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ABSTRACT

Realizing that the community college serves in a special capacity through the development of varied and flexible curriculms, this program guide was developed by the Automobile Manufacturers-American Vocational Association Industry Planning Council. For the benefit of administrators and curriculum specialists, it gives a setting for associate degree programs in automotive service/management and provides specifics about its application. Two-year curriculums (four semesters and an institutional or cooperative summer program) are outlined for associate degrees in Auto Service/Management and in Truck Service/Management. Course descriptions include credit hours and class and laboratory hours. Additional information covers: (1) guidance and selection of candidates, (2) instructor qualifications, (3) facilities, (4) tools and equipment, and (5) industry cooperation. (JS)

Community College Guide for Associate Degree Programs in Auto and Truck Service/Management

Prepared for educators and industry
as a special project of
The Automobile Manufacturers-
American Vocational Association
Industry Planning Council

in cooperation with the
Service Managers Committee
Automobile Manufacturers Association, Inc.
320 New Center Building
Detroit, Michigan

Editorial consultation: Bud Goodman, Inc.

Foreword

Associate degree programs in automotive service/management are relevant to today's students, schools, and communities.

This publication gives both a setting for such education and provides specifics about its application.

It is our hope that teachers, board members, presidents, deans, and members of the business community will recognize in this field of study a challenge and an opportunity.

We in industry recognize the contribution being made by our nation's post-secondary institutions. With this "Guide" we indicate our deep interest and our continuing support.

NORRIS G. WILTSE
Chairman, Service Managers Committee
Automobile Manufacturers Association

Service Managers Committee

NORRIS G. WILTSE, *Chairman*
General Service Manager
Kaiser Jeep Corporation

JOHN BATES
Director of Service
General Motors Corporation

GEORGE E. BROWN
General Service Manager
American Motors Corporation

G. J. CUTLER
Manager, Product Service
Chrysler Corporation

NORMAN KRANDALL
National Service Manager
Ford Division
Ford Motor Company

Automobile Manufacturers-American Vocational Association Industry Planning Council

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Wisconsin Board of Education

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Co-Chairman (*Industry*)
Service Planning-Marketing Staff,
Ford Motor Company, Michigan

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Director, Educational Services,
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Michigan

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North Carolina

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Los Angeles City School Districts, California

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Chairman,
Department of Vocational Education &
Practical Arts, School of Education,
University of Michigan

Resource

LOUIS GODLA
Director of Vocation Education,
Fairfax County School Board, Virginia

FRANK P. PLOVICK
Service Promotion & Training Manager,
Delco-Remy Division, General Motors
Corporation, Indiana

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"They're always changing the damn things."

Marc Connelly, Pulitzer Prize playwright, recalls in his autobiography, *Voices Offstage*, a visit with Henry Ford senior.

Connelly notes:

"Mr. Ford invited me to ride with him to hear the music of the organ just installed in the newly completed Greenfield Village chapel in Dearborn.

"It was a warm spring day and as we approached the chapel my host stopped the car so that we could hear from a distance the strains of 'Pomp and Circumstance.'

"After listening for a minute, Mr. Ford suggested that we say hello to the organist. He released the car's brakes and attempted to start the ignition. The engine did not respond. He pulled this, turned that, pressed knobs and pedals. He shook his head, looked at me and sighed:

" '*They're always changing the damn things*'."

* * *

The year was 1931. The "damn things" were, indeed, changing.

Plymouth offered "floating power" rubber engine mountings, Buick went to an eight-cylinder engine, Oldsmobile adopted a synchromesh transmission.

Freewheeling was available on Chrysler, Dodge, Plymouth, Lincoln and others—remember the Marmon, Peerless, Pierce-Arrow, Willys-Knight, Hudson and Essex?

Thirty-one was the year a retractable, hardtop convertible was patented and directors of the National Automobile Chamber of Commerce recommended a standard passenger-car warranty of 90 days or 4,000 miles.

In 1931, a GMC truck and refrigerated trailer delivered 21 tons of California fruit to New York in 117 hours running time, "proof" of the "efficiency of the motor truck as practical for transporting perishable goods." Today trucks haul some 65 percent of fruit and vegetables to the nation's leading markets.

On that spring day in Greenfield Village when Mr. Ford spoke of change, there were some 26 million cars, trucks and buses on the road.

By 1975 it is estimated the number will be 118 million.

Change and growth. These are "as true as taxes is. And nothing's truer than them."

In 1931, there were some 300-plus "junior" colleges, most of them private institutions. Today there are nearly three times that number, most of them part of the public school system. Total enrollment is approaching two million.

What does this onward-and-upward arithmetic mean? What is the relationship between the dynamics of the automotive industry and the two-year college?

Consider this:

"The Community requires . . . certain kinds of knowledge and skill to carry on its economical and other activities; and it is the business of the schools to turn out young people equipped with such forms of knowledge and skill."

And this:

"If we give our pupils the knowledge which is 'of most worth'—that is the knowledge which had indispensable practical value in regulating the affairs of life—we shall at the same time give them the best possible mental training; for it is incredible that the pursuit of the best kind of knowledge should not also afford the best mental discipline."

Within the framework of these two statements (the first by Sir T. Percy Nunn, onetime principal of London Day Training College and professor of education, the University of London; the second, by Herbert Spencer) is the *common denominator* for *auto industry* and *community college.*

The key phrases, perhaps, are:

"*The community requires certain kinds of knowledge and skill . . .*"

"*Knowledge which has indispensable practical value.*"

What knowledge and skill does the community require that the community college can provide?

Is this knowledge truly of "indispensable practical value?"

Let's take another look at the automobile.

The auto makers, like educators, anticipate tomorrow's needs today.

Cars, trucks and special-purpose vehicles must meet the increasing transportation requirements of a society whose social and economic structure demands mobility.

In the expanding automotive market, the buyer is knowledgeable and critical. He welcomes—and, in fact insists on—styling innovations. But he is also concerned, and rightfully so, with design and engineering improvements.

"They're always changing the damn things."

Better performance, greater reliability, increased safety, extra comfort, more convenience—these are changes the consumer expects, these are demands that manufacturers, in an intensely competitive field, are obliged to meet.

That's not all. A nation on wheels insists that those wheels keep turning, that cars and trucks operate at peak performance, that service and maintenance facilities are easily available and professionally staffed.

Keeping those wheels turning is no longer a simple matter of personal convenience, family fun or isolated commercial concern.

- Nearly 80 percent of all U.S. families own automobiles.
- More than 90 percent of inter-city travel is by automobile.
- More than 1,000 billion motor-vehicle miles are logged each year.
- Nearly 90 percent of all commuting workers use automobiles to get to and from the job.
- School buses carry more than 40 percent of public school students.
- More than 50 percent of manufacturers' intercity tonnage is hauled by trucks. Over 10 million men and women are employed in truck transportation, working to move some 600 million tons of intercity freight alone.

The service market, generated by the auto-transportation industry, is a more than $14 billion a year business. This "aftermarket," representing the sale of automotive parts and labor, is bigger by-the-dollar than annual total car sales.

The curve is pointing up—in numbers and percentages.

This is a national not a regional phenomenon. Every community is involved. One business in every six depends on the manufacture, distribution, servicing and use of motor vehicles.

The service market is opportunity—not a knock-once opportunity but a continuing and expanding opportunity for professionals in auto and truck service/management.

The "vehicles population" is growing at a much faster rate than the supporting service industry and has been for more than 20 years.

The service market is opportunity for the community college to provide "certain kinds of knowledge and skill" of "indispensable practical value."

The community requires this knowledge and skill. The community colleges are, in large measure, best structured to meet the community need.

Now then, some questions:

Is a course of study leading to an associate degree in auto (or truck) service/management consistent with the educational and community responsibility of your college?

How about student interest? Are professional automotive careers appealing—earnings, status? What are the prerequisites for associate degree candidates? Is recruiting a problem?

Curriculum? What would comprise an acceptable minimum standard? Is the curriculum flexible enough to permit a "mix" of academic subjects needed if the student decides to continue his education in a four-year college?

Facilities, tools and equipment? What are needed?

Teachers? Qualifications?

There are, indeed, a great many questions. We'll try to provide some of the answers.

Guidance, Counseling and Selection of Candidates

"Test Your Skill—Put the Round Bottles in the Square Holes"

Signs with that intriguing suggestion turn up now and then on soft-drink vending machines. The idea: To encourage customers to put empties back in the cases stacked near the machines.

With bottles, it's easy. With people, it won't work.

As Sydney Smith, 19th Century clergyman, philosopher and wit, once observed:

"We find that the triangular person has got into the square hole, the oblong into the triangular, and a square person has squeezed himself into the round hole."

And, as a result, the "doer and the thing done seldom fit so exactly that we can say they were almost made for each other."

Successful recruiting of candidates for associate degree courses in auto service/management requires an "almost made for each other fit."

Career opportunities must fit the candidate's—

- Social and economic goals
- Personal and professional potential
- Self-image

In turn, the candidate must satisfy the college's acceptance standards and together—candidate and college—must satisfy the needs of the growing and expanding automotive service industry.

First, how do we fit the candidate and the college? How are qualified young men attracted to service/management? How does the school reach out to these young people?

