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ABSTRACT

This document contains materials developed for and about the automotive diagnostic technologies tech prep program of the South-Western City Schools in Ohio. Part 1 begins with a map of the program, which begins with an automotive/diagnostic technologies program in grades 11 and 12 that leads to entry-level employment or a 2-year automotive technology program at a community college that in turn leads to a technical career or transfer to a four-year college or university. Also included in part 1 are the high school curriculum pathways and pathway narratives. Part 2, which constitutes approximately 60% of the document, lists the program's (unleveled) secondary technical competencies. Secondary academic competencies (unleveled) and postsecondary competencies are presented in parts 3 and 4, respectively. The following are among the categories of competencies included: workplace safety; quality assurance; supervision; fundamentals of electricity; troubleshooting and repair; test and measurement equipment; equipment maintenance; mechanical power transmission; basic hydraulic theory and pneumatics; welding; engine repair; and diesel engines. Concluding the document are the following: labor market data; list of advisory/review committee members; and program application (information on employment opportunities in the area, potential exit occupations for the program, and plans for the program's delivery). (MN)

# HEART of OHIO TECH PREP CONSORTIUM



# Automotive Diagnostic Technologies

**Approved, Consortium Board of Directors, 1997**

- Secondary & Postsecondary Curriculum Pathways & Narratives
- Secondary Academic Competencies - Unleveled
- Secondary Competencies - Leveled per School
- Postsecondary Competencies
- Labor Market Data
- Advisory/Review Committee Members
- Program Application



**Heart of Ohio Tech Prep Consortium**

Central Office
c/o Columbus State
Community College
550 E. Spring Street
Columbus, OH 43215
614/227-5319

Regional Office
c/o Ohio University-
Lancaster
1570 Granville Pike
Lancaster, OH 43130
614/654-6711, ext. 216

# AUTOMOTIVE DIAGNOSTIC TECHNOLOGIES

**Heart of Ohio Tech Prep Consortium**
**Approved 1997, Consortium Board of Directors**

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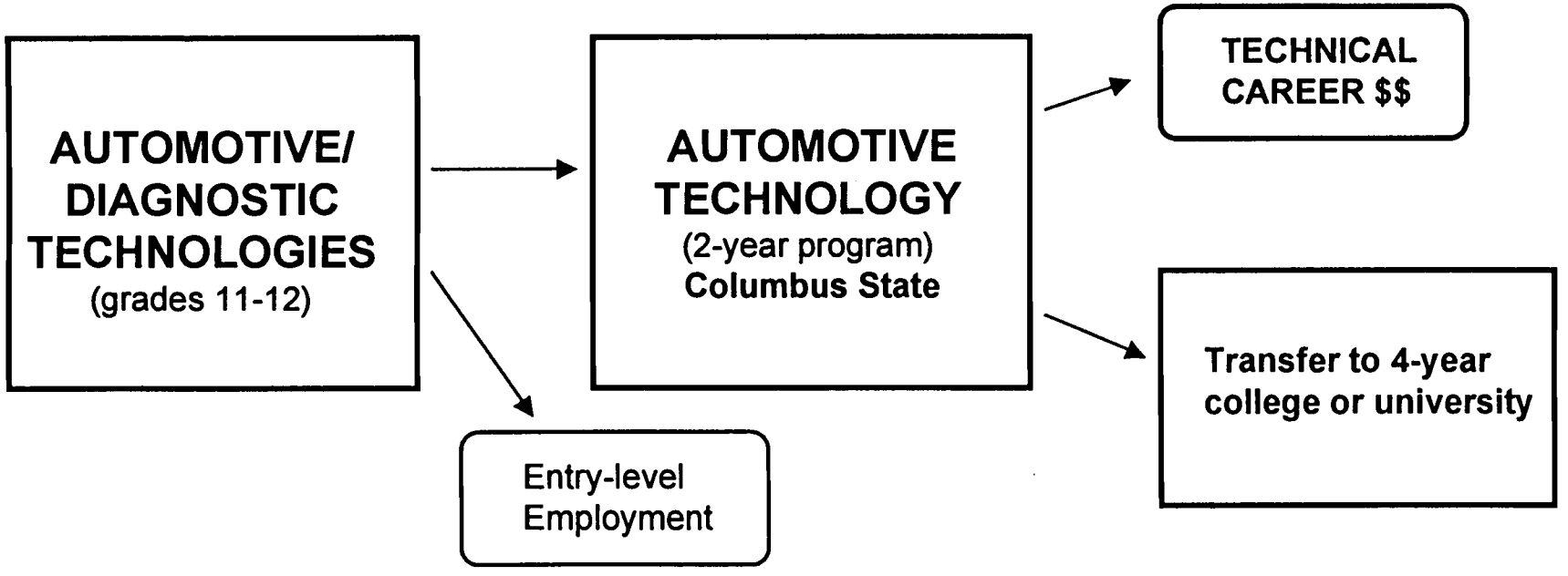
Heart of Ohio Tech Prep Consortium

**MAP of <u>AUTOMOTIVE/DIAGNOSTIC TECHNOLOGIES</u> Tech Prep Program** (12/97)



# HEART of OHIO TECH PREP CONSORTIUM

1997

## Automotive Diagnostic Technologies Model

## PART I.A:
## Secondary Curriculum Pathways and Narratives

South-Western City VEPD | Heart of Ohio Tech Prep Consortia | Automotive Diagnostic Technology

May 1997

| 9th Grade | Min | 10th Grade | Min | 11th Grade | Min | 12th Grade | Min |
|---|---|---|---|---|---|---|---|
| Algebra<br>English<br>Science<br>Global Studies<br>Keyboarding | 250 | Algebra/Geometry<br>Bio-Chemistry<br>English<br>U.S. History<br>Computer Applications | 250 | Tech Prep ADT Lab<br>includes 1 credit<br>Transitions to Coll. Math<br>and 1 credit<br>English III | 190 | Elective<br>Elective<br>Lunch<br>Conceptual Physics<br>Tech Prep ADT Lab<br>includes 1 credit<br>of Algebra II<br>and 1 credit<br>English IV | 50<br>50<br>30<br>50<br>190 |
| Physical Education | 50 | Health/P.E. | 50 | Skills for Work Place | 50 | | |
| Elective | 50 | Elective | 50 | U.S. Govt. | 50 | | |
| Elective | 50 | Elective | 50 | Elective | 50 | | |
| Lunch | 30 | Lunch | 30 | Lunch | 30 | | |

PREREQUISITES FOR GRADE 11 OF TECH PREP
Demonstrates potential for college preparatory course work as measured by a standardized achievement test and by being enrolled in a college preparatory curriculum with no academic deficiencies for grades 9 and 10, Algebra I.

PREREQUISITIES FOR COLLEGE PORTION OF TECH PREP:
Enrollment in 11th and 12th grade Tech Prep academic and technical course work or college preparatory course work. Articulation or proficiency testing will determine where students place into the program.

SUGGESTED ELECTIVES:
Foreign Language Grades 9 & 10; Performing Arts
Tech Prep Physics (Grade 12)

EXPLANATION OF TECH PREP BLOCK:
11th Grade: Tech Prep Automotive Diagnostic Technology occupa competencies taught in 190-minute lab.
12th Grade: Tech Prep occupational and academic competencies taught in a 150-minute lab.
12th Grade: Occupational competencies developed through participation in school-based learning; worksite-based internships, mentorship; and/or enrollment in post-secondary options.

HIGH SCHOOL EXIT OCCUPATIONS:
General automotive service technician
Automotive technician apprentice

Heart of Ohio Tech Prep Consortium
CURRICULUM PATHWAY NARRATIVE
South-Western City Schools
May 1997

The Tech Prep program in South-Western City Schools is designed to meet the needs of a group of students who have traditionally participated in a segmented and often unfocused course of study. With the Tech Prep emphasis on the integration of academics with workplace applications, this group of students will now be prepared to pursue a focused post-secondary course and will have practical skills that will enable them to be good employees.

Students participating in the Tech Prep program have available to them integrated academic courses which emphasize learning and practice in real-life settings. Through exposure to problem situations which reflect actual events in the working world, students can apply their learning immediately; they relate this learning to future problem situations that may arise. This group of students has access to keyboarding training and the use of technology in practice and application settings. With an emphasis on the global setting, students are better prepared to deal with the array of situations which are now a reality in our information age. These experiences make their skills much more marketable than those gained in a lecture format or a rote memorization setting.

Time periods are no longer static, but constantly changing based on the needs of the students and the project or topic of study. The artificial time periods are no longer a barrier to innovation. A flexible schedule allows a range of opportunities from a traditional 4-5 period block to an entire morning or afternoon spent on one project area which incorporates one or more subject areas in an application and/or problem solving situation. Teachers are working towards collaborative planning which results in increased continuity among subject area and teachers teaming with combined groups of students to meet project goals.

The primary focus of the South-Western City Schools Automotive Diagnostics Technology Tech Prep program is to prepare students for continued study in two-year or four-year colleges after high school graduation and be prepared to be come Automotive Service Excellence (ASE) certified. Automotive technicians of the new century will need to become increasingly skilled in order to keep up with the changing high technology products of the automotive industry.

The occupational competencies will be delivered in the 100 - 150-minute Automotive Diagnostics lab. Troubleshooting and diagnosing of detailed automotive problems requires students to have solid skills in not only automotive technology but also higher-level academics. Flexible scheduling allows the Automotive Diagnostics Technology teacher and the academic teaching team to work with the same group of students. This scheduling provides the flexibility for teachers to develop interdisciplinary units, to team

teach, and to adjust periods allowing more instructional time for specific topics. Collaborative planning is being provided to implement the course of study.

Business and industry partnerships are a strong component of the two-year secondary curriculum. This curriculum provides opportunities for students to participate in field experiences which include, but not be limited to, post-secondary enrollment options with Columbus State Community College as well as shadowing, mentoring, and internships in the automotive community.

As the Tech Prep program expands, the relationship and partnership with area business and industry grows. The utilization of real life problems is made possible through sharing with businesses. The employees/employers in the area are becoming more and more involved in the teaching and learning process as they engage in site visits and become "visiting teachers" within the Tech Prep classrooms. Students see more relevance to what they are doing, and as a result, have improved attendance and decreased discipline problems. A variety of authentic assessments are implemented.

# HEART of OHIO TECH PREP CONSORTIUM

1997

## Automotive Diagnostic Technologies Model

## PART I.B:
## Postsecondary Curriculum
## Pathways & Narratives

## Columbus State Community College

Columbus State Community College

Automotive/Diagnostic Technologies Model
College Pathway: Automotive Technology
April, 1997

## Heart of Ohio Tech Prep Consortium

| 1st Qtr. | Cr. | 2nd Qtr. | Cr. | 3rd Qtr. | Cr. | 4th Qtr. | Cr. | 5th Qtr. | Cr. | 6th Qtr. | Cr. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ENGL 101 Beginning Composition | 3 | ENGL 102 Essay & Research | 3 | ENGL 204 Technical Writing | 3 | ~~AUTO 150 Brake Systems~~ | 4 | COMM 105 Speech | 3 | HUM 111, 112, 113, 151, or 152 Humanities course | 5 |
| MATH 104 Intermediate Algebra | 5 | NSCI 101 Natural Science I or PHYS 100 | 5 | ~~AUTO 140 Suspension & Steering~~ | 4 | SSCI 10x Social Science 101, 102, 103, or 104 | 5 | AUTO 19x Technical Elective | 3 | AUTO 300 Shop Experience | 4 |
| CPT 101 Computer Literacy I | 3 | ~~AUTO 110 Engine Repair~~ | 4 | AUTO 170 Heating & Air Conditioning | 3 | AUTO 155 Advanced Brake Systems | 3 | AUTO 19x Technical Elective | 3 | BMGT xxx Business Mgmt. Elective | 3-5 |
| ~~AUTO 061 Automotive Principles~~ | 4 | ~~AUTO 160 Electrical Systems~~ | 4 | AUTO 125 Advanced Automotive Transmissions | 3 | AUTO 165 Advanced Electrical Systems | 3 | AUTO 19x Technical Elective | 3 | AUTO 19x Technical Elective | 3 |
| ~~AUTO 062 Shop Orientation~~ | 4 | AUTO 120 Automatic Transmissions | 4 | AUTO 145 Advanced Suspension & Steering | 3 | AUTO 220 Current Trends in Automatic Transmissions | 2 | *AUTO 185 Advanced Engine Performance | 3 | *AUTO 270 Current Trends in Heating & A/C | 2 |
| AUTO 115 Advanced Engine Repair | 3 | AUTO 180 Engine Performance | 4 | AUTO 210 Current Trends in Engine Repair | 2 | AUTO 240 Current Trends in Suspension & Steering | 2 | *AUTO 250 Current Trends in Brake Systems | 2 | *AUTO 280 Current Trends in Engine Performance | 2 |
| AUTO 130 Manual Transmissions | 3 | AUTO 135 Advanced Manual Transmissions | 3 | AUTO 230 Current Trends in Manual Transmissions | 2 | * AUTO 175 Advanced Heating & Air Conditioning | 3 | * AUTO 260 Current Trends in Electrical Systems | 2 | | |
| | 17 | | 19 | | 16 | | 18 | | 19 | | 19 |

Struck-out courses = those that students may articulate or pass via proficiency testing.
*Shaded courses = advanced skills added to the curriculum.

