



Acme threads, 476, 593
Actual size, 56
Allowance, 56
Alloy Steels, 32
Applications, 34
Designation, 32
Guide lines for selection, 35
Properties, 33
Aluminum, 38
Alloys, 38
Applications, 38
Designation, 38
Annealing, 104
Arc welding, 98, 437

Arrow line, 441 ASME elliptical curve, 316 Assembly methods, 107 Axial loads, 454, 646

Axles, 645

Arch, 863

Babbitt, 42
Basic size, 56
Beam supports, 169
Bearing materials, 42
Bearing pressures, 599, 602
Bearing stresses, 16

Bell crank lever, 778 Belleville spring, 846 Bending moment, 161

Bending moment diagram, 171

Bending stresses, 160 Bergsträsser factor, 808 BIS Designation of steels, 24 Blank length of weld, 443 Boiler joints, 412

Circumferential, 417 Longitudinal, 412

Bolt, 472

Load sharing by bolt and components, 510

Manufacturing, 481 Materials, 480 Maximum load, 512 Uniform strength, 500 versus screws, 485

Bolts and nuts, 479

Brass, 22, 40

British Standard Whitworth threads, 475

Bronze, 22, 40 Bulk modulus, 139 Butt joint Riveted, 394

Welded, 438 Buttress threads, 476

Dutiless tiffettes, 170



C- Clamp, 183 Cross lever, 782 Camber, 863 Cumulative design, 302 Cantilever, 169 Curved beams, 179 Cap bolt, 488 Cylinder cover joint design, 501 Cap screws, 485 Carbon Steels, 24 Deflection of beams, 173 Design for assembly, 106 Carburizing, 104 Casting, 86 Guidelines, 109 Factors controlling tolerances, 90 Design considerations, 3 for assembly, 106 Cast iron, 28 for machining, 101 Applications, 31 Effects of impurities on properties, 32 for sand castings, 86 Types, 30 for welded parts, 99 Design for rigidity, 200 Castle nut, 483 Clearance fit, 72 Designing for strength, 753 Closed coil end, 799, 804 Deviation, 56 Closed thin sections, 205 Diamond riveting, 409 Coefficient of friction, 496, 594, 596, 598 Die casting, 91 Combined stresses, 214 Differential screw, 628 Drawing process, 94 Axial load with torsion and bending, 224 Bending with axial load, 214 Eccentric load, 178, 540 Bending with torsion, 221 in plane of rivets, 541 Compound lever, 785 parallel and offset to plane of welds, 576 Compound screw, 629 parallel to circular base, 561 Compression spring, 803 Compressive stresses, 127 parallel to plane of bolts, 557 plane of welds, 570 Direct axial, 600, 635 with rectangular base, 557 in long columns, 129 Edge joint, 98 Copper alloys, 40 Edge preparation, 439 Cost of DFA, 108 Elastomers, 44 Cotter, 353 Electric discharge machine, 103 Cotter joint, 352 Electro chemical machining, 103 Couplings Electroplating, 103 Detachable, 472, 721 Flexible, 739 Endurance Limit, 280 Endurance strength, 287 Half lap muff, 730 Approximate, 297 Marine, 721 by rotary test machine, 288 Muff, 724 for reversed stresses, 289 Protected flange, 736 for given number of cycles, 292 Rigid flange, 730 Modifying factors, 294 Split muff, 727 Energy, 6, 8 Cranking lever, 771 Crest, 473, 475 Etching, 103 Euler's formula, 129 Critical speeds for shafts, 682



Index 901

Extension helical springs, 838 Gerber parabola, 315 External locking devices, 484 Gib and cotter joint design, 369, 370 Extrusion process, 94 Goodman Line, 314 Guest's theory, 221 Factor of ignorance,121 Hand press, 617 Factor of safety,121 Hard gasket, 515 Failures of a riveted joint, 397 Hardening, 104 Plate failure, 398 Helical springs, 797 Rivet failure, 397 Design procedure, 810 Fatigue, 118, 288 Free length, 799 Design under combined loads, 338 Helical torsion springs, 838 High cycle, 289 Hertz stresses 146, 147 Low cycle, 289 High speed steels, 36 Fatigue strength, 288, 290, 312 Hollow shaft design, 201 Number of cycle, 290 Hoop stress, 148 Strength testing, 288 Feather key, 686, 688 Infinite life, 289 Ferrous metals, 23 Initial stresses, 489 Fillet welds, 449 Interchangability, 74 Fits, 70, 72 Interference fit, 72 Fixed ends, 169, 665 International Tolerance grade, 57, 58, 60 Fixtures, 102 Flank, 473 Jigs, 102 Flexible couplings, 739 Joint efficiency, 400 Rivetd joints, 404 Flexural strength, 161 Welded joints, 435 Fluctuating loads, 312 Axial, 316 Joint proportions, 402, 752 Axial and bending, 328 Keys, 684 Bending, 321 Allowable stresses, 685 Torsional and axial, 333 Materials, 685 Torsional and bending, 335 Types of keys, 686 Foot lever, 768 Keyways, 686 Forging in dies, 93 Kinetic energy, 8 Forging, 92 Cold, 93 Knuckle joint design, 378 Design aspects, 94 Lateral rigidity, 678 Hot, 93 Lead screw, 605 Fundamental deviation, 57 Leaf spring, 862 Fundamental tolerances, 60 Analysis, 865 Design procedure, 871 Gaskets in threaded joints,514 Graduated leaves, 866 Confined, 514 Materials, 863 Soft, 515 Hard, 515 Master leaf, 862 Leaf spring types, 864 Gas welding, 437