It is improbable that any considerable number of young men (or women) ever decided independently on an automotive service career.

Too often auto service is equated only with mechanics rather than management. This is understandable. College-level, associate degree courses in this field are relatively new.

There is therefore a communications problem—one of telling rather than selling. There is a story to tell and an audience for the story.

In its broadest terms, the recruit reservoir can be measured by estimates of the U.S. Department of Health, Education and Welfare. Of every 10 who start high school, seven are graduated and three of the seven go on to further education.

This national audience is being reached, with increasing effectiveness, by the automotive industry and related businesses.

The community audience can be reached by the college through a public-service oriented communications program.

The local audience for the service/management story is primarily among high school students who are seeking guidance and counseling from faculty advisors in choosing a career and in extending their education to prepare for that career. It is essential, therefore, that guidance and counseling specialists are provided with "information kits" and that liaison is established between the secondary school specialists and the college.

Students with vocational training in automotive skills (at the secondary school level) may well be of associate degree caliber.

Beyond the recruit reservoir in the high schools (and the vocational schools), there are other pools of potential, including those who can participate part time, evening or day.

These sources often disclose areas of interest and leadership (management) capability beyond in-school achievement. Lines of communication can be established among:

- Franchised auto dealerships and their service departments
- Auto service centers (operated by department stores, retail chains, oil companies)
- Retail gasoline stations (and dealer associations)
- State employment offices
- Church groups—(Young People's Fellowship, CYO and others)
- The NAACP, Urban League and similar organizations
- Local branches of national new and used car dealers' associations
- Local branches of national auto service organizations
- Independent garages

Guidance, Counseling and Selection of Candidates

- Explorer Scout Posts (Special interest posts emphasize automotive design, styling, engineering, safe-driving, hot rods. Co-operating in these Explorer activities are auto manufacturers and such groups as the Sports Car Club of America)

A recruiting relationship in this area involves the community with the program and identifies and strengthens the college's community role.

Further, in some instances, the recruiting campaign will open placement opportunities for service/management graduates.

The audience is defined. How do we tell the story?

The answer, of course, is the communications program, a locally-developed effort.

Emphasis is on the increasing need for auto-service specialists and management personnel; the opportunity this provides for qualified young men (and women); how the school makes it possible for young people to embrace the opportunity.

It's simple but not easy.

Background material on the dynamics of the industry, the "aftermarket," growth patterns, employment potential and sought-after skills is readily available from the Automobile Manufacturers Association and other authoritative sources.

This information provides the "core" for guidance and counseling "information kits," for press releases, for speakers appearing before school and community groups, for the college catalog and as a direct recruiting tool.

Advantage can be taken of public-service "talk" and "interview" programs on local radio and TV; school pages in daily and weekly newspapers; the scholastic press; house organs (church, civic, fraternal as well as commercial).

Personal contact and direct mail open the way for speaking engagements before student and other groups; participation in school Career Days. Panel discussions can be developed in cooperation with auto industry representatives, service/management personnel and others.

In telling the service/management story to potential associate degree candidates the college's minimum entrance requirements must be clearly stated.

"Is it for me?" is as important a question for the student as "What's in it for me?"

An acceptable minimum educational prerequisite for an associate degree course is, generally, a high school diploma or equivalent. The "equivalent" permits some flexibility in considering older applicants, dropouts, returning veterans and applicants "from the industry."

In these categories, and others, it would appear that in-depth interviews, aptitude and personality testing are required for that "almost made for each other fit."

One educator has suggested that a success profile for an "automotive technician" would show an individual who—in some measure and in some circumstances—

- helps turn ideas and theories into actual results
- works with scientists and engineers
- is involved in the making of decisions
- uses his talents in bringing decisions to a practical conclusion
- works in a blend of doing and thinking
- is a cross between an engineer and mechanic
- is one with more mechanical skill than the engineer and more engineering theory than the mechanic
- is ready for employment on graduation

Guidance, Counseling and Selection of Candidates

- can work on a project alone
- can work with/supervise a crew of mechanics
- can interpret and work from drawings
- can interpret written instructions
- can identify problems if and when encountered
- can analyze and resolve problems
- is coherent in oral communication
- is coherent in written reports which may include drawings and graphics
- has knowledge of world and people around him
- can appreciate and enjoy life
- can contribute to society

It takes a big man to measure up to a big opportunity.

And that opportunity presents a big challenge to the individual and the school.

In auto-industry terms we have, to this point, considered:

- *the market*—jobs, careers, opportunities, change, growth
- *raw material*—sources, availability, standards and specifications, quality and quality control
- *the product*—automotive technicians with "more mechanical skill than the engineer, more engineering theory than the mechanic."

Next is manufacturing, turning the raw material into a product to meet the needs and demands of the market.

Manufacturing is, in effect, the college—plant, facilities, personnel, tools and equipment.

And curricula, the working blueprint and master plan.

Curricula

Professional manager-technician curricula for careers in automobile and truck service were developed to meet the needs of the student and industry within accepted educational disciplines.

The curricula are structured to insure that:

- The graduate will be prepared to take an entry job in automotive service in which he will be productive
- The training, with a reasonable amount of experience, should make it possible for the graduate to advance to positions of increasing responsibility
- The foundation provided by the training is broad enough so that the graduate can do further study—for advanced standing or by transfer to a four-year college

Further, the curricula reflect four elements considered basic:

- Functional utility
- Units of instruction in specialized technical subjects
- Provision for the teaching of principles by application
- General education values

The curricula, suggested as a minimum requirement for an associate degree in service/management, demands two years of full-time study, including one summer session, to provide 68 semester-credit hours of instruction.

In special cases—financial or other personal problems—provisions can be made for a student to withdraw from school with an option to reenter at a more favorable time. Students leaving for temporary jobs to finance their education should be encouraged and assisted in finding work in some area of the automotive industry.

The recommended minimum curricula result from several years of cooperative effort by qualified professionals and practitioners in education and the automotive industry. *It is the consensus* of those who developed the study outline *that the basic structure* and *content not be revised.*

Because this is a minimum program, deletions, substitutions or other substantive changes could result in an imbalance that would handicap the graduate in seeking employment and in job advancement.

General education elements in the program are vital. The subjects were selected to develop qualities of leadership in the graduate, to enable him to work with others and communicate effectively in his own field of technology and in his relationships with the public.

In the total program, the emphasis on science, mathematics and technology provides a foundation which will enable the graduate to deal with problem-solving situations he will encounter because of the continuing changes in motor-vehicle technology.

Local conditions may warrant modifications in non-core segments of the curriculum. Local administrators or instructors might decide to offer technical courses of special local interest.

The curriculum recognizes and anticipates the inevitable introduction of new materials, new processes, new production techniques and new engineering developments.

Today's technology will not be adequate to service and repair tomorrow's auto, trucks and buses.

Curricula

Consider one of the once "simple" items—electrical wiring.

The manager of one auto manufacturer's development department makes the point:

"In the first 'one-lungers,' there was a wire from the spark plug to a magneto, connected through a simple on-off switch and grounded. Then someone added a second cylinder, and two more, and then you needed a distributor to make sure the cylinders fired in the right order.

"Then came electric headlamps, and then tail lamps and parking lamps and turn signals and backup lights and warning lights for overheating and low oil pressure and cigarette lighters and ammeters and lights in glove compartments and under the hood and in the trunk, and lights overhead with switches in the doors, and an upper beam indicator and electric clocks and courtesy lamps and tape players and fuel gauges and a light to tell you your emergency brake is set, and electric two-speed windshield wipers and power windows and power seats and air conditioning . . .

"Our little straggle of wires has become a mass of colored conductors tied into bunches half as big around as your arm . . . "

These curricula are directed to provide the student with a background in basic science and technology and with skills that he can call on to help him solve problems resulting from progress.

Provided in the course of study is a measured "mix" of classroom instruction, laboratory experience and "hands on" work experience with actual vehicles and components.

To capitalize on the interest, enthusiasm and desire that led students to enroll in the program, *technical courses* are *introduced* in the *first semester*.

Two curricula follow. First, for an Associate Degree in Auto Service/Management; second, for an Associate Degree in Truck Service/Management.

Included, too, are suggested criteria for summer program credits, course descriptions, a detailed outline of the course in Business Organization and Management and suggested guidelines for determining advanced standing.

Curriculum
Auto Service/Management

First Year

Semester I

	Credit Hours	Class Hours	Laboratory Hours
Communication Skills I	3	3	0
Mathematics I	3	3	0
Engines	5	2	3
Electricity	4	2	6
Service Orientation and Maintenance	3	1	6
Total hours	16	11	15

Semester II

	Credit Hours	Class Hours	Laboratory Hours
Service Management I	2	2	0
Mathematics II	3	3	0
Suspension and Brakes I	3	2	3
Auto Accessories	3	2	3
Engine Diagnosis and Tune Up	3	2	3
Cranking and Charging Systems	2	1	3
Total hours	16	12	12

Summer Program *(Institutional or cooperative with industry.)*

During the summer session, the school will arrange programs with local dealerships to provide school-supervised work and study experience on operational vehicles. If institutional facilities are adequate, programs providing this type of practical experience may be scheduled at school.