AUTO 19x technical electives: see next page.

AUTOMOTIVE/DIAGNOSTIC TECHNOLOGIES --- COLUMBUS STATE PATHWAY IN AUTOMOTIVE TECHNOLOGY
Spring 1997

**High School Exit Occupations:**
Light Repair Technician; Maintenance Technician

**College Exit Occupations:**
Automotive Technician, Heavy Repair Technician, Diagnostic Technician

**Prerequisites for College Portion of Tech Prep:**
No specific prerequisites because articulation or proficiency testing (including external A.S.E. certification, where appropriate) will determine where students enter into the program. However, in order to follow the sequence as closely as possible, students should be computer literate and proficient in typing and basic work processing, and should be ready to enter Columbus State's MATH 104 and ENGL 101 academic courses.

**Suggested Electives:**

| | |
|---|---|
| AUTO 190 Automotive Business Management | AUTO 195 Auto Parts - Sales |
| AUTO 191 Service Advising | AUTO 196 Auto Parts - Inventory Control |
| AUTO 192 Automotive Service Management | AUTO 197 Auto Parts - Management |
| AUTO 181 Fundamentals of Alternate Fuels | AUTO 186 Advanced Alternate Fuels |

**Advanced Skills Portion of Tech Prep:**
Shaded areas represent the advanced skills portion.

**Explanation of Tech Prep Course Differences:**
Struckout courses represent those that students may articulate or pass via proficiency testings (including external A.S.E. certification, where appropriate). The current technical program is represented by 106 credits. A student must articulate or proficiency 38 credit hours represented by the struckout courses in order to complete the advanced skills portion of the program within the 106 credit hours.

## *Curriculum Pathways Narrative*

Automotive Technologies, Columbus State Community College
Spring 1997

In the space below, briefly describe the systemic change at the postsecondary level and what new options will be available for Tech Prep college students (occupation, employability, and academic).

Systemic change that will occur in the Automotive Technology Department at Columbus State as a result of the installation of Tech Prep pathways in the Heart of Ohio Tech Prep Consortium include the following:

- Competencies offering additional breadth and depth will be possible at the postsecondary level as a result of Tech Prep high school graduates coming to Columbus State better prepared to do college-level work. This will help ensure that business and industry's expectations for qualified automotive repair professionals are met by freeing up time in the college program to offer additional competencies that employers are requesting in the following areas: Advanced Heating & Air-Conditioning, Advanced Engine Performance, and courses covering current trends in Brake Systems, Electrical Systems, Heating & Air-Conditioning, and Engine Performance. In the past, these competencies were addressed through the student's selection of electives. The competencies are now part of the college Tech Prep pathway, and will prepare students for Master A.S.E. certifications.

- An articulation agreement between Columbus State's Automotive Technology program and the Heart of Ohio Consortium's Automotive/Diagnostic program model will be formalized to facilitate the matriculation of high school Tech Prep students into the college program through either Post-Secondary Enrollment Options (PSEO) in the senior year, or upon completion of the high school program at the end of grade 12.

- Columbus State's Automotive Technology program (including the Tech Prep advanced skills portion) is regularly validated through ongoing industry surveys, as well as by the college program advisory committee. Although the college is confident that the Automotive Technology program currently meets industry needs, the faculty and administration of Columbus State acknowledge that some foundational competencies can be delivered effectively within a collaboratively developed secondary Tech Prep curriculum. The development of this Tech Prep curriculum provides students with a unique opportunity to augment a solid associate degree curriculum with valuable courses and educational experiences that are not currently required in the standard degree program. Students will benefit from the additional depth and breadth offered by the Tech Prep advanced skills associate degree as well as by the elimination of the need for academic remediation upon matriculation to Columbus State.

- The automotive repair industry is seeking graduates who are broadly educated across disciplines as well as prepared specifically in automotive technology specialties. The Heart of Ohio Tech Prep Automotive/Diagnostic program model provides this broad preparation, and optimizes the ability of graduates to be immediately productive and job-ready upon graduation from Columbus State. Graduates from the college's advanced skills Tech Prep program are expected to enhance the employers' competitive edge in a period of rapid technological change.

# HEART of OHIO TECH PREP CONSORTIUM

1997

## Automotive Diagnostic Technologies Model

## PART II.A:
## Secondary Technical
## Competencies (Unleveled)

## COMMON CORE

| | |
|---|---|
| **14.01.00** | **WORKPLACE SAFETY** |
| **14.01.01.00** | **Apply general safety precautions** |
| 14.01.01.01 | Follow local, state, and federal rules and regulations |
| 14.01.01.02 | Identify personal protective wear and equipment |
| 14.01.01.03 | Use personal protective wear and equipment |
| 14.01.01.04 | Apply workplace safety rules and procedures |
| 14.01.01.05 | Apply personal safety rules and procedures (e.g. clothing, jewelry) |
| 14.01.01.06 | Apply workplace organization (e.g. housekeeping) |
| 14.01.01.07 | Apply electrical, mechanical, steam, hydraulic and pneumatic safety rules and procedures |
| 14.01.01.08 | Apply fire safety rules and procedures |
| 14.01.01.09 | Apply hazardous waste rules and procedures |
| 14.01.01.10 | Apply first aid and CPR procedures |
| 14.01.01.11 | Describe corrective procedures for unsafe condition |
| 14.01.01.12 | Identify visual controls (e.g. monitors, read outs) |
| 14.01.01.13 | Identify auditory controls |
| 14.01.01.14 | Use proper shop equipment (e.g. hoist, jack, stands, press) |
| **14.01.02.00** | **Demonstrate knowledge of workplace hazards** |
| 14.01.02.01 | Identify types of workplace hazards (e.g. physical hazards, fire, chemicals, noise, ultraviolet, temperature extremes, ergonomics, biological hazards) |
| 14.01.02.02 | Interpret hazardous materials notices on containers |
| 14.01.02.03 | Locate Material Safety Data Sheets |

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| 14.01.02.04 | Read Material Safety Data Sheets |
| 14.01.02.05 | Explain purpose(s) of OSHA and NIOSH |
| 14.01.02.06 | Explain purpose(s) of NEC and NFPS |
| 14.01.02.07 | Identify purpose of emergency evacuation routes, master switch and lockout locations, and safety color coding systems |
| 14.01.02.08 | Describe methods of evaluating potential hazards (e.g. visual analysis) |
| 14.01.02.09 | Describe methods of correcting potential hazards |
| 14.01.02.10 | Describe various types of toxicity (e.g. chronic, immediate) |
| 14.01.02.11 | Identify need for reporting accidents |
| 14.01.02.12 | Explain precautions required when using toxic and flammable materials |
| 14.01.02.13 | Recycle scrap metal, chips, shavings, coolants, solvents, trash, and waste materials |
| 14.01.02.14 | Define confined space and related requirements |
| **14.01.03.00** | **Explain purpose of industrial pollution control systems** |
| 14.01.03.01 | Describe types of air, water, solid waste, and noise pollution |
| 14.01.03.02 | Explain purpose of air pollution control systems |
| 14.01.03.03 | Explain purpose of water pollution control systems |
| 14.01.03.04 | Explain purpose of solid waste pollution control systems |
| 14.01.03.05 | Explain purpose of noise pollution control systems |
| 14.01.03.06 | Explain basic philosophy of "right to know" legislation |
| 14.01.03.07 | Explain purpose(s) of EPA |

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| **14.02.00** | **QUALITY ASSURANCE** |
| **14.02.01.00** | **Demonstrate knowledge of quality assurance** |
| 14.02.01.01 | Identify features of quality planning |
| 14.02.01.02 | Explain importance of internal and external customers |
| 14.02.01.03 | Identify internal and external customers |
| 14.02.01.04 | Explain importance of interdepartmental relationships |
| 14.02.01.05 | Describe successful efforts by industry to improve quality and/or reduce costs |
| 14.02.01.06 | Explain how statistical techniques are tools used to control quality |
| **14.02.02.00** | **Demonstrate knowledge of quality costs and implications** |
| 14.02.02.01 | Identify cost/quality objectives |
| 14.02.02.02 | Differentiate convergent and divergent thinking |
| 14.02.02.03 | Classify costs (i.e. direct and indirect, fixed and variable, methods and standards) |
| 14.02.02.04 | Classify quality costs (i.e. prevention, evaluation, pre-delivery failure, post-delivery failure) |
| 14.02.02.05 | Define product liability |
| 14.02.02.06 | Explain consumerism and liability prevention |
| 14.02.02.07 | Define safety terms of product |
| 14.02.02.08 | Identify safety responsibility within organization |
| 14.02.02.09 | Differentiate express and implied warranty |
| 14.02.02.10 | Explain how warranties are part of contract law |
| 14.02.02.11 | List questions that would need answering in liability claim or tort |

**14.02.03.00 Explain importance of interdepartmental relationships to quality assurance**

14.02.03.01 Explain how quality assurance philosophy has changed in recent years

14.02.03.02 Explain need for everyone's commitment in assuring quality

14.02.03.03 Explain phrase "Everyone is a customer/supplier"

14.02.03.04 Describe future trend of predictive maintenance

**14.03.00 SUPERVISION**

**14.03.01.00 Perform supervisory functions**

14.03.01.01 Define supervision

14.03.01.02 Conduct task analysis

14.03.01.03 Create organizational and/or departmental charts

14.03.01.04 Apply company policies and procedures

14.03.01.05 Maintain workplace procedures manuals

14.03.01.06 Prepare budgets

14.03.01.07 Monitor budgets

14.03.01.08 Prepare managerial reports

14.03.01.09 Analyze daily product reports

14.03.01.10 Maintain appropriate work environment

14.03.01.11 Facilitate assignments

14.03.01.12 Assign work

14.03.01.13 Delegate job tasks

14.03.01.14 Monitor progress

14.03.01.15 Prepare productivity reports

14.03.01.16 Provide training for new policies

14.03.01.17 Troubleshoot workplace problems

14.03.01.18 Coordinate workplace activities

14.03.01.19 Appraise performance

14.03.01.20 Document personnel issues

14.03.01.21 Coordinate administrative duties

**14.03.02.00 Conduct meetings**

14.03.02.01 Plan meetings

14.03.02.02 Set agenda

14.03.02.03 Schedule meeting

14.03.02.04 Schedule meeting room

14.03.02.05 Invite appropriate personnel

14.03.02.06 Identify need for outside speakers

14.03.02.07 Assign someone to take minutes

14.03.02.08 Make introductions

14.03.02.09 Invite questions, comments and group participation related to agenda

14.03.02.10 Decide appropriate follow up action, time frame and accountability to talks

14.03.02.11 Monitor time

14.03.02.12 Publish minutes in timely manner to appropriate persons

**14.03.03.00 Coordinate training**

14.03.03.01 Assess training needs

14.03.03.02 Secure training resources, materials and equipment

14.03.03.03 Train employees

14.03.03.04 Evaluate progress of trainee

14.03.03.05 Provide feedback

14.03.03.06 Solicit feedback

14.03.03.07 Receive feedback

14.03.03.08 Assess feedback

**14.04.00 FUNDAMENTALS OF ELECTRICITY**

**14.04.01.00 Demonstrate proficiency in basic theory**

14.04.01.01 Describe atomic structure and its relationship to electricity

14.04.01.02 Describe the relationship between electrical and magnetic properties

14.04.01.03 Describe the electrical and magnetic properties of a magnet

14.04.01.04 Describe the photoelectric effect

14.04.01.05 Describe the thermocouple effect

14.04.01.06 Describe the electrical effect of friction

14.04.01.07 Identify sources of electricity

**14.04.02.00 Maintain basic electrical systems**

14.04.02.01 Replace electrical cords

14.04.02.02 Replace batteries

14.04.02.03 Replace fuse(s)

14.04.02.04 Replace switches

14.04.02.05 Replace plugs and sockets

| | |
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| **14.04.03.00** | **Interpret electrical/electronic drawings** |
| 14.04.03.01 | Interpret basic electric/electronic standards and symbols |
| 14.04.03.02 | Interpret schematic drawings |
| 14.04.03.03 | Interpret component drawings |
| 14.04.03.04 | Interpret interconnection drawings |
| 14.04.03.05 | Interpret printed circuit board drawings |
| 14.04.03.06 | Interpret harness drawings |
| **14.04.04.00** | **Demonstrate proficiency in direct current (DC) circuits** |
| 14.04.04.01 | Describe voltage, current, resistance, power, and energy |
| 14.04.04.02 | Solve algebraic problems to include exponential (prerequisite to DC) |
| 14.04.04.03 | Measure properties of a circuit using volt-ohm meter (VOM) and digital volt-ohm meter (DVM) meters and oscilloscopes |
| 14.04.04.04 | Construct operations of series circuits |
| 14.04.04.05 | Apply Ohm's Law |
| 14.04.04.06 | Construct parallel circuits |
| 14.04.04.07 | Construct series circuits |
| 14.04.04.08 | Construct series, parallel and bridge circuits |
| 14.04.04.09 | Define voltage divider circuits (loaded and unloaded) |
| 14.04.04.10 | Construct DC circuits and demonstrate the maximum power transfer theory |
| 14.04.04.11 | Solve problems in electrical units utilizing metric prefixes |
| 14.04.04.12 | Describe the principles and operation of electrochemical supplies |
| 14.04.04.13 | Use Watt's Law |

