

CONTENTS

Chapter-Page

1 SHOP SAFETY AND HAZARDOUS WASTE MANAGEMENT

Lifting Hazards	1-1
Accidents During Installation	1-2
Respiratory Hazards in the Shop	1-3
Substance Abuse in the Workplace	1-4
General Safety Guidelines	1-4
Handling Hazardous Materials	1-8
Best Management Practices	1-10
Summary	1-12
Review Questions	1-14

2 FUNDAMENTALS OF MACHINING

Machining Processes	2-1
Tool Materials	2-4
Cutting Tool Glossary	2-6
Single Pointed Tools	2-6
Milling Cutters	2-9
Drills, Reamers and Other Drilling Tools	2-11
Grinding and Honing	2-15
Speeds and Feeds	2-16
Machine Installation and Set-Up	2-18
Correcting Alignments Between Centers	2-20
Tramming Spindles	2-23
Summary	2-24
Review Questions	2-25

3 MEASURING TOOLS

Understanding Specifications and Tolerances	3-1
Calculating Thermal Expansion	3-3
Comparing Units of Measurement	3-4
Using Micrometers	3-5
Making Transfer Measurements	3-8
Using Dial Indicators	3-10
Using Dial Bore Gauges	3-10
Using Calipers	3-12
Checking Alignments	3-12

Measuring Surface Finishes	3-13
Measuring Thicknesses of Castings	3-14
Summary	3-15

Review Questions	3-16
------------------	------

4 FASTENERS

Determining the Strength of Fasteners	4-1
Comparing Clamping Force and Torque	4-3
Identifying Threads	4-3
Using Pipe Threads and Fittings	4-4
Removing Broken Fasteners	4-5
Installing Helicoils	4-6
Removing Broken Tools	4-8
Summary	4-8

Review Questions	4-9
------------------	-----

5 ENGINE THEORY

The Four-Stroke Cycle	5-1
Compression Ignition Engines	5-3
Variable Valve Timing and Valve Action	5-6
Valve Train Configurations	5-7
Valve Lifters and Lash Compensators	5-9
Engine Oiling	5-12
Engine Oils	5-15
Engine Measurements	5-20
Fits and Clearances	5-22
Cooling System Operation	5-23
Combustion Efficiency	5-24
Summary	5-26

Review Questions	5-27
------------------	------

6 ENGINE DIAGNOSIS

Looking for Signs of Engine Wear	6-2
Checking the Block Assembly	6-2
Testing Power Balance	6-3
Testing Compression	6-4
Testing Cylinder Leakage	6-5
Checking Valve Timing	6-5
Testing Manifold Vacuum	6-7
Testing Exhaust Back Pressure	6-9

Testing With a Scan Tool; An Introduction	6-10
Diagnosing Engine Noises	6-12
Testing Engine Oil Pressure	6-14
Testing Cooling systems	6-15
Summary	6-16
Review Questions	6-17

7 ENGINE DISASSEMBLY

Hints for Disassembly in the Chassis	7-1
Disassembling Cylinder Heads	7-2
Numbering Connecting Rods	7-4
Ridge Reaming	7-5
Removing Piston and Rod Assemblies	7-6
Removing the Timing Chain and Sprockets	7-7
Removing the Crankshaft	7-7
Removing Cams, Lifters and Followers	7-8
Removing Camshaft Bearings	7-9
Removing Oil Plugs and Core Plugs	7-10
Summary	7-12
Review Questions	7-13

8 CLEANING ENGINE PARTS

Using Solvent and Cold Solutions	8-2
Cleaning in Hot Tanks	8-2
Degreasing in Ovens	8-3
Using Airless Shot Blasters	8-4
Bead Blasting	8-4
Blasting With Baking Soda	8-5
Blasting With High Pressure Water	8-6
Tumbling Small Parts	8-6
Using Hand and Power Tools	8-7
Removing Rust and Scale	8-8
Working Under Regulations	8-8
Summary	8-10
Review Questions	8-11

9 INSPECTING VALVE TRAIN COMPONENTS

Determining Valve Guide Wear	9-1
Checking Valves	9-2

Checking Natural Gas Valve Trains	9-4
Testing Valve Springs	9-5
Inspecting Camshafts, Lifters, and Followers	9-6
Inspecting Rocker Arms and Pushrods	9-10
Checking Timing Chains and Gears	9-12
Checking Cylinder Head Castings	9-13
Summary	9-15
Review Questions	9-16

10 INSPECTING ENGINE BLOCK COMPONENTS

Measuring Cylinder Wear	10-1
Measuring Piston Clearance	10-3
Checking Pistons	10-3
Checking Piston Pin Clearances	10-5
Checking Cylinder Block Flatness	10-6
Measuring Main Bearing Bores	10-6
Checking the Crankshaft	10-7
Measuring Connecting Rod Bores	10-9
Summary	10-10
Review Questions	10-11

11 CRACK DETECTION AND REPAIR

Using Dry Magnetic Particle Inspection	11-1
Using Wet Magnetic Particle Inspection	11-2
Using Dye Penetrants	11-3
Pressure Testing Castings	11-3
Using Crack Repair Pins	11-4
Stop Drilling	11-11
Welding Head and Block Castings	11-12
Sealing Castings	11-14
Summary	11-15
Review Questions	11-17