Instruction or working experience should concentrate on: Tune-up, Electrical, Brakes, Chassis Service, Engines, Transmission and Drive Lines, Service Orientation and Maintenance. Maximum of 4 credit hours.

Second Year

Semester III

	Credit Hours	Class Hours	Laboratory Hours
Social Science I	3	3	0
Science I	3	2	3
Suspension and Brakes II	2	1	3
Transmissions and Drive Lines	3	2	3
Service Management II	2	2	0
Accounting and Business Organization	3	3	0
Total hours	16	13	9

Semester IV

	Credit Hours	Class Hours	Laboratory Hours
Social Science II	3	3	0
Science II	3	2	3
Electrical Circuits	2	1	3
Communication Skills II	3	3	0
Elective	3	1	6
Air Conditioning	2	1	3
Total hours	16	11	15

Curriculum
Truck Service/Management

First Year

Semester I

	Credit Hours	Class Hours	Laboratory Hours
Communication Skills I	3	3	0
Mathematics I	3	3	0
Engines	3	2	3
Electricity	4	2	6
Service Orientation & Maintenance	3	1	6
Total hours	16	11	15

Semester II

	Credit Hours	Class Hours	Laboratory Hours
Service Management I	2	2	0
Mathematics II	3	3	0
Suspension and Brakes I	3	2	3
Fuel Systems	3	2	3
Engine Diagnosis and Tune-Up	3	2	3
Cranking and Charging Systems	2	1	3
Total hours	16	12	12

Summer Program *(Institutional or cooperative with industry.)*

The summer program requires student participation in industry-sponsored schools conducted at facilities operated by truck manufacturers, producers of truck engines or truck components. If this is not feasible, arrangements may be made to bring industry-sponsored instruction to the classroom. Arrangements must be made annually for this type of study.

As an alternate or supplementary approach, schools will arrange a program with local automobile dealers or fleet operators to provide school-supervised work and study experience on operational vehicles or components. If institutional facilities are available, program providing practical instruction may be scheduled in the school laboratory. Maximum of 4 credit hours.

Second Year

Semester III

	Credit Hours	Class Hours	Laboratory Hours
Social Science I	3	3	0
Science I	3	2	3
Air Brakes	2	1	3
Transmissions and Drive Lines	3	2	3
Service Management II	2	2	0
Accounting and Business Organization	3	3	0
Total hours	16	13	9

Semester IV

	Credit Hours	Class Hours	Laboratory Hours
Social Science II	3	3	0
Science II	3	2	3
Electrical Circuits	2	1	3
Communication Skills II	3	3	0
Elective	2	1	3
Refrigeration and Air Conditioning	3	2	3
Total hours	16	12	12

Suggested Criteria for Summer Program Credits

Summer sessions are an integral part of the associate degree curricula. These sessions, it will be noted, are conducted on an institutional basis, in cooperation with industry, or in combination.

Credit for work experience has been proposed—provided that:

- A plan of work experience is approved by the school advisor before the student starts work.
- The student works full time in the approved field for two weeks (80 hours) for each credit to a maximum of eight weeks and four credits.
- The student submits weekly summaries of the work experience to the school advisor.
- The student submits a comprehensive report at the end of the work period with emphasis on relating the experience to the employment objective.
- The student and employer are visited and counselled (at least two) during the work-experience period and an evaluation of the learning experience is made by a field supervisor.

Curricula

Course Descriptions

Accounting and Business Organization

CREDIT HOURS 3 CLASS HOURS 3 LABORATORY HOURS 0

Business management procedures related to automotive service and industrial operation. Fundamentals of accounting and accounting systems. Exposure to basic business machines. Record keeping, preparation of income and expense statements, credit control. Parts department practices and procedures. Explanation of parts operation from warehouse to local level with systems of inventory, ordering, receiving, claims, material return examined. Emphasis on salesmanship and merchandising within the parts operation.

Air Brakes

CREDIT HOURS 2 CLASS HOURS 1 LABORATORY HOURS 3

Theory and principles of air brake systems, design and function. Problems, service, maintenance. Mechanics of single and double-action compressors, cooling systems.

Air Conditioning

CREDIT HOURS 2 CLASS HOURS 1 LABORATORY HOURS 3

Principles, design, construction, installation, maintenance, removal, problems and service of automotive air conditioners, including temperature controls and air distribution. Nomenclature, testing and troubleshooting. Safe service procedures.

Auto Accessories

CREDIT HOURS 3 CLASS HOURS 2 LABORATORY HOURS 3

Service and repair of power-operated accessories, including: seats, windows, convertible tops, decks, headlights, doors, locks, antennas, windshield washers and wipers, testing units, gauges, signaling, warning and speed-control devices.

Communication Skills I

CREDIT HOURS 3 CLASS HOURS 3 LABORATORY HOURS 0

Spelling, vocabulary, sentence structure, organization of essays, oral communication, business correspondence and forms, writing of technical reports (using illustrations and drawings), analysis of written material for tone, style and clarity. Individual speech analysis, business and social conversation, information talks, explanations and demonstrations. Supplementary reading assignments, including suitable models for the student in his writing.

Communication Skills II

CREDIT HOURS 3 CLASS HOURS 3 LABORATORY HOURS 0

Directed to help the student understand others and to make himself understood. Practice is provided in developing business reports, group speaking, oral reading, analysis and discussion of general and technical periodical material. The general objective is to provide a graduated scale of activities to help the student achieve a greater competency of expression and a sense of confidence in communicating his thoughts and ideas. Supplementary reading assignments are in the novel, short story and poetry. Techniques in preparing and writing research papers are explored.

Cranking and Charging Systems

CREDIT HOURS 2 CLASS HOURS 1 LABORATORY HOURS 3

Comprehensive instruction on components and circuitry in cranking and charging systems. Function, design, operation, repair procedures, problem analysis, use of tools and instruments.

Electricity

CREDIT HOURS 4 CLASS HOURS 2 LABORATORY HOURS 6

Fundamental theory, Ohm's Law, circuit identification, electrical symbols, magnetism, induction, generators, alternators, motors. Use of such test equipment as the voltmeter, ammeter, ohmmeter and other devices used in troubleshooting and diagnosing automotive electrical problems. Principles of automotive electrical systems are studied including: batteries, charging, cranking and ignition systems, electrical and electronic diagnostic equipment, transistor circuits and electronic control devices.

Electrical Circuits

CREDIT HOURS 2 CLASS HOURS 1 LABORATORY HOURS 3

Intensive study of chassis and body wiring diagrams as basis for diagnosis of malfunctions. Replacement (or repair) of lights, horn and accessory circuits, gauges, signal and warning devices. Use of testing instruments and tools. Mockup circuits are built on test panels in the laboratory. Experiments are conducted on generators and alternators with disassembly and assembly of all electrical components.

Engines

CREDIT HOURS 3 CLASS HOURS 2 LABORATORY HOURS 3

Major objective is to offer the student practical experience in engine maintenance and service. Foundation knowledge in engine theory and repair. Principles, design, construction, operation and service procedures are studied. Development of work skills and proficiency in engine rebuilding are emphasized. The student learns to disassemble, clean, inspect, service and assemble an engine.

Curricula

Engine Diagnosis and Tune Up

CREDIT HOURS 3 CLASS HOURS 2 LABORATORY HOURS 3

Diagnosis and tune-up procedures as they pertain to the function and control of the engine with emphasis on the fuel, ignition, starting and charging systems. The student is given a broad background in diesel, propane, butane and gasoline fuel applications. Types of carburetion are studied along with diagnostic procedures for exhaust and fuel system malfunctions. Students perform tests with oscilloscopes, generator, regulator, alternator testers, battery starter testers and distributor testers. Presented, too, are operation principles of fluid couplings, torque converter planetary gears, servos, multiple disc clutches, hydraulic circuitry, disassembly and assembly procedure and diagnosis, adjustment and repair. Laboratory time is spent working with necessary equipment in measurement, machining and replacement of worn parts and testing.

Fuel Systems

CREDIT HOURS 3 CLASS HOURS 2 LABORATORY HOURS 3

Introduction of fuel system service for trucks and heavy vehicles. Function, construction, operation, troubleshooting and service of fuel systems. A thorough study of diesel fuels, primary and secondary fuel, distribution and fuel injection.

Mathematics I

CREDIT HOURS 3 CLASS HOURS 3 LABORATORY HOURS 0

Basic algebra and trigonometry. Review of mathematical expressions, notations, fundamentals, and the laws of exponents. Trigonometric functions, angular measure using degree and radian measurement, and the development of sine and cosine laws. Slide rule and its use in multiplication, division, powers, roots, combined multiplication and division and use of the C1 scale.

Mathematics II

CREDIT HOURS 3 CLASS HOURS 3 LABORATORY HOURS 0

Advanced algebra, including an introduction to and use of logarithms and an explanation of exponential equations. Functional notation, graphs of curves and the solution of problems by utilizing simultaneous linear equations. Special products or expansions, factoring, operation with fractions, complex fractions, solution of formulas and practical problem solving. Introductory analytical geometry involving linear equations is studied as it relates to slopes of straight lines, the slope intercept formula and sketching graphs.

Refrigeration and Air Conditioning

CREDIT HOURS 3 CLASS HOURS 2 LABORATORY HOURS 3

Principles, design, construction, installation, removal, repair and troubleshooting of truck air conditioners and refrigerators. Temperature controls and air distribution.