| | |
|---|---|
| 14.04.04.14 | Use Kirchoff's Law (i.e., voltage drop test) |
| 14.04.04.15 | Interpret color codes and symbols to identify electrical components and values |
| 14.04.04.16 | Measure properties of a circuit using analog and digital meters and oscilloscopes |
| 14.04.04.17 | Measure conductance and resistance of conductors and insulators |
| 14.04.04.18 | Describe magnetic properties of circuits and devices |
| 14.04.04.19 | Describe the physical and electrical characteristics of capacitors and inductors |
| 14.04.04.20 | Set up power supplies for DC circuits |
| 14.04.04.21 | Operate power supplies for DC circuits |
| 14.04.04.22 | Analyze frequency spectrums |
| **14.04.05.00** | **Demonstrate proficiency in alternating current (AC) circuits** |
| 14.04.05.01 | Analyze AC analog signals utilizing VOM, DVM, oscilloscope, frequency counter and function generator |
| 14.04.05.02 | Analyze properties of an AC signal |
| 14.04.05.03 | Describe the principles and operation of the characteristics of sinusoidal and non-sinusoidal wave forms |
| 14.04.05.04 | Identify AC sources |
| 14.04.05.05 | Describe the principles and operation of the characteristics of inductive circuits |
| 14.04.05.06 | Demonstrate the operation of inductive circuits |
| 14.04.05.07 | Describe basic motor theory and operation |
| 14.04.05.08 | Describe basic generator theory and operation |

**14.04.06.00 Explain circuit protectors**

14.04.06.01 Explain ground methods

14.04.06.02 Explain overcurrent protection

14.04.06.03 Explain thermal protective devices (e.g., heat sink)

**14.04.07.00 Use soldering tools**

14.04.07.01 Select appropriate soldering tools and supplies for job

14.04.07.02 Perform soldering and desoldering techniques (e.g., micro-miniature, standard)

**14.05.00 TROUBLESHOOTING AND REPAIR**

**14.05.01.00 Demonstrate troubleshooting skills**

14.05.01.01 Explain role of preventive maintenance

14.05.01.02 Differentiate normal and abnormal operations

14.05.01.03 Explain troubleshooting procedures

14.05.01.04 Explain logical support actions taken to troubleshoot

14.05.01.05 Identify troubleshooting aids

14.05.01.06 Demonstrate knowledge of safety rules for troubleshooting and repair procedures

14.05.01.07 Maintain troubleshooting and repair records

14.05.01.08 Use manufacturer's manuals, schematics, and troubleshooting charts

14.05.01.09 Isolate faults, shorts, and open circuits

**14.05.02.00 Apply troubleshooting techniques to DC circuits**

14.05.02.01 Isolate faults in series, parallel and series parallel

14.05.02.02 Isolate faults in bridge circuits

14.05.02.03 Isolate faults in DC power supplies

14.05.02.04 Perform polarity check

14.05.02.05 Isolate faults in DC drive system

14.05.02.06 Isolate faults in voltage divider circuits (loaded and unloaded)

**14.05.03.00 Apply troubleshooting techniques in discrete solid state devices**

14.05.03.01 Isolate faults in diode circuits

14.05.03.02 Isolate faults in transistor circuits

14.05.03.03 Isolate faults in open circuits

**14.06.00 TEST AND MEASUREMENT EQUIPMENT**

**14.06.01.00 Demonstrate proficiency in use of test equipment**

14.06.01.01 Describe function and operation of logic probe

14.06.01.02 Describe function and operation of power monitor

14.06.01.03 Describe function and operation of signal generator

14.06.01.04 Describe function and operation of megger

14.06.01.05 Describe function and operation of megger carbon pile tester

14.06.01.06 Apply test equipment to DC circuits

14.06.01.07 Apply test equipment to AC circuits

14.06.01.08 Apply test equipment to solid-state devices

14.06.01.09 Apply test equipment to digital circuits

14.06.01.10 Apply test equipment to analog circuits

14.06.01.11 Apply test equipment to microprocessors

**14.06.02.00 Demonstrate proficiency in use of measurement**

14.06.02.01 Describe function and operation of analog volt-ohm-meter (AVOM)

14.06.02.02 Describe function and operation of digital volt-ohm-meter (DVOM)

14.06.02.03 Describe function and operation of amp prove

14.06.02.04 Describe function and operation of oscilloscopes

14.06.02.05 Describe function and operation of infrared heat sensor

14.06.02.06 Describe function and operation of 4-gas analyzer

14.06.02.07 Apply measurement equipment to DC circuits

14.06.02.08 Apply measurement equipment to AC circuits

14.06.02.09 Apply measurement equipment to solid-state devices

14.06.02.10 Apply measurement equipment to digital circuits

14.06.02.11 Apply measurement to analog circuits

14.06.02.12 Apply measurement equipment to microprocesors

**14.07.00 EQUIPMENT MAINTENANCE**

**14.07.01.00 Perform housekeeping**

14.07.01.01 Dispose of scrap metal chips, shavings, trash and waste

14.07.01.02 Clean work area

14.07.01.03 Store tools and equipment

14.07.01.04 Follow tool crib procedures

14.07.01.05 Inspect machine guards

14.07.01.06 Replace or adjust machine guards

14.07.01.07 Report problems to supervisor

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| **14.07.02.00** | **Perform record keeping** |
| 14.07.02.01 | Complete work order |
| 14.07.02.02 | Complete internal requisition |
| 14.07.02.03 | Complete external requisition |
| 14.07.02.04 | Complete time cards |
| 14.07.02.05 | Complete job status reports |
| 14.07.02.06 | Complete equipment failure reports |
| 14.07.02.07 | Record preventive maintenance activities |
| 14.07.02.08 | Record repair activities |
| 14.07.02.09 | Read job orders and process sheets |
| 14.07.02.10 | Locate tooling and set up information |
| 14.07.02.11 | File reports |
| 14.07.02.12 | Analyze system failure |
| 14.07.02.13 | Make minor adjustments/repairs |
| 14.07.02.14 | Coordinate maintenance services |
| 14.07.02.15 | Prepare new/replacement equipment recommendations |
| **14.07.03.00** | **Inspect machine systems** |
| 14.07.03.01 | Explain planned maintenance |
| 14.07.03.02 | Explain predictive maintenance measures |
| 14.07.03.03 | Explain preventive maintenance measures (e.g., lubrication) |
| 14.07.03.04 | Explain machine system(s) calibration |
| 14.07.03.05 | Inspect linkages and lever mechanisms |

14.07.03.06 Inspect safety systems

14.07.03.07 Prepare planned maintenance schedules

14.07.03.08 Explain breakdown maintenance

14.07.03.09 Explain reasons for keeping maintenance records

14.07.03.10 Explain reasons for keeping cost records

**14.07.04.00 Perform machine maintenance**

14.07.04.01 Use operator's and manufacturer's manuals

14.07.04.02 Operate individual machines

14.07.04.03 Diagnose malfunctions

14.07.04.04 Disassemble defective section

14.07.04.05 Clean equipment

14.07.04.06 Repair or replace defective parts

14.07.04.07 Test machine for performance

14.07.04.08 Make minor adjustments to equipment

**14.07.05.00 Maintain hand tools**

14.07.05.01 Demonstrate use and care of measuring devices (e.g., rules, tapes, calipers, micrometers, multimeter, thermometer, and coordinate measuring system)

14.07.05.02 Demonstrate use and care of equipment used to bend tubing

14.07.05.03 Demonstrate use and care of common hand tools

14.07.05.04 Demonstrate proper metal working bench skills (including use of vices, hacksaws, files, taps, dies, and reamers)

**14.07.06.00 Maintain portable power tools**

14.07.06.01 Demonstrate use and care of light-duty and heavy-duty drills

14.07.06.02 Demonstrate use and care of pneumatic drills and hammers

14.07.06.03 Demonstrate use and care of power screwdrivers and impact wrenches

14.07.06.04 Demonstrate use and care of pad and disc sanders

14.07.06.05 Demonstrate use and care of grinders

14.07.06.06 Demonstrate use and care of portable brake lathe

**14.07.07.00 Maintain stationary equipment**

14.07.07.01 Demonstrate use and care of mechanical presses

14.07.07.02 Demonstrate use and care of hydraulic presses

14.07.07.03 Demonstrate use and care of wheel balancer

14.07.07.04 Demonstrate use and care of drill presses

14.07.07.05 Demonstrate use and care of electric grinders

14.07.07.06 Demonstrate use and care of bench grinders

14.07.07.07 Demonstrate use and care of lathe

14.07.07.08 Demonstrate use and care of power saws (e.g., hack, cut-off, chop)

**14.08.00 MECHANICAL POWER TRANSMISSION**

**14.08.01.00 Demonstrate knowledge of basic mechanics**

14.08.01.01 Explain working forces of torque, tension, and compression

14.08.01.02 Explain the laws of motion

14.08.01.03 Explain how to calculate work

14.08.01.04 Explain the function of simple machines including levers, incline plane, wedge wheel and axle, pulley and screw