902 Index

Length of leaves, 870 Neutral and central axis, 180 Length of weld, 443 Nickel alloys, 41 Letter symbol of tolerance, 60 Nipping, 869 for holes, 60 Normalizing, 104 for shafts, 61 Notch factor, 280 Lever design, 765, 781 Notch sensitivity, 278 Limits, 56 Nut design, 494, 611 Line shafts, 645, 677 Number of turns of helical springs, 799, 808, Load factor, 294, 298 Load types, 118 Impact, 118 O ring, 514 Fluctuating, 312 Oldham coupling design, 746 Reversed, 287 One dimensional stress, 229, 239 Static, 121 Open coil helical spring, 799 Variable, 286 Open thin sections, 208 Lock nut, 481 Locking devices, 481 Parallel fillet weld (Axial loading), 454 Locking with pin, 482 Parallel sunk keys, 688 Long shafts, 664 Parameters causing stress concentration, 256 Pascal, 6 Machine frame, 185 Pin joints, 378 Machine shafts, 645 Pitch, 395, 402 Major diameter, 473, 478, 593 Pitch diameter, 473 Maximum distortion energy theory, 237 Pitch of thread, 473 Maximum efficiency Plug welds, 444 of square threads, 597 Poisson's ratio, 122 Maximum shear stresses in parallel fillet Welds, Potential energy, 8 Power screws, 591 Maximum shear stresses in transverse fillet Acme thread, 597 Welds, 452 Square thread, 593, 595 Maximum strain energy theory, 236 Power transmission using Mechanical properties of aluminum alloys, 33 gears, 657 Methods of reducing stress concentration, pulleys and belt, 654 2.77 Preferred numbers, 12 Metric threads, 475 Pressure welding, 437 Miner's equation, 302 Seam, 444 Minor diameter, 473 Spot, 444 Modified Goodman line, 314 Principal stresses, 216 Modified Goodman line for torsional shear Proof resilience, 139 stresses, 324 Proof stress, 480 Mohr's Circle Property class of the bolts, 480 One dimensional, 228 Protected flange coupling, 736 Three dimensional, 230 Two dimensional, 226 Rankine theory, 650 Moment of area, 167, 704 Rankine's formula, 130 Rapid prototyping, 104 Natural frequency of helical springs, 822



Index 903

Reference line, 441	Screws, 485
Reliability factor, 295	Design of screw, 608
Repeated loads, 287	Hex cap screws, 485
Resilience, 139	Seam welds, 444
Reversed loads, 287	Selecting a material, 45
Right hand threads, 473	Selecting a steel, 28
Rigid couplings, 720, 721	Selection of fits, 72
Protected flange coupling, 736	Selection of processes, 83
Rigid flange couplings, 721	Selection of spring index, 810
Ring and groove nut, 484	Set screws, 701
Rivet heads, 393	Shafts, 644
Rivet materials, 393	Materials, 645
Rivets, 391	in parallel, 680
Riveted joints, 392	in series, 679
Butt, 394	Shaft design for
Design, 401	Bending strength, 649
Lap, 394	Bending and torsion, 650
Diamond, 409	Rigidity, 677
Riveted joint failure	Torsion only, 677
of plates, 403	Varying loads, 673
of rivets, 403	Shaft manufacturing, 645
Rocker arm, 783	Shape of helical spring ends, 800, 804
Rolling process, 94	Shapes of leaf springs, 864
Root diameter, 473	Shaping processes, 86
	Shear force diagram, 70
Safe and unsafe zones, 313	Shear modulus of resilience, 139
Safety valve, 814	Shear modulus of rigidity, 138
Lever, 775	Shear strain, 138
Spring, 814	Shear stress at the root of the threads, 609
Sand casting, 86	Shear stress in beams, 169
Sawn nut, 483	Shear stress, 134
Screw and nut materials, 599	Simply supported beams, 160
Screw jack design, 608	Single head screw key, 686, 689
Construction and working, 606	Single start thread, 474
Thrust collar design, 602	Size factor, 294
Torque for lowering load, 595	Sleeve and cotter joint design, 353, 354
Torque for raising load with square threads,	slenderness ratio, 129
593	Slip coupling, 721
Torque for raising load with Acme threads,	Slotted nut, 483
597	Steels
Screw of a vice, 621	Applications, 26
Screw of broaching machine, 625	S-N Curve, 288
Screw of pipe vice, 623	Socket and spigot joint, 359, 360