Service Management I

CREDIT HOURS 2 CLASS HOURS 2 LABORATORY HOURS 0

Various types of business organizations are studied in relation to the automotive industry, wholesale and retail, with final focus directed to the automotive service department. Service department management covered in depth, ranging from the large organization to the smaller shop. The conventional line method of management is stressed.

Service Management II

CREDIT HOURS 2 CLASS HOURS 2 LABORATORY HOURS 0

The human relations aspect of management is applied to the service department in the areas of employer-employe relationships, customer relations and interdepartmental relations. Students are given an understanding of the role and function of an automotive service manager, staff responsibilities and procedures for completing the service of customer vehicles.

Service Orientation and Maintenance

CREDIT HOURS 3 CLASS HOURS 1 LABORATORY HOURS 6

Students perform minor maintenance and service on working vehicles, such as lubrication, minor adjustments, replacing simple components, correcting malfunctions, appearance reconditioning on used cars and preparing new cars for delivery.

Science I

CREDIT HOURS 3 CLASS HOURS 2 LABORATORY HOURS 3

Basic physical principles as applied to modern automotive technology. Included are: precision measurement, properties of matter, mechanics of liquids and gases, force, motion, work, energy, power, analysis of basic machines, temperature and effects of heat, thermal expansion, calorimetry, change of state, heat transfer, elementary thermodynamics, heat engines, refrigeration and air conditioning.

Science II

CREDIT HOURS 3 CLASS HOURS 2 LABORATORY HOURS 3

General physics including: wave motion, sound, acoustics, nature of light, illumination, reflection, refraction, interference, diffraction, polarization, magnetism, electrostatics, basic AC and DC electric theory, circuits and ma-

chines and brief overviews of electronics and nuclear energy. Some metallurgy and fabrication methods as they apply to metal parts.

Social Science I

CREDIT HOURS 3 CLASS HOURS 3 LABORATORY HOURS 0

American social and political institutions related to contemporary problems. An examination of the impact of industrialization and urbanization on the family, religion, education and government; the American political system and its constitutional foundations; international relations. The processes and determinants of overall economic activity: income and employment, demand and supply, money and banking, monetary and fiscal policy, economic growth, consumer and personal economics.

Social Science II

CREDIT HOURS 3 CLASS HOURS 3 LABORATORY HOURS 0

Motivation, feelings, emotions and learning are considered with particular reference to their application to on-the-job problems. Other topics investigated are intelligence and aptitude tests, employe selection, supervision, job satisfaction, personal and group dynamics, mental hygiene.

Suspension and Brakes I

CREDIT HOURS 3 CLASS HOURS 2 LABORATORY HOURS 3

Nomenclatures of suspensions and brakes, theory of operation and service procedures on automotive suspension systems, brake systems, wheels and tires, steering gears and related components.

Suspension and Brakes II

CREDIT HOURS 2 CLASS HOURS 1 LABORATORY HOURS 3

Power systems, major components and suspension correction procedures for light frame damage; advanced alignment techniques.

Transmissions and Drive Lines

CREDIT HOURS 3 CLASS HOURS 2 LABORATORY HOURS 3

Maintenance and servicing techniques of driveline units, such as clutch assemblies, manual and automatic transmissions, propeller shafts and joints, final drives and differentials. Practical experience in disassembly and reassembly of working units.

Electives

The fourth semester curricula provide three credit hours for an elective course comprising one class hour, six laboratory hours.
Suggested as examples of typical electives:

Chemistry

Basic principles of inorganic chemistry, nomenclature, chemical calculations and laboratory techniques, major elements and compounds, their chemical reactions, atomic and nuclear structure and the nature of chemical bonds.

Economics

Economic systems, the role of business, government, labor; income distribution, the money and banking system, the national income and national product and their determination.

Manufacturing Processes

Technical fundamentals of the major manufacturing processes, engineering materials and the machine tools used in processing materials.

Metallurgy

Introductory course in metallurgy, following metals or their ores from the mining process through refinement and purification, the admixture or alloying of metals, to their end use by industry. Development of new metals.

Technical Drafting I

Introduction to the theory of engineering drawings, their content and the instruments and skill necessary to make acceptable drawings. Topics include geometric constructions, lettering and the theory and practice of orthographic projection.

Technical Drafting II

Advanced course on technical drafting, giving the student an opportunity to apply his skills to working situations. The range of work covers pictorial representation, sections, auxiliary views and an introduction to dimensioning.

Curricula

Because of the special nature of the Automotive Associate Degree program, two specific areas of instruction may require special guide lines: Accounting and Business Organization, and Service/Management I and II.

Suggested Course Outlines for Accounting and Business Organization & Service/Management I and II

I. Orientation to the Auto Industry

II. Common Channels of Distribution

A. Franchises
   1. Long line
   2. Allied lines

III. The Service Department

A. Managing
   1. Service managers responsibilities
      a. Personnel
      b. Facilities
      c. Establishing objectives
      d. Controlling performance
         - Traffic control
         - The repair order

Controlling performance (*cont'd*)
- Work schedules
- Mechanics efficiency record
- Daily operations control
- Evaluation of return service
- Evaluation of customer satisfaction

B. Service layout
   1. Traffic flow
      a. Parking—customers, personnel
      b. Vehicle storage
      c. Vehicle protection
   2. Space utilization
      a. Quick service
      b. Get ready
      c. Reconditioning
      d. Body and paint
   3. Building facilities
      a. Air
      b. Electricity
      c. Lighting
      d. Ventilation
      e. Heating
      f. Drains
   4. Structural facilities
      a. Obstructions
      b. Access

C. Service equipment
   1. Diagnosis and adjustment services
   2. Lubrication, wash, tire, undercoat, etc. services
   3. Repair services
   4. Body and paint services
   5. New car preparation
   6. Used car reconditioning

D. Personnel management
   1. Selection
      a. Job description
      b. Selection procedure
   2. Training
      a. Indoctrination
      b. The training program
      c. Continuation of training
   3. Supervision
      a. Motivation
      b. Leadership
   4. Compensation (incentive-time schedule)

E. Merchandising
   1. Pricing, discounts and payment plans
   2. Attracting customers
   3. Selling additional services
      a. Sell service and services
      b. Incentive for additional sales
      c. Display
      d. Follow-up
   4. Advertising
      a. Newspaper
      b. Direct mail
      c. Telephone
      d. Radio
      e. Other media

F. Promotion
   1. Planning promotions
      a. Set objectives
      b. Determine budget
      c. Instruction
   2. Execution
   3. Analyze results

G. Customer relations
   1. Pre-delivery and get ready
   2. Delivery
   3. Follow-up
   4. Handling the customer
   5. Customer complaints (dissatisfaction)
   6. Adjustments—Warranty

IV. The Parts Department

A. Facilities
   1. Size
   2. Location
   3. Arrangement
      a. Bins and racks
      b. Parts managers offices
      c. Doors, lights, counters, aisles

Curricula

Arrangement (*cont'd*)
- d. Shipping and receiving area
- e. Displays
- f. Security
- g. Files, control system, counter equipment, catalog holders

B. Personnel
1. Selection
   a. Job description
      - parts sales manager
      - counterman
      - outside salesman (wholesale)
      - inventory control man
   b. Selection procedure
2. Training
   a. Indoctrination
   b. The training program
   c. Continuation of training
3. Supervision
   a. Motivation
   b. Leadership
4. Compensation plans and incentives

C. Establishing objectives
1. Parts sales objectives
2. Department and individual objectives

D. Controlling performance
1. Daily operating control
2. Weekly and monthly control

Controlling performance (*cont'd*)
3. Scheduling, delegating and follow-up
4. Expense control
   a. Overhead expense
   b. Indirect expense
   c. Fraud and theft

E. Stock
1. Balanced inventory
   a. Overstock; understock
   b. Inventory turnover
2. Purchase control
3. Stock ordering
   a. Parts classification
   b. Types of orders

Considerations for determining advanced standing

Credit will be based on previous education and/or work experience. Maximum credit allowed for any course should not exceed local credit standards for similar courses.

Procedures and Requirements

A. Applications for advanced standing for credits earned in other educational institutions should be made to an accrediting committee. Credit granted for advanced standing should be temporary and subject to revision at the end of the first semester following enrollment.

B. Students should be in residence at the school for one year to be eligible for graduation and degree honors.

C. The diploma awarded to graduates from accredited programs should not be presented unless the students have obtained satisfactory achievement in their major fields.

D. Accrediting Committee: The local accrediting committee for advanced standing should consist of three staff members who could be the Instructional Supervisor, Department Head, and one other person. Their findings to be submitted to the school director for approval.

E. The school evaluating advance standing reserves the right to determine questions of doubt on advanced standing by tests or examinations.

F. Grades of less than "C" should not be considered for credit evaluation.

G. The responsibility for evidence of credits earned at other educational institutions should rest upon the student.

In assessing credits based on previous education, the accrediting committee may find helpful the publication, "Standards for Automotive Service Instruction in Secondary Schools," a project of the Automobile Manufacturers—American Vocational Association Industry Planning Council.