14.08.01.05 Explain the types of power and the method of producing power including compound gears

14.08.01.06 Calculate volume mathematically and by displacement

14.08.01.07 Explain the laws of friction

14.08.01.08 Explain mechanical efficiency

**14.08.02.00 Demonstrate knowledge in mechanical power transmission systems**

14.08.02.01 Describe the principles and operation of compound and reverted gear trains

14.08.02.02 Describe the principles and operation of internal and planetary gear trains

14.08.02.03 Describe the principles and operation of helical and bevel gear trains

14.08.02.04 Describe the principles and operation of rack and pinion, worn and wheel and block and screw mechanisms

14.08.02.05 Describe the principles and operation of counter rotating mechanisms and differentials

14.08.02.06 Describe the principles and operation of spring mechanisms, pulley blocks and differentials

14.08.02.07 Describe the principles and operation of chain, belt and disc drives and universal joints

14.08.02.08 Describe the principles and operation of clutch and coupling mechanisms

14.08.02.09 Describe the principles and operation of braking mechanisms

14.08.02.10 Describe the necessity for proper alignment of mechanical devices

**14.08.03.00 Use bearings**

14.08.03.01 Define bearing

14.08.03.02 Identify types of bearings and their applications

14.08.03.03 Identify installation method

14.08.03.04 Install bearings

14.08.03.05 Maintain bearings

14.08.03.06 Remove bearings

**14.08.04.00 Use seals**

14.08.04.01 Define seal

14.08.04.02 Identify types of seals and their applications

14.08.04.03 Identify installation method

14.08.04.04 Install seals

14.08.04.05 Maintain seals

14.08.04.06 Remove seals

**14.08.05.00 Use gears**

14.08.05.01 Define gears

14.08.05.02 Identify types of gears and their applications

14.08.05.03 Identify installation method

14.08.05.04 Install gears

14.08.05.05 Maintain gears

14.08.05.06 Remove gears

**14.08.06.00 Use belts and pulleys**

14.08.06.01 Define belts and pulleys

14.08.06.02 Identify types of belts and pulleys and their applications

14.08.06.03 Identify installation method

14.08.06.04 Install belts and pulleys

14.08.06.05 Maintain belts and pulleys

14.08.06.06 Remove belts and pulleys

**14.08.07.00 Use sprockets and chains**

14.08.07.01 Define sprockets and chains

14.08.07.02 Identify types of sprockets and chains and their applications

14.08.07.03 Identify installation method

14.08.07.04 Install sprockets and chains

14.08.07.05 Maintain sprockets and chains

14.08.07.06 Remove sprockets and chains

**14.08.08.00 Use clutches and brakes**

14.08.08.01 Define clutches and brakes

14.08.08.02 Identify types of clutches and brakes and their applications

14.08.08.03 Identify installation

14.08.08.04 Install clutches and brakes

14.08.08.05 Maintain clutches and brakes

14.08.08.06 Remove clutches and brakes

**14.08.09.00 Apply lubricants**

14.08.09.01 Explain the function of lubricants

14.08.09.02 Explain the properties of oil lubricants and factors determining the selection of lubricants

14.08.09.03 Identify types and functions of lubricant additives

14.08.09.04 Describe types of circulating oils and their purposes

14.08.09.05 Describe lubricating systems, including the charts and methods used

14.08.09.06 Demonstrate proper grease application

14.08.09.07 Demonstrate proper lubricant storage and handling

14.08.09.08 Identify specified lubricant or equivalent

14.08.09.09 Explain lubricant recovery and disposal

**14.09.00 BASIC HYDRAULIC THEORY AND PNEUMATICS**

**14.09.01.00 Explain fluid flow concepts**

14.09.01.01 Explain Pascal's Laws

14.09.01.02 Describe flow velocity

14.09.01.03 Explain how heat and pressure relate to power and transmission

14.09.01.04 Describe physical and chemical properties of a fluid

14.09.01.05 Describe fluids in motion in closed conductors

14.09.01.06 Describe continuity of mass flow

14.09.01.07 Identify types of fluids

14.09.01.08 Identify properties of fluids

14.09.01.09 Identify units of measurement for pressure, density, and viscosity

14.09.01.10 Explain pressure, density, and viscosity

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| **14.09.02.00** | **Describe energy considerations** |
| 14.09.02.01 | Differentiate work and power |
| 14.09.02.02 | Differentiate potential and kinetic energy |
| 14.09.02.03 | Explain energy conservation concept |
| 14.09.02.04 | Explain hydraulic horsepower |
| 14.09.02.05 | Explain work of compression in compressible fluids |
| **14.09.03.00** | **Describe system losses** |
| 14.09.03.01 | Differentiate turbulent and laminar flow |
| 14.09.03.02 | Explain friction factor |
| 14.09.03.03 | Explain pressure losses |
| 14.09.03.04 | Identify potential system losses (e.g., leaks, wear, component sizing, dirt) |
| **14.09.04.00** | **Calculate energy** |
| 14.09.04.01 | Apply Pascal's Law |
| 14.09.04.02 | Calculate work and power |
| 14.09.04.03 | Calculate flow velocity and pressure |
| 14.09.04.04 | Calculate pressure losses |
| 14.09.04.05 | Calculate pump capacity |
| 14.09.04.06 | Calculate system requirements |
| **14.09.05.00** | **Explain component operation** |
| 14.09.05.01 | Identify functions and operation of hydraulic components |
| 14.09.05.02 | Explain application(s) of different materials (e.g., plastic, copper) |

**14.09.06.00 Troubleshoot hydraulic circuits**

14.09.06.01 Analyze hydraulic circuits

14.09.06.02 Troubleshoot hydraulic circuits

**14.10.00 WELDING**

**14.10.01.00 Perform basic gas welding, brazing, and cutting**

14.10.01.01 Follow safety guidelines

14.10.01.02 Differentiate welding and brazing

14.10.01.03 Identify gas welding and cutting equipment and accessories

14.10.01.04 Use personal protective equipment required for welding and cutting

14.10.01.05 Explain capillary attraction as it applies to metal

14.10.01.06 Demonstrate proper lighting, adjusting, and shutting down of gas torch

14.10.01.07 Cut mild steel

14.10.01.08 Braze mild steel

14.10.01.09 Apply basic metallurgy technology

**14.10.02.00 Perform basic arc welding/cutting**

14.10.02.01 Identify arc welding equipment and accessories

14.10.02.02 Explain process of spot welding

14.10.02.03 Explain process of shielded metal-arc welding (SMAW)

14.10.02.04 Explain process of gas metal-arc welding (GMAW)

14.10.02.05 Explain welding rod alloys

14.10.02.06 Read welding rods

14.10.02.07 Demonstrate use of mild steel welding rod

14.10.02.08 Weld stainless steel using (SMAW) process

14.10.02.09 Explain rationale for preheating and post-heating metal

14.10.02.10 Weld steel requiring preheat

14.10.02.11 Weld cast iron

14.10.02.12 Weld aluminum

14.10.02.13 Apply basic metallurgy technology

14.10.02.14 Demonstrate (GMAW) welding in flat, horizontal, vertical positions

14.10.02.15 Demonstrate (GTAW) welding on mild steel, stainless steel, and aluminum

**14.11.00 ENGINE REPAIR**

**14.11.01.00 Troubleshoot engine**

14.11.01.01 Interpret complaint

14.11.01.02 Road test vehicle

14.11.01.03 Inspect engine assembly for fuel, oil, coolant, and other leaks

14.11.01.04 Identify presence and operational status of emission control apparatus

14.11.01.05 Listen to engine noises

14.11.01.06 Diagnose excessive oil consumption, unusual engine exhaust color, odor, and sound

14.11.01.07 Perform engine vacuum tests

14.11.01.08 Perform cylinder power balance tests

14.11.01.09 Perform cylinder leakage tests

14.11.01.10 Remove front-wheel-drive engine and prepare for tear down

14.11.01.11 Reinstall front-wheel-drive engine

14.11.01.12 Remove rear-wheel-drive engine and prepare for tear down

14.11.01.13 Reinstall rear-wheel-drive engine

**14.11.02.00 Troubleshoot cylinder head and valve train**

14.11.02.01 Visually inspect cylinder heads for cracks

14.11.02.02 Inspect gasket surface aras for warpage and leakage

14.11.02.03 Check passage condition

14.11.02.04 Identify need to send cylinder head out for inspection and repair

14.11.02.05 Inspect valve springs for squareness, pressure, and free height comparison

14.11.02.06 Test valve springs for squareness, pressure, and free height comparison

14.11.02.07 Inspect valve spring retainers, locks, and valve-lock grooves

14.11.02.08 Inspect valve guides for wear, height, and stem-to-guide clearance

14.11.02.09 Inspect valves

14.11.02.10 Inspect valve seats

14.11.02.11 Check valve face-to-seat contact and seat concentricity (run-out)

14.11.02.12 Check valve spring assembled height

14.11.02.13 Inspect pushrods, rocker arms, rocker arm pivots, and shafts for wear, bending, cracks, looseness, and blocked oil passages

14.11.02.14 Inspect hydraulic and mechanical lifters

14.11.02.15 Test hydraulic and mechanical lifters

14.11.02.16 Inspect camshaft drives (e.g., check gear wear and backlash, sprocket and chain wear, overhead cam drive sprockets, drive belts, belt tension, tensioners)

14.11.02.17 Inspect camshaft journals and lobes

14.11.02.18 Measure camshaft bearing surfaces for damage, out-of-round, and alignment

14.11.02.19 Identify needed repairs to camshaft

14.11.02.20 Measure camshaft timing

**14.11.03.00 Restore cylinder head and valve train**

(Refer to shop manual and technical bulletins for proper procedure)

14.11.03.01 Remove cylinder head

14.11.03.02 Clean cylinder heads

14.11.03.03 Clean gasket surface areas

14.11.03.04 Install cylinder heads and gaskets

14.11.03.05 Replace valve springs

14.11.03.06 Replace valve stem seals

14.11.03.07 Recondition valve guides

14.11.03.08 Replace valve guides

14.11.03.09 Resurface valves

14.11.03.10 Resurface valves

14.11.03.11 Replace valves

14.11.03.12 Resurface valve seals

14.11.03.13 Service valves and seals

14.11.03.14 Repair valve and spring assemblies

14.11.03.15 Repair or replace pushrods, rocker arms, rocker arm pivots, and shafts

14.11.03.16 Replace hydraulic and mechanical filters

14.11.03.17 Adjust valves

14.11.03.18 Replace camshaft drives

**14.11.04.00 Troubleshoot engine block**

(Refer to shop manual and technical bulletins for proper procedure)

14.11.04.01 Inspect pans, covers, gaskets, and seals

14.11.04.02 Inspect damaged threads

14.11.04.03 Inspect cylinder walls

14.11.04.04 Measure cylinder walls

14.11.04.05 Inspect camshaft bearings

14.11.04.06 Measure camshaft bearings

14.11.04.07 Inspect crankshaft for surface cracks and journal damage

14.11.04.08 Check oil passage condition

14.11.04.09 Measure journal wear

14.11.04.10 Inspect main and connecting rod bearings

14.11.04.11 Measure main and connecting rod bearings

14.11.04.12 Identify piston and bearing wear patterns

14.11.04.13 Inspect rod alignment and bearing bore condition

14.11.04.14 Inspect pistons

14.11.04.15 Measure pistons

14.11.04.16 Inspect crankshaft vibration damper (harmonic balancer)

14.11.04.17 Inspect crankshaft flange and flywheel and flexplate for burrs

14.11.04.18 Inspect flywheel and flexplate, including ring gear, for cracks and wear

14.11.04.19 Measure flywheel and flexplate run-out

14.11.04.20 Identify needed repairs

14.11.04.21 Inspect crankshaft pilot bearing and bushing

14.11.04.22 Inspect auxiliary (i.e., balance, intermediate, idler, counterbalance, silencer) shafts

14.11.04.23 Time auxiliary (i.e., balance, intermediate, idler, counterbalance, silencer) shafts

**14.11.05.00 Restore engine block**

(Refer to shop manual and technical bulletins for proper procedure)

14.11.05.01 Replace pans, covers, gaskets, seals

14.11.05.02 Service engine block

14.11.05.03 Repair damaged threads

14.11.05.04 Remove cylinder wall ridges

14.11.05.05 Hone cylinder walls

14.11.05.06 Clean cylinder walls

14.11.05.07 Repair or replace pistons

14.11.05.08 Install new piston pins and bushings

14.11.05.09 Repair or replace crankshaft vibration damper (harmonic balancer)

14.11.05.10 Repair crankshaft flange and flywheel and flexplate

14.11.05.11 Remove crankshaft pilot bearing and bushing

14.11.05.12 Replace crankshaft pilot bearing and bushing

14.11.05.13 Reassemble engine parts using correct gaskets and sealants

14.11.05.14 Repair auxiliary (i.e., balance, intermediate, idler, counterbalance, silencer) shafts

14.11.06.17 Test auxiliary oil coolers

14.11.06.18 Inspect oil temperature and pressure switches and sensors

14.11.06.19 Test oil temperature and pressure switches and sensors

**14.11.07.00 Restore lubrication and cooling systems**

(Refer to shop manual and technical bulletins for proper procedure)

14.11.07.01 Perform oil pressure tests

14.11.07.02 Repair or replace oil pumps, pressure relief devices, and pump drives

14.11.07.03 Replace drive belts and pulleys

14.11.07.04 Adjust drive belts and pulleys

14.11.07.05 Replace engine cooling and heater system hoses

14.11.07.06 Replace thermostat, bypass, and housing

14.11.07.07 Drain cooling system

14.11.07.08 Flush cooling system

14.11.07.09 Refill cooling system with recommended coolant

14.11.07.10 Bleed cooling system

14.11.07.11 Replace water pump

14.11.07.12 Replace radiator, pressure cap, and coolant recovery system

14.11.07.13 Clean electrical and mechanical fans, fan clutch, fan shroud, and cooling system temperature sensors and switches

14.11.07.14 Replace electrical and mechanical fans, fan clutch, fan shroud, and cooling system temperature sensors and switches

14.11.07.15 Repair or replace auxiliary oil coolers

14.11.07.16 Replace oil temperature and pressure switches and sensors

14.11.07.17 Perform oil change (Note: Special diesel/turbocharged engine procedures must be followed.)

14.11.07.18 Dispose of waste fluids according to Environmental Protection Agency

ALL DIESEL COMPETENCIES - ENHANCEMENT ONLY FOR THE CONSORTIA

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| **14.12.00** | **DIESEL ENGINES** |
| **14.12.01.00** | **Troubleshoot engine** |
| 14.12.01.01 | Listen to and verify operator's complaint |
| 14.12.01.02 | Review past maintenance documents |
| 14.12.01.03 | Inspect fuel, oil, and coolant levels |
| 14.12.01.04 | Inspect engine assembly and compartment for fuel, oil, coolant, air and other leaks |
| 14.12.01.05 | Listen to engine noises |
| 14.12.01.06 | Check engine exhaust color and quantity |
| 14.12.01.07 | Check fuel system |
| 14.12.01.08 | Perform air-intake system restriction and/or pressure test |
| 14.12.01.09 | Perform manifold pressure test, air box pressure test, and/or compression test and determine needed repairs |
| 14.12.01.10 | Perform exhaust back-pressure test and determine needed repairs |
| 14.12.01.11 | Perform crankcase pressure test and determine needed repairs |
| 14.12.01.12 | Diagnose no-cranking and determine needed repairs |
| 14.12.01.13 | Diagnose surging, rough operation, misfiring, low power, slow deceleration, slow acceleration, and shutdown and determine needed repairs |
| 14.12.01.14 | Diagnose engine vibration and determine needed repairs |
| 14.12.01.15 | Locate misfiring cylinder and determine needed repairs |
| 14.12.01.16 | Test cooling system |
| 14.12.01.17 | Test lubrication system |

