

STUDY CONTENT AND STUDENT DIRECTIONS
IN
AUTOMOBILE MECHANICS

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By

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Foreword

The field of Industrial Education like all fields of Education is undergoing rapid changes. New ideas in Education, changing social and economic conditions, the rapid increase in new building projects have each contributed their share toward encouraging or demanding changes in equipment, curricula and methods.

The Board of Education in Tulsa has just completed a new high school, and it will be operated for the first time during the school year of 1939-1940. It will be the privilege of the writer to have charge of one of the shops in the new structure. Along with this privilege comes the responsibility of recommending equipment, tools and supplies, and the formulation of a functioning course of study to be used in the auto mechanics shop.

The material presented, herewith, represents the summary of the study which was made in formulating the course of study for the auto mechanics shop program. It is sincerely hoped by the writer that his efforts in preparing the material as represented in this paper, will be of value to others in the field who may have similar problems to solve.

TABLE OF CONTENTS

	Page
I. The Problem	1
Statement of Problem.	1
General Consideration Regarding Course of Study	1
Limitation of Problem	4
General Objectives of the Course. .	10
Specific Objectives of the Course .	11
II. Instructional Methods Considered . . .	13
The Commercial Method	13
The Laboratory Method	14
The Text Book Method	15
Factors Determining Methods To Be Used	16
III. Collection and Organization of Material	17
Sources of Information for Laboratory and Related Subject Material . .	17
Methods of Securing Reference Materials	18
Selection of Jobs to be Performed in Laboratory	19
Selection of Topics for Related Subject Study	19
IV. Form and Use of Instruction Sheets . .	21
Representative Set of Operation Sheets	21
Code or List of Abbreviations . . .	23
Use of Job Assignment Sheet	76
Job Assignment Sheet	77
Methods of Rotating Operations . .	78
Progress Chart	80

TABLE OF CONTENTS
(Continued)

	Page
V. Related Information	79
Value of Related Information. . .	79
Discussion and Reports.	79
Experiments and Demonstrations. .	81
Outline of Related Information. .	83
VI. Summary	89
Appendix "A" Bibliography	91
Appendix "B" List of Student References	92
Appendix "C" List of Tools and Equipment	94
Appendix "D" List of Supplies . .	100
Appendix "E" Repair Record . . .	104

I

The Problem

Statement of Problem

The problem which is undertaken in this study is to set up a concise, workable, practical course of study which will meet the needs of a student enrolled in a unit trade course in auto mechanics.

To do this the writer has set up general and specific objectives, and indicated in detail the sources from which information has been secured for the development of the course.

The basis of selection of functioning material and the methods which will be used in its presentation both in the shop and in the classroom are carefully set forth.

General Consideration Regarding Course of Study

A functioning course of study is a necessity in any laboratory or shop course. In its simplest form a course of study may be a collection of subject matter organized and arranged in logical order for instructional purposes. If made up in more complete form, it may include several other features for the purpose of assisting the teacher in presenting the subject matter in a most effective way.

The construction of a course of study may be considered as the fourth step in the procedure of establishing a course. The others are: (1) determining aims and objectives; (2) surveying or analyzing the field or industry from which subject matter may be chosen; (3) choosing or selecting from the sum total of the possible items of subject matter those which will function toward satisfying the accepted objectives; and (4) having the analysis and training plan validated by local and state advisory committees.

According to the State Plans for Vocational Education the following conditions must also be met in any course of day unit trade course of study:

(1) In such a class there must be offered, as a minimum division of the six-hour day, not less than three consecutive clock hours of shop work each day on a useful productive basis.

(2) In cities over twenty-five thousand population, this type of instruction is to be organized on a unit-trade basis and to be so conducted as, in the language of the law, "to fit for useful employment," those who are preparing for a trade or industrial pursuit.

(3) The instruction in the shops must be open to all over sixteen years of age who can profit by the

instruction offered and who desire, "to fit themselves for employment in trade or industrial pursuit."

(4) In addition to the minimum of fifteen hours for shop work in a thirty-hour week, there must be offered a course in related subjects of not less than seven and one-half hours a week. Where pupils taking training for unrelated trades are being taught, they shall be grouped separately, when numbers justify, for each instruction. When grouped together, the instruction shall be conducted on an individual basis. Such courses in related subjects shall be open to all students taking shop work who are capable of profiting by the instruction, irrespective of their academic standing.

(5) Where an industrial or trade class is conducted as a part of a high school organization, special classes shall be organized and such instruction given in related subject matter as will enable the pupil to make application of the principles to the shop work done.

The course of study will aid the instructor in checking the individual progress of the student. The rate of progress will often depend upon the instructor's ability to manage things so that time and effort will be conserved at all times. Though the quality of work done is more important than the amount, it is desirable to stress the time element, for that is very typical of the adult world of work.

Limitation of Problem

This study covers those divisions of the auto mechanics trade which are common the general repair shop as found acceptable to employers and employees in Tulsa.

Highly skilled operations such as reboring, body repair, front wheel alignment and others belonging to the specialized divisions have been purposely eliminated. Many of the simpler ones that constantly repeat on many jobs, such as draining radiators, draining oil, and cleaning parts have also been eliminated. The operations selected are those most commonly done in the repair of the motor, electrical units, transmission, and rear axle assembly.

The amount of work offered is further limited by such factors as the amount of equipment, floor space and time available for the training program in the Tulsa program.

The operations contained in this course of study were taken from a more complete course, which was developed by a state teachers' committee under the direction of Oklahoma Agricultural and Mechanical College, Trade and Industrial Education Department. The material in the state course was examined and approved by several tradesmen in Tulsa and in other towns offering this work.

Organized labor has recently become very critical of the manner in which educators administer the vocational education program. The following is a criticism

made by organized labor found in the Report of the Advisory Committee on Education (p. 260):

As a method of recruitment for the skilled trades, the all-day trade school at the high school level is well nigh a failure. It operates without definition of responsibility either to industry or to adult labor already engaged in the trades. Within its own vacuum it produces a legion of graduates, unrelated in numbers to any competent standard of employment needs. It turns out graduates with false ideas as to career opportunities in trades for which training has been taken.

Such criticism, no doubt, is quite severe, and whether it is true or false, it is time for educators and organized labor to perfect an organization whereby courses of study can be worked out to meet the approval of all concerned.

Quoting further from the same source, organized labor makes the following recommendations(p. 284):

To bring the system of vocational education more nearly into conformity with good employment practice, the following recommendations are made:

- (1) That all high school time be devoted to general and academic subjects and that strictly vocational training be given after the boy or girl has entered industry, and that this training be closely allied with the vocational needs of that industry.
- (2) That all pre-employment training for a specific trade be gradually eliminated.
- (3) That students receive an adequate instruction in industrial organization, collective bargaining, the standards

as to wages, hours, and labor conditions affecting their industry, as well as general social and economic problems as part of their trade training.

- (4) That no contracting of work, outside employment or productive work within the school be engaged in by any trade school students.

This course is constructed to meet the requirements of the Smith-Hughes Act, but special consideration has been given to the recent report of the Advisory Committee on Vocational Education.

This course can be given so as to conflict in no way with the Committee's recommendation and at the same time develop in the student the special aptitude he may have for auto mechanics. It must be clearly understood that the course is not a substitution for apprenticeship or that its completion will qualify the student to accept a position as a trained mechanic. At least four years of daily shop work is required to develop a first class mechanic. It should be mentioned at this point that the labor organization to which an auto mechanic could belong specifically states that an apprentice of four years, or at least four years' work in the trade, constitutes the requirements for membership as a journeyman.

The fundamental training the boy receives should be an asset to the to the employer, and the correct ground

work given should be a solid basis for the apprenticeship training that follows, creating a great desire to become a fully competent mechanic.

The first recommendation of the Committee may easily be carried out by making all the car units used for instruction a part of the shop equipment.

The operations to be learned and performed on the various units are exactly the same whether the emphasis be vocational or industrial arts. The entire course can be presented from the industrial arts viewpoint and stress basic principles for vocationally interested boys and still meet the approval of labor. School people are generally agreed that the third recommendation is important in any training program.

The conclusions of those attending the National Conference on Trade and Industrial Education held in Minneapolis show very conclusively that a variety of experiences under a competent instructor, in addition to an apprenticeship training is valuable to the learner. It will be seen from the following statements, taken from "Training for the Painting and Decorating Trade," p. 12 that the school and labor should work together:

- (1) Society profits because of better craftsmanship and it is the job of trade and industrial education to develop craftsmanship.

- (2) Apprenticeship is the most practical and efficient means of completing the training program started in the public trade schools.
- (3) Apprenticeship has usually been a failure when operated by a single group. Trade and Industrial Education brings together the three parties necessary to the success of a vocational training program--workers, employers, and the public school authorities.
- (4) The trade and industrial education divisions have the funds, techniques, trained personnel, and facilities necessary to operate a training program.

Quoting from the same source (Chapter 3, page 13)

the procedure for setting up a training program follows:

Before a training program is set up, a list of all the type jobs and technical information necessary to develop a craftsman in a particular trade should be available. The program should be simple and flexible enough so that the craftsman-teacher may quickly and easily determine what he must teach the apprentices during the four hours a week he spends in school. Moreover it should provide for coordination of the practical work in the trade school and the work done in industry, through the cooperation of an advisory committee, representing employers, workers, and the vocational school.

The writer has, as far as possible, attempted to follow this procedure in setting up this course in auto mechanics. After each operation a definite reference is made to the most up-to-date material in the field, making it unnecessary for any student to wait for further instructions.

A few of the many advantages in lesson planning as stated by Dr. F. T. Struck in his book Creative

Teaching, Chapter 3, page 176, follow:

- (1) Lesson plans help to clarify objectives.
- (2) It provides for definite assignments, availability of materials, and checking outcomes.
- (3) Lesson planning provides for suitable transition from previous experiences to contemplated ones.
- (4) The lesson plan serves as an incentive to the teacher to make adequate preparation for instruction.

As recommended by Dr. Struck, and as stated elsewhere in this paper all the literature such as circulars, booklets, charts, diagrams, and other teaching and learning aids and devices are contained in the operation references.

Some consideration is given to the matter of related subject instruction. However, the writer believes this topic to be so important that it merits a complete and separate treatment. Therefore, only a suggestive list of related topics and a short discussion of values and methods of presentation are included. The instructor need not slavishly follow a course of study, but he should be guided by it to a very great extent.

Teachers generally have found it difficult to teach facts in a class room and make proper application of that information in the shop or laboratory. There must be a close correlation between the knowledge gained and the

application of that information if favorable results are to be obtained. The gap between the class room instruction and the shop or laboratory is often so wide that the average and below average student fails to make a practical connection. Though much of this is a problem of methods, it must also be given consideration in the selection of content for the course of study.

General Objectives of the Course

The shop in which the material worked out in this study will be used is operated under the day unit trade plan. General objectives which must be given consideration are those which are usually accepted as fundamental for this type of work. Over a period of years advisory committees have been at work setting up general objectives which have proven acceptable to vocational educators and tradesmen. The following objectives set forth some of the principles of vocational education:

1. To train for immediate employment in industry as an advanced apprentice.
2. To develop the ability to apply theoretical knowledge to practical, concrete situations, and to material things.
3. To widen the pupil's experience in auto mechanics and thereby reveal to him his inclination and abilities or lack of them.
4. To reveal to the student, in such measures as are possible, opportunities in auto mechanics and also the advantages and disadvantages in this work.

5. To further develop mechanical aptitude, thereby enabling one to better meet the situations of modern life which are so largely mechanical in their nature.
6. To teach the boy how to contribute his share to the physical upkeep of the family car.
7. To develop ability in the consumer to judge and appreciate qualities and values.
8. To develop an appreciation of organized labor position in society.
9. To develop a spirit of cooperation between the employers, the workers and the schools in operating the program.

Specific Objectives of the Course

The foregoing general objectives apply to any trade course. At this point it is advisable to set by some specific objectives which the course under consideration will attempt to meet. The objectives as set up are chosen because of their importance in the development of the student as a future automobile mechanic. The following nine objectives have been accepted by a state committee of vocational educators.

