Fitting and Machining Book By Ron Culley (L341)

The contents include the following:

* Useful facts and figures:
  o Mathematical signs and common abbreviations
  o Conversion factors for common English units
  o Conversion table, mm-inch
  o Areas and related formulae of plane figures
  o Volumes
  o Geometrical propositions
  o Right-angled triangles
  o Trigonometry tables
  o Useful tapers and angles
  o Machine tapers
    o Mechanics - The Principle of Work; Levers; Pulleys and Wheels; Screws; Wedges; Pascal’s Law

1. Workshop hints
   * General hints
   * Metal fret
   * Hardening and tempering a small object
   * Press fit assembly
   * Turning a sleeve bearing
   * Chatter
   * Setting to marked centre in the lathe

2. Safety in the workplace
   * Accidents; Causes; Prevention
   * Personal safety; Eyes; Ears; Manual Lifting
   * First aid
   * Orderly workshop habits; Personal Cleanliness; Horseplay; Industrial Houskeeping
   * Workshop safety
   * Equipment safety; Hand Tools; Machinery; Electrical Equipment; Ladders; Compressed Air; Cranes
   * Firefighting; Types of fire

3. Engineering drawing-How to read and use
   * Types of drawing; General Arrangement Drawings; Assembly Drawings; Detail Drawings; Drawing Re-issues
   * Types of Line-Their Application and meaning
   * Projection; Orthopraphic; Isometric
   * Sections
   * Scales
   * Conventional representations, symbols and abbreviations; Representations; Symbols and Abbreviations
   * Dimensions; Units used and Placement for Dimensions; Dimensions for Screw Threads; Auxiliary Dimensions;
     Chamfers; Dimensions Not to Scale and Breaklines; Tabular Dimensions; Use of Other Markings
   * Tolerances; General Dimensions; Screw Threads; Geometric Tolerance Symbols

4. Limits-Fits and tolerances
   * Types of fit; Clearance Fits; Interference Fits; Transition Fits; Summary
   * Basis for Fits; Individual Measuring; When the Hole is Produced by a Fixed Tool; When Standard Sized
     Shafting is Used; Summary
   * Tolerances; Variations in Size; Interchangeability of Parts
   * Definitions; Standard System of Limits and Fits; Tolerances; Designations of Holes, Shafts and Fits
   * Selective Assembly
   * Machining Tolerances; Working to Drawings; Working from Tables; Working to Tolerances
   * Accuracy of Process, Surface Finish and Tolerance; Surface Finish; Relationship between Surface Finish and
     Tolerance; Surface Finish, Tolerance and the Machine Process; Special Cases Needing Very Good Surface
     Finish
   * Standards of linear measurement; Direct Standards; Derived Standards
   * Geometric tolerances; Selected Use; Specifications on Drawings; Applications of Geometric Tolerances

5. Materials-Metals
   * Uses of common metals; Iron; Copper; Lead; Zinc; Aluminium; Nickel and Chromium; Tin
   * Ferrous metals; Cast iron; Steel; Alloy steels
   * Non-ferrous metals; Copper and Copper Alloys; Nickel and Chromium Alloys; Nickel-chromium Alloys;
     Aluminium and Aluminium Alloys; Magnesium and Magnesium Alloys; Titanium and Titanium Alloys; Zinc and
     Zinc Alloys
   * Bearing materials; Friction and Wear; Properties of Bearing Materials; Selection of Bearing Material; Some
Common Bearing Materials

   * Synthetic rubbers
   * Applications of some common plastics
   * Properties and uses of thermoplastics
   * Properties and uses of thermosetting materials

7. Heat treatment
   * Metals; Structural Changes in Iron on Heating and Cooling; Ferrous Metals in use today
   * Tool steels; Schedule of Tool Steel Composition
   * Heat treatment of steels; Features Determining Successful Heat Treatment
   * Heat treatment of tool steels; Heating of Austenitize; Quenching, to Harden; Tempering
   * Constructional steels; Group 1 steels; Group 2 Steels
   * The Heat treatment of Non-ferrous metals; The Hardening of Non-ferrous Alloys by Heat Treatment
   * Useful books for reference
   * Glossary of terms