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| **14.12.02.00** | **Troubleshoot and repair cylinder head and valve train** |
| 14.12.02.01 | Remove, clean, inspect, and replace cylinder head assembly |
| 14.12.02.02 | Inspect threaded holes, studs, and bolts |
| 14.12.02.03 | Repair or replace threaded holes, studs, and bolts |
| 14.12.02.04 | Inspect cylinder head mating surface areas for warpage, visible cracks, or damage and determine needed repairs |
| 14.12.02.05 | Check condition of cylinder head and block passages and determine needed repairs |
| 14.12.02.06 | Pressure-test cylinder head for coolant leakage and determine needed repairs |
| 14.12.02.07 | Inspect and test valve springs for squareness, pressure, and free height comparison and replace as needed |
| 14.12.02.08 | Inspect and replace valve spring retainers and/or rotators and locks |
| 14.12.02.09 | Measure valve guides for wear, and repair or replace as needed |
| 14.12.02.10 | Check valve guide-to-stem clearance and repair or replace as needed |
| 14.12.02.11 | Measure valve guide height and repair or replace as needed |
| 14.12.02.12 | Replace or recondition valve guides |
| 14.12.02.13 | Inspect and recondition or replace valves |
| 14.12.02.14 | Inspect and recondition or replace valve seats |
| 14.12.02.15 | Measure valve head height relative to deck, valve face-to-seat contact, and valve seat concentricity |
| 14.12.02.16 | Repair seats and valves |
| 14.12.02.17 | Inspect and replace injector sleeves and seals |
| 14.12.02.18 | Measure injector tip or nozzle protrusion according to manufacturer's specifications |
| 14.12.02.19 | Inspect, clean, and replace precombustion chambers |

14.12.02.20 Inspect and replace valve bridges (crossheads) and guides

14.12.02.21 Adjust valve bridges

14.12.02.22 Reassemble cylinder head and vacuum-test valve sealing

14.12.02.23 Inspect pushrods, rocker arms, rocker-arm shafts, and brackets

14.12.02.24 Inspect and adjust or replace cam followers

14.12.02.25 Adjust valve clearance

**14.12.03.00 Troubleshoot and repair engine block**

14.12.03.01 Inspect, repair, and install pans, covers, vents, gaskets, seals, and wear rings

14.12.03.02 Clean and inspect engine block for cracks and mating surface areas for warpage

14.12.03.03 Check conditions of passages, core, and gallery plugs

14.12.03.04 Inspect threaded holes, studs, dowel pins, and bolts for serviceability

14.12.03.05 Pressure-test engine block for leakage and determine needed repairs

14.12.03.06 Inspect cylinder sleeve counterbore and lower bore, check bore distortion, and determine needed repairs

14.12.03.07 Clean, inspect, and measure cylinder walls or liners and determine needed repairs

14.12.03.08 Replace cylinder liners and seals

14.12.03.09 Check and adjust liner height

14.12.03.10 Inspect camshaft bearings and determine needed repairs

14.12.03.11 Inspect, measure, and replace or reinstall camshaft

14.12.03.12 Measure and/or adjust end-play of camshaft

14.12.03.13 Clean and inspect crankshaft

14.12.03.14 Check condition of oil passage(s) in crankshaft

14.12.03.15 Check passage plugs in crankshaft

14.12.03.16 Check main bearing bore cap fit and determine needed repairs

14.12.03.17 Inspect and replace main bearings

14.12.03.18 Check bearing clearance

14.12.03.19 Check and adjust crankshaft end-play

14.12.03.20 Inspect, replace, and time drive gear train

14.12.03.21 Clean, inspect, measure, and replace pistons, pins, and retainers

14.12.03.22 Measure piston-to-cylinder wall clearance

14.12.03.23 Check ring-to-groove clearance and end gap and install rings on pistons

14.12.03.24 Identify piston and bearing wear patterns, check bearing bore and bushing conditions, and determine needed repairs

14.12.03.25 Assemble pistons and connecting rods and install in block

14.12.03.26 Replace rod bearings and check clearances

14.12.03.27 Check condition, position, and clearance of piston cooling jets (nozzles)

14.12.03.28 Inspect, measure, and repair or replace crankshaft vibration damper and flywheel

14.12.03.29 Inspect, install, and align flywheel housing

**14.12.04.00 Troubleshoot and repair lubrication systems**

14.12.04.01 Check engine oil, pressure, gauge, and sending unit

14.12.04.02 Check level, contamination, and consumption of engine oil and pull sample for oil analysis

14.12.04.03 Inspect, measure, and repair or replace oil pump, drives, inlet pipes, and screens

14.12.04.04 Inspect and repair or replace oil-pressure regulator valves, bypass, and pressure-relief proper valves and filters

14.12.04.05 Inspect, clean, test, reinstall or replace, and align oil cooler

14.12.04.06 Test and reinstall or replace differential valve and thermostat

14.12.04.07 Inspect and repair or replace lines and hoses

14.12.04.08 Inspect turbocharger lubrication system

**14.12.05.00 Troubleshoot and repair cooling system**

14.12.05.01 Check engine coolant level, contamination, and consumption

14.12.05.02 Check coolant temperature, gauge, and sending unit

14.12.05.03 Inspect, reinstall or replace, and adjust drive belts

14.12.05.04 Inspect and replace thermostat, bypasses, housing(s), and seals

14.12.05.05 Identify coolant types and additives

14.12.05.06 Discuss use of refractometer

14.12.05.07 Check conditioner and coolant concentration levels

14.12.05.08 Flush and refill cooling system

14.12.05.09 Bleed air from cooling system

14.12.05.10 Inspect and repair or replace conditioner and/or filter, check valves, lines, and fittings

14.12.05.11 Inspect and repair or replace water pump, hoses, and idler pulley

14.12.05.12 Inspect, pressure-test, and clean radiator, pressure cap, and tanks

14.12.05.13 Inspect and repair or replace fan hub, fan, fan clutch, controls, thermostat, and fan shroud

14.12.05.14 Inspect and repair or replace radiator shutter assembly and controls

**14.12.06.00 Troubleshoot and repair air-induction and exhaust systems**

14.12.06.01 Inspect and repair or replace air-induction piping, air cleaner, and element

14.12.06.02 Inspect turbocharger or engine-driven blowers and piping system

14.12.06.03 Remove and replace turbocharger

14.12.06.04 Remove and replace engine blower

14.12.06.05 Inspect and repair or replace intake manifold, gaskets, and connections

14.12.06.06 Inspect, clean, tests, and repair or replace aftercooler assembly

14.12.06.07 Inspect and repair or replace exhaust manifold, piping, mufflers, and mounting hardware

14.12.06.08 Inspect and repair or replace preheater system and controls

14.12.06.08 Inspect and repair or replace ether or starting-fluid system and controls

14.12.06.09 Inspect and repair or replace emergency air-induction shutoff system

**14.12.07.00 Troubleshoot and repair fuel system**

14.12.07.01 Explain and comply with emission control laws

14.12.07.02 Check level, contamination, and consumption of fuel

14.12.07.03 Inspect and repair or replace fuel tanks, vents, caps, mounts, screens, supply, crossover, and return lines and fittings

14.12.07.04 Inspect, clean, test, and repair or replace fuel transfer (lift) pump, pump drives, screens, separators, proper filters, heaters, and associated mounting hardware

14.12.07.05 Check fuel system for air

14.12.07.06 Prime and bleed fuel system

14.12.07.07 Repair or replace primer pump

14.12.07.08 Inspect, adjust, and repair or replace throttle-control linkage and/or electronic controls

14.12.07.09 Inspect, adjust, and repair or replace electronic fuel controls

14.12.07.10 Perform on-engine inspections, tests, and adjustments or distributor-type injection pump drives

14.12.07.11 Adjust and/or replace PT-type injection pump, drives, injectors, and/or electronic controls

14.12.07.12 Perform on-engine inspections and test of unit injectors and/or electronic controls

14.12.07.13 Adjust and/or replace unit injectors andor electronic controls

14.12.07.14 Inspect, test, and adjust injection nozzles and determine needed repairs

14.12.07.15 Inspect smoke limiters and determine needed repairs

14.12.07.16 Inspect and reinstall or replace high-pressure injection lines, fittings, and seals

14.12.07.17 Replace or repair and reinstall low-pressure fuel lines, fittings, and seals

14.12.07.18 Inspect, test, and adjust engine governors and/or electronic controls and determine needed repairs

14.12.07.19 Inspect, test, and adjust engine fuel shutdown devices and controls

14.12.07.20 Inspect, test, and adjust safety shutdown devices, circuits, and sensors and determine needed repairs

**14.12.08.00 Troubleshoot and repair engine brake systems**

(Refer to manufacturer's specifications)

14.12.08.01 Inspect and adjust engine brakes

14.12.08.02 Inspect, test, adjust, and repair or replace engine brake control

14.12.08.03 Inspect and repair or replace engine brake housing, valves, seals, screens, lines, and fittings

**14.13.00 AUTOMATIC TRANSMISSION/TRANSAXLE**

**14.13.01.00 Troubleshoot transmission/transaxle**

(Refer to shop manual and technical bulletins for proper procedure)

14.13.01.01 Identify vehicle history

14.13.01.02 Interpret complaint

14.13.01.03 Verify engine operation

14.13.01.04 Identify needed engine repairs

14.13.01.05 Diagnose transmission noise and vibration problems

14.13.01.06 Identify needed transmission repairs

14.13.01.07 Diagnose fluid usage, level, and condition problems

14.13.01.08 Identify needed repairs related to fluids

14.13.01.09 Perform pressure tests

14.13.01.10 Identify needed repairs based on pressure test results

14.13.01.11 Perform stall tests

14.13.01.12 Identify needed repairs based on stall test results

14.13.01.13 Perform lock-up converter system tests

14.13.01.14 Identify needed repairs based on lock-up converter system tests

14.13.01.15 Diagnose electrical and electronic, mechanical, and vacuum control system problems

14.13.01.16 Identify needed repairs based on electrical, electronic, mechanical, and vacuum control system test results

14.13.02.05 Replace fluids and filters

14.13.02.06 Adjust electronic sensors, wires, and connectors

14.13.02.07 Replace electronic sensors, wires, and connectors

**14.13.03.00 Restore in-vehicle transmission and transaxle**

(Refer to shop manual and technical bulletins for proper procedure)

14.13.03.01 Adjust vacuum modulator

14.13.03.02 Replace vacuum modulator

14.13.03.03 Repair or replace lines and hoses

14.13.03.04 Repair or replace governor cover, seals, sleeve, valve, weights, springs, retainers, and gear

14.13.03.05 Replace external seals and gaskets

14.13.03.06 Repair or replace extension housing

14.13.03.07 Replace bushing and seal in extension housing

14.13.03.08 Flush cooler, lines, and fittings

14.13.03.09 Replace cooler, lines, and fittings

14.13.03.10 Replace speedometer drive gear, driven gear, and retainers

14.13.03.11 Repair or replace valve body

14.13.03.12 Repair or replace servo

14.13.03.13 Repair or replace accumulator

14.13.03.14 Adjust, repair or replace transmission-related electrical and electronic components (e.g., computers, solenoids, sensors, relays, swtiches)

14.13.03.15 Replace power train mounts

14.13.03.16 Align power train mounts

**14.13.04.00 Restore off-vehicle transmission and transaxle**

(Refer to shop manual and technical bulletins for proper procedure)

14.13.04.01 Remove rear-wheel-drive transmission and torque converter

14.13.04.02 Reinstall rear-wheel-drive transmission and torque converter

14.13.04.03 Remove transaxle and torque converter assembly

14.13.04.04 Reinstall transaxle and torque converter assembly

14.13.04.05 Disassemble rear-wheel-drive transmission

14.13.04.06 Clean rear-wheel-drive transmission

14.13.04.07 Inspect rear wheel-drive transmission

14.13.04.08 Disassemble transaxle assembly

14.13.04.09 Clean transaxle assembly

14.13.04.10 Inspect transaxle assembly

14.13.04.11 Assemble rear-wheel-drive transmission

14.13.04.12 Assemble transaxle

**14.13.05.00 Troubleshoot oil pump and converter**

(Refer to shop manual and technical bulletins for proper procedure)

14.13.05.01 Inspect converter flex plate, attaching parts, pilot and pump drive, and seal areas

14.13.05.02 Measure torque converter end play

14.13.05.03 Check for interference in torque converter end play

14.13.05.04 Check starter clutch

14.13.05.05 Inspect oil pump housing, shafts, vanes, rotors, gears, valves, seals, and bushings

14.13.05.06 Measure oil pump housing, shafts, vanes, rotors, gears, valves, seals, and bushings

14.13.05.07 Perform lockup converter and control system checks

**14.13.06.00 Restore oil pump and converter**

(Refer to shop manual and technical bulletins for proper procedure)

14.13.06.01 Replace oil pump housings, shafts, vanes, rotors, gears, valves, seals, and bushings

14.13.06.02 Flush torque converter and transmission cooling system

**14.13.07.00 Troubleshoot gear train, shafts, bushings, and case**

(Refer to shop manual and technical bulletins for proper procedure)