1. To develop an understanding of the principles and theory underlying the construction and operation of the gasoline engine.
2. To develop an understanding of the functions and operations of various parts of an automobile.
3. To develop an understanding and appreciation of the value of proper upkeep of an automobile.
4. To develop in the student the ability to diagnose difficulties in the operation of a car and to appreciate the value of good workmanship and material in its repair.
5. To develop sufficient skill to do an acceptable job.

6. To develop an industrious attitude.
7. To form safe working habits.
8. To develop self-reliance, self-discipline and the proper regard for others.
9. To develop resourcefulness and initiative.

INSTRUCTIONAL METHODS CONSIDERED

The Commercial Method

The commercial method of operating an auto mechanics shop in a school may be compared to the operation of a high class garage. Live cars belonging to the general public supply the material upon which the students work. The completed repair jobs must meet high standards to satisfy the customer. Adequate floor space to accommodate a large number of cars must be provided, together with all necessary tools and testing equipment. The time element in getting out a job is also an important factor in operating under this plan. The time consumed in completing a job must not be excessive, and a definite time for its completion must be set up.

The commercial method is considered by vocational educators and industrialists the only satisfactory way to teach a trade course in auto mechanics. The course under consideration is a trade course and must be based upon the commercial method to be successful.

School administrators are increasing class sizes in many cities of the United States. With large classes, floor space for an adequate number of cars is often excessive and difficult to secure. Tools and testing equipment are expensive and only a limited amount can be provided for each shop.

Since the classes meet for three hours a day, more than one boy or group of boys have to work on the same car, which complicates instruction procedure. Time for delivery of the completed job is difficult to estimate, and unless extreme care is taken in this matter general dissatisfaction to the customer results.

For these and other reasons the commercial method of handling the course is difficult. Even with the difficulties mentioned the plan is the best yet devised.

The Laboratory Method

As a solution to the problem of large classes and of the maintenance of student interest, the laboratory method has been devised. By this method, in addition to working on road cars, the various car units are made a permanent part of the shop equipment. The shop is thus partially independent of cars from the outside. Every student receives the same instruction and performs the same jobs as on road cars.

This method gives the instructor an opportunity to organize and present instructional material which will have pre-vocational value and will definitely fix fundamental principles in the minds of the students.

Live motors with transmissions mounted on substantial forms are set about the shop with adequate space for a group to work. It is possible by this method for the student or group of students to understand the construction

and operation of many different makes of gasoline engines.

It is the usual procedure for the class to be divided into groups of two or more to a unit. The unit is dismantled, cleaned, reassembled, and must be in working order when completed. In other words the unit must run. The same procedure is used on other motor units, although many of the jobs involved will be of an individual nature.

Manuals and other printed material including textbooks are used to supplement the laboratory work.

The Textbook Method

In the use of the textbook and discussion method a good text or group of texts is selected, and the course is conducted similarly to academic work. Assignments covering the various portions of auto mechanics work are made for student study, which are followed by recitation and discussion.

A certain number of demonstrations with the use of cut-away motors, sectional units, charts and diagrams, and various experiments are used by the instructor to present the subject to the student. Large groups can be handled, but the work becomes so academic that student interest is difficult to maintain and the value of the course carried on by this method is decreased.

Factors Determining Method To Be Used

The following factors will determine the method to be used:

1. General objectives of the course.
2. Specific objectives of the course.
3. Size of classes.
4. The amount of money available for equipment.
5. The space available for shop purposes.
6. The time allowed for instruction.

COLLECTION AND ORGANIZATION OF MATERIAL

Sources of Information for Laboratory and Related Subject Material

The sources of information for the formulation of the course of study in elementary auto mechanics as presented in this paper were many and varied. The writer has been teaching auto mechanics on a unit trade basis and also on the industrial arts basis for fifteen years. Before teaching he has had many years' training in a commercial auto mechanics garage. From this rich experience has been drawn much of the material included in the course of study. Analysis of the auto mechanics trade validated by local advisory committee and the adaptation of this analysis to the school training shop has been the foundation of the selection of jobs and the necessary related information for the course of study.

Supplementing the above and adding a very important part to the procedure in the collection and organization of material for the study has been the use of trade journals, service manuals, engineering and service bulletins and many good text books.

It is generally believed by the auto mechanics teachers of the state, endorsed by trade, committees that to keep up with the changing conditions and improvements in the automotive field material such as that

listed in the paragraph above is essential. Text books become out of date rapidly, while the other material is undergoing constant revision and change. Fundamentally all automobiles operate the same, but mechanical detail is undergoing such rapid changes that text books are too indefinite for the general trade.

Methods of Securing Reference Materials

Car manufacturers and makers of all types of motor equipment are glad to furnish, upon request, innumerable numbers of printed booklets, catalogs, and manuals for use in the school shop. This material is well written and illustrated and makes excellent class room instructional material to put into the hands of the students.

In addition to the free material which will be sent on request, there are magazines and trade publications for which subscriptions are required. There is much discussion in trade journals which is very technical and beyond the understanding of the student of high school age and consequently not usable in an elementary auto mechanics course. However, there is considerable material of interest which the student can understand, and this makes a valuable contribution to the course. As new material arrives, it is the duty of the instructor to select, for student reference, those articles most valuable for the training program.

Reference books are purchased by the students or the school. Those used should be recommended by the trade advisory committee and the school officials concerned.

Selection of Jobs for Laboratory

As stated in the limitations of the problem the shop is to do the repair jobs commonly done on the motor, electrical units, transmission and rear axle assembly. With this in mind a list of the common operations included in the above divisions of the trade was compiled from which the instructor and the student may select operations to be performed when doing a specific repair job on power units used in representative cars.

In this process several important considerations were set forth as a basis for selection:

1. Aims and objectives of the course.
2. Amount of skill required to do the job.
3. Available equipment with which to work.
4. Available tools.
5. Time consumed in doing the job.

Selection of Topics for Related Information

In the selection of the topics for this phase of the course it was again necessary to set up some basis for choice. The factors given consideration were as follows:

1. Aims and objectives of the course
2. Time allowed for study of related information

3. Level of understanding of students.

4. Equipment for demonstrations

In general, informational material selected adds to student interest in the course and supplements his laboratory work. General and technical information will aid in the understanding of the operation of a gasoline engine and in doing the jobs included in the course.

On page 22 of "Training for the Painting and Decorating Trade," the following comment is made:

Related technical instruction is always most effective when it is available at the time the apprentice is ready to use it. The tendency in connection with training programs is to give general technical instruction to all apprentices in the class without any regard to the types of jobs on which they are working, and with no reference to the job experience of the apprentice. Any tendency to give instruction in related work without regard to the specific needs of the individual must be avoided if the program is to function effectively.

There is danger in offering related work, to follow a text and present the material according to academic procedure. This method is inefficient since it disregards the working experiences of the student.

FORM AND USE OF INSTRUCTION SHEETS

Representative Set of Operation Sheets

On making up the following set of operation sheets three factors were considered: (1) Makes of cars commonly repaired in school shops; (2) Operations which fall within the limitations of the training program; and (3) Job frequency.

Operations are listed in the order of difficulty as nearly as possible, and are numbered from one hundred to one hundred sixty. Regardless of the automobile unit being studied or reconditioned the operation numbers remain the same. In most cases it will be noted that a manufacturer's manual has been used for the first reference. This was done because the writer found that he could not improve upon the procedure recommended by the manufacturer. References to other manuals, magazines and bulletins are also included when the manufacturer's manual is incomplete.

A sheet showing the meaning of abbreviations used in listing references is supplied each student and is posted in a convenient location in the shop.

The operation sheet for each make of car is mounted on a stiff card board and shellaced to keep it in good condition. The mounted sheets are kept in the tool room and checked out by students when needed.

In addition to the operation sheet as used in this study, Dr. Struck lists the assignment sheet, the information sheet and the job sheet.

These four types of instruction are similar in construction and use all of which may be used in auto mechanics today.

Dr. Struck says:

Instruction sheets are definitely helpful in that they conserve the teacher's time.

ABBREVIATION CODE FOR OPERATION SHEETS

A. M.	Automobile Shop Mathematics.
C. C.	Carter Carburetor Sales and Service Manual.
C. I.	Carter Service Instructions.
C. N.	Copper Nerves.
E. M.	Engine Bearing Service Manual.
M. M.	Motor Manual.
M. M. D.	Modern Methods of Differential Driving Gear and Pinion Installation.
M. H.	Motor's Handbook.
M. S.	Motor Annual Show Number.
O. G.	Oil and Gasoline Economy.
O. M.	Owner's Manual.
P.	Page.
S. S.	Shurhit Specification Manual.
S. N.	Service News.
S. P. B.	Sealed Power Service Bulletin.
S. P.	Spark Plug and Engine Performance.
T.	Adopted text.
W. C.	Wall Charts.

LIST OF OPERATIONS

Make of CarBuick

Student Instruction

1. Fill in form 1, using the following list of operations as a guide.
2. Read reference material and get instructor's check before beginning a job.

<u>No.</u>	<u>Operations</u>	<u>References</u>
100	Identify motor parts.	W. C., M. M.
101	Diagram four stroke cycle engine.	T., p. 84.
102	Find the firing order of a motor, Chev.	M. M. T., p. 100.
103	Find the compression ratio of a motor.	A. M., p. 115-116.
104	Determine the piston displacement of a motor.	A. M., p. 113-114.
105	Clean spark plugs.	S. P., p. 1-18.
106	Remove and replace cylinder head.	M. H., p. 32-33, M. M., p. 109.
107	Remove valves from L-head motor.	
108	Remove and replace overhead rocker arm assemblies.	M. M., p. 112-113.
109	Remove valves from overhead motor.	M. M., p. 112.
110	Reface Valves.	M. M., p. 124.
111	Grind valve seats.	See instructor.
112	Lapp in valves with compound.	See instructor.
113	Replace L-head motor valves.	

<u>No.</u>	<u>Operations</u>	<u>References</u>
114	Replace overhead motor valves.	See instructor.
115	Adjust L-head motor valve clearance.	
116	Adjust overhead motor valve clearance.	M. M., p. 113.
117	Remove and replace oil pan.	See instructor.
118	Remove piston assemblies.	M. M., p. 110.
119	Clean and replace piston rings.	M. M., p. 11, O. G., p. 20-24.
120	Replace piston assemblies.	M. M., p. 111.
121	Replace and adjust connecting rod bearings.	M. M., p. 111, E. M., p. 26-30.
122	Replace and adjust main bearings.	M. M., p. 110, E. M., p. 24.
123	Remove and replace camshaft, and check valve timing.	M. M., p. 112-113, 124.
124	Remove and replace transmission.	M. M., p. 174.
125	Remove flywheel housing.	M. M., p. 110, 118.
126	Remove and replace clutch.	M. M., p. 167-176.
127	Remove and replace flywheel.	M. M., p. 109-110, 117-119.
128	Remove and replace oil lines and pump.	
129	Attach water hose lines.	T., p. 156-157.
130	Attach cables to battery.	M. M., p. 268.
131	Test battery connections.	C. N., p. 3-19.

<u>No.</u>	<u>Operations</u>	<u>References</u>
132	Remove and replace starter.	M. M., p. 233.
133	Determine firing order.	M. M., p. 270.
134	Diagram ignition circuit.	M. M., p. 27.
135	Remove and replace distributor.	M. M., p. 245-250.
136	Time a single point ignition system.	M. M., p. 248-249.
137	Time a two-point system.	
138	Wire an ignition circuit.	M. M., p. 270.
139	Remove and clean generator.	M. M., p. 239.
140	Disassemble and assemble transmission.	M. M., p. 183-198.
141	Disassemble and assemble differential.	M. M., p. 71-84.
142	Adjust differential.	M. M., p. 77.
143	Wire complete electrical circuit.	M. M., p. 270.
144	Test condenser.	M. M., p. 248, S. S. chart 2, p. 9.
145	Test coil.	M.,M., p. 251, S. S. chart 2, 4, p. 9.
146	Adjust and test distributor.	M. M., p. 248, S. S. chart 2, 4, p. 9.
147	Test vacuum.	M. M., p. 140, S. S. chart 1.
148	Test compression.	M. M., p. 116, S. S. chart 1.
149	Test generator.	M. M., p. 239-242.