8. Cutting fluids
   * Functions; Cooling; Lubricating; Chip Removing; Preventing Corrosion; Additional Properties
   * Types; Alkaline Solutions; ‘Soluble’ Mineral Cutting Oils; Oilless Cutting Fluids; ‘Straight’ Cutting Oils
   * Using cutting fluids; Flow and Temperature; Choosing a Cutting Fluid; Method of Supply; Application;
     Filtering, Sterilizing and Reclaiming; Care of Electrical Equipment

9. Lubricants
   * Types; Lubricating Oils; Greases
   * Applying lubricants; Methods; Frequency of Application

10. Cutting speed and feed rate
    * Cutting speed; Cutting Speed and Tool Life; Factors Affecting Cutting Speed; Cutting Speed and r.p.m.
    * Feed rate; Factors Affecting Feed Rate; Feed Rate Recommendations

11. Cutting tools
    * General principles; Orthogonal Cutting; Inclined Cutting
    * Cutting tool angles: Normal rake; Inclination; Direction of Cutting; Approach Angle and Side Cutting-edge
      Angle; End Relief Angle; Nose Radius; Clearance Angles
    * Guide to the selection of lathe tools
    * Cemented carbide tools; manufacture; Classification; Selection of Insert; Tool Design and Type of Clamping;
      Operating Conditions and Tool Life; Tool Failures and Remedies
    * Tools made from other materials; Cemented Oxide Tools; Diamond Tools; Comparing Tool Materials

12. Benches and bench vices
    * Benches; Types; Construction; Position of the Bench; Tidiness
    * Engineers’ vices; Types; Location of the Bench Vice; Special jaws; Care and Use of the Vice

13. Fasteners

14. Screw threads
    * Uses
    * Screw thread terms
    * Common V-thread forms; ISO metric; Whitworth; British Association; Unified; V-thread calculations; Screw
      Thread Table
    * Square-thread forms; Acme-thread forms; Trapezoidal-thread forms; Buttress-thread forms; Worm-thread
      forms

15. Hand tools
    * Files; Parts of a File; Classification; Using a File; Testing Filed Surfaces; Filing a Square Hole; Filing a Square
      on a Shaft; Care of Files; Files for Use Under Special Conditions
    * Chisels and chipping; Common Types; Cutting Angles; Using a Chisel
    * Spanners; Types
    * Wrenches; Pipe wrenches
    * Pliers; General purpose; Cutting; Circlip
    * Tinsnips; Hacksaws; Keys; Screwdrivers; Hammers; Punches; Wheel or bearing pullers; Pop riveting tools;

16. Drills and reamers
    * Drills; Types; Accessories; Nomenclature; Operation
    * Reamers; Types; Nomenclature; Tolerances; Operation Of Reamers Sharpening; Storage

17. Threading tools
    * Taps and dies; Tap range; Sets of Taps; Nomenclature; Sharpening; Using a tap
    * Screw extractors; Tap wrenches
    * Dies; Adjustable Button Dies; Die Nuts; Using a Die

18. Work-holding methods
    * Holding workpieces on machines
    * Clamping principles; Clamping Devices; Application of Force; Height of Packing; Position of Clamps;
19. Marking and measuring tools
* Scribers; Using a Scriber
* Dividers; Hermaphrodite calipers; Trammels
* Surface gauges; Types; Setting; Using; Uses
* Punches; Parallel strips; V-blocks; Angle plates; Screw jacks; Steel rules
* Micrometers; Outside Micrometer Calipers; Inside Micrometer Calipers; Micrometer Depth Gauge; Screw-thread Micrometers; Care of a Micrometer
* Verniers; Principle of a Vernier; Vernier Calipers; Vernier Height Gauges
* Calipers; Taking a Measurement
* Straight edges
* Try squares; Testing a Try Square; Using a Try Square; Care of the Try Square
* Combination set; Toolmakers square
* Protractors; Vernier Protractors
* Box square and keyseat clamps
* Bevel gauges; Using a Bevel Gauge
* Depth gauges; Telescoping gauges; Small hole gauges; Screw pitch gauges; Centre gauges; Feeler gauges; Radius gauges; Toolmakers buttons; Centre finder and wiggler
* Indicators; Lever Indicators; Dial Indicators; Care of Indicators