14.13.07.01 Check end play to determine needed repairs to gear train, shafts, bushings, and case

14.13.07.02 Preload to determine needed repairs

14.13.07.03 Inspect thrust washers and bearing

14.13.07.04 Measure thrust washers and bearings

14.13.07.05 Inspect shafts

14.13.07.06 Inspect oil delivery seal rings, including ring, ring groove, and sealing surface area

14.13.07.07 Inspect bushings

14.13.07.07 Inspect planetary gear assembly

14.13.07.08 Measure planetary gear assembly

14.13.07.09 Inspect cases

14.13.07.10 Inspect transaxle drive-link chains, sprockets, gears, bearings, and bushings

14.13.07.11 Inspect transaxle final drive components

14.13.07.12 Measure transaxle final drive components

14.13.07.13 Inspect parking pawl, shaft, springs, and retainer

**14.13.08.00 Restore gear train, shafts, bushings, and case**

(Refer to shop manual and technical bulletins for proper procedure)

14.13.08.01 Clean gear train, shafts, bushings, and case

14.13.08.02 Replace thrust washers and bearings

14.13.08.03 Replace shafts

14.13.08.04 Replace bushings

14.13.08.05 Replace planetary gear assembly

14.13.08.06 Repair or replace cases

14.13.08.07 Repair or replace transaxle drive-link chains, sprockets, gears, bearings, and bushings

14.13.08.08 Adjust transaxle final drive components

14.13.08.09 Repair or replace transaxle final drive components

14.13.08.10 Repair or replace parking pawl, shaft, springs, and retainer

**14.13.09.00 Troubleshoot friction and reaction units**

(Refer to shop manual and technical bulletins for proper procedure)

14.13.09.01 Inspect clutch assembly

14.13.09.02 Measure clutch pack clearance

14.13.09.03 Air-test clutch pack and servo assemblies

14.13.09.04 Inspect roller and sprag clutches

14.13.09.05 Inspect bands and drums

**14.13.10.00 Restore friction and reaction units**

(Refer to shop manual and technical bulletins for proper procedure)

14.13.10.01 Repair or replace clutch assembly

14.13.10.02 Adjust clutch pack clearance

14.13.10.03 Repair roller and sprag clutches

14.13.10.04 Replace bands and drums

**14.13.11.00 Restore non-gear-driven transmission/transaxle**

(Refer to shop manual and technical bulletins for proper procedure)

14.13.11.01 Replace belts, chains or link-belt

14.13.11.02 Replace transmission lubricants

14.13.11.03 Remove transmission

14.13.11.04 Replace transmission

**14.14.00 SUSPENSION AND STEERING**

**14.14.01.00 Troubleshoot steering systems**

(Refer to shop manual and technical bulletins for proper procedure)

14.14.01.01 Disable inflatable restraints system

14.14.01.02 Diagnose noises, looseness, and binding problems in steering column, including tilt and locking mechanisms

14.14.01.03 Identify needed repairs to steering column, including tilt, telescoping, and locking mechanisms

14.14.01.04 Diagnose power non-rack-and-pinion steering gear binding, uneven turning effort, looseness, hard steering, and fluid leakage problems

| | |
|---|---|
| 14.14.01.05 | Identify needed repairs to power non-rack-and-pinion steering |
| 14.14.01.06 | Diagnose manual non-rack-and-pinion steering gear binding, uneven turning effort, looseness, hard steering, and fluid leakage problems |
| 14.14.01.07 | Diagnose power rack-and-pinion steering gear vibration, looseness, and hard steering |
| 14.14.01.08 | Identify needed repairs to power rack-and-pinion steering |
| 14.14.01.09 | Diagnose manual rack-and-pinion steering gear vibration, looseness, and hard steering |
| 14.14.01.10 | Identify needed repairs to manual rack-and-pinion steering |
| 14.14.01.11 | Inspect steering shafts, bearings, retainers, universal joint(s), flexible coupling(s) collapsible columns, and steering wheel |
| 14.14.01.12 | Inspect inner tie-rod ends (sockets) and bellows boots of manual and power rack-and-pinion steering gears |
| 14.14.01.13 | Inspect mounting bushings and bracket of rack-and-pinion steering gear |
| 14.14.01.14 | Inspect manual and power steering fluid levels and condition |
| 14.14.01.15 | Diagnose power steering fluid leakage |
| 14.14.01.16 | Identify needed repairs to remedy power steering fluid leakage |
| 14.14.01.17 | Inspect power steering pump belt(s) |
| 14.14.01.18 | Inspect pump mounts |
| 14.14.01.19 | Inspect power steering pump seals and gaskets |
| 14.14.01.20 | Inspect power steering pump pulley |
| 14.14.01.21 | Perform power steering system pressure test |
| 14.14.01.22 | Identify needed repairs to power steering system based on pressure test results |
| 14.14.01.23 | Inspect power steering hoses and fittings |

14.14.01.24 Inspect power non-rack-and-pinion steering gear seals and gaskets

14.14.01.25 Inspect pitman arm

14.14.01.26 Inspect relay (center link, intermediate) rod

14.14.01.27 Inspect idler arm and mountings

14.14.01.28 Inspect tie rod

14.14.01.29 Inspect steering linkage damper

**14.14.02.00 Restore steering systems**

(Refer to shop manual and technical bulletins for proper procedure)

14.14.02.01 Replace steering shafts, bearings, retainers, universal joint(s), flexible coupling(s) collapsible columns, and steering wheel

14.14.02.02 Remove manual and power non-rack-and-pinion steering gears

14.14.02.03 Replace manual and power non-rack-and-pinion steering gears

14.14.02.04 Disassemble manual non-rack-and-pinion steering gears

14.14.02.05 Inspect manual non-rack-and-pinion steering gears

14.14.02.06 Repair or replace manual non-rack-and-pinion steering gears

14.14.02.07 Reassemble manual non-rack-and-pinion steering gears

14.14.02.08 Adjust worn-bearing preload and sector lash of manual and power non-rack-and-pinion steering gears

14.14.02.09 Remove manual and power rack-and-pinion steering gears

14.14.02.10 Replace manual and power rack-and-pinion steering gears

14.14.02.11 Disassemble manual and power rack-and-pinion steering gears

14.14.02.12 Inspect manual and power rack-and-pinion steering gears

14.14.02.13 Repair or replace manual and power rack-and-pinion steering gears

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|---|---|
| 14.14.02.14 | Reassemble manual and power rack-and-pinion steering gears |
| 14.14.02.15 | Adjust manual and power rack-and-pinion steering gears |
| 14.14.02.16 | Replace inner tie-rod ends (sockets) and bellows boots of manual and power rack-and-pinion steering gears |
| 14.14.02.17 | Replace mountings bushings and brackets of rack-and-pinion steering gear |
| 14.14.02.18 | Flush power steering system |
| 14.14.02.19 | Adjust power steering pump belt(s) |
| 14.14.02.20 | Replace power steering pump belt(s) |
| 14.14.02.21 | Remove power steering pump |
| 14.14.02.22 | Replace power steering pump |
| 14.14.02.23 | Replace power steering pump seals and gaskets |
| 14.14.02.24 | Replace power steering pump pulley |
| 14.14.02.25 | Replace power steering hoses and fittings |
| 14.14.02.26 | Replace power non-rack-and-pinion steering gear seals and gaskets |
| 14.14.02.27 | Replace pitman arm |
| 14.14.02.28 | Replace relay (center link, intermediate) rod |
| 14.14.02.29 | Replace idler arm and mountings |
| 14.14.02.30 | Replace tie rod |
| 14.14.02.31 | Adjust tie rod |
| 14.14.02.32 | Replace steering linkage damper |
| 14.14.02.33 | Check alignment |

**14.14.03.00 Troubleshoot front suspension systems**

(Refer to shop manual or technical bulletins for proper procedure)

14.14.03.01 Diagnose noises, body sway and uneven riding height in short-arm and long-arm type suspension system

14.14.03.02 Identify needed repairs to short-arm and long-arm type suspension system

14.14.03.03 Diagnose noises, body sway, and uneven riding height in MacPherson strut suspension system

14.14.03.04 Identify needed repairs to MacPherson strut suspension system

14.14.03.05 Inspect upper and lower control arms

14.14.03.06 Inspect bushings, shafts, and rebound bumpers of upper and lower control arms

14.14.03.07 Inspect strut rods and bushings

14.14.03.08 Inspect upper and lower ball joints on short-arm and long-arm suspension systems

14.14.03.09 Inspect steering knuckle assemblies

14.14.03.10 Inspect coil springs and spring insulators on short-arm and long-arm front suspension systems

14.14.03.11 Inspect torsion bars on front suspension system

14.14.03.12 Inspect torsion bar mounts on front suspension system

14.14.03.13 Inspect stabilizer bar bushings, brackets, and links

14.14.03.14 Inspect ball joints on MacPherson strut suspension systems

14.14.03.15 Inspect MacPherson strut cartridge or assembly

14.14.03.16 Inspect front MacPherson strut coil spring and insulators

14.14.03.17 Inspect front wheel bearings and hubs

**14.14.04.00 Restore front suspension systems**

(Refer to shop manual or technical bulletins for proper procedure)

14.14.04.01 Replace upper and lower control arms

14.14.04.02 Replace bushings, shafts, and bumpers of upper and lower control arms

14.14.04.03 Adjust strut rods and bushings

14.14.04.04 Replace strut rods and bushings

14.14.04.05 Replace upper and lower ball joints on short-arm and long-arm suspension systems

14.14.04.06 Replace steering knuckle assemblies

14.14.04.07 Replace coil springs and spring insulators on short-arm and long-arm front suspension systems

14.14.04.08 Replace torsion bars on front suspension system

14.14.04.09 Adjust torsion bars on front suspension system

14.14.04.10 Replace stabilizer bar bushings, brackets, and links

14.14.04.11 Replace ball joints on MacPherson strut suspension systems

14.14.04.12 Replace MacPherson strut cartridge or assembly

14.14.04.13 Replace front MacPherson strut coil spring and insulators

14.14.04.14 Lubricate suspension and steering systems

14.14.04.15 Check alignment

14.14.04.16 Adjust, repair or replace front wheel bearing

**14.14.05.00 Troubleshoot rear suspension systems**

(Refer to shop manual or technical bulletins for proper procedure)

14.14.05.01 Inspect coil springs and spring insulators of rear suspension system

14.14.05.02 Inspect transverse links, control arms, ball joints, tie rods, bushings, and mounts of rear suspension system

14.14.05.03 Inspect leaf springs, leaf-spring insulators (silencers), shackles, brackets, bushings, and mounts of rear suspension system

14.14.05.04 Inspect rear MacPherson strut cartridge or assembly of rear suspension system

14.14.05.05 Inspect rear MacPherson strut coil spring and insulators

14.14.05.06 Inspect rear-wheel-drive axle assembly for bending, warpage, and misalignment

14.14.05.07 Inspect rear wheel bearings and hubs

**14.14.06.00 Restore rear suspension systems**

(Refer to shop manual or technical bulletins for proper procedure)

14.14.06.01 Replace coil springs and spring insulators for rear suspension system

14.14.06.02 Replace leaf springs, leaf-spring insulators (silencers), shackles, brackets, bushings, and mounts of rear suspension system

14.14.06.03 Replace rear MacPherson strut cartridge or assembly of rear suspension system

14.14.06.04 Replace rear MacPherson strut coil spring and insulators

14.14.06.05 Lubricate steering and suspension systems

14.14.06.06 Adjust, repair, or replace rear wheel bearings

**14.14.07.00 Troubleshoot shock absorbers and electronically controlled suspension systems**

(Refer to shop manual or technical bulletins for proper procedure)

14.14.07.01 Inspect shock absorbers

14.14.07.02 Inspect components of electronically controlled suspension systems

**14.14.08.00 Restore shock absorbers and electronically controlled suspension systems**

(Refer to shop manual or technical bulletins for proper procedure)

14.14.08.01 Replace shock absorbers

14.14.08.02 Adjust components of electronically controlled suspension systems repair or replace components of electronically controlled suspension systems

**14.14.09.00 Troubleshoot wheel alignment**

(Refer to shop manual or technical bulletins for proper procedure)

14.14.09.01 Diagnose vehicle wandering, pulling, hard steering, and poor steering return

14.14.09.02 Identify needed repairs based on diagnosis of vehicle wandering, pulling, hard steering, and poor steering return

14.14.09.03 Check pressure, condition, and size of tire

14.14.09.04 Measure vehicle riding height

14.14.09.05 Identify needed repairs based on vehicle riding height

14.14.09.06 Identify needed repairs to cambers on nonadjustable suspension systems

14.14.09.07 Identify needed repairs to caster on nonadjustable suspension systems

14.14.09.08 Identify needed repairs to remedy problems in toe-out-on-turns

14.14.09.09 Identify needed repairs to SAI, KPI, and included angle

14.14.09.10 Identify needed repairs to rear-wheel thrust-angle

14.14.09.11 Identify needed repairs to front-wheel setback

**14.14.10.00 Restore wheel alignment**

(Refer to shop manual or technical bulletins for proper procedure)