The manual is available, at no charge, from:

AM-AVA Industry Planning Council
Automobile Manufacturers Association
320 New Center Building
Detroit, Michigan 48202

Instructor Qualifications

" . . . the value of a true teacher?

"Give me a log hut, with only a single bench, Mark Hopkins on one end and I on the other, and you may have all the buildings, apparatus and libraries without him."

The words are those of an Ohio congressman—born along a canal towpath, a carpenter, farmer, professor of ancient languages, a college president at 26 and President of the United States—James Abram Garfield.

Hopkins, of course, was the educational innovator and president of Williams College, from which Garfield was graduated in 1856.

But where do you find a Mark Hopkins today, a "true teacher" capable of preparing candidates for associate degrees in automotive technology? What are the requirements for instructors in this field?

It is not suggested that instructors be capable of conducting classes "in a log hut" without proper facilities, tools and equipment. But they should have:

- Broad technical competence in the automotive service industry
- A depth of knowledge in the academic subjects equalling or surpassing that completed by associate degree graduates
- Knowledge and understanding of teaching and learning
- Knowledge of student needs and interests
- A broad understanding of society

Many states have well-defined certification standards which must be met if a program is to qualify for State and Federal funds. Further, most post-secondary institutions have developed criteria for selecting instructors. The above qualifications, therefore, are stated in general terms so that they may apply to instructors in many situations.

The following combinations of educational and industrial experiences are recommended and considered preferable, but are not the only avenues of preparation of instructional personnel:

1. two (2) years of appropriate experience and a B.S. degree which is based on an associate degree in Automotive Technology.
2. two (2) years of appropriate experience with a B.S. Degree in Education with a specialization in Automotive Service.
3. four (4) years of appropriate experience and a Baccalaureate.

Experience in an appropriate field should be recent and broad in scope so as to insure technical competency.

The technical content proposed in this manual demands that the laboratory instructor has experience in

1. Engines
2. Engine Tune-up
3. Suspensions
4. Brakes
5. Transmissions and drive lines
6. Electrical systems, etc.

Resource Personnel

Resource persons should be used to supplement full time instructors; they may be used to teach certain short-term or specialized areas such as: service/management, personnel management and air conditioning.

Instructor Qualifications

Continuing Education

With the rapid increase in automotive technology, a program of continuing education is necessary to avoid obsolescence in service procedures and techniques.

Continuing education for the instructor can be achieved by attending courses at the college or university level, at manufacturer's training schools and workshops, by participation in meetings of professional and technical societies, through reading and contributing to the technical and professional literature.

Consideration should be given to the instructor's participation in these activities, as well as formal courses in education, when determinations are made for salary increases, professional advancements, and certificate renewal.

In the secondary school "Standards" manual, referred to in the section on Curricula (Advanced Standing), several instructor recruiting techniques are discussed. "Standards" suggests:

"Teachers should have a creative interest in *students* who might be developed into *good instructors.* These young men will be the students with intense interest in the subject, especially in the fine points of the operation of mechanical devices. They will have above-average skills. They should possess skills in the area of communication—speaking and, to a lesser degree, writing. Most of all, they should exhibit an intellect, temperament and personality adaptable to teaching in both shop and classroom.

"Often overlooked are the possibilities of *recruiting* capable men from the *automotive trades,* men who are not attending schools. These men can be discovered only by the observations of *shop supervisors, service managers,* or *car dealers,* who will recognize in their work force men with noticeable talents in training helpers or in explaining mechanical conditions to others.

"A major problem in this field is how to expose men with this background to teaching without jeopardizing their present job connections. The most desirable solution would be to arrange locally for a *leave of absence* from regular employment to permit handling a specific teaching assignment on a *trial basis for one semester*. Following this experience, the individual will usually be able to make a sound decision as to entering teaching—full time, part time, or not at all.

"The requirements for individuals from industry to teach automotive courses vary, but most states will issue temporary or provisional teaching certificates to those who have a high school diploma and several years of trade experience, provided they complete, or agree to complete, several college level teacher preparation courses. These courses might include principles of vocational and adult education, teaching methods and aids, educational psychology, and course development.

"In some instances colleges will allow credit toward a degree for trade experience, usually after the completion of a written and a performance test, and an oral examination.

"In some states, a standard teaching certificate will be issued to replace the provisional certificate after the required college level courses have been completed, along with several years of satisfactory teaching. It is thus possible for a working automobile mechanic, with a high school education and with specific skills and interests, to enter teaching, secure more education, and become a competent and successful instructor."

Recruiting in this area for resource personnel, potential instructors and instructors reinforces the college's role as a relevant force within the community.

Now, let's look at some "log huts" and a bench or two. What facilities and equipment are needed?

Facilities

Facilities is a rascally word.

Torn loose from its Latin roots, this once pure and precise noun has been forced into what Fowler would describe as elegant variations.

Chicken coops have become poultry facilities; a one-burner gas plate is a cooking facility. There are golf, swimming, eating, drinking, boating, medical and military facilities.

Here the concern is automotive facilities, within the definition of Webster's New World Dictionary of the American Language.

Facilities:

"The means by which something can be more easily done."

Providing "the means" is not "easily done." Even under optimum conditions—adequate money, suitable land, and plans that express the functional needs of the project—a facility for teaching automotive technology presents a challenge.

If existing buildings are to be used, the challenge is sharper. Although budgets may be limited, there need be no limitation on imagination, innovation and old-fashioned "make-do."

A starting point, for a new building or an upgrading of present facilities, might be a resources inventory. The planning guidelines included in this section were established principally for schools considering a new-building program. The suggestions, however, can be adapted to programs for remodeling, refurbishing or extending existing facilities.

The fourth edition of "Standards of Automotive Service Instruction in Secondary Schools" contains scale drawings of facilities layout and design, covering:

- Entrance requirements
- Ideas for aisle and stall arrangements
- Relationship of aisle to stall width
- Typical requirements for 45, 60 and 90-degree stalls
- Suggested arrangement of a mechanical stall and a body repair stall

- Floor detail showing trench drain and interceptor detail
- Suggested floor plan using several stall drive-in doors
- Arrangement using one main drive-in door
- Typical automotive body training facility
- Automotive hand tool shop
- Automotive chassis shop
- Automotive engine shop
- Suggestions for the construction of bases for running engines
- Suggested transmission shop
- Automotive electrical shop
- Collision damage and reconditioning shop

The secondary schools "Standards" manual is available as noted on page 42.

In addition, manufacturers provide dealerships with "model" service department plans, layouts and equipment recommendations that can be helpful and often can be obtained locally. In some cases, franchised dealers have easy access to slidefilms and related materials on service department construction, expansion and upgrading.

* * *

Marcus Porcius Cato, who some 2,200 years ago handled words like "facilitas" and "facilis" with facility, had some advice on acquiring a farm that, in part, is appropriate to planning the automotive facility.

"Be not over eager in buying nor spare your pains in examining. Do not be hasty in despising the methods of management adopted by others . . . see that it be equipped as economically as possible and that the land be not extravagant . . . it should be well-furnished (but) however great the income, if there is extravagance, little is left."

Here, then, is a guide for an automotive educational facility in which something can be more easily and effectively done.

Facilities

Land Area

The land area needed for the automotive facilities varies with the type of program and number of students.

State and local building codes relative to the location of automotive facilities near schools, residences, thoroughfares, public occupancy buildings, and other legal requirements should be checked.

Building

The area needed for the building varies. Its size (a minimum of 10,000 square feet for 16-20 students is suggested) depends, however, on the type of facility and on the size and number of the classes.

Entrance

The entrance to any lab should not be from a busy thoroughfare. The recommended distance between the sidewalk and the shop doorway should not be less than 25 feet. The driveway should be a minimum of 12 feet wide. The entrance approach and doorway should provide a straight entrance into the shop. Avoid sharp turns at the entrance way. The grade approaching the doorway should be as slight and gradual as possible, consistent with good drainage (15 percent maximum).

Outside Storage Area (Fenced, Lighted)

Land area should be provided for outside storage of such units as will be used in the laboratories. There should be two units of storage area for every unit used in the lab and should be in close proximity to the lab.

Safety Area

The automobile facilities and storage facilities may be required by code to be a certain open land space distance from other areas in the vicinity.

I. Building

A. Doors

1. (Vehicle Entrance Doors) The door or doors for vehicle entrance should be of the overhead type, carefully counter-balanced and electrically operated. The opening should be at least 12 feet clear in width for passenger cars, 14 feet for trucks. The height of the door should be 10 feet clear when fully open for cars and 15 feet for trucks.
   The large doors should be fitted with windows except in the lower segment.

2. (Personnel Doors) A small door for personnel use should be located adjacent to or near the main vehicle entrance door. It must comply with fire codes.
   The student entrance should be a double door, 6 feet opening minimum, and 7 feet high. Mullions should be removable. Doors should be equipped with panic bars. At least two exits from the shop should be provided, as this practice will reduce the personal hazard in case of fire.

B. Floors

1. Laboratory floors should be a grease resistant floor tile or treated concrete.

C. Stalls (The following stall dimensions to enable efficient vehicle movement will serve as a general guide)

1. Stall width
   a. Fourteen Foot
      - Hoist stalls
      - General service stalls
      - Wash stalls
   b. Twenty Foot
      - Dynamometer
      - Alignment
2. Stall length
   a. Should be 25′ minimum

D. Walls

1. Exterior walls should be glazed, light-colored block or some other smooth ceramic surface for a height of not less than 8 feet.

