249
Sodium chloride, structure of, 66
Softening, 259, 286, 297
Soils, plasticity of, 312, 315
Solid solutions, 57, 68, 78, 292
Sols, 211, 250
Solutions, 57, 68
Sound waves, 158, 387
Sources and sinks,
 of fluids, 396
 of vacancies, 75, 204, 256
Space lattice, 61
Specific heat, 4, 20, 184, 205
Spontaneous plasticity, 338
Spring, elastic, 130
Stacking faults, 71
Stagnation point in fluid, 381, 399
Standing waves, 171, 175
Statically determinate and indeterminate
 problems, 120, 303
Statistical mechanics, 15
Steady-state flow, 296, 379
Stokes' law, 226
Stokes-Einstein formula, 227
Stokes-Navier fluid equations, 385
Strain concentration, 324
Strain energy, 116
Strain tensor, 95
Strain-ageing, 282, 367
Strain-hardening, 284, 289
Stream function, 398
Streamlines, 379
Strength,
 grain boundary, 260
 ideal, 234, 271
Stress concentration, 145, 153, 235, 343
 371
Stress corrosion, 261, 351
Stress function, 136, 245
Stress relaxation, 197, 295, 336
Stress tensor, 105
Stress waves, 158
Stretcher strains, 282
Strong fibres, 89, 235, 295, 347
Struts, buckling of, 132, 337
Sublimation, 36
Substitutional solutions, 68
Super-aerodynamic behaviour, 419
Superfluidity, 206
Superposition principle, 86, 119, 395
Supersaturation, 41, 251
Supersonic waves, 168, 411
Surface energy, 231, 253, 344, 363
Surface forces, 105
Surface tension, 234
Surface waves, 407
Surface-active agents, 246, 347
Symmetry, lattice, 62
Temper brittleness, 368
Temperature, absolute, 10, 12
Tempering, 293
Tensile crack, 151, 343
Tensile necking, 170, 287, 322
Tensile strain, 87, 93
Tensile strength, 234, 260, 287
Tensile stress, 87
Tensile waves, 169
Tension,
 dislocation, 280
 surface, 231
Tensors, 95, 102, 105
Tertiary creep, 296
Textures, 278
Thermal anisotropy, 338
Thermal conductivity, 4, 24, 189
Thermal diffusion, 179
Thermal expansion, 102, 187
Thermal fatigue, 103
Thermal insulators, 191
Thermal noise, 20

Thermal shock, 189
 Thermodynamical probability, 38
 Thermodynamical stability, 83
 Thermoelasticity, 178
 Thermoplastic polymers, 217
 Thermosetting polymers, 216
 Thick-walled tubes, 141, 312
 Thixotropy, 199, 211
 Thomson's vortex theorem, 392
 Three-point loading, 128
 Tidal waves, 410, 411
 Tin pest, 84
 Torricelli's formula, 383
 Torsion, 123, 161, 244
 Toughness, 346, 348, 363
 Transformations in crystals, 83, 285
 Transient creep, 296
 Transition temperature,
 ductile-brittle, 356
 glass, 208
 Transitional metals, 56
 Transpiration, 11
 Transport properties, 24
 Transverse waves, 160
 Tresca yield criterion, 314
 Triple point, 45
 True strain and stress, 288
 Turbulence, 394, 402, 405
 Turbulent mixing, 407
 Twins, 71, 265

Ultimate tensile stress, 169, 287
 Ultrasonics, 167
 Umklapp processes, 190
 Unit crystal cell, 61
 Unstable streamlines, 394

Vacancy, 68
 Vacancy creep, 203, 256, 352, 355
 Vacancy diffusion, 201
 van der Waals' equation, 39
 van der Waals forces, 51, 248

The Mechanical Properties of Matter

Vapour, 33, 34, 36
 Velocity of waves, 159, 162, 387
 Venturi meter, 382
 Vibrations, elastic, 171, 175
 Vickers hardness, 329
 Virtual work, 84
 Viscosity, 4, 24, 26, 196, 402
 Viscous adhesives, 225
 Viscous damping, 172
 von Mises' yield criterion, 313, 371
 Vortices, 207, 388, 390

Wakes, 390, 406
 Wallner lines, 349
 Warping, 244
 Wave equation, 157
 Wave packet, 158
 Wave surface, 407
 Wave velocity, 159, 162, 387
 Wear, 330
 Welding, friction, 330, 333
 Wetting, 238
 Whirlpools, 390
 Whisker crystals, 89, 236, 256, 271, 347
 Wire drawing, 291
 Work of fracture, 363
 Work-hardening, 284, 289
 Wulff's surface energy diagram, 254

X-ray diffraction, 3, 43

Yield,
 plastic, 169, 213, 281
 of polymers, 218
 Yield criterion, 313
 Yield strength, 87, 274
 Young's modulus, 4, 113, 126, 179, 218

Zachariasen's glass rules, 208
 Zero-point motion, 185, 206
 Zone refining, 79