<u>No.</u>	<u>Operations</u>	<u>References</u>
150	Adjust third brush.	
151	Adjust cut-out and voltage control.	M. M., p. 243-245.
152	Test starter.	M. M., p. 233-238.
153	Test complete ignition circuit for voltage.	C. M., p. 11-14.
154	Test battery.	M. M., p. 268-269.
155	Test vacuum advance.	M. M., p. 247, S. S. chart 2, p. 31.
156	Test governor advance.	M. M., p. 247, S. S., p. 31.
157	Clean and adjust carburetor.	M. M., p. 142-159.
158	Test fuel pump.	M. M., p. 163-165.
159	Space plug gap.	M. M., p. 251-252.
160	Tune motor.	C. I., p. 1-6, C. C. Dodge, M. M., p. 69-72

LIST OF OPERATIONS

Make of CarChevrolet

Student Instruction

1. Fill in form 1, using the following list of operations as a guide.
2. Read reference material and get instructor's check before beginning a job.

<u>No.</u>	<u>Operations</u>	<u>References</u>
100	Identify motor parts.	W. C., M. M.
101	Diagram four stroke cycle engine.	T., p. 84.
102	Find the firing order of a motor.	M. M., p. 257, T., p. 100.
103	Find the compression ratio of a motor.	A. M., p. 115-116.
104	Determine the piston displacement of a motor.	A. M., p. 113-114.
105	Clean spark plugs.	S. P., p. 1-18.
106	Remove and replace cylinder head.	M. M., p. 149, 154.
107	Remove valves from L-head motor.	
108	Remove and replace overhead rocker arm assemblies.	M. M., p. 115.
109	Remove valves from overhead motor.	M. M., p. 153-154.
110	Reface valves.	M. M., p. 153.

<u>No.</u>	<u>Operations</u>	<u>References</u>
111	Grind valve seats.	M. M., p. 152.
112	Lapp in valves with compound.	See instructor.
113	Replace L-head motor valves.	
114	Replace overhead motor valves.	M. M., p. 154.
115	Adjust L-head motor valve clearance.	
116	Adjust overhead motor valve clearance.	M. M., p. 115-116.
117	Remove and replace oil pan.	M. M., p. 147.
118	Remove piston assemblies.	M. M., p. 129.
119	Clean and replace piston rings.	M. M., p. 132.
120	Replace piston assemblies.	M. M., p. 145.
121	Replace and adjust connecting rod bearings.	M. M., p. 145.
122	Replace and adjust main bearings.	M. M., p. 136.
123	Remove and replace camshaft, and check valve timing.	M. M., p. 138-139.
124	Remove and replace transmission.	M. M., p. 188.
125	Remove fly wheel housing. Do not remove.	
126	Remove and replace clutch.	M. M., p. 178-185.
127	Remove and replace flywheel.	M. M., p. 142.
128	Remove and replace oil lines and pump.	M. M., p. 148.
129	Attach water hose lines.	T., p. 156-157.
130	Attach cables to battery.	M. M., p. 249.
131	Testing battery connections.	C. N., p. 3-19.
132	Remove and replace starter.	M. M., p. 251.

<u>No.</u>	<u>Operations</u>	<u>References</u> 30
133	Determine firing order.	Use own method.
134	Diagram ignition circuit.	M. M., p. 255.
135	Remove and replace distributor.	M. M., p. 257.
136	Time a single point ignition system.	M. M., p. 257, 159.
137	Time a two-point system.	
138	Wire an ignition circuit.	M. M., p. 255.
139	Remove and clean generator.	M. M., p. 231-235.
140	Disassemble and assemble transmission.	M. M., p. 189-202.
141	Disassemble and assemble differential.	M. M., p. 80-108.
142	Adjust differential.	M. M., p. 89.
143	Wire complete electrical circuit.	M. M., p. 259.
144	Test condenser. M	M. M., p. 256.
145	Test coil.	S. S. chart 2, 4, p. 9.
146	Adjust and test distributor.	M. M., p. 257, 158.
147	Test vacuum.	S. S. chart 1.
148	Test compression.	S. S. chart 1.
149	Test generator.	M. M., p. 245-249.
150	Adjust third brush.	M. M., p. 244.
151	Adjust cut-out and voltage control.	M. M., p. 235-242.
152	Test starter.	M. M., p. 252-254.

<u>No.</u>	<u>Operations</u>	<u>References</u>
153	Test complete ignition circuit for voltage.	C. N., p. 11-14.
154	Test battery.	M. M., p. 249.
155	Test vacuum advance.	M. M., p. 256.
156	Test governor advance.	M. M., p. 256.
157	Clean and adjust carburetor.	M. M., p. 160-165.
158	Test fuel pump.	M. M., p. 165-167.
159	Space plug gap.	M. M., p. 158.
160	Tune motor.	M. M., p. 157-159.

LIST OF OPERATIONS

Make of Car DeSota

Student Instructions

1. Fill in form 1, using the following list of operations as a guide.
2. Read reference material and get instructors check before beginning a job.

<u>No.</u>	<u>Operations</u>	<u>References</u>
100	Identify motor parts.	W. C., M. M.
101	Diagram four stroke cycle engine.	T., p. 84.
102	Find the firing order of a motor.	Chev. M., M., p. 257, T., p. 100.
103	Find the compression ratio of a motor.	A. M., p. 115-116.
104	Determine the piston displacement of a motor.	A. M., p. 113-114.
105	Clean spark plugs.	S. P., p. 1-18.
106	Remove and replace cylinder head.	M. M., p. 81.
107	Remove valves from L-head motor.	M. M., p. 81.
108	Remove and replace overhead rocker arm assemblies.	
109	Remove valves from overhead motor.	
110	Reface valves.	M. M., p. 82.
111	Grind valves seats.	M. M., p. 82.
112	Lapp in valves with compound.	See instructor.
113	Replace L-head motor valves.	M. M., p. 82.

<u>No.</u>	<u>Operations</u>	<u>References</u>
114	Replace overhead motor valves.	
115	Adjust L-head motor valve clearance.	AGRICULTURAL & MECHANICAL COLLEGE LIBRARY OCT 27 1939 M. M., p. 82.
116	Adjust overhead motor valve clearance.	
117	Remove and replace oil pan.	See instructor.
118	Remove piston assemblies.	M. M., p. 79.
119	Clean and replace piston rings.	M. M., p. 80.
120	Replace piston assemblies.	T., p. 112-115.
121	Replace and adjust connecting rod bearings.	M. M., p. 78, E. M., p. 24.
122	Replace and adjust main bearings.	M. M., p. 76-77.
123	Remove and replace camshaft and check valve timing.	M. M., p. 82.
124	Remove and replace transmission.	M. M., p. 113.
125	Remove flywheel housing.	M. M., p. 113.
126	Remove and replace clutch.	M. M., p. 36-39.
127	Remove and replace flywheel.	M. M., p. 37.
128	Remove and replace oil lines and pump.	M. M., p. 83.
129	Attach water hose lines.	T., p. 156-157.
130	Attach cables to battery.	N. C., p. 10.
131	Testing battery connections.	C. N., p. 3-19.
132	Remove and replace starter.	M. M., p. 57.
133	Determine firing order.	Use own method.
134	Diagram ignition circuit.	M. M., p. 53.
135	Remove and replace distributor.	M. M., p. 58.

<u>No.</u>	<u>Operations</u>	<u>References</u>
136	Time a single point ignition system.	M. M., p. 59.
137	Time to two-point system.	S. S., p. 11-12.
138	Wire an ignition circuit.	M. M., p. 53.
139	Remove and clean generator.	M. M., p. 55.
140	Disassemble and assemble transmission.	M. M., p. 113-117.
141	Disassemble and assemble differential.	M. M., p. 17-23.
142	Adjust differential.	M. M., p. 21-22.
143	Wire complete electrical circuit.	M. M., p. 53.
144	Test condenser.	S. S. chart 2, p. 9.
145	Test coil.	S. S. chart 2, 4, p. 9.
146	Adjust and test distributor.	M. M., p. 58, 72.
147	Test vacuum.	M. M., p. 74.
148	Test compression.	M. M., p. 72.
149	Test generator.	M. M., p. 55.
150	Adjust third brush.	
151	Adjust cut-out and voltage control.	M. M., p. 56.
152	Test starter.	M. M., p. 57.
153	Test complete ignition circuit for voltage.	C. N., p. 11-14.

<u>No.</u>	<u>Operations</u>	<u>References</u>
154	Test battery.	M. M., p. 62.
155	Test vacuum advance.	M. M., p. 61, S. S. chart 2, p. 31.
156	Test governor advance.	S. S., p. 31.
157	Clean and adjust carburetor.	M. M., p. 90-93, C. C.
158	Test fuel pump.	M. M., p. 88-89.
159	Space plug gap.	M. M., p. 72.
160	Tune motor.	C. I., p. 1-6, C. C., M. M., p. 71-74.

LIST OF OPERATIONS

Make of CarDodge

Student Instruction

1. Fill in form 1, using the following list of operations as a guide.
2. Read reference material and get instructor's check before beginning a job.

<u>No.</u>	<u>Operations</u>	<u>References</u>
100	Identify motor parts.	W. C., M. M.
101	Diagram four stroke cycle engine.	T., p. 84.
102	Find the firing order of a motor.	Chev. M. M., 252, T., p. 100.
103	Find the compression ratio of a motor.	A. M., p. 115- 116.
104	Determine the piston displacement of a motor.	A. M., p. 113- 114.
105	Clean spark plugs.	S. P., p. 1-18.
106	Remove and replace cylinder head.	M. M., p. 79.
107	Remove valves from L-head motor.	M. M., p. 79.
108	Remove and replace overhead rocker arm assemblies.	
109	Remove valves from overhead motor.	
110	Reface valves.	See instructor.
111	Grind valve seats.	M. M., p. 81.
112	Lapp in valves with compound.	See instructor.
113	Replace L-head motor valves.	M. M., p. 79.
114	Replace overhead motor valves.	

<u>No.</u>	<u>Operations</u>	<u>References</u>
115	Adjust L-head motor valve clearance.	M. M., p. 80.
116	Adjust overhead motor valve clearance.	
117	Remove and replace oil pan.	See instructor.
118	Remove piston assemblies.	M. M., p. 77.
119	Clean and replace piston rings.	M. M., p. 78.
120	Replace piston assemblies.	Chev., M. M., p. 143-145.
121	Replace and adjust connecting rod bearings.	M. M., p. 76.
122	Replace and adjust main bearings.	M. M., p. 74.
123	Remove and replace camshaft, and check valve timing.	M. M., p. 75, 80.
124	Remove and replace transmission.	M. M., p. 115.
125	Remove fly wheel housing.	M. M., p. 115- 181.
126	Remove and replace clutch.	M. M., p. 35-37.
127	Remove and replace flywheel.	M. M., p. 35.
128	Remove and replace oil lines and pump.	M. M., p. 81.
129	Attach water hose lines.	T., p. 156-157.
130	Attach cables to battery.	N. C., p. 10.
131	Testing battery connections.	N. C., p. 3-19.
132	Remove and replace starter.	M. M., p. 55.
133	Determine firing order.	Use own method.
134	Diagram ignition circuit.	M. M., p. 51.
135	Remove and replace distributor.	M. M., p. 56.

<u>No.</u>	<u>Operations</u>	<u>References</u>
136	Time a single-point ignition system.	M. M., p. 57-58.
137	Time a two-point system.	
138	Wire an ignition circuit.	M. M., p. 51.
139	Remove and clean generator.	M. M., p. 53.
140	Disassemble and assemble transmission.	M. M., p. 115-117.
141	Disassemble and assemble differential.	M. M., p. 14-21.
142	Adjust differential.	M. M., p. 20.
143	Wire complete electrical circuit.	M. M., p. 51.
144	Test condenser.	S. S. chart 2, T., p. 213.
145	Test coil.	S. S. chart 2, 4, p. 9.
146	Adjust and test distributor.	M. M., p. 57, S. S. chart.
147	Test vacuum.	M. M., p. 72, S. S. chart 1.
148	Test Compression.	M. M., p. 70, S. S. chart 1.
149	Test generator.	M. M., p. 53, S. S. chart 1.
150	Adjust third brush.	T., p. 247-249.
151	Adjust cutout and voltage control.	M. M., p. 545.
152	Test starter.	M. M., p. 56, S. S. chart 3.
153	Test complete ignition circuit for voltage.	C. N., p. 11-14.
154	Test battery.	M. M., p. 60-61.