12 RECONDITIONING VALVE TRAIN COMPONENTS

Removing and Replacing Valve Guides	12-1
Knurling Valve Guides	12-3
Fitting Oversized Valve Stems	12-6
Replacing Integral Valve Guides	12-6
Refacing Valves and Valve Stems	12-12
Grinding Valve Seats	12-14

Cutting Valve Seats	12-19
Installing Valve Seats	12-21
Fitting Valve Seals	12-24
Replacing Rocker Arm Studs	12-27
Correcting Installed Spring Height	12-28
Correcting Installed Stem Height	12-29
Refacing Rocker Arms	12-31
Straightening Aluminum Heads	12-31
Correcting Overhead Camshaft Centerlines	12-35
Regrinding Camshafts, Lifters, and Followers	12-37
Summary	12-41
Review Questions	12-42

13 RECONDITIONING ENGINE BLOCK COMPONENTS

Honing Cylinders for Overhaul	13-1
Piston Inspection and Knurling	13-2
Reboring and Honing Cylinders	13-4
Sleeving Cylinders	13-10
Line Boring and Honing	13-11
Fitting Piston Pins	13-14
Resizing Connecting Rod Housing Bores	13-16
Assembling and Aligning Pistons and Connecting Rods	13-21
Regrinding and Polishing Crankshafts	13-26
Removing and Replacing Crankshaft Reluctor Rings	13-36
Overhauling Oil Pumps	13-41
Summary	13-44
Review Questions	13-45

14 RESURFACING CYLINDER HEADS AND BLOCKS

Comparing Resurfacing Machines	14-1
General Precautions	14-3
Correcting V-Block Intake Manifold Alignment	14-6
Determining V-Block Ratios	14-9
Resurfacing Overhead Cam Cylinder Heads	14-11
Resurfacing Diesel Cylinder Heads	14-12
Resurfacing Air Cooled Cylinder Heads	14-13
Summary	14-14
Review Questions	14-15

15 ENGINE BALANCING

Weighing Pistons and Connecting Rods	15-3
Balancing Connecting Rods	15-4
Balancing Pistons and pins	15-4
Balancing Crankshafts	15-5
Balancing Flywheels and Clutches	15-10
Balancing Torque Converters	15-10
Balancing with Heavy Metal	15-11
Suggestions for Minimum Balancing	15-12
Summary	15-13
Review Questions	15-14

16 ENGINE ASSEMBLY

Cleaning and Deburring for Assembly	16-1
Assembling Cylinder Heads	16-2
Installing Core Plugs	16-3
Installing Camshaft Bearings and Camshaft	16-4
Installing Oil Plugs	16-7
Sealing Rotating Shafts; the Basics	16-8
Fitting the Rear Main Seal	16-10
Installing the Main Bearings and Crankshaft	16-12
Setting Valve Timing	16-15
Installing Piston Rings	16-18
Installing Piston and Connecting Rod Assemblies	16-20
Assembling Cylinder Heads to Engine Blocks	16-21
Installing Rocker Arms	16-22
Adjusting Valves	16-23
Installing the Oil Pump	16-24
Pre-Oiling the Engine	16-25
Installing Timing Covers	16-26
Hints on Gaskets, Seals, and Sealants	16-27
Using an Assembly Checklist	16-28
Testing in a Run-In Stand	16-31
Assembling Flywheels and Flexplates	16-32
Attaching Bellhousings	16-33
Summary	16-34
Review Questions	16-35

17 PREPARING PERFORMANCE ENGINES

Improving Efficiency	17-2
----------------------	------

Improving Flow Through Ports	17-3
Reducing Restriction at the Valves	17-7
Flow Testing	17-11
Improving Flow through Manifolds	17-14
Extrude Honing	17-16
Dealing with Tumble and Swirl	17-16
Synchronizing Valve Opening and Piston Travel	17-17
Maximizing Cylinder Pressure	17-18
Selecting Camshafts	17-24
Selecting Camshafts for Forced Induction	17-27
Matching Intake Airflow to the Engine	17-29
Matching Exhaust Systems to the Engine	17-31
Running Computer Simulations	17-34
Tuning Performance Engines	17-35
Project; Preparing a Vintage Performance Engine	17-36
Studying Sport Compact Engines	17-47
Summary	17-51
Review Questions	17-52

18 ENGINE INSTALLATION AND BREAK-IN

Removing and Installing the Engine	18-1
Inspecting and Servicing the Cooling System	18-3
Preparing for Emissions Testing	18-5
Making a Final Inspection	18-8
Starting and Breaking-In the Engine	18-8
Following Up on the Installation	18-9
Summary	18-9
Review Questions	18-10

KEY TO REVIEW QUESTIONS

K-1

APPENDIX REFERENCE TABLES

Torque Recommendations, English	A-1
Torque Recommendations, Metric	A-1
Pipe Plug Torque Recommendations	A-2
Torque Conversions	A-3
Decimal Equivalents for Drills	A-4
Tap Drill Sizes, English	A-5
Tap Drill Sizes, Metric	A-6
Helicoil Tap Drill Sizes, English and Metric	A-7
English-Metric Conversions	A-8
Metric-English Conversions	A-9
Conversion Factors	A-10