14.14.10.01 Check front-wheel and rear-wheel camber on suspension systems

14.14.10.02 Adjust front-wheel and rear-wheel camber on suspension systems

14.14.10.03 Check front-wheel and rear-wheel camber on nonadjustable suspension systems

14.14.10.04 Check caster on suspension systems

14.14.10.05 Adjust caster on suspension systems

14.14.10.06 Check caster on nonadjustable suspension system

14.14.10.07 Check front-wheel toe

14.14.10.08 Adjust front-wheel toe

14.14.10.09 Center steering wheel

14.14.10.10 Check toe-out-on-turns (turning radius)

14.14.10.11 Check steering axis inclination (SAI), king pin inclination (KPI), and included angle

14.14.10.12 Check rear-wheel toe

14.14.10.13 Adjust rear-wheel toe

14.14.10.14 Check rear-wheel thrust-angle

14.14.10.15 Check for front-wheel setback

**14.14.11.00 Troubleshoot wheel(s) and tire(s)**

(Refer to shop manual or technical bulletins for proper procedure)

14.14.11.01 Diagnose unusual tire wear patterns

14.14.11.02 Identify needed repairs based on unusual tire wear patterns

14.14.11.03 Inspect tires

14.14.11.04 Diagnose wheel/tire vibration, shimmy, and tramp

14.14.11.05 Identify needed repairs based on wheel/tire vibration, shimmy , and tamp

14.14.11.06 Measure wheel, tire, axle, and hub run-out

14.14.11.07 Identify needed repairs based on wheel, tire, axle, and hub run-out measurements

14.14.11.08 Diagnose tire pull (lead) problems

14.14.11.09 Identify needed repairs based on diagnosis of tire pull (lead) problems

**14.14.12.00 Restore wheel(s) and tire(s)**

(Refer to shop manual or technical bulletins for proper procedure)

14.14.12.01 Check air pressure

14.14.12.02 Adjust air pressure

14.14.12.03 Rotate tires according to manufacturer's standard recommendations

14.14.12.04 Balance static or dynamic wheel-and-tire assembly

14.14.12.05 Dismount tire on wheel

14.14.12.06 Inspect tire and wheel

14.14.12.07 Repair or replace tire and wheel

14.14.12.08 Remount tire and wheel

14.14.12.09 Reinstall wheel and torque lug nuts

**14.15.00 DRIVETRAIN**

**14.15.01.00 Troubleshoot and repair clutch**

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|---|---|
| 14.15.01.01 | Diagnose clutch noise, binding, slippage, pulsation, grabbing, and chatter |
| 14.15.01.02 | Diagnose clutch failure |
| 14.15.01.03 | Inspect, adjust, and repair or replace clutch linkage, cables, levers, brackets, bushings, pivots, and springs |
| 14.15.01.04 | Inspect brake lines and brake hoses |
| 14.15.01.05 | Bleed brake hydraulic system |
| 14.15.01.06 | Inspect and adjust or replace release (throwout) bearing |
| 14.15.01.07 | Inspect sleeve, bushing, springs, levers, shafts, and seals of clutch system |
| 14.15.01.08 | Inspect and replace single-disc clutch assembly |
| 14.15.01.09 | Inspect, adjust, measure, and align or replace double-disc clutch |
| 14.15.01.10 | Inspect and adjust or replace clutch/brake assembly |
| 14.15.01.11 | Inspect input shaft splines |
| 14.15.01.12 | Inspect self-adjusting clutch mechanisms |
| 14.15.01.13 | Inspect and replace pilot bearing |
| 14.15.01.14 | Inspect flywheel mounting area on crankshaft |
| 14.15.01.15 | Check crankshaft end-play |
| 14.15.01.16 | Inspect and repair or replace flywheel and starter ring gear |
| 14.15.01.17 | Measure flywheel face run-out and pilot bore run-out and determine needed repairs |
| 14.15.01.18 | Inspect engine block, flywheel housing, and transmission housing mating surfaces |
| 14.15.01.19 | Measure flywheel housing bore run-out and face run-out and determine needed repairs |

**14.15.02.00 Troubleshoot and repair transmission**

14.15.02.01 Diagnose transmission noise, shifting, lockup, jumping out-of-gear, overheating, and vibration problems

14.15.02.02 Diagnose transmission component failure before and during disassembly and determine needed repairs

14.15.02.03 Inspect, adjust, and repair or replace transmission remote shift linkages, brackets, bushings, pivots, and levers

14.15.02.04 Inspect, test, adjust, and repair or replace air shift controls, lines, hoses, valves, regulators, filters, and cylinder assemblies

14.15.02.05 Inspect and replace transmission mounts, insulators, and mounting bolts

14.15.02.06 Inspect transmission cover plates, gaskets, seals, and cap bolts for leakage and replace as needed

14.15.02.07 Inspect seal surfaces

14.15.02.08 Check transmission fluid for proper level, type, and condition according to manufacturer's specifications

14.15.02.09 Drain and refill transmission

14.15.02.10 Check magnetic plugs and vents

14.15.02.11 Inspect and adjust or replace transmission shift lever, cover, rails, forks, levers, bushings, sleeves, detents, interlocks, springs, and lock bolts

14.15.02.12 Remove and reinstall transmission and check crankshaft end-play

14.15.02.13 Inspect and replace input shaft, gear, spacers, bearings, retainers, and slingers

14.15.02.14 Inspect, adjust, and replace main shaft, gears, sliding clutches, washers, spacers, bushings, bearings, auxiliary drive assemblies, retainers, and keys

14.15.02.15 Inspect and replace countershafts, gears, bearings, retainers, and keys

14.15.02.16 Adjust bearing preload and time-multiple countershaft gears

14.15.02.17 Inspect and replace out shafts, gears, washers, spacers, bearings, retainers, and keys

14.15.02.18 Inspect and replace reverse idler shafts, gears, bushings, bearings, thrust washers, and retainers

14.15.02.19 Check reverse idler gear end-play

14.15.02.20 Inspect and replace synchronizer hub, sleeve, keys, springs, blocking rings, synchronizer plates, blocker pins, and sliding clutches

14.15.02.21 Inspect and repair or replace transmission cases

14.15.02.22 Inspect and repair or replace transmission lubrication system pumps, troughs, collectors, and slingers

14.15.02.23 Inspect and replace transmission oil filters and inspect coolers

14.15.02.24 Inspect mechanical speedometer components

14.15.02.25 Inspect electronic speedometer components

14.15.02.26 Inspect, adjust, and repair or replace power take-off (PTO) assemblies, controls, and shafts

14.15.02.27 Inspect and test backup light, neutral start, and warning device circuit switches

14.15.02.28 Inspect and test transmission temperature gauge circuit for accuracy

14.15.02.29 Inspect, adjust, remove, and replace transfer case assemblies

**14.15.03.00 Troubleshoot and repair driveshaft and universal joint**

14.15.03.01 Diagnose noise and vibration problems in driveshaft and universal joint and determine needed repairs

14.15.03.02 Inspect and repair or replace driveshaft, slip joints, yokes, drive flanges, and universal joints

14.15.03.03 Check phasing of all yokes

14.15.03.04 Inspect and repair or replace driveshaft center support bearings and mounts

14.15.03.05 Measure and adjust loaded and unloaded driveling angles

**14.15.04.00 Troubleshoot and repair drive axle**

14.15.04.01 Diagnose noise and overheating in rear-axle drive unit problems and determine needed repairs

14.15.04.02 Check for and repair fluid leaks

14.15.04.03 Inspect and replace cover gaskets, vents, magnetic plugs, and seals of rear-axle drive unit

14.15.04.04 Check fluid level and condition in rear-axle drive unit and determine needed repair

14.15.04.05 Add lubricant to rear-axle drive unit

14.15.04.06 Inspect and repair or replace differential carrier assembly

14.15.04.07 Inspect and repair or replace differential case assembly

14.15.04.08 Inspect and replace components of traction-control differential case assembly

14.15.04.09 Inspect differential carrier case and cap, side-bearing bores, and pilot-bearing bore and determine needed repairs

14.15.04.10 Measure ring-gear run-out and determine needed repairs

14.15.04.11 Inspect and replace ring gears, drive-pinion gears, spacers, sleeves, bearing cage, and bearings

14.15.04.12 Measure and adjust drive-pinion bearing preload

14.15.04.13 Adjust drive-pinion depth

14.15.04.14 Measure and adjust side-bearing preload and ring and pinion blacklash

14.15.04.15 Check and interpret ring and pinion tooth contact pattern and adjust according to manufacturer's specifications

14.16.01.02 Diagnose poor stopping or dragging caused by master cylinder

14.16.01.03 Identify needed repairs based on diagnosis of poor stopping or dragging caused by master cylinder

14.16.01.04 Diagnose poor stopping, dragging, high/low pedal, or hard pedal caused by step-bore master cylinder or internal valves

14.16.01.05 Identify needed repairs based on diagnosis of poor stopping, dragging, high/low pedal, or hard pedal caused by step-bore master cylinder or internal valves

14.16.01.06 Diagnose poor stopping, pulling, or dragging caused by brake fluid, lines, or hoses

14.16.01.07 Identify needed repairs based on diagnosis of poor stopping, pulling, or dragging caused by brake fluid, lines, or hoses

14.16.01.08 Diagnose poor stopping, pulling, or dragging caused by hydraulic system valve(s)

14.16.01.09 Inspect metering (hold-off), proportioning (balance), pressure differential, and combination valves

14.16.01.10 Test metering (hold-off), proportioning (balance), pressure differential, and combination valves

14.16.01.11 Inspect load-sensing and height-sensing proportioning valve(s)

14.16.01.12 Test load-sensing and height-sensing proportioning valve(s)

14.16.01.13 Inspect brake lines and fittings for leaks, dents, kinks, rust, cracks, or wear

14.16.01.14 Inspect flexible brake hoses for leaks, kinks, cracks, bulging, or wear

14.16.01.15 Inspect brake warning light system switch and wiring

14.16.01.16 Test brake warning light system switch and wiring

**14.16.02.00 Restore hydraulic system**

(Refer to shop manual or technical bulletins for proper procedure)

| | |
|---|---|
| 14.16.02.01 | Measure pedal pushrod length |
| 14.16.02.02 | Adjust pedal pushrod length |
| 14.16.02.03 | Check master cylinder for internal and external leaks and proper operation |
| 14.16.02.04 | Identify needed repairs based on diagnosis of internal and external leaks and proper operation of master cylinder |
| 14.16.02.05 | Remove master cylinder |
| 14.16.02.06 | Bench bleed master cylinder |
| 14.16.02.07 | Replace master cylinder |
| 14.16.02.08 | Tighten loose fittings and supports on brake lines |
| 14.16.02.09 | Tighten loose fittings and supports on flexible brake hoses |
| 14.16.02.10 | Replace double flare and ISO brake lines, hoses, fittings, and supports |
| 14.16.02.11 | Select brake fluid |
| 14.16.02.12 | Install brake fluid |
| 14.16.02.13 | Replace metering (hold-off), proportioning (balance), pressure differential, and combination valves |
| 14.16.02.14 | Replace load-sensing and height-sensing proportioning valve(s) |
| 14.16.02.15 | Adjust load-sensing and height-sensing proportioning valve(s) |
| 14.16.02.16 | Replace brake warning light system switch and wiring |
| 14.16.02.17 | Reset brake pressure differential valve |
| 14.16.02.18 | Bleed (using manual, pressure, vacuum, or surge method) hydraulic system |
| 14.16.02.19 | Flush hydraulic systems |
| 14.16.02.20 | Check master cylinder fluid levels |
| 14.16.02.21 | Adjust master cylinder fluid levels |

14.16.02.22 Verify stoplight switch operation

**14.16.03.00 Troubleshoot drum brake**

(Refer to shop manual or technical bulletins for proper procedure)

14.16.03.01 Diagnose poor stopping, pulling, or dragging caused by drum-brake wheel assembly

14.16.03.02 Identify needed repairs based on diagnosis or poor stopping, pulling, or dragging caused by drum-brake wheel assembly

14.16.03.03 Diagnose poor stopping, noise, pulling, grabbing, or pedal pulsation caused by drum-brake mechanical assembly

14.16.03.04 Identify needed repairs based on diagnosis of poor stopping, noise, pulling, grading, drafting, or pedal pulsation caused by drum-brale mechanical assembly

14.16.03.05 Identify needed repairs to brake shoes and lining, springs, pins, clips, levers, adjusters and self-adjusters, and other related brake hardware

**14.16.04.00 Restore drum brake**

(Refer to shop manual or technical bulletins for proper procedure)