<u>No.</u>	<u>Operations</u>	<u>References</u>
155	Test vacuum advance.	M. M., p. 59, S. S. chart 2, p. 31.
156	Test governor advance.	S. S., p. 31.
157	Clean and adjust carburetor.	M. M., p. 90- 92, C. C.
158	Test fuel pump.	M. M., p. 88-89.
159	Space plug gap.	M. M., p. 70.
160	Tune motor.	M. M., p. 69- 72, C. I., p. 1-6.

LIST OF OPERATIONS

Make of CarFord V-8

Student Instruction

1. Fill in form 1, using the following list of operations as a guide.
2. Read reference material and get instructor's check before beginning a job.

<u>No.</u>	<u>Operations</u>	<u>References</u>
100	Identify motor parts.	W. C., M. M.
101	Diagram four stroke cycle engine.	T., p. 84.
102	Find the firing order of the motor.	Chev., M. M., p. 257, T., p. 100.
103	Find the compression ratio of a motor.	AA. M., p. 115-116.
104	Determine the piston displacement of a motor.	
105	Clean spark plugs.	S. P., p. 1-18.
106	Remove and replace cylinder head.	M. H., p. 32-33, M. M., p. 15-16.
107	Remove valves from L-head motor.	M. M., p. 11-12.
108	Remove and replace overhead rocker arm assemblies.	
109	Remove valves from overhead motor.	
110	Reface valves.	See instructor.
111	Grind valve seats.	M. M., p. 51.
112	Lapp in valves with compound.	See instructor.
113	Replace L-head motor valves.	M. M., p. 11-12.

<u>No.</u>	<u>Operations</u>	<u>References</u>
114	Replace overhead motor valves.	
115	Adjust L-head motor valve clearance.	M. M., p. 11.
116	Adjust overhead motor valve clearance.	
117	Remove and replace oil pan.	See instructor.
118	Remove piston assemblies.	M. M., p. 31, 51.
119	Clean and replace piston rings.	M. M., p. 32, 52.
120	Replace piston assemblies.	M. M., p. 31.
121	Replace and adjust connecting rod bearings.	E. M., p. 26-30.
122	Replace and adjust main bearings.	M. M., p. 11, E. M., p. 24.
123	Remove and replace camshaft and check valve timing.	See instructor.
124	Remove and replace transmission.	M. M., p. 1, 2, 11-12.
125	Remove flywheel housing.	See instructor.
126	Remove and replace clutch.	M. M., p. 1, 2, 11-12.
127	Remove and replace flywheel.	M. M., p. 21-22.
128	Remove and replace oil lines and pump.	M. M., p. 22
129	Attach water hose lines.	See instructor.
130	Attach cables to battery.	C. N., p. 5.
131	Testing battery connections.	C. N., p. 3-19.
132	Remove and replace starter.	M. M., p. 3, 7, 9, 12, 11.
133	Determine firing order.	M. M., p. 33.

<u>No.</u>	<u>Operations</u>	<u>References</u>
134	Diagram ignition circuit.	M. M., p. 43.
135	Remove and replace distributor.	M. M., p. 1-60.
136	Time a single point ignition system.	
137	Time a two-point system.	M. M., p. 59-60, 7.
138	Wire an ignition circuit.	M. M., p. 51.
139	Remove and clean generator.	M. M., p. 1.
140	Disassemble and assemble transmission.	M. M., p. 3-4.
141	Disassemble and assemble differential.	M. M., p. 17-22.
142	Adjust differential.	M. M. D., Read entire bulletin.
143	Wire complete electrical circuit.	M. M., p. 51.
144	Test condenser.	M. M., p. 3-4. S. S. chart 2, p. 9.
145	Test coil.	M. M., p. 11-12, 7, 8, S. S. chart 2, 4, p. 9.
146	Adjust and test distributor.	M. M., p. 2, 1, 5, 6, 9, 10, 13, 14, 59, 60.
147	Test vacuum.	S. S. chart 1.
148	Test compression.	M. M., p. 12, S. S. chart 1.
149	Test generator.	M. M., p. 3.
150	Adjust third brush.	M. M., p. 41.
151	Adjust cut-out and voltage control.	M. M., p. 21, 3, 91, 22.
152	Test starter.	S. S. chart 3.
153	Test complete ignition circuit for voltage.	C. N., p. 11-14.

<u>No.</u>	<u>Operations</u>	<u>References</u>
154	Test battery.	M. M., p. 1.
155	Test vacuum advance.	M. M., p. 3, 4, 7, 8, S. S. p. 31.
156	Test governor advance.	M. M., p. 7, S. S., p. 31.
157	Clean and adjust carburetor.	M. M., p. 5-52.
158	Test fuel pump.	M. M., p. 1-4.
159	Space plug gaps.	M. M., p. 11-12, Ford no. 12405.
160	Tune motor.	C. I., p. 1-6, M. H.

LIST OF OPERATIONS

Make of CarHudson

Student Instruction

1. Fill in form 1, using the following list of operations as a guide.
2. Read reference material and get instructor's check before beginning a job.

<u>No.</u>	<u>Operations</u>	<u>References</u>
100	Identify motor parts.	W. C., M. M.
101	Diagram four stroke cycle engine.	T., p. 84.
102	Find the firing order of a motor.	Chev., M. M., p. 257, T., p. 100.
103	Find the compression ratio of a motor.	A. M., p. 115- 116.
104	Determine the piston displacement of a motor.	A. M., p. 114-115.
105	Clean spark plugs.	S. P., p. 1-18.
106	Remove and replace cylinder head.	M. H., p. 32-33, S. P. B., p. 10-16.
107	Remove valves from L-head motor.	See instructor.
108	Remove and replace overhead rocker arm assemblies.	
109	Remove valves from overhead motor.	
110	Reface valves.	See instructor.
111	Grind valve seats.	C. I., p. 1. See instructor.
112	Lapp in valves with compound.	See Instructor.

<u>No.</u>	<u>Operations</u>	<u>References</u>
113	Replace L-head motor valves.	See instructor.
114	Replace overhead motor valves.	
115	Adjust L-head motor valve clearance.	O. M., p. 19.
116	Adjust overhead motor valve clearance.	
117	Remove and replace oil pan.	See instructor.
118	Remove piston assemblies.	O. M., p. 19.
119	Clean and replace piston rings.	S.P.B., p. 10-14, O. G., p. 1-25.
120	Replace piston assemblies.	O. M., p. 19, See instructor.
121	Replace and adjust connecting rod bearings.	O. M., p. 19, E. M., p. 26-30.
122	Replace and adjust main bearings.	E. M., p. 24, See instructor.
123	Remove and replace camshaft and check valve timing.	W. M., p. 20.
124	Remove and replace transmission.	O. M., p. 34-36.
125	Remove flywheel housing.	O. M., p. 34.
126	Remove and replace clutch.	O. M., p. 32-34.
127	Remove and replace flywheel.	See instructor.
128	Remove and replace oil lines and pump.	O. M., p. 20, E. M., p. 20.
129	Attach water hose lines.	O. M., p. 30.
130	Attach cables to battery.	O. M., p. 52.
131	Testing battery connections.	C. N., p. 3-19.
132	Remove and replace starter.	O. M., p. 28.

<u>No.</u>	<u>Operations</u>	<u>References</u>
133	Determine firing order.	Use knowledge previously gained.
134	Diagram ignition circuit.	O. M., p. 51, S. N. Vol. 12, No. 8.
135	Remove and replace distributor.	O. M., p. 23.
136	Time a single point ignition system.	O. M., p. 23.
137	Time a two-point system.	
138	Wire an ignition circuit.	C. N., p. 11-19.
139	Remove and clean generator.	O. M., p. 29.
140	Disassemble and assemble transmission.	O. M., p. 35.
141	Disassemble and assemble differential.	O. M., p. 37.
142	Adjust differential.	M.M.D. Read entire edition.
143	Wire complete electrical circuit.	O. M., p. 51.
144	Test condenser.	C. I., p. 5, S. S. chart 2, T., p. 213.
145	Test coil.	S. S. chart 2, 4, p. 9.
146	Adjust and test distributor.	S. S. chart 2, p. 51.
147	Test vacuum.	S. S. chart 1.
148	Test compression.	C. I., p. 1-3, S. S. chart 1.
149	Test generator.	Chev. M. M., p. 234-248.
150	Adjust third brush.	O. M., p. 28, T., p. 247-249.

<u>No.</u>	<u>Operations</u>	<u>References</u> ⁴⁷
151	Adjust cut-out and voltage control.	Chev. M. M., p. 240.
152	Test starter.	Chev. M. M., p. 252-253.
153	Test complete ignition circuit for voltage.	C. N., p. 11-14.
154	Test battery.	Chev. M. M., p. 249.
155	Test vacuum advance.	S. S. chart 2, p. 31.
156	Test governor advance.	S. S. chart, p. 31.
157	Clean and adjust carburetor.	C. I., p. 1-14, C. C.
158	Test fuel pump.	Dodge M. M., p. 88-89.
159	Space plug gap.	M. H., p. 92.
160	Tune motor.	O. M., p. 27, C. C.

LIST OF OPERATIONS

Make of CarLaSalle

Student Instruction

1. Fill in form 1, using the following list of operations as a guide.
2. Read reference material and get instructor's check before beginning a job.

<u>No.</u>	<u>Operations</u>	<u>References</u>
100	Identify motor parts.	W. C., M. M.
101	Diagram four stroke cycle engine.	T., p. 84.
102	Find the firing order of a motor.	Chev. M. M., p. 257, T., p. 100.
103	Find the compression ratio of a motor.	A. M., p. 115-116.
104	Determine the piston displacement of a motor.	A. M., p. 113-114.
105	Clean spark plugs.	S. P., p. 1-18, M. M., p. 94.
106	Remove and replace cylinder head.	M. M., p. 81, M. H., p. 32-33.
107	Remove valves from L-head motor.	M. M., p. 83-85.
108	Remove and replace overhead rocker arm assemblies.	
109	Remove valves from overhead motor.	
110	Reface valves.	See instructor.

<u>No.</u>	<u>Operations</u>	<u>References</u>
111	Grind valve seats.	See instructor.
112	Lapp in valves with compound.	See instructor.
113	Replace L-head motor valves.	M. M., p. 83-85.
114	Replace overhead motor valves.	
115	Adjust L-head motor valve clearance.	M. M., p. 83-85.
116	Adjust overhead motor valve clearance.	
117	Remove and replace oil pan.	M. M., p. 89.
118	Remove piston assemblies.	M. M., p. 74-75, 106.
119	Clean and replace piston rings.	M. M., p. 107.
120	Replace piston assemblies.	M. M., p. 75, 106.
121	Replace and adjust connecting rod bearings.	M. M., p. 75-76, 105.
122	Replace and adjust main bearings.	M. M., p. 72-73, 105.
123	Remove and replace camshaft and check valve timing.	M. M., p. 82-83, 105.
124	Remove and replace transmission.	M. M., p. 125.
125	Remove flywheel housing.	M. M., p. 110-111, 116.
126	Remove and replace clutch.	M. M., p. 111-116.
127	Remove and replace flywheel.	
128	Remove and replace oil lines and pump.	M. M., p. 90-91, 88, 106.
129	Attach water hose lines.	M. M., p. 165-167.
130	Attach cables to battery.	M. M., p. 157.