20. Introduction to precision measurement
* Systems of measurement
* Errors in workshop measurement; Common Sources of Error
* Comparative measurement; Use of a Dial Gauge; Use of a Floating Carriage Micrometer
* The use of gauge blocks; Composition of Gauge Sets; How to Use Gauge Blocks; Accuracy; Accessories; Using an Optical Flat to Test Flatness of Gauge Blocks
* Use of length bars
* Use of balls, rollers and discs in precision measurement; Checking External Tapers; Checking Internal Tapers; Checking Small Internal Tapers; Checking Dovetail Slides; Checking Taper Angles
* Use of sine bars in precision movement; Construction; Principle and Application; Accuracy of Sine Bars; Sine Centres
* Use of spirit levels in precision measurement; Construction and Use; Reading a Level
* Use of clinometers in precision movement; Mechanical Clinometers; Optical Clinometers
* The digital readout system

21. Operational planning
* Planning machining operations; Importance of Planning; Information Needed; Planning Procedure

22. Principles of marking out work
* Purpose of marking out
* Types of line; Datum Lines; Centre Lines; Outlines
* Tools and equipment
* Marking-out procedure; Inspection Before Marking Out; Preparing the Work
* Permanent establishment of lines

23. Cut-off machines
* Power hacksaws; Reciprocating Hacksaw; Automatic Bar-Feed Reciprocating Hacksaw
* Horizontal band saw
* The abrasive cut-off saw
* The friction saw
* The cold circular saw; The Blade

24. The vertical handsaw
* Description; Machine Capacity
* Operating the band saw; Drive System; Job Selector; The Table; Installing the Blade
* Attachments
* Welding blades; Welding Operating; Annealing Operation
* Selection of blades; Pitch of Teeth; Blade Size

25. Drilling machines
* Types of drilling machine; Bench Drill; Pillar Drill; Radial Drill; Multi-spindle Drill
* Setting up and holding work; Using a Machine Vice; Clamped to the Machine Table; Clamped to an Angle Plate; Clamped on V-blocks
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26. Centre lathes
* Units of a centre lathe; The Bed; The Headstock; The Tailstock; The Saddle or Carriage; Feeding Mechanism
* Facing and boring lathes

27. Capstan and turret lathes
* General features and uses; Capstan Lathe; Turret Lathe
* Parts of a capstan or turret lathe; The Mid-saddle; The Headstock; Stop Systems; Bar Feed Mechanism
* Work-holding methods; Bar Feed Work; Chuck Work
* Cutting methods; Single Cutting Operations; Multiple Cutting Operations; Combined Cutting Operations
* Cutting tools; Turret Tools; Mid-saddle Tools
* Setting an operations sequence