2. Interior partitions should be constructed of material that would allow flexibility.

E. Ceilings

1. Ceiling heights should be based on 17 feet minimum, clear of obstructions for passenger car and medium truck service. Reinforcements may be required for monorail or other installations.

2. Because of a school situation, the use of acoustical material should be a prime consideration.

F. Windows

1. Windows of the fixed type or with adequate mechanical ventilation provided.

2. If windows are used, consideration should be given to heat diffusing glass. Skylights are not recommended.

G. Lab Storage Area

There are several classifications of storage concerns that should be individually planned such as:

1. General storage
2. Tool panels
3. Volatiles and flammables

Check the local and state codes for regulations concerning types and locations of storage areas.

H. Lecture Area

A classroom should be provided reasonably near the lab area. Blackboard space, bulletin board, projector, screen, teacher station, files should be provided. Provision for closed circuit television is recommended.

II. Utilities

A. Water

A hot and cold water supply is needed for instructional and maintenance purposes, as well as for personal needs. It is highly recommended that a drinking fountain be provided within the shop, and wash-up facilities are essential.

B. Sewer

The sewer system must be provided with special grease and sand traps prior to the enclosing of conduits. The floor of each lab should have a properly graded drain, accessible and easy to clean.

C. Electrical

Electrical outlets should be placed at approximately 10 foot intervals around the room.

No outlets should be less than 4 feet above the floor. Outlets should be wired for 115V, 60 cycles, alternating current, single phase circuits. It is considered good practice not to exceed four outlets per fuse or circuit breaker. Three phase, 230V current should be wired into the room for necessary ventilating fans, and specialized automotive equipment with motors which develop over ½ H.P. Master emergency "stop" switches should be included in all power circuits preferably near each exit door. Each machine should be relay controlled to prevent the machine starting unexpectedly when the master switches are activated.

D. Communications

A signal system should provide a means for giving the clean-up call. Installation of the regular school change-of-class bell and a public address system speaker is also recommended. It is desirable to have a noise proof telephone.

E. Lighting

The direct lighting system should provide for a minimum illumination of 100 foot-candles at 30″ above the floor level.

F. Sprinkler System

The paint booth should be provided with an automatic sprinkler system in addition to the portable fire extinguishers and a fire alarm box in the general facility.

Facilities

III. Heating, Cooling, and Ventilating

A. Heating

In addition to the normal heating, cooling, air cleaning, and ventilating requirements, it is necessary to consider such items as comfort floor temperature, effective hot air compensation for heat loss at outside door areas, and zone heating control.

B. Ventilating

1. Positive air movement should be provided to minimize carbon monoxide danger in all areas of the facility.
2. The operation of a service facility necessitates a high volume exhaust system.
3. Sufficient conditioned air change should be considered in the design of the ventilating system to provide adequate protection against specific conditions such as toxic gases, common air contamination and loss of temperature control.
4. Local and state health regulations should be followed for safe operating conditions.

C. Engine Exhaust

1. An external-fan system of ventilation is required to carry away the exhaust from running engines. The underground system is to be connected to openings in the floor (two for each car stall and one for each engine stand) to which one end of a flexible conduit may be attached, the other end being attached to the tail pipe of the car or the engine exhaust pipe.
2. Relatively quiet, a forced convection fan of ample capacity should be provided.
3. For those situations where underground vents are impractical, an overhead exhaust or individual exhaust system may be used. The exhaust duct system should be designed to allow for corrosive condensate.

D. Cooling

Some sections of the country need air conditioning facilities.

Tools and Equipment

Christien Thomsen, an early 19th Century archeologist, once ventured that human history is divided into three parts.

The first, when metal was unknown, and all tools were made of wood, stone and bone.

Second, when the smelting of copper and its hardening with tin produced bronze.

Finally, when man learned to prepare and work iron.

But, as Mr. Ford remarked of his Model "A" back in 1931,

"They're always changing the damn things."

Tools go in and out of fashion, changes in automotive design often change service procedures. As a result, new tools and equipment are needed. Obsolescence and wear must be considered in budget estimates. Quality and replacement warranty are prime purchase factors.

Catalogs of tool manufacturers, some of them covering thousands of items, are excellent "shopping guides" and reference works. Instructors, and others involved in purchasing, should be acquainted with local suppliers and manufacturers' representatives.

Auto manufacturers' service manuals, revised regularly, are the best source of information on special service tools required in the assembly, disassembly and testing of particular components.

In this section a check list for a "basic student tool kit" is included. This is in keeping with the retail service tradition of a technician "owning" the hand tools he uses most frequently. However, some instructors may prefer that all tools be drawn as needed from a school toolcrib on an individual check-out basis.

The secondary school "Standards" manual suggests an amortization plan for budgeting and replacement of tools, equipment and supplies.

Hand Tools
No set schedule, replace when obsolete or worn out

Special Tools
No set schedule, replace when obsolete

Service Equipment
5 years—update to meet current manufacturer's specifications, replace when worn out

Testing Equipment
5 years—update to meet current manufacturer's specifications

Automotive Assemblies and Components
3 years—replace when obsolete or worn out

Tool "life," obviously, is related to proper use, care and maintenance. In course descriptions, the phrase "use of tools" includes care. Some instructors have found that a general introduction to the history and development of hand and machine tools is helpful in creating respect and appreciation for tools.

The tools, equipment and supplies listed here are generally found in auto-dealership service establishments. Quantities, of course, can be decided only on an individual school basis depending on student enrollment. The list is a guide, basic but flexible.

Tools and Equipment

Automotive Laboratory General Equipment

Benches, work bench cabinet type 28″ x 72″, combination study, work and audiovisual
Cable, extension 14 ga. min., 3 conductor
Compressor, air—air and water cleaner
    Hose, air, 25′ length, ¼″ I.D., complete with ¼″ pipe fitting and should be equipped with "quick disconnects", 4-6
    Hose, water, 50′ length ½″ I.D., 2-3
Containers
    Can, gasoline, safety, size to be determined by local safety code.
    Can, dirty rags, covered
    Can, waste, covered
Covers
    Fender (2 per vehicle)
    Seat
Creepers, 6-12
    Flat, head rest with casters
Dispenser, lubricant fluid
Drain, lift, 5 gal. capacity
Drills
    electric, heavy-duty ¼″ with 90° attachment with stand and accessories
    electric, heavy-duty ½″ with stand and accessories
Drill press, bench model and accessories
Dynamometer, chassis type with accessories
Glasses, safety
Grinders
    pedestal, heavy-duty ½″ h.p. (grinding wheel-wire brush combination)
    pedestal, heavy-duty ½″ h.p. (7 "X" wheels), 1 fine grit, 1 coarse grit
Jacks
    Bumper, air, hydraulic
    Hand, hydraulic, 2 ton-8 ton capacities
    Service, hydraulic, 2 ton capacity
    Service, hydraulic, 5 ton capacity
    Transmission, hydraulic
Lifts
    Frame contact
    Frame contact (surface mounted or portable)
    Twin post
Lubrication equipment
    chassis, air, low-high pressure with adapters hand gun
Pans, oil drain
Stands
    Hi-lift, used with lift
    Safety, adjustable

Shop Tools

A kit of hand tools should be available to each student. The general laboratory tools should include 3 additional student kits plus the following:

Bars, pry
Brushes
- Parts cleaning
- Wire, wooden handle, also motor driven

Busters
- Nut
- Rivet

Calipers 6″ I.D.
Calipers 6″ O.D.
Cans, oil
C-Clamps, assorted sizes
Chisel-punch sets, 2
Cord, extension
Cutter, bolt
Dispensers, oil, engine, transmission
Drills
- Fractional set 1/16″ through ½″
- Numbered set 0 through 80
- Spark plug drills and taps

Droplights, reel type
Extractor, screw (set)
Files, assorted, with handles
Gauges
- Feeler set, flat
- Thread

Gun, air blow
Hammers
- Ball pein 4 oz. to 32 oz.
- Plastic
- Rubber
- Sledge

Knives, putty
Leads, jumper
Metric sized tools, appropriate, where required
Pans, water drain
Pliers
- Diagonal 7″
- Hose clamp
- Needle nose 6″
- Slip joint
- Snap ring external
- Snap ring internal
- Snap ring truarc, internal, external, assorted tips
- Vise grip 5″-8″

Pullers, universal
- Axle
- Bearing
- Gear
- Steering wheel

Tools and Equipment

Saw, hacksaw, adjustable frame
Scale, 6″
Scraper, carbon
Screwdrivers
- Allen
- Clutch head, set
- Phillips, set
- Standard 1¼ to 12″

Snips, tin
- Curved
- Straight

Socket sets
- ¼″ drive
- ⅜″ drive
- ⅜″ drive, universal sockets
- ½″ drive, 6 point and 12 point
- ¾″ drive
- ½″ drive, deep sockets

Stethoscope
Stone, oil
Stud removing set
Tap and die set
Tap set, spark plug and drain plug
Vise, 4″ jaw, heavy-duty