<u>No.</u>	<u>Operations</u>	<u>References</u> ⁵⁰
131	Testing battery connections.	C. N., p. 3-19, 162.
132	Remove and replace starter.	M. M. p. 154-155, 163.
133	Determine firing order.	M. M., p. 144.
134	Diagram ignition circuit.	Use knowledge previously gained.
135	Remove and replace distributor.	M. M., p. 94-96.
136	Time a single point ignition system.	M. M., p. 108, S. S., p. 30.
137	Time a two-point system.	
138	Wire an ignition circuit.	M. M., p. 144, 148.
139	Remove and clean generator.	M. M., p. 155, 146.
140	Disassemble and assemble trans- mission.	M. M., p. 118- 128.
141	Disassemble and assemble differ- ential.	M. M., p. 49-51.
142	Adjust differential.	M.M.D. Read entire edition.
143	Wire complete electrical circuit.	M. M., p. 114.
144	Test condenser.	C. I., p. 5, S. S. chart 2, p. 9.
145	Test coil.	S. S. chart 2, 4, p. 9.
146	Adjust and test distributor.	S. S. chart 2, p. 31, M. M., p. 108.
147	Test vacuum.	S. S. chart 1.
148	Test compression.	S. S. chart 1, C. I., p. 1-3.
149	Test generator.	M. M., p. 162.

<u>No.</u>	<u>Operations</u>	<u>References</u>
150	Adjust third brush.	
151	Adjust cut-out and voltage control.	M. M., p. 145-155, 162.
152	Test starter.	M. M., p. 154-155, 163, S. S. chart 3.
153	Test complete ignition circuit for voltage.	C. N., p. 11-14.
154	Test battery.	M. M., p. 157.
155	Test vacuum advance.	M. M., p. 108, S. S., p. 30.
156	Test governor advance.	M. M., p. 108, 94, 96.
157	Clean and adjust carburetor.	M. M., p. 97-104, 109, C. I., p. 1-14.
158	Test fuel pump.	M. M., p. 97, 104.
159	Space plug gap.	M. M., p. 94.
160	Tune motor.	C. I., p. 1-6, DeSota M. M., p. 71-74.

LIST OF OPERATIONS

Make of CarNash

Student Instruction

1. Fill in form 1, using the following list of operations as guide.
2. Read reference material and get instructor's check before beginning a job.

<u>No.</u>	<u>Operations</u>	<u>References</u>
100	Identify motor parts.	W. C., M. M.
101	Diagram four stroke cycle engine.	T., p. 84.
102	Find the firing order of a motor.	M. H., p. 92, T., p. 100.
103	Find the compression ratio of a motor.	A. M., p. 115-116.
104	Determine the piston displacement of a motor.	A. M., p. 115-116.
105	Clean spark plugs.	S. P., p. 1-18.
106	Remove and replace cylinder head.	M. H., p. 32.
107	Remove valves from L-head motor.	T., p. 85-86.
108	Remove and replace overhead rocker arm assemblies.	
109	Remove valves from overhead motor.	
110	Reface valves.	Chev. M. M., p. 153.
111	Grind valve seats.	Ford M. M., p. 51, job No. E.-6505.
112	Lepp in valves with compound.	See instructor.
113	Replace L-head motor valves.	T., p. 106-110.

<u>No.</u>	<u>Operations</u>	<u>References</u>
114	Replace overhead motor valves.	
115	Adjust L-head motor clearance.	M. H., p. 88.
116	Adjust overhead motor valve clearance.	
117	Remove and replace oil pan.	See instructor.
118	Remove piston assemblies.	T., p. 112.
119	Clean and replace piston rings.	O. G., p. 23.
120	Replace piston assemblies.	O. G., p. 22-23.
121	Replace and adjust connecting rod bearings.	E. M., p. 24.
122	Replace and adjust main bearings.	E. M., p. 24.
123	Remove and replace camshaft and check valve timing.	M. H., p. 28, 88.
124	Remove and replace transmission.	M. M. Section 6, p. 1-32.
125	Remove flywheel housing.	See instructors.
126	Remove and replace clutch.	T., p. 315-326.
127	Remove and replace flywheel.	See instructor.
128	Remove and replace oil lines and pump.	E. M., p. 20.
129	Attach water hose lines.	T., p. 156-157.
130	Attach cables to battery.	C. N., p. 5.
131	Testing battery connections.	C. N., p. 3-19.
132	Remove and replace starter.	T., p. 257-262.
133	Determine firing order.	Use own method.
134	Diagram ignition circuit.	M. H., p. 160.
135	Remove and replace distributor.	T., p. 215-226.
136	Time a single point ignition system.	M. H., p. 14, T., p. 127-128.

<u>No.</u>	<u>Operations</u>	<u>References</u>
137	Time a two-point system.	
138	Wire an ignition circuit.	M. H., p. 160.
139	Remove and clean generator.	T., p. 247-254.
140	Disassemble and assemble transmission.	M. M., Section 6, p. 32.
141	Disassemble and assemble differential.	M. M., Section 7, p. 1-6.
142	Adjust differential.	M. M., p. 2-4.
143	Wire complete electrical circuit.	M. H., p. 160.
144	Test condenser.	S. S. chart 2, p. 9, T., p. 213.
145	Test coil.	S. S. chart 3, 4, p. 9.
146	Adjust and test distributor.	S. S. chart 2, p. 31.
147	Test vacuum.	S. S. chart 1, p. 31.
148	Test compression.	S. S. chart 1.
149	Test generator.	S. S. chart 1.
150	Adjust third brush.	
151	Adjust cut-out and voltage control.	Chev. 235-242, M. S., p. 206.
152	Test starter.	S. S. chart 3.
153	Test complete ignition circuit for voltage.	C. N., p. 11-14.
154	Test battery.	T., p. 291.
155	Test vacuum advance.	S. S., p. 31.

<u>No.</u>	<u>Operations</u>	<u>References</u>
156	Test governor advance.	S. S., p. 31.
157	Clean and adjust carburetor.	M. M., p. 1-24.
158	Test fuel pump.	Dodge, M. M., p. 88-89.
159	Space plug gap.	M. H., p. 92.
160	Tune motor.	Dodge, M. M., P. 69-72.

LIST OF OPERATIONS

Make of CarOldsmobile

Student Instruction

1. Fill in form 1, using the following list of operations as a guide.
2. Read reference material and get instructor's check before beginning a job.

<u>No.</u>	<u>Operations</u>	<u>References</u>
100	Identify motor parts.	W. C., M. M.
101	Diagram four stroke cycle engine.	T., p. 84.
102	Find the firing order of a motor.	Chev., M. M., p. 257, T., p. 100.
103	Find the compression ratio of a motor.	A. M., p. 115-116.
104	Determine the piston displacement of a motor.	A. M., p. 113-114.
105	Clean spark plugs.	S. P., p. 1-18.
106	Remove and replace cylinder head.	M. H., p. 32-33, M. M., p. 118.
107	Remove valves from L-head motor.	M. M., p. 106- 107, 125.
108	Remove and replace overhead rocker arm assemblies.	
109	Remove valves from overhead motor.	
110	Reface valves.	See instructor.
111	Grind valve seats.	See instructor.
112	Lapp in valves with compound.	See instructor.

<u>No.</u>	<u>Operations</u>	<u>References</u>
113	Replace L-head motor valves.	T., p. 106.
114	Replacement overhead motor valves.	
115	Adjust L-head motor valve clearance.	M. M., p. 127, M. H., p. 88.
116	Adjust overhead motor valve clearance.	
117	Remove and replace oil pan.	M. M., p. 101.
118	Remove piston assemblies.	M. M., p. 104, 106, 164.
119	Clean and replace piston rings.	M. M., p. 105, 123, 164.
120	Replace piston assemblies.	O. F., p. 22-24, 120-122, 124.
121	Replace and adjust connecting rod bearings.	M. M., p. 105, 164, 124.
122	Replace and adjust main bearings.	M. M., p. 103, 119-120.
123	Remove and replace camshaft and check valve timing.	M. M., p. 106, 127.
124	Remove and replace transmission.	M. M., p. 179.
125	Remove flywheel housing. Do not remove.	
126	Remove and replace clutch.	M. M., p. 169- 176.
127	Remove and replace flywheel.	M. M., p. 119.
128	Remove and replace oil lines and pump.	M. M., p. 108, 128-129.

<u>No.</u>	<u>Operations</u>	<u>References</u>
129	Attach water hose lines.	T., p. 156-157.
130	Attach cables to battery.	M. M., p. 237, 252.
131	Testing battery connections.	C. N., p. 3-19.
132	Remove and replace starter.	M. M., p. 235.
133	Determine firing order.	Choose own method.
134	Diagram ignition circuit.	M. M., p. 265.
135	Remove and replace distributor.	M. M., p. 238- 240, 253-254.
136	Time a single point ignition system.	M. M., p. 253-254.
137	Time a two-point system.	
138	Wire an ignition circuit.	M. M., p. 265.
139	Remove and clean generator.	M. M., p. 236.
140	Disassemble and assemble trans- mission.	M. M., p. 179- 204.
141	Disassemble and assemble differ- ential.	M. M., p. 66-76.
142	Adjust differential.	M. M., p. 70-71.
143	Wire complete electrical circuit.	M. M., p. 265.
144	Test condenser.	M. M., p. 240, S. S. chart 2, p. 9.
145	Test coil.	M. M., p. 252-253, S. S. chart, 2, 4, p. 9.
146	Adjust and test distributor.	M. M., p. 253- 254.
147	Test vacuum.	M. M., p. 239, S. S. chart 1.

<u>No.</u>	<u>Operations</u>	<u>References</u>
148	Test compression.	M. M., p. 163, S. S., chart 1.
149	Test generator.	M. M., p. 236, 245.
150	Adjust third brush.	T., p. 247-249.
151	Adjust cut-out and voltage control.	M. M., p. 2, 246-248.
152	Test starter.	M. M., p. 243- 245, S. S. chart 3.
153	Test complete ignition circuit for voltage.	C. N., p. 11-14.
154	Test battery.	M. M., p. 252.
155	Test vacuum advance.	M. M., p. 239, S. S. chart 2, p. 31.
156	Test governor advance.	M. M., p. 238, S. S., p. 31.
157	Clean and adjust carburetor.	M. M., p. 112, 133, 16.
158	Test fuel pump.	M. M., p. 116, 155-159.
159	Space plug gaps.	M. M., p. 24.
160	Tune motor.	Dodge M. M., p. 69-72.

LIST OF OPERATIONS

Make of CarPlymouth

Student Instruction

1. Fill in form 1, using the following list of operations as a guide.
2. Read reference material and get instructor's check before beginning a job.

<u>No.</u>	<u>Operations</u>	<u>References</u>
100	Identify motor parts.	W. C., M. M.
101	Diagram four stroke cycle engine.	T., p. 84.
102	Find the firing order of a motor.	Chev., M. M. T., p. 100.
103	Find the compression ratio of a motor.	A. M., p. 115-116.
104	Determine the piston displacement of a motor.	A. M., p. 113-114.
105	Clean spark plugs.	S. P., p. 1-18.
106	Remove and replace cylinder head.	M. M., p. 79.
107	Remove valves from L-head motor.	M. M., p. 79.
108	Remove and replace overhead rocker arm assemblies.	
109	Remove valves from overhead motor.	
110	Reface valves.	See instructor.
111	Grind valve seats.	M. M., p. 80-81.
112	Lapp in valves with compound.	M. M., p. 81.
113	Replace L-head motor valves.	M. M., p. 79.

<u>No.</u>	<u>Operations</u>	<u>References</u>
114	Replace overhead motor valves.	
115	Adjust L-head motor valves clearance.	M. M., p. 79-80.
116	Adjust overhead motor valve clearance.	
117	Remove and replace oil pan.	See instructor.
118	Remove piston assemblies.	M. M., p. 76-78.
119	Clean and replace piston rings.	M. M., p. 78.
120	Replace piston assemblies.	M. M., p. 77.
121	Replace and adjust connecting rod bearings.	M. M., p. 75.
122	Replace and adjust main bearings.	M. M., p. 72-74.
123	Remove and replace camshaft and check valves.	M. M., p. 74, 80.
124	Remove and replace transmission.	M. M., p. 111.
125	Remove flywheel housing. Do not remove.	
126	Remove and replace clutch.	M. M., p. 35-37.
127	Remove and replace flywheel.	M. M., p. 35.
128	Remove and replace oil lines and pump.	M. M., p. 74.
129	Attach water hose lines.	T., p. 156-157.
130	Attach cables to battery.	M. M., p. 61.
131	Testing battery connections.	M. M., p. 61.
132	Remove and replace starter.	M. M., p. 55-56.
133	Determine firing order.	Use own method.
134.	Diagram ignition circuit.	M. M., p. 51.