28. Lathe operations-Turning
* Mounting and removing chuck, faceplate, driving plate and centre; Fitting the Chuck, Faceplate and Driving Plate; Remove the Chuck, Faceplate and Driving Plate
* Chuck work; Four-jaw Independent Chuck; Three-jaw Self-centering Chuck
* Faceplate work; Methods of Holding Work
* Turning between centres; General Description; Types of Lathe Centre; Centre Drilling; Aligning Lathe Centres; Setting the Workpiece Between Centres
* Setting the cutting tool; Overhang and Rigidly; Height of Cutting tool; Setting the Approach Angle
* Turning a stepped spindle; Turning the Diameters; Turning the Lengths
* Taper turning; Using a Form Tool; Using the Top-Slide; Using a Taper Turning Attachment; Taper Turning by Off-setting the Tailstock
* Form turning; Free-hand Form Turning; Form Turning with Tools
* Drilling in the lathe
* Threading with taps and dies; Using Taps with a Centre Hole; Tapping Using Small Taps; Threading with a Button Hole Die; Threading with Hand Dies
* Boring operations; Uses; Types of Tool; Shape of the Tool; Boring a Parallel Hole; Boring a Tapered Hole
* Reaming in the lathe; Work Preparation; Using a Machine Reamer; Using a Hand Reamer
* Knurling; Knurling Tools; Method of Use
* Parting off; Holding the Workpiece; Parting-off Tools; Procedure
* Work requiring steady rests; Fixed Steady Rest; Travelling Steady Rest; Problems with Unstable Work
* Work requiring use of mandrels; Mandrel use; Types
* Copy turning; Methods; The Hydraulic Attachment; Elements of Copy Turning; Masters; The Cutting Tool; Holding and Driving the Work; Setting Up; General Comments

29. Lathe operations-Setting up and cutting threads
* Preparing the blank
* Preparing the lathe; Setting Up the Machine; Metric Pitches from Inch-based Lead Screws; Gear Settings for Non-metric Threads
* Grinding the screw-cutting tools; Tool Shape and Angles; Grinding the tool
* Setting the tool; Requirements; Procedure
* Registering the screwing tool; Tool Register
* Cutting external threads; Setting the Speed; Thread-cutting Methods; Cutting the Thread; Finishing Thread Ends
* Cutting internal threads; The Blank; Setting the Machine; Tool Sharpening and Setting; Cutting the Thread
* Multiple-start threads; Some Characteristics; Applications; Change Gear Calculations; Sharpening Tools; Setting Up the Tool; Indexing the Starts
* Worm gears

30. Vertical boring machines
* General features; Size; Additional Features; Types
* Parts of a vertical boring machine; The Bed; The Work Table or Chuck; The Cross-rail; The Toolhead; The Tool Blocks
* Use of vertical boring machines; Advantages; Machining Techniques; Types of Cutting Tool

31. The Shaping machine
* Construction and operation; Classification; Column-type Crank
* Methods of holding work; In the Vice; On the Table; In V-blocks; On Angle Plates
* Operating the machine; Setting the Stroke Length; Positioning the Stroke; Setting the Speed; Setting the Cut; Setting the Feed; Shaping the work
* Basic Shaping Operations; Square and Parallel Surfaces; Squaring the Ends; Shaping a Vertical Surface; Horizontal and Vertical Shaping; Shaping Angular Surfaces; Shaping a V-block; Shaping a Dovetail Slide

32. The slotting machine
* Construction and operation; Classification ; General Purpose Slotting Machine
* Basic slotting operations; Holding the Workpiece; Slotting a Parallel Keyway; Slotting a Tapered Keyway; Cutting an Internal Slot; Slotting a Large Internal Cavity; Straight and Circular Slotting

33. The planing machine
* Construction and operation; Classification; Double Housing Planing Machine
* Holding and setting work; Checking the Machine; Holding the Work
* Basic planing operations; Planing Horizontal Surfaces; Planing Vertical Surfaces; Planing Horizontal and Vertical Surfaces; Planing an Angular Surface