Wrenches
- Box set, short
- Box set, long
- Open end, ⅜″ to 1⅛″
- Open end, box combination
- Pipe set, 6″, 10″, 18″
- Torque
  - 0-120 in/lbs
  - 0-150 ft/lbs
  - 0-250 ft/lbs

Basic Student Tool Kit—Chassis Service

1/2" Drive
Ratchet 10"
Breaker Bar
2-1/2" Extension
10" Extension
Universal Adapter
Socket 1/2"
Socket 9/16"
Socket 5/8"
Socket 11/16"
Socket 3/4"
Socket 13/16"
Socket 7/8"
Socket 15/16"
Socket 1"
Socket 1-1/16"
Socket 1-1/8"

3/8" Drive
Ratchet
3" Extension
6" Extension
Speed Wrench
Socket 3/8" (Regular)
Socket 7/16" (Regular)
Socket 1/2" (Regular)
Socket 9/16" (Regular)
Socket 5/8" (Regular)
Socket 11/16" (Regular)
Socket 3/4" (Regular)
Socket 1/2" (Deep)
Socket 9/16" (Deep)
Socket 5/8" (Deep)
Socket 11/16" (Deep)
Socket 7/16" Universal
Socket 1/2" Universal
Socket 9/16" Universal
Socket 5/8" Universal
Socket 11/16" Universal
Socket 5/8" (Spark Plug)
Socket 13/16" (Spark Plug)

Adapters
3/8" Male—1/2" Female
1/2" Female—3/8" Male

1/4" Drive
Ratchet
2" Extension
Socket 3/16" (Regular)
Socket 1/4" (Regular)
Socket 5/16" (Regular)
Socket 3/8" (Regular)
Socket 7/16" (Regular)

Wrenches
Box Wrench 1/4" x 9/32"
Box Wrench 5/16" x 3/8"
Box Wrench 3/8" x 7/16"
Box Wrench 7/16" x 1/2"
Box Wrench 9/16" x 5/8"
Box Wrench 11/16" x 3/4"
Box Wrench 13/16" x 7/8"
Box Wrench 15/16" x 1"
Open End Wrench 1/4" x 5/16"
Open End Wrench 5/16" x 3/8"
Open End Wrench 7/16" x 1/2"
Open End Wrench 1/2" x 9/16"
Open End Wrench 9/16" x 5/8"
Open End Wrench 5/8" x 3/4"
Open End Wrench 11/16" x 3/4"
Open End Wrench 13/16" x 7/8"
Open End Wrench 15/16" x 1"
Allen Wrenches (7) with Case

Hammers
Hammer, Ball Peen 12 oz.
Hammer, Ball Peen 24 oz.
Hammer, Rubber
Hammer, Plastic

Screwdrivers
Straight Screwdriver 2-1/2"
Straight Screwdriver 6"
Straight Screwdriver 8"
Phillips Screwdriver #1
Phillips Screwdriver #2—9/16"
Phillips Screwdriver #2—4-1/4"

Pliers
Pliers, 6-1/2" Slip-Joint
Pliers, 7" Diagonal
Pliers, 6-3/4" Needle-Nose
Pliers, 8" Vise-Grip
Pliers, Hose Clamp

Miscellaneous
Punch, Drift 10-1/4" x 3/8"
Punch, Pin 1/8"
Punch, Pin 1/16"
Chisel, 1/2"
File, Mill 10"
File, Round 8"
File, Ignition Point
Scratch Awl
Magnetic Pickup Tool 18"
Gasket Scraper
Feeler Gauge Set:
.0015" thru .040"
Wire Brush
Spark Plug Gauge Set:
.022", .025", .027", .028", .030", .032", .035", .040"

Torque Wrench 0-150 lb. ft. w/Ratchet Head

Tool Box

Tools and Equipment

Basic Student Tool Kit—Body Service

1/2" Drive

Ratchet
Flex Head
3" Extension
6" Extension
Socket 1/2"
Socket 9/16"
Socket 5/8"
Socket 11/16"
Socket 3/4"
Socket 13/16"
Socket 7/8"
Socket 15/16"
Socket 1"

3/8" Drive

Ratchet
3" Extension
6" Extension
Universal Joint
Socket 3/8" (Regular)
Socket 7/16" (Regular)
Socket 1/2" (Regular)
Socket 9/16" (Regular)
Socket 5/8" (Regular)
Socket 11/16" (Regular)
Socket 3/4" (Regular)
Socket 13/16" (Regular)
Socket 3/8" (Deep)
Socket 7/16" (Deep)
Socket 1/2" (Deep)
Socket 9/16" (Deep)

1/4" Drive

Ratchet
2" Extension
6" Extension
Nut Spinner
Sliding Bar
Universal Joint
Socket 3/16" (Regular)
Socket 7/32" (Regular)
Socket 1/4" (Regular)
Socket 9/32" (Regular)
Socket 5/16" (Regular)
Socket 11/32" (Regular)
Socket 3/8" (Regular)
Socket 7/16" (Regular)
Socket 1/2" (Regular)
Socket 3/8" (Deep)
Socket 7/16" (Deep)
Socket 1/2" (Deep)

Wrenches

Adjustable Wrench 10"
Combination Wrench 1/4"
Combination Wrench 5/16"
Combination Wrench 11/32"
Combination Wrench 3/8"
Combination Wrench 7/16"
Combination Wrench 1/2"
Combination Wrench 9/16"
Combination Wrench 5/8"
Combination Wrench 11/16"
Combination Wrench 3/4"
Combination Wrench 13/16"
Combination Wrench 7/8"
Ratchet End Wrench 3/8" x 7/16"
Ratchet End Wrench 1/2" x 9/16"

Screwdrivers

Straight Screwdriver 4"
Straight Screwdriver 8"
Straight Screwdriver 12"
Straight Stubby Screwdriver
Phillips Screwdriver #1
Phillips Screwdriver #2
Phillips Screwdriver #3
Phillips Stubby Screwdriver

Pliers

Pliers 8" Slip-Joint
Pliers, Diagonal
Pliers, Vise Grip 7"

Metal repair hand tools

General Purpose Dolly
Roughing Dolly
Toe Dolly
Utility (Pick) Hammer
Dinging Hammer
Curved Face Hammer
Ball Peen Hammer 24 oz.
Long Curved Spoon
Dinging Spoon
Short Chisel Bit Pick
Flat Body File w/Wood Holder
Shell File w/Wood Holder
Hack Saw

Miscellaneous

Line-Up Punch 12"
Center Punch 6"
Chisel 6"
File, Mill 10"
Door Inside Handle Tool
Door Trim Removal Tool
Scratch Awl
Tin Snips

Tool Box

Visual Aids

Projectors
- 16 mm motion picture projector and stand
- 35 mm filmstrip projector (tape and record)
- Overhead projector

Reproducers
- Ditto master producer
- Transparency producer

Screens

Teaching machines (programmed instruction)

Air Conditioning and Refrigeration

Educational Assemblies

Compressors
Condensers
Controls
Evaporators
Mockup (operational) air conditioning systems
Tubing

Equipment

Portable air conditioning service station including:
- Equipment, test and charging
- Equipment and tools, special, to overhaul and service different makes and models
- Tools, general hand

Tools and Equipment

Brake Systems

Educational Assemblies

Assemblies, complete, including wheel, brake cylinder, linkage, master cylinder, and foot pedal for instruction on brakes (hydraulic and air brake units)
Assemblies, disc brake
Assemblies, individual brake (front and rear)
Components, air brake, (compressor, brake actuators, treadle valve assembly, and tank and valve assembly)
Display board, exploded view display of units, such as: master cylinder, wheel cylinders, power brake cylinders, etc.

Equipment and Special Tools

Brake drum
    Lathe with attachments
    Micrometer
Brake shoe
    Adjusting tools
    Grinder
    Retaining spring pliers
Clamps, wheel cylinder
Disc brake equipment for cutting and grinding for proper finish
Flaring tool (double flare) and tubing cutter kit
Hone, cylinder
Pliers, brake spring
Pressure bleeder and accessories
Puller, wheel and axle
Testing station, brake performance
Wrenches, bleeder valve box

Electrical Systems

Educational Assemblies

Alternators and regulators, 10
Assemblies, windshield wiper motor, 5
Batteries, 10
Coils and condensers (disassembled units are available from manufacturers)
Display boards
    Individual circuits (cranking, ignition, charging, lighting, etc.) mounted on separate boards
Distributors, units from current model vehicles including distributors used with transistorized systems, 10
Generators and regulators, D.C., 10
Motors, cranking
Relays
Solenoids, 10
Spark plugs, with insulator tip color and condition showing different heat range conditions
Wiring, complete system, all units operational

Equipment and Special Tools

Alternator
- Alternator-generator test bench, speeds 0-5000 rpm
- Service tool kit
- Test equipment

Armature
- Growler
- Lathe and under cutter

Battery
- Chargers
  - Fast charge
  - Slow charge
- Service tools
  - Cable pliers
  - Carrier
  - Cleaning equipment
  - Terminal pliers
  - Water container, syringe
- Testers
  - Batteries, 12v.
  - Hydrometer
  - Light load
  - Starter tester

Diode testing equipment

Distributor tester, off-the-car

Dynamometer, chassis (portable controls) (not recommending dual purpose equipment, e.g. engine and break testing combinations)