<u>No.</u>	<u>Operations</u>	<u>References</u>
135	Remove and replace distributor.	M. M., p. 57.
136	Time a single point ignition system.	M. M., p. 58.
137	Time a two-point system.	
138	Wire an ignition circuit.	M. M., p. 51.
139	Remove and clean generator.	M. M., p. 53.
140	Disassemble and assemble transmission.	M. M., p. 111-113.
141	Disassemble and assemble differential.	M. M., p. 14-21.
142	Adjust differential.	M. M., p. 19-21.
143	Wire complete electrical circuit.	M. M., p. 51-52.
144	Test condenser.	S. S. chart 2, p. 9.
145	Test coil.	S. S. chart 2, 4, p. 9.
146	Adjust and test distributor.	M. M., p. 58-59, S. S. chart 2, 4, p. 9.
147	Test vacuum.	M. M., p. 72.
148	Test compression.	M. M., p. 70, S. S. chart 1.
149	Test generator.	M. M., p. 53-54.
150	Adjust third brush.	M. M., p. 54.
151	Adjust cut-out and voltage control.	M. M., p. 55.
152	Test starter.	M. M., p. 56-57.
153	Test complete ignition circuit for voltage.	C. M., p. 11-14.
154	Test battery.	M. M., p. 61.

<u>No.</u>	<u>Operations</u>	<u>References</u>
155	Test vacuum advance.	M. M., p. 60, S. S. chart 2, p. 31.
156	Test governor advance.	S. S., p. 31.
157	Clean and adjust carburetor.	M. M., p. 86-90.
158	Test fuel pump.	M. M., p. 86.
159	Space plug gap.	M. M., p. 60.
160	Tune motor.	M. M., 69-72.

LIST OF OPERATIONS

Make of CarPontiac

Student Instruction

1. Fill in form 1, using the following list of operations as a guide.
2. Read reference material and get instructor's check before beginning a job.

<u>No.</u>	<u>Operations</u>	<u>References</u>
100	Identify motor parts.	W. C., M. M.
101	Diagram four stroke cycle engine.	T., p. 84.
102	Find the firing order of a motor.	Chev. M. M., p. 257, T., p. 100.
103	Find the compression ratio of a motor.	A. M., p. 115- 116.
104	Determine the piston displacement of a motor.	A. M., p. 113- 114.
105	Clean spark plugs.	S. P., p. 1-18.
106	Remove and replace cylinder head.	M. H., p. 32-33, M. M., p. 90-91.
107	Remove valves from L-head motor.	M. M., p. 97.
108	Remove and replace overhead rocker arm assemblies.	
109	Remove valves from overhead motor.	
110	Reface valves.	See instructor.
111	Grind valve seats.	See instructor.
112	Lapp in valves with compound.	See instructor.

<u>No.</u>	<u>Operations</u>	<u>References</u>
113	Replace L-head motor valves.	See instructor.
114	Replace overhead motor valves.	
115	Adjust L-head motor valve clearance.	M. M., p. 97.
116	Adjust overhead motor valve clearance.	
117	Remove and replace oil pan.	M. M., p. 90.
118	Remove piston assemblies.	M. M., p. 94-95.
119	Clean and replace piston rings.	M. M., p. 95-96, O. G., p. 1-25.
120	Replace piston assemblies.	T., p. 46.
121	Replace and adjust connecting rod bearings.	M. M., p. 93.
122	Replace and adjust main bearings.	M. M., p. 93.
123	Remove and replace camshaft and check valve timing.	M. M., p. 96-97.
124	Remove and replace transmission.	M. M., p. 147.
125	Remove flywheel housing.	See instructor.
126	Remove and replace oil lines and pump.	M. M., p. 108.
127	Remove and replace flywheel.	M. M., p. 92.
128	Remove and replace oil lines and pump.	M. M., p. 108.
129	Attach water hose lines.	T., p. 156-157.
130	Attach cables to battery.	M. M., p. 177.
131	Testing battery connections.	M. M., p. 167, C. N., p. 3-19.
132	Remove and replace starter.	M. M., p. 183.
133	Determine firing order.	Use knowledge previously gained.

<u>No.</u>	<u>Operations</u>	<u>References</u>
134	Diagram ignition circuit.	M. M., p. 179.
135	Remove and replace distributor.	M. M., p. 192-193.
136	Time a single point ignition system.	M. M., p. 193.
137	Time a two-point system.	
138	Wire an ignition circuit.	M. M., p. 179.
139	Remove and clean generator.	M. M., p. 173, 190.
140	Disassemble and assemble transmission.	M. M., p. 144-149.
141	Disassemble and assemble differential.	M. M., p. 54-63.
142	Adjust differential.	M. M., p. 64, M.M.D., p. 1-28.
143	Wire complete electrical circuit.	M. M., p. 179.
144	Test condenser.	M. M., p. 194, S. S. chart 2, p. 9.
145	Test coil.	M. M., p. 195, S. S. chart 2, 4, p. 9.
146	Adjust and test distributor.	M. M., p. 193, S. S. chart 2, p. 31.
147	Test vacuum.	M. M., p. 114, S. S., p. 31.
148	Test compression.	M. M., p. 98, S. S. chart 1.
149	Test generator.	M. M., p. 173-174, 186.
150	Adjust third brush.	
151	Adjust cut-out and voltage control.	M. M., p. 186-190.

<u>No.</u>	<u>Operations</u>	<u>References</u>
152	Test starter.	M. M., p. 185.
153	Test complete ignition circuit for voltage.	C. N., p. 11-14.
154	Test battery.	M. M., p. 177.
155	Test vacuum advance.	M. M., p. 175, S. S. chart 2, p. 31.
156	Test governor advance.	M. M., p. 175.
157	Clean and adjust carburetor.	M. M., p. 111-119.
158	Test fuel pump.	M. M., p. 120-125.
159	Space plug gaps.	M. M., p. 195-196.
160	Tune motor.	C. I., p. 1-6, C. C.

LIST OF OPERATIONS

Make of CarStudebaker

Student Instruction

1. Fill in form 1, using the following list of operations as a guide.
2. Read reference material and get instructor's check before beginning a job.

<u>No.</u>	<u>Operations</u>	<u>References</u>
100	Identify motor parts.	W. C., M. M.
101	Diagram four stroke cycle engine.	T., p. 84.
102	Find the firing order of a motor.	Chev. M. M., p. 257, T., p. 100
103	Find the compression ratio of a motor.	A. M., p. 115- 116.
104	Determine the piston displacement of a motor.	A. M., p. 113- 114.
105	Clean spark plugs.	S. P., p. 1-18.
106	Remove and replace cylinder head.	M. M., p. 27, 133, job 6.
107	Remove valves from L-head motor.	M. M., p. 23, 140, job 66.
108	Remove and replace overhead rocker arm assemblies.	
109	Remove valves from overhead motor.	
110	Reface valves.	M. M., p. 24, C. I., p. 1 See instructor.

<u>No.</u>	<u>Operations</u>	<u>References</u>
111	Grind valves seats.	T., p. 107.
112	Lapp in valves with compound.	See instructor.
113	Replace L-head motor valves.	M. M., p. 140, job 66.
114	Replace overhead motor valves.	
115	Adjust L-head motor valve clearance.	M. M., p. 140, job 66.
116	Adjust overhead motor valve clearance.	
117	Remove and replace oil pan.	M. M., p. 141, job 72.
118	Remove piston assemblies.	M. M., p. 21, 140, job 61.
119	Replace piston rings.	M. M., p. 21, 140, job 64.
120	Replace piston assemblies.	M. M., p. 21, 140, job 61.
121	Replace and adjust connecting rod bearings.	M. M., p. 137, job 37, E. M., p. 26.
122	Replace and adjust main bearings.	M. M., p. 138, job 40, E. M., p. 24.
123	Remove and replace camshaft, and check valve timing.	M. M., p. 23, 20, 137, job 34.
124	Remove and replace transmission.	M. M., p. 152, job 15, p. 62.
125	Remove flywheel housing.	M. M., p. 152, job 2.
126	Remove and replace clutch.	M. M., p. 154, job 12, p. 73.
127	Remove and replace flywheel.	M. M., p. 140, job 59.

<u>No.</u>	<u>Operations</u>	<u>References</u>
128	Remove and replace oil lines and pump.	E. M., p. 20, M. M., p. 141, job 7a.
129	Attach water hose lines.	M. M., p. 149, job 7.
130	Attach cables to battery.	M. M., p. 145, job 10.
131	Test Battery connections.	C. N.P., p. 3-19.
132	Remove and replace starter.	M. M., p. 147, job 33-37.
133	Determine firing order.	Use previous knowledge.
134	Diagram ignition circuit.	M. M., p. 49, Chev. M. M., p. 255.
135	Remove and replace distributor.	M. M., p. 145, job 8, p. 43.
136	Time a single point ignition system.	M. M., p. 43.
137	Time a two-point ignition system.	
138	Wire an ignition circuit.	M. H., p. 166.
139	Remove and clean generator.	M. M., p. 42, 146, job 15.
140	Disassemble and assemble transmission.	M. M., p. 152, job 15.
141	Disassemble and assemble differential.	M. M., p. 155, job 1.
142	Adjust differential.	M. M., p. 80-86.
143	Wire complete electrical circuit.	M. M., p. 49.
144	Test condenser.	C. I., p. 5, S. S., chart 2.

<u>No.</u>	<u>Operations</u>	<u>References</u>
145	Test coil.	S. S., p. 2, 4, 9.
146	Adjust and test distributor.	S. S., p. 11, 30, chart 2.
147	Test vacuum.	S. S. chart 1.
148	Test compression.	S. S. chart 1, C. I., p. 1-3.
149	Test generator.	Chev. M. M., p. 234-248.
150	Adjust third brush.	T., p. 247-249.
151	Adjust cut-out and voltage control.	Chev., M. M., p. 240.
152	Test starter.	Chev. M. M., p. 252-253.
153	Test complete ignition circuit for voltage.	C. N., p. 11-14.
154	Test battery.	M. M., p. 52.
155	Test vacuum advance.	S. S. chart 2, p. 30.
156	Test governor advance.	S. S. chart 2, p. 30.
157	Clean and adjust carburetor.	M. M., p. 30-40, C. C.
158	Test fuel pump.	M. M., p. 29-30, S. S.
159	Space plug gap.	M. M., p. 135, job 20.
160	Tune motor.	C. E., p. 1-6, Dodge, M. M., p. 69-72.

LIST OF OPERATIONS

Make of CarTerraplane

Student Instruction

1. Fill in form 1, using the following list of operations as a guide.
2. Read reference material and get instructor's check before beginning a job.

<u>No.</u>	<u>Operations</u>	<u>References</u>
100	Identify motor parts.	W. C., M. M.
101	Diagram four stroke cycle engine.	T., p. 84.
102	Find the firing order of a motor.	T., p. 100, O. M., p. 24.
103	Find the compression ratio of a motor.	A. M., p. 115-116.
104	Determine the piston displacement of a motor.	A. M., p. 113-114.
105	Clean spark plugs.	S. P., p. 1-18.
106	Remove and replace cylinder head.	M. H., p. 32-33, S.P.B., p. 10.
107	Remove valves from L-head motor.	See instructor.
108	Remove and replace overhead rocker arm assemblies.	
109	Remove valves from overhead motor.	
110	Reface valves.	See instructor.
111	Grind valve seats.	C. I., p. 1. See instructor.
112	Lapp in valves with compound.	See instructor.