34. Milling machines
* The knee-type mill; Plain Milling Machine; Universal Machine; Vertical Machine
35. Milling operations 1
- Bed-type mills; Types of arbors and adaptors; Plain Arbor; Shell End Mill and Face Mill Arbor; Adaptors; Direct Mounting of Cutter to Spindle
- Types and uses of cutters; Types of Cutter
- Milling cutter design; Milled Type Teeth; Form-relieved-type teeth; Cemented Carbide Cutters; Inserted Tooth Cutters
- Methods of milling; Normal or Up-Cut; Climb or Down-Cut; Application to End Milling
- Mounting the cutter; Arbor-type Cutters; Shank-type Cutters
- Cutting speeds and feeds; Speeds; Feeds
- Method of holding work; On the Machine Table; In a Vice; In a V-block; In an Indexing Head
- Milling machine attachments; Vertical Attachment; Universal Attachment; Slotting Attachment; Other Attachments
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- Milling the cutter; Arbor-type Cutters; Shank-type Cutters
- Cutting speeds and feeds; Speeds; Feeds
- Method of holding work; On the Machine Table; In a Vice; In a V-block; In an Indexing Head
- Milling machine attachments; Vertical Attachment; Universal Attachment; Slotting Attachment; Other Attachments
- Care and use of cutters and equipment; Cutters; Equipment and Machine

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- Types of machine; Floor Type; Table Type
- Features of construction; The Bed; The Column; The Spindle Head; The Universal All-angle Milling Head; The Facing and Boring Head; The Carriage; The Boring Stay; Positioning
- Basic machining operations; Boring; Facing; Turning; Machining holes
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38. Types and elements of gearing
- Applications of toothed gearing; Application to Parallel Shafts; Application to Crossed Shafts in Parallel Planes; Application to Intersecting Shafts
- Gear tooth profile; Development of Involute Curves
- Gear terminology; For Spur Gears; For Helical Gears; Terminology for Worm Gearing
- Gearing systems; ISO metric 20 degrees Involute; British Standard 20 degrees Involute; American Standard 14 1/2 degrees Full Depth Involute; American Standard 20 degrees Full Depth Involute; American Standard 14 1/2 degrees Composite; American Standard 20 degrees Stub Tooth Involute; Summary of Gear Systems
- Relationship between Metric Module Pitch, Diametral Pitch and Transverse Pitch; Metric Module System; Diametral Pitch System; Transverse Pitch System

39. Cutting of gears by the milling process
- Cutting a spur gear; Preparation of the Blank; Selecting the Cutter; Mounting the Cutter; Setting Cutter to Depth; Application of Simple Indexing; Cutting Spaces to Form Teeth
- Cutting a short spur rack; Holding the Work; Setting the Cutter
- Cutting a long spur rack; Holding the work; Holding the Cutter; Indexing the Flutes
- Cutting a helical gear; Effect of Helix Angle; Calculations; Setting up and Cutting
- Cutting a short helical rack; Holding the Work; Setting the Cutter; Indexing the Teeth; Cutting the Teeth; Cutting a Worm

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- Selecting the grinding wheel; Features to be Considered
- Wheel mounting, balancing and trueing; Inspection; Mounting; Balancing; Trueing and Dressing
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44. Tool and cutter grinding
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* Grinding angular surfaces on cutting tools and gauges; Grinding Angular Surfaces; Compound Angles
* General information about grinding milled tooth cutters; Grinding Wheel Shapes; Milled Tooth Cutters; Form-relieved Cutters; Need for Sharp Cutters; Clearance Angles for Milled Cutters; Holding the Cutter; Methods of Grinding Clearance Angles
* Grinding straight-tooth milling cutters; Requirements; Holding the Cutter; Preparing the Grinding Wheel; Locating the Tooth Rest; Grinding the Teeth
* Grinding helical flute milling cutters; Requirements; Holding the Cutter; Preparing the Grinding Wheel; Locating the Tooth Rest; Grinding the Teeth
* Grinding side or end teeth on cutters; Requirements; Holding the Cutter; Setting the Workhead; Locating the Tooth Rest; Grinding the Teeth
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* Action of a cutting tool; Shear Angle
* Life of a cutting tool; Tool Failure; Factors Affecting Tool Life
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* Press toolmaking; Use of Press Tools; Basic Press-working Operations; Types of Die; The Blanking Die; Action of Blanking and Piercing Dies
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