Engine analyzer, complete, should include: Oscilloscope, tach-dwell meter, cylinder leakage tester, ohmmeter, ignition advance tester, vacuum gauge, coil-condenser tester, exhaust gas analyzer

Gauges
- Spring tension
- Spark plug feeler

Headlight aimer (portable)

Indicator, dial

Light(s), timing

Pliers, insulated

Pullers (generator-alternator drive pulley)

Pulse amplifier for pointless distributors

Rheostat, variable

Scope simulator

Spark plug
- Adapter set
- Cleaner and tester
- Sockets, insulated, various sizes
- Taps 14MM, 18MM

Voltage regulator tool kit

Volt-amp meter

Wrench kit, ignition

Tools and Equipment

Engine Area

Educational Assemblies

Assemblies, head, 10. The head assemblies should include the valve, valve spring retainers and rocker arm assemblies. A variety should be chosen to represent those currently being used.
Assemblies, piston and connecting rod
Camshafts (good condition and others with worn lobes)
Cutaway Units
- Assembly, head
- Assembly, manifold, showing heat control valve
- Assembly, piston and connecting rod
- Engine cylinder and cooling system
- Pump, oil
- Pump, water

Display board showing a variety of oil seals and retainers
Display board of engine bearings (comparison of good and defective units)
Display of timing gears and timing chain and sprockets
Engines, cylinder, mounted in portable stands, 5-6, (complete and in running condition). These engines should be reasonably current models and they should represent a cross section of the 6 cylinder engines being used.
Engines, V-8, mounted in portable stands, 5, (complete and in running condition). These engines should be reasonably current models and they should represent a cross section of the V-8 engines being used.
Lifters, hydraulic (variety)
Pumps, oil (gear and rotor types)

Equipment and Tools

Cleaner, high pressure water and air
Crankshaft pulley
Cylinder
- Dial indicator
- Head holding fixtures
- Hone, flexible
- Hone, rigid

Detector, bearing leak
Dispensers, engine oil
Drain pans
- Radiator
- Oil

Dynamometer, engine
Exhaust system servicing tools:
- Air-cutting tools with accessories
- Tailpipe cutter
- Tailpipe expander tool

Gauges, engine
- Compression, with flexible hose and connections
- Cooling system pressure
- Fan belt tension
- Oil pressure
- Vacuum and pressure

Hydraulic Lifter
- Pullers
- Leak-down tester

Hydrometer, antifreeze
Micrometer set
- Inside dia. 1½″ to 8″
- Outside dia. 0″ to 5″

Piston ring
- Compressor
- Groove cleaner
- Removing and installing tool

Pliers, hose clamp
Radiator
- Filler
- Reverse flush gun

Reamer, ridge
Remover, stud
Slings, engine
Stands, portable engine
Tester, thermostat
Thermometer
Valve
- Guide cleaners
- Reconditioning equipment (This should include the necessary equipment to service: valves, valve seats, rocker arms and valve guides, valve lifters)
- Spring compressor, I head
- Spring compressor, L head
- Spring tester

Wrenches
- Drain plug
- Oil filter removing tool
- Tappet 7/16″ to 9/16″ opening range
- Torque indicating, 0-150 ft. lb. range ½″ drive
- General hand tools will be listed in the basic tool section.

Fuel Systems

Educational Assemblies

Carburetors
- A variety of single barrel, double barrel and four barrel carburetors representing popular current models

Filters and regulators, fuel
Gauges, fuel, dash and tank units
Pumps, fuel
- Double action
- Electric
- Single action

Tools and Equipment

Special Tools

Carburetor
- Stands
- Tool kits to overhaul and service:
  - Carter
  - Rochester
  - Others currently being used

Testers
- Cleaner, air
- Pump. fuel (vacuum, pressure and volume)

Suspension Systems

Educational Assemblies

Absorbers, shock
Assemblies, individual suspension
Assemblies, steering gear
Bars, torsion
½ Chassis units (portable) representative of current model vehicles, including unitized body construction models
Columns, steering, energy absorbing tilt and telescopic
Springs, leaf
Units, power steering

Equipment and Special Tools

Alignment, wheel
- Pit type
- Portable
- Ramp type

Balancer, wheel
- on-the-car
- off-the-car

Ball joint checking equipment and gauges to check upper and lower ball joints
Bending equipment (truck)
Gauges
- Scuff
- Torsion bar height

Packer, wheel bearing
Pullers and drivers, seal
Special Tools
- Coil spring retaining tool
- Drive set, impact air wrench ½″
- Hub cap and dust cover tool
- Puller, pitman arm
- Sockets, drag link
- Socket set, ball joint removing and installing
- Spreader, tie rod sleeve
- Weight, wheel
- Wrenches for removing and installing shims
- Wrench set, caster-camber

Tire Service Equipment and Tools
- Bead
  - Breaker
  - Expander
- Changer, automatic tire
- Testers
  - Tire pressure
  - Tubeless tire
- Wrench, lug

Transmission and Drive Line Units

Educational Assemblies

Assemblies, clutch, various types

Assemblies, propeller shaft. Units from current model vehicles including the constant velocity joint

Assemblies, rear axle (complete). Units from current model vehicles, should include conventional and limited slippage differentials.

Transmissions, automatic. Units from current model vehicles including units with a fluid coupling, and those with torque converters.

Transmissions, standard. Units from current model vehicles, 3-speed and 4-speed units.

Equipment and Special Tools

Automatic transmission
- Filler funnel
- Tester (This equipment is recommended as a teaching aid to facilitate learning efficiency)
- Tools for overhauling current models
- Tools for servicing and adjusting transmission and linkage

Clutch shaft aiigning tool set

Indicator, dial

Transmission
- Holding fixtures
- Jack

Customer Service and Industry Cooperation

"The Community College (also known as Junior College, Technical Institute or Trade Technical College) is one of the fastest growing segments of technical or vocational training.

"The quality of the automotive courses is excellent.

"The students are more mature and many have made personal and financial sacrifices to attend, attesting to the seriousness with which they view a career in automotive service. If you have one in your community, the school will welcome a visit from you, a talk by you, an offer by you to serve on their advisory committee, and an invitation to visit your dealership. It could be a steady supply of quality manpower."

In that message to dealers, one auto manufacturer answers a basic question for community colleges:

"*Will the auto industry cooperate? Will industry representatives work on advisory groups with college faculty and staff?*"

The answer is emphatically, "Yes."

The initiative for cooperation has been taken by industry. The dealer message cited above from a manpower booklet is not unique. There is help available.

One area in which this help is essential is in establishing a "customer service" procedure where work is performed on cars and trucks at the school's shop.

Automotive interns need this clinical experience.

And for the experience to be of maximum benefit, an Advisory Group is required—a standing committee of school, dealer and other industry representatives. The Advisory Group will be charged with recommending policies and procedures in operating school facilities in "out-patient" activity.

Cars and trucks to be serviced in the school will come from teachers and students, from the community generally, from operators of truck fleets, car and truck leasing operations and by purchase. Teacher and student cars are ideal for preventive maintenance instruction.

In all cases, the amount of service work performed must not conflict or compete with local business interests.

It is important that the school be insured against any contingency. For the school's and "customer's" protection, customers will sign a release to comply with the insurance carried by the school.

When a vehicle is brought into the school shop for service a complete diagnosis of malfunctions and other problems should be made by a student "service salesman." The student will recommend work to be done and after consulting with an instructor, a descriptive repair order is written.

Only parts meeting manufacturer's specifications should be used, and only parts actually installed during the training session should be invoiced. Charges for parts should be made at manufacturer's suggested list price, plus applicable state and local taxes. In most cases there should be some additional charge against overhead. The amount will, obviously, vary with local conditions. It may, however, be based on a percentage of the list price of parts, or a percentage of normal labor charge for the service. The overhead charge may also be a fixed amount per repair order.

In diagnosing service needs and writing repair orders, the manufacturers' Service Manual, Flat Rate Manual and Parts Book are helpful. Instructions to the student should note the Flat Rate Manual operation number and name of the operation.

Flat rate times for service operations are based on work done by experienced mechanics and technicians, following procedures outlined in manufacturers' manuals and using whatever special tools are required. Students should not be expected to perform service work in the flat rate times suggested by the factory. The flat rate is, however, a convenient guide to student performance under actual working conditions.

Finances involved in a customer service operation should be made part of the school's general accounting procedures. It is recommended that the school cashier handle money and receipts to relieve students and instructors of the responsibility.

In customer service and, in fact, in every phase of an automotive technology program, the counsel and assistance of an Advisory Group is a "must."

Customer Service and Industry Cooperation

Industry is asking its people to—

- Get acquainted with local automotive teachers—they can be helpful in identifying particularly adept students and help steer them your way
- Hire automotive teachers to help you in your service department during the summer months—they will likely appreciate the opportunity for part-time employment . . . particularly in their own field
- Offer scholarships to top students
- Give summer employment to students
- Arrange a co-op program with the schools

Industry is ready if you are.

"For Education is, Making Men;
So is it now, so was it when
Mark Hopkins sat on one end of a log
And James Garfield sat on the other."

Education
Arthur Guiterman (1871-1943)