<u>No.</u>	<u>Operations</u>	<u>References</u>
113	Replace L-head motor valves.	See instructor.
114	Replace overhead motor valves.	
115	Adjust L-head motor valve clearance.	O. M., p. 19.
116	Adjust overhead motor valve clearance.	
117	Remove and replace oil pan.	See instructor.
118	Remove piston assemblies.	O. M., p. 19, S.P.B.
119	Clean and replace piston rings.	S. P., p. 10-14, O. G., p. 1-25.
120	Replace piston assemblies.	O. M., p. 19, See instructor.
121	Replace and adjust connecting rod bearings.	O. M., p. 19, E. M., p. 26.
122	Replace and adjust main bearings.	E. M., p. 26, See instructor.
123	Remove and replace camshaft and check valve timing.	O. M., p. 20.
124	Remove and replace transmission.	O. M., p. 37.
125	Remove flywheel housing.	O. M., p. 37.
126	Remove and replace clutch.	O. M., p. 20, E. M., p. 20.
127	Remove and replace flywheel.	See instructor.
128.	Remove and replace oil lines and pump.	O. M., p. 20, E. M., p. 20.
129	Attach water hose lines.	O. M., p. 31.
130	Attach cables to battery.	O. M., p. 55.

<u>No.</u>	<u>Operations</u>	<u>References</u>
131	Testing battery connections.	C. N., p. 3-19.
132	Remove and replace starter.	O. M., p. 14-29.
133	Determine firing order.	Use knowledge previously gained.
134	Diagram ignition circuit.	O. M., p. 52, S. N., Volume 12, No. 8.
135	Remove and replace distributor.	O. M., p. 23.
136	Time a single point ignition system.	O. M., p. 23.
137	Time a two-point system.	
138	Wire an ignition circuit.	O. M., p. 11-19.
139	Remove and clean generator.	O. M., p. 30.
140	Disassemble and assemble transmission.	O. M., p. 36.
141	Disassemble and assemble differential.	O. M., p. 38.
142	Adjust differential.	M.M.D. Read entire edition.
143	Wire complete electrical circuit.	O. M., p. 52.
144	Test condenser.	C. I., p. 5, T., p. 213, S. S. chart 2.
145	Test coil.	S. S. chart 2, 4.
146	Adjust and test distributor.	S. S. chart 2, p. 31.
147	Test vacuum.	S. S. chart 1.
148	Test compression.	S. S. chart 1, C. I., p. 1-3.
149	Test generator.	Chev. M. M., p. 234-248.
150	Adjust third brush.	O. M., p. 31, T., p. 247-249.
151	Adjust cut-out and voltage control.	Chev. M. M., p. 240.

<u>No.</u>	<u>Operations</u>	<u>References</u>
152	Test starter.	Chev. M. M., p. 252-253.
153	Test complete ignition circuit for voltage.	C. N., p. 11-14.
154	Test battery.	Chev. M. M., p. 240.
155	Test vacuum advance.	S. S. chart 2, p. 31.
156	Test governor advance.	S. S., p. 31.
157	Clean and adjust carburetor.	C. I., p. 1-14, C. C.
158	Test fuel pump.	Dodge, M. M., p. 88-89.
159	Space plug gap.	M. M., p. 92.
160	Tune motor.	O. M., p. 28, C. C.

Use of Job Assignment Sheet

When a car enters the shop and the repair job has been determined, a job assignment sheet is filled out.

The procedure for filling out this sheet follows:

1. Secure and record information regarding car and owner.
2. Designate students for the job.
3. Students list operations necessary to do the job. This list is to be taken from the operation sheet whenever possible, however, other operations should be added when necessary.
4. Students submit analysis of job to instructor or foreman for approval.
5. Instructor or foreman assigns operations.
6. Instructor checks job when completed.
7. Assignment sheet is then used to record operations learned by each student on progress chart.

Method of Rotating Operations

From the information recorded on the progress chart it is possible for the instructor or foreman to assign operations to the individual student so that each has the opportunity to perform all the operations listed on the progress chart.

RELATED INFORMATION

Value of Related Information

As indicated in another portion of this paper one hour each week will be devoted to the study of related information. It is difficult to impart related information in the laboratory and be sure that each student gets the benefit of the instruction. A class room situation where the students may be comfortably seated and a discussion may be carried on seems to be the best manner in which to present this phase of the course.

Related information properly given should help the students understand what they are doing in the laboratory and give them a clearer insight into the theory and operation of a gasoline engine. It is hoped also that the study and discussion will aid the student to develop an ability for analytic thinking. A thorough discussion of the working conditions and requirements of the various divisions of the trade is also very important in the related work.

Discussion and Reports

An adopted text or texts is recommended and assignments made from time to time for the students to study and later discuss. Individual assignments from other references should be made from time to time and students

asked to make oral or written reports on these readings.

Experiments and Demonstration

In addition to the textbook work and the individual assignments and reports many experiments and demonstrations should be performed by the instructor or by specialists from the outside. Motion pictures which have recently been made should be shown when they are of value and interest to the student.

Following is a master list of units with sub-divisions to be used in the related study hour.

RELATED INFORMATION UNITS

- 1 I. Gas engine theory
- 1 II. Engine parts and construction
- 2 III. Transmission
 - 2 IV. Clutches
 - 2 V. Differentials
 - 4 VI. Lubrication
- 3 VII. Electrical systems
- 1 VIII. Carburetion
- 5 IX. Brakes
 - 1 X. Cooling systems
- 5 XI. Frames, springs and shackles
- 5 XII. Front wheel suspension and adjustment
- 5 XIII. Steering gears
- 1 XIV. Motor overhaul
- 1 XV. Motor tune-up

- I. The gas engine
 - a. The four-cycle principle
 - b. Horse power and efficiency
- II. Engine parts and construction
 - a. Block
 - b. Cylinder
 - c. Piston
 - d. Rings
 - e. Wrist pin
 - f. Connecting rods
 - g. Crank shaft
 - h. Fly wheel
 - i. Valves
 - j. Cam shaft
 - k. Timing gears and chain
 - l. Manifolds
- III. Transmissions
 - a. Construction
 - b. Operation
 - c. Method of shifting for various speeds.
 - d. Universal joints
 - e. Speedometer drive
 - f. Bearings
 - g. Ratio
 - h. Drive shafts

IV. Clutches

- a. Construction
- b. Pressure plate
- c. Springs
- d. Throw out bearings
- e. Clutch fork
- f. Linings
- g. Adjustment

V. Differentials

- a. Construction
- b. Operation
- c. Care
- d. Ratio
- e. Specifications

VI. Lubrication

- a. Engine lubrication
- b. S. A. E. Viscosity
- c. Crank case change
- d. Crank case dilution
- e. Water in crank case
- f. Corrosion
- g. Water pump lubrication
- h. Accelerating pump lubrication
- i. Starting motor lubrication
- j. Clutch throw-out lubrication
- k. Dist. shaft lubrication

- l. Transmission lubrication
- m. Universal joint lubrication
- n. Rear axle lubrication
- o. Differential lubrication
- p. Front wheel lubrication
- q. Rear wheel lubrication
- r. Steering gear lubrication
- s. Shackle lubrication
- t. Oil pumps

VII. Electrical systems

- a. Theory of magnetism
- b. Electrical terms and measurements
- c. Starters
- d. Generators
- e. Coils
- f. Distributors
- g. Switches
- h. Ammeter
- i. Voltage controls
- j. Relays
- k. Lights
- l. Fuses
- m. Condenser
- n. Battery
- o. Plugs

VIII. Carburetion and fuel

- a. The float circuit
- b. The low speed circuit
- c. The high speed circuit
- d. The pump circuit
- e. The choke circuit
- f. Automatic chokes
- g. Fuel pump
- h. Theory of carburetion

IX. Brakes

- a. Mechanical
- b. Hydraulic
- c. Lining
- d. Operation
- e. Service operation
- f. Care and adjustment

X. Cooling system

- a. The radiator
- b. Thermostats
- c. Hose
- d. Water jackets
- e. Anti-freeze
- f. Water pumps
- g. Corrosion
- h. Temperature gage

XI. Frames, springs and shackles

- a. Frame construction
- b. Transverse springs
- c. Longitudinal springs
- d. Coil springs
- e. Shackle types

XII. Front wheel suspension and adjustment

- a. Plain axle
- b. Independent suspension
- c. Caster
- d. Camber
- e. King pin inclination
- f. Toe-in

XIII. Steering gears

- a. Worm and sector
- b. Cam and lever
- c. Bearings
- d. Adjustment
- e. Ratio

XIV. Motor overhaul

- a. Grind and adjust valves
- b. Replace rings
- c. Replace pins
- d. Replace pistons
- e. Replace bearings
- f. Replace gaskets

XV. Motor tune-up

- a. Test instruments
- b. Check compression
- c. Set points
- d. Set valves
- e. Set plug gap
- f. Time ignition
- g. Check carburetor

XVI. Trends in the work of automobile mechanics

- a. Preparation needed
- b. Work performed
- c. Employer-employee relations

The writer has endeavored to:

(1) List the objectives for teaching this course which are acceptable to industry, to the educator, and to the public.

(2) Describe the necessity for instructional material. What is thought to be the best and latest material in the field is used as references for the various operations.

(3) List commonly used sources and methods of securing data for this type of work. Motor and service manuals, trade journals, engineering and service bulletins, and many good text books comprise the list of reference material used in constructing the course.

(4) Instruction sheets are used in presenting the material to be taught which consists of sixty typical operations listed as far as possible in logical order.

No one can believe that job or instruction sheets will solve the many problems involved in dealing with large classes in auto mechanics. It is considered only as a valuable aid in helping to solve some of the difficulties arising where individual instruction is impossible. Any device a teacher can use to lessen his load and improve instruction is valuable.

The course is designed to permit changes as necessities arise. Automotive equipment changes so rapidly

that courses in the subject must be revised yearly to maintain standards, and if we expect to be of much value to our students, trade standards must be set up and maintained. Courses should be made flexible enough to permit continuous revision and shop fossils should be disposed of and replaced with modern equipment.

APPENDIX "A"

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- Wright, J. C., and Smith, Fred G., Automotive Construction and Operation, John Wiley & Sons, Inc., New York, 1933.

APPENDIX "B"

LIST OF STUDENT REFERENCES

A. Textbooks

- Fletcher, Gurlav L., Unified Physics, McGraw-Hill Book Company, New York, 1936.
- Kuns, Ray F., Automobile Essentials, The Bruce Publishing Company, Milwaukee, Wisconsin, 1931.
- Wright, J. C., and Smith, Fred G., Automobile Construction and Operations, John Wiley & Sons, Inc., New York, 1933.

B. Manuals, Service Bulletins and Magazines

- Automobile Shop Mathematics, D. Van Nostrand Company, New York, 1928.
- Carter Service Instructions, Carter Carburetor Corporation, St. Louis, Missouri, 1939.
- Carter Carburetor Sales and Service Manual, Carter Carburetor Corporation, St. Louis, Missouri, 1939.
- Copper Nerves, Packard Electric Division, General Motors Corporation, Warren, Ohio, 1938.
- Engine Bearing Service Manual, Federal-Mogul Corporation, Detroit, Michigan, 1939.
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- Motor's Hand Book, Motor, New York, 1938.
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- Oil and Gas Economy, Sealed Power Corporation, Muskegon, Michigan, 1939.
- Shurhit Specification Manual, Shurhit Ignition Corporation, Waukegan, Illinois.

Service News, Chevrolet Motor Division, General Motors, Detroit, Michigan.

Sealed Power Service Bulletin, Sealed Power Corporation, Muskegon, Michigan, 1939.

Spark Plug and Engine Performance, A. C. Plug Division, General Motors, Flint, Michigan, 1939.

C. Manufacturer's Manuals

Buick Shop Manual, Buick Motor Company, Flint, Michigan, 1938.

Cadillac Shop Manual, Cadillac Motor Company, Detroit, Michigan, 1938.

Chevrolet Shop Manual, Chevrolet Motor Company, Lansing, Michigan, 1938.

De Sota Shop Manual, De Sota Motor Company, Detroit, Michigan, 1938.

Dodge Shop Manual, Dodge Motor Company, Detroit, Michigan, 1938.

Ford Shop Manual, Ford Motor Company, Detroit, Michigan, 1938.

Hudson Owners Manual, Hudson Motor Corporation, Detroit, Michigan, 1938.

Nash Shop Manual, Nash Motor Corporation, Kenosha, Wisconsin, 1938.