904 Index

Soderberg line, 314	Stress - Strain curve, 120
Specifications of threads, 478	Stress concentration, 255
Specifying a fit, 71	Actual, 278
Specifying a welded joint, 441	Areas, 255
Spindle, 645	Factor, 256
Spiral spring, 844	Due to Keyway, 276
Splines, 701	Stress concentration in
Spot welds, 444	Bending, 268
Spring design with	Cylinder with a fillet, 266
impact load, 820	Cylinder with a notch, 272
varying Loads, 832	Gears, 277
Springs helical, 797	Screw threads, 277
Buckling, 809	Shaft, 644
Deflection, 808	Torsion, 274
Energy stored, 871	Welds, 98
Free lengtrh, 799	Stress concentration with
Index selection, 810	Circular hole, 258
Materials, 800	Elliptical hole, 257
Multiple, 824	Two circular holes, 260
Number of turns, 805	Stress concentration with axial loads or
Solid length, 799	Cylinders, 266
Spring steels, 37	Flats with a fillet, 263
Springs of non-circular cross-section, 816	Flats with circular hole, 258
Square threads, 475	Flats with notch, 265
St. Venant's theory, 650	Stresses
Stages in design, 2	in screws, 277
Stainless steels, 35	in power screws, 600
Standard mechanical component designations,	due to impact, 143
11	in springs, 805
Standard rod / Shaft sizes, 646	in threaded joints, 489
Standard size, 55	Stud and nut, 489
Standardization, 8	Surface finish factor, 295
Advantages, 9	Surface finish symbols, 440
Objectives, 9	Surface finishing processes, 105
Start of thread, 474, 478, 479	Surge in springs, 824
Steels for high temperatures, 36	Systems of fits, 70
Stepped shafts, 679	Hole basis, 70
Stiffness of	Shaft basis, 70
Bolt, 506	
Components, 508	Tee joint, 438
Threaded joints, 505	Temperature factor, 296
Strain energy, 8	Tempering, 104
Strength and stiffness, 119	Tensile load, 119
Strength of a butt weld, 445	Tensile strain – Linear / Lateral, 119



Index 905

Tensile stress, 119	Turnbuckle design, 495
Tension spring, 804	Two dimensional stresses, 338
Theories of failure, 233	Varying loads, 341
Maximum principal strain, 233	Types of threaded joints, 488
Maximum principal stress, 244	Cap bolt, 488
Maximum shear stress, 234	Stud and nut, 488
Thermal stresses, 140	Through bolt and nut, 488
Thermit welding, 437	
Thermoplastics, 43	Units, 5
Thermosetting plastics, 43	Universal coupling, 750
Thick-walled vessels, 149	Construction, 751
Thin wall, 148	Unsymmetrical axial welds, 459
Threads	V - 11 1 1 20/
Hand of helix, 473	Variable loading, 286
Helix angle, 473	Design procedure for springs, 832
Thread designation, 477	Torsional, 325
Threaded joint	Von-Mises stresses in transverse fillet welds
Advantages/Disadvantages, 472	453
Thread profiles, 475	Wahl correction factor, 807
B.S.W., 475	Weld in bending, 461
Buttress, 476	Weld size, 442
Knucle, 476	Welded joints, 435
Square, 475	All around, 581
Vee, 475	In torsion, 461
Threads per inch, 474	Parallel and transverse fillet, 457
Three dimensional stresses, 230	Parallel fillet, 454
Throat size, 449	Transverse fillet, 450
Toggle jack design, 630	Versus castings, 436
Tin, 41	Versus riveted joint, 435
Tolerances, 56	Weld Symbols, 439
Manufacturing processes, 59	Contour symbols, 440
Torsion bar, 798	Additional symbols, 440
Torsion in thin sections, 205	Groove symbols, 439
Torsion spring, 805	Welding symbol, 439
Torsion with axial load, 219	White metal, 42
Torsional rigidity, 677	Woodruff key, 698
Torsional shear due to friction, 601	Wrought iron, 24
Torsional shear stresses, 198	
Transition fit,72	Young's modulus of elasticity, 123
Transverse fillet weld, 450	•
Triple start thead, 474	Zinc alloys, 41