Oldsmobile Shop Manual, Oldsmobile Motor Company, Lansing, Michigan, 1938.

Pontiac Shop Manual, Pontiac Motor Company, Pontiac, Michigan, 1938.

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Terraplane Owners Manual, Hudson Motor Corporation, Detroit, Michigan, 1938.

APPENDIX "C"

LIST OF TOOLS AND EQUIPMENT

<u>Quantity</u>	<u>Name of Tool or Machine</u>
2 only	Drag Link Socket
1 only	Universal Joint
1 only	Ratchet with Lug
1 only	Extension 5"
1 only	Set of Screw Drivers
1 only	Shop knife
2 only	Heavy Duty 7" Bench Grinder; 110 volt, 60 cycle, single phase, $\frac{1}{2}$ HP, 3450 RPM motor; 1" maximum stone width.
1 only	Spark Plug Tap, 10 mm.
1 only	Spark Plug Tap, 14 mm.
1 only	Spark Plug Tap, 18 mm.
1 only	Spark Plug Tap, 7/8--18.
1 only	Emery Wheel Dresser, star-wheel type.
1 only	Kit of Cold Chisels, containing one each of 3/8", 1/2", 5/8", 3/4", 7/8", and 1".
6 only	Black Hair Bench Brushes, 9".
1 only	Tin Snips, 3" cutters.
4 only	Wire Scratch Brushes and Scrapers.
4 only	Sets of Extra Bristles for Wire Scratch Brushes.
1 only	Hack Saw Frame
2 only	Sets Outside Micrometer Calipers, Range 0 to 4", with ratchet stop and with standards.

<u>Quantity</u>	<u>Name of Tool or Machine</u>
1 only	Teacher's Desk
1 only	Teacher's Chair
1 only	Portable Blackboard (Reversible)
40 only	Steel Frame Tablet Arm Chairs
1 only	Set Socket Wrenches and Handle
2 only	Oil Dispensing Units, 30 gallon, rectangular with pump.
1 only	Kerosene Dispensing Unit, 30 Gallon, rectangular with pump.
1 only	Welding Outfit, equipped with 25 ft. red hose and 25 ft. green hose.
1 only	Stud Extractor
1 only	Set Tappet Wrenches, 18 assorted sizes.
1 only	Set Box Wrenches, 16 assorted sizes.
1 only	Set Box End Wrenches, 7/16", 1/2", 9/16", and 5/8".
1 only	Set End Wrenches, 9 assorted sizes.
1 only	Set Crestoloy Wrenches, 6", 12", and 18".
1 only	Set Box Wrenches
2 only	Rigid Pipe Wrenches, 14" and 18".
1 only	Soldering Iron, 200 watt.
2 only	Valve Spring Compressors.
3 only	Valve Spring Lifters, Heavy Duty.
3 only	Valve Spring Compressors.
2 only	Valve Grinding Bushings.

<u>Quantity</u>	<u>Name of Tool or Machine</u>
1 only	Guide Puller Set.
2 only	Motor Lifters.
2 only	Piston Ring Compressors and Handle
1 only	Set of Speed Wrenches.
2 only	Sets Ignition Wrenches.
4 only	Sets Spark Plug Sockets
1 only	Growler
1 only	Cylinder Gauge
1 only	Combination Vacuum and Compression Tester.
1 only	Holding Tool
3 only	Gauge Holders
1 only	Discharge Cell Tester
1 only	Soft Face Hammer
1 only	50 ft. Extension Cord
2 only	50 ft. Drop Light & Cord
1 only	50 ft. Drop Light & Cord
1 only	15 ft. Tow Chain and End Hooks
2 only	Safety Gasoline Cans, 1 gallon.
1 only	Galvanized Funnel, 1 quart.
2 only	Galvanized Funnel Measures, 2 quarts.
1 only	Oil Measure, flexible spout, 6 quarts.
1 only	Funnel Measure, 1 pint.
12 only	Oil Cans, 1 pint Rigid Spout, Heavy Steel.

<u>Quantity</u>	<u>Name of Tool or Machine</u>
1 only	Portable Electric Drill, 1/2".
1 only	Portable Electric Drill, 1/4".
1 Only	Freezometer
4 only	Screwdrivers, 4".
1 only	Screwdriver, 6".
1 only	Screwdriver, 8".
1 only	Screwdriver, 1".
1 only	Machinist's Screwdriver, 4 1/2".
1 only	Machinist's Screwdriver, 8 1/2".
1 only	Machinist's Screwdriver, 1 3/4".
1 only	Adjustable Pliers
24 only	Combination Pliers, 6".
1 only	Side Cutting Pliers, 8".
2 only	Thin Combination Pliers, 6".
1 only	Battery Pliers
20 Only	Screwdrivers, 4".
1 only	Set Socket Wrenches, 1/2" to 3/4 x 16ths
1 only	Wire Stapler
1 only	Chain Hoist, 1 ton
1 only	Screw Clamp, 14".
2 only	Screw Clamps, 6".
1 only	Ball Bearing Trolley, Self-aligning for 6" 1 beam to hold 1 ton differ- ential hoist.
1 only	Gas Plate, 2 burner
6 only	Putty Knives

<u>Quantity</u>	<u>Name of Tool or Machine</u>
2 only	Moulding Tools
1 only	Bunsen Burner
18 only	File Cards, Wood Back
3 only	Hand Drills
1 only	Valve Seat Grinder
1 only	Valve Grinding Indicator
1 only	Set Valve Grinding Stones
1 only	Set Tapered Expanding Valve Grinding Pilots; 5/16", 11/32"; 3/8"; 13/32"; 19/32".
1 only	Expanding Valve Guide Cleaner
1 only	Valve Face Grinding Machine
1 only	Combination Spray Gun Set
12 only	Extra Cans for Combination Spray Gun Set
1 only	Motor Driven Air Compressor, complete with Motor.
1 only	Oil and Moisture Separator and Air Regulator
7 only	Automobile Storage Batteries, 6 volt
2 only	Spark Plug Cleaners
1 only	De Soto Automobile Motor
1 only	Dodge Automobile Motor
1 only	Terraplane Automobile Motor
1 only	Hudson Automobile Motor
1 only	Studebaker Automobile Motor
1 only	Cadillac or La Salle Automobile Motor

<u>Quantity</u>	<u>Name of Tool or Machine</u>
1 only	Ford V-8 Automobile Motor
1 only	Buick 8 Automobile Motor
1 only	Oldsmobile 6 Motor
1 only	Pontiac 8 Automobile Motor
1 only	Plymouth Automobile Motor
1 only	Nash Automobile Motor, type 400
1 only	Chevrolet Motor
500 only	Visible Filing Pockets, for 8" x 5" Cards
6 only	Ball Pein Hammers, 8 oz.
1 only	Motor Analyzer, complete with cabinet stand and instrument panel, including voltage regulator unit and vacuum compression unit which produces vacuum.
1 only	Hi-Speed Press, 32" between side frames, 28 ton, with two pressure blocks, two vise blocks, and two sections of 6" channel steel.
3 only	Hand Star Drills 1/2" x 12"
3 only	Hand Star Drills 1" x 18"
3 only	Hand Star Drills 3/4" x 18"
3 only	Hand Star Drills 1 1/4" x 18"
1 only	Steel Tape 50' x 3/8"
2 only	Hydraulic Jacks
1 only	Sensitive drill
1 only	9" lathe
1 only	Rear axle Stand

APPENDIX "D"
LIST OF SUPPLIES

<u>Quantity</u>	<u>Name of Item</u>
3 pounds	5/16" S.A.E. Plain Washers
4 pounds	3/8" S.A.E. Plain Washers
3 pounds	7/16" S.A.E. Plain Washers
3 pounds	1/2" S.A.E. Plain Washers
100 only	1/4" lead corks
1 dozen	12" smooth cut flat files
1 dozen	10" hack saw blades, 18 teeth
25 feet	No. 1 battery cable
50 only	Eyelet battery cable terminals
20 only	Radio type battery terminals
1 dozen	Master battery clips
5 dozen	Junior battery clips
1 only	Hand bulb battery filler
200 feet	7 mm. ignition cable
100 feet	14 ga. ignition cable
1 only	Terminal crimper
100 only	Plug clips
100 only	Plug clips
100 only	Distributor clips
50 only	Plug terminals
50 only	Angle plug terminals
100 only	3/16" eyelet terminals
1 gross	1" x 6/32" R. H. brass machine screws
1 gross	1" x 8/32" R. H. brass machine screws

<u>Quantity</u>	<u>Name of Item</u>
1 gross	6/32" hex brass nuts
1 gross	8/32" hex brass nuts
100 only	5/16" x 1/2" N. C. hex hd. cap screws
100 only	5/16" x 1 1/2" N. C. hex hd. cap screws
100 only	3/8" x 1" N. C. hex hd. cap screws
100 only	3/8" x 3" N. C. hex hd. cap screws
100 only	1/2" x 1 1/2" N. C. hex hd. cap screws
100 only	5/16" x 1" N. F. hex hd. cap screws
100 only	3/8" x 1" N. F. hex hd. cap screws
100 only	3/8" x 2" N. F. hex hd. cap screws
100 only	5/16" N. F. nuts
200 only	3/8" N. F. nuts
100 only	7/16" N. F. nuts
100 only	1/2" N. F. nuts
100 only	5/16" N. C. nuts
200 only	3/8" N. C. nuts
100 only	7/16" N. C. hex nuts
100 only	1/2" N. C. hex nuts
100 only	3/8" N. F. hex nuts castle
100 only	No. 6 S.A.E. lock washers
100 only	No. 8 S.A.E. lock washers
100 only	3/16" lock washers
100 only	1/4" lock washers
100 only	5/16" lock washers

<u>Quantity</u>		<u>Name of Item</u>
100	only	3/8" lock washers
100	only	7/16" lock washers
100	only	1/2" lock washers
3	pounds	No. 6 S.A.E. plain washers
3	pounds	No. 8 S.A.E. plain washers
3	pounds	3/16" plain washers
4	pounds	1/4" plain washers
6	only	1 pint all steel oil cans
1	sq. yd.	1/16" gasket material
1	sq. yd.	1/32" gasket material
10	only	Split plug connections, unbreakable rubber spring action
2	only	4 oz. cans penetrating oil
2	only	1 lb. cans fine valve compound
6	only	8 oz. rolls friction tape
2	bars	50-50 solder
18	only	1 lb. spools acid core solder
2	only	1 lb. spools rosin core solder
2	only	1 lb. spools plain solder
5	pounds	3/32" pure soft lead wire
1	only	Center reamer
2	each	Taps, 1/4" N. F.
2	each	Taps, 5/16" N. F.
2	each	Taps, 3/8" N. F.
2	each	Taps, 7/16 N. F.
2	each	Taps, 1/2" N. F.
50	feet	2" OD flexible exhaust tubing

<u>Quantity</u>		<u>Name of Item</u>
100	feet	Braided 5/8" heavy duty, wash rack hose
4	only	Ammeters
2	only	Ignition coils
2	only	Ignition coils
50	only	18. mm. spark plug gaskets
100	only	14 mm. spark plug gaskets
10	only	Ford V-8 starter switches
2	only	Distributor caps
10	only	Distributor rotors
11	only	Ignition condensers
100	only	3/16" x 1" R.H. stove bolts and nuts
100	only	3/16" x 2" R.H. stove bolts and nuts
100	only	1/4" x 1 1/4" R.H. stove bolts and nuts
100	only	1/4" x 2" R.H. stove bolts and nuts
100	only	3/16" x 1" F.H. stove bolts and nuts
100	only	3/16" x 2" F.H. stove bolts and nuts
100	only	1/4" x 1 1/4" F.H. stove bolts and nuts
100	only	1/4" x 2" F.H. stove bolts and nuts
100	only	5/16" x 3" F.H. stove bolts and nuts
1000	only	1/16" x 1" cotterpins
1000	only	3/32" x 1" cotter pins
1000	only	1/8" x 1 1/2" cotter pins
50	only	Spark plugs
24	only	Ignition points
6	only	Distributor caps

STRATHMORE PARCHMENT

100% RAG U.S.A.

Typist:

T. Anne Cochran

PARCHMENT

100