14.16.04.01 Remove brake drums

14.16.04.02 Clean brake drums

14.16.04.03 Inspect brake drums

14.16.04.04 Measure brake drums

14.16.04.05 Mount brake drum on lathe

14.16.04.06 Machine brake drum on lathe without exceeding drum specifications

14.16.04.07 Remove brake shoes and linings, springs, pins, clips, levers, adjusters and self-adjusters, and other related brake hardware

14.16.04.08 Clean brake shoes and linings, springs, pins, clips, levers, adjusters and self-adjusters, and other related brake hardware

| | |
|---|---|
| 14.16.04.09 | Inspect brake shoes and linings, springs, pins, clips, levers, adjusters and self-adjusters, and other related brake hardware |
| 14.16.04.10 | Clean brake backing (support) plates |
| 14.16.04.11 | Inspect brake backing (support) |
| 14.16.04.12 | Remove brake backing (support) |
| 14.16.04.13 | Reinstall brake backing (support) |
| 14.16.04.14 | Remove wheel cylinders |
| 14.16.04.15 | Reinstall wheel cylinders |
| 14.16.04.16 | Replace wheel cylinders |
| 14.16.04.17 | Disassemble wheel cylinder assembly |
| 14.16.04.18 | Clean wheel cylinder assembly |
| 14.16.04.19 | Inspect wheel cylinder assembly parts for wear, rust, scoring, and damage |
| 14.16.04.20 | Hone wheel cylinder |
| 14.16.04.21 | Replace cups, boots, and damaged or worn parts of wheel cylinder assembly |
| 14.16.04.22 | Lubricate brake shoe support pads on backing (support) plate, adjuster and self-adjuster mechanisms, and other brake hardware |
| 14.16.04.23 | Identify correct brake shoe application |
| 14.16.04.24 | Install brake shoes and related hardware |
| 14.16.04.25 | Adjust brake shoes |
| 14.16.04.26 | Reinstall brake drums, drum and hub assemblies, and wheel bearings |
| 14.16.04.27 | Reinstall wheel torque lug nuts |
| 14.16.04.28 | Make final checks of wheel and lug nuts |
| 14.16.04.29 | Make final adjustments to wheel and lug nuts |

**14.16.05.00 Troubleshoot disc brake**

(Refer to shop manual or technical bulletins for proper procedure)

14.16.05.01 Diagnose poor stopping, pulling, or dragging caused by disc-brake caliper assembly

14.16.05.02 Identify needed repairs based on diagnosis of poor stopping, pulling, or dragging caused by disc-brake caliper assembly

14.16.05.03 Diagnose poor stopping, noise, pulling, grabbing, dragging, or pedal pulsation caused by disc-brake mechanical assembly

14.16.05.04 Identify needed repairs based on diagnosis of poor stopping, noise, pulling, grabbing, dragging, or pedal pulsation caused by disc-brake mechanical assembly

**14.16.06.00 Restore disc brake**

(Refer to shop manual or technical bulletins for proper procedure)

14.16.06.01 Remove caliper assembly from mountings

14.16.06.02 Support caliper assembly

14.16.06.03 Clean caliper housing

14.16.06.04 Inspect caliper housing for leaks and damage

14.16.06.05 Clean caliper mountings and slides

14.16.06.06 Inspect caliper mountings and slides for wear and damage

14.16.06.07 Remove caliper assembly

14.16.06.08 Disassemble caliper assembly

14.16.06.09 Clean caliper assembly

14.16.06.10 Inspect caliper assembly parts for wear, rust, scoring, and damage

14.16.06.11 Replace all caliper assembly seals, boots, and any damaged or worn parts

14.16.06.12 Visually inspect internal condition of lines and hoses

14.16.06.13 Reassemble caliper

14.16.06.14 Reinstall caliper

14.16.06.15 Clean rotor

14.16.06.16 Inspect rotor

14.16.06.17 Measure rotor with dial indicator and micrometer

14.16.06.18 Remove rotor

14.16.06.19 Mount rotor on lathe

14.16.06.20 Machine rotor without exceeding specifications

14.16.06.21 Apply nondirectional finish

14.16.06.22 Identify correct brake pad application

14.16.06.23 Lubricate caliper guides and slides with proper lubricant

14.16.06.24 Install right and left pads, calipers, and related attaching hardware

14.16.06.25 Adjust calipers with integrated parking brakes

14.16.06.26 Fill master cylinder with recommended fluid

14.16.06.27 Seat pads

14.16.06.28 Inspect caliper for leaks

14.16.06.29 Reinstall wheel, torque lug nuts

14.16.06.30 Perform final checks and adjustments

**14.16.07.00 Troubleshoot power-assist units**

(Refer to shop manual or technical bulletins for proper procedure)

14.16.07.01 Test pedal free travel with and without engine running

14.16.07.02 Check power booster operation

14.16.07.03 Check manifold and auxiliary pump vacuum supply to vacuum-type power booster with a vacuum gauge

14.16.07.04 Inspect vacuum-type power booster unit for vacuum leaks

14.16.07.05 Inspect check valve for proper operation

14.16.07.06 Inspect hydro-boost system and accumulator to leaks and proper operation

14.16.07.07 Test hydro-boost system and accumulator for leaks and proper operation

14.16.07.08 Inspect electrically controlled power boost system for leaks and proper operation

**14.16.08.00 Restore power-assist units**

(Refer to shop manual or technical bulletins for proper procedure)

14.16.08.01 Repair or replace check valve parts

14.16.08.02 Depressurize hydro-boost system and accumulator

14.16.08.03 Repair or replace parts of hydro-boost system and accumulator

14.16.08.04 Depressurize power-boost system

14.16.08.05 Repair or replace parts of hydro-boost system and accumulator

14.16.08.06 Diagnose tire pull (lead) problems

14.16.08.07 Identify needed repairs based on diagnosis of tire(lead) problems

**14.16.09.00 Troubleshoot antilock brakes**

(Refer to shop manual or technical bulletins for proper procedure)

14.16.09.01 Liability

14.16.09.02 Perform comprehensive brake warning system diagnosis

14.16.09.03 Identify needed repairs based on comprehensive brake warning system diagnosis

**14.16.10.00 Restore antilock brakes**

(Refer to shop manual or technical bulletins for proper procedure)

14.16.10.01 Repair or replace components

**14.16.11.00 Troubleshoot miscellaneous components**

(Refer to shop manual or technical bulletins for proper procedures)

14.16.11.01 Diagnose wheel bearing noises, wheel shimmy, and vibration problems

14.16.11.02 Identify needed repairs based on diagnosis of wheel bearing noises, wheel shimmy, and vibration problems

14.16.11.03 Check parking brake system

14.16.11.04 Inspect cables and parts of parking brake system for wear, rusting. Binding and corrorsion

14.16.11.05 Check parking brake assembly operation

14.16.11.06 Test parking indicator lights, switches, and wiring

14.16.11.07 Test brake stoplight switch and wiring

**BRAKE SYSTEMS (DIESEL)**

**14.17.00 Air Brakes (subunit)**

**14.17.01.00 Troubleshoot and repair air supply and service systems**

14.17.01.01 Diagnose poor stopping, air leaks, pulling, grabbing, and dragging and determine needed repairs

14.17.01.02 Check air-system buildup time

14.17.01.03 Drain air reservoir tanks and check for oil, water, and foreign material

14.17.01.04 Inspect, align, and adjust or replace compressor drive belts and pulleys

14.17.01.05 Inspect, repair or replace, and time compressor drive gear and coupling

14.17.01.06 Inspect and repair or replace air compressor, air cleaner, and oil and water lines and fittings

14.17.01.07 Inspect, test, adjust, and replace system-pressure controls, couplings, filters, lines, hoses, and fittings

14.17.01.08 Inspect, test, adjust, and replace unloaded assembly valves

14.17.01.09 Inspect, test, clean, and replace air-tank relief valves, one-way check valves, drain-cocks, spitter valves, heaters, wiring, and connectors

14.17.01.10 Inspect, clean, and repair or replace air-drier systems, filters, valves, heaters, wiring, and connectors

14.17.01.11 Inspect, test, adjust, and repair or replace brake application valve, fittings, and mounts

14.17.01.12 Inspect, test, clean, and replace two-way check valves

14.17.01.13 Inspect, test, and repair or replace circuit switches, wiring, and connectors of stoplight and parking brake light

14.17.01.14 Inspect, test, and repair or replace hand brake (trailer) control valve, lines, fittings, and mountings

14.17.01.15 Inspect, test, and repair or replace brake-relay valve

14.17.01.16 Inspect, test, and replace quick-release valves

14.17.01.17 Inspect, test, and replace limiting quick-release valve

14.17.01.18 Inspect, test, and replace tractor-protection valve

14.17.01.19 Inspect, test, and replace emergency brake-control valve

14.17.01.20 Inspect, test, and replace inversion valve

14.17.01.21 Inspect, test, and repair or replace low-pressure warning devices

14.17.01.22 Inspect, test, and replace air-pressure gauges, lines, and fittings

14.17.01.23 Identify operation of automatic braking system (ABS)

**14.17.02.00 Troubleshoot and repair mechanical/foundation brake components**

14.17.02.01 Diagnose poor stopping, brake noise, pulling, grabbing, and dragging and determine needed repairs

14.17.02.02 Inspect, test, and adjust, repair or replace brake chambers, diaphragm, clamp, spring, pushrod, clevis, and mounting brackets

14.17.02.03 Inspect and adjust, repair, or replace manual and automatic slack adjusters

14.17.02.04 Inspect and repair or replace cams, rollers, shafts, bushings, seals, specters, and retainers

14.17.02.05 Inspect, and repair or replace brake spider, shields, anchor pins, bushings, and springs

14.17.02.06 Inspect, repair or replace, and adjust wedge-type brake housing, plungers, and wedge assembly

14.17.02.07 Inspect, clean, and adjust air-disc brake caliper assemblies

14.17.02.08 Inspect and replace brake shoes or pads

14.17.02.09 Inspect brake drums or rotors and ensure parts meet Department of Transportation specifications

**14.17.03.00 Troubleshoot and repair parking brakes**

14.17.03.01 Inspect and adjust, repair, or replace drums, rotors, bands, shoes, mounting hardware, and adjusters of driveline parking brake

14.17.03.02 Inspect and adjust, repair or replace application system pedal, cables, linkage, levers, pivots, and springs of driveline parking brake

14.17.03.03 Check operation of parking brake chamber (i.e., air brakes and spring brake

14.17.03.04 Demonstrate proper changing of spring chamber during removal and replacement

14.17.03.05 Inspect, test, and replace check valves, lines, hoses, and fittings of parking brake

14.17.03.06 Inspect, test, and replace parking brake application and release valve

14.17.03.07 Release and reset parking brakes manually according to manufacturer's recommendations

**14.18.00 BASIC HYDRAULICS**

**14.18.01.00 Examine basic hydraulic theory**

14.18.01.01 Explain Pascal's Law

14.18.01.02 Explain hydraulic pressure (i.e., neutral, working, and relief)

14.18.01.03 Identify major causes of hydraulic failure (i.e., dirt, air, heat)

**14.18.02.00 Examine hydraulic components and their relationships**

14.18.02.01 Identify sump characteristics

14.18.02.02 Identify filtration characteristics

14.18.02.03 Identify fluid characteristics according to manufacturer's specifications

14.18.02.04 Identify characteristics of different pumps (e.g., vain, gear, piston)

14.18.02.05 Identify hydraulic motor characteristics

14.18.02.06 Identify control valve characteristics

14.18.02.07 Identify relief valve characteristics

14.18.02.08 Identify hydraulic symbols

14.18.02.09 Identify single and double action symbols

## 14.19.00 ELECTRICAL SYSTEMS

### 14.19.01.00 Troubleshoot general electrical system

(Refer to shop manual or technical bulletins for proper procedure)

14.19.01.01 Interpret wiring diagrams

14.19.01.02 Check continuity in noncomputerized electrical circuits based on test light results

14.19.01.03 Identify needed repairs to noncomputerized electrical circuits based on test light results

14.19.01.04 Check continuity in computerized circuits using digital ohmmeter

14.19.01.05 Identify needed repairs in computerized circuits based on digital ohmmeter results

14.19.01.06 Check applied voltages and voltage drops in electrical circuits using analog and digital voltmeters

14.19.01.07 Identify needed repairs to electrical circuits based on analog and digital voltmeter results

14.19.01.08 Check applied voltages in electrical circuits using oscilloscope

14.19.01.09 Identify needed repairs to electrical circuits based on oscilloscope results

14.19.01.10 Check current flow in electrical circuits and components using ammeter

14.19.01.11 Identify needed repairs to electrical circuits and components using ammeter

14.19.01.12 Check continuity and resistances in electrical circuits and components using analog and digital ohmmeters

14.19.01.13 Identify needed repairs to electrical circuits and components based on analog and digital ohmmeter results

14.19.01.14 Trouble shoot electrical circuits using fused jumper wires

14.19.01.15 Use short-finder instrument to determine needed repairs

14.19.01.16 Identify splicing techniques for wiring repairs

14.19.01.17 Diagnose abnormal battery drain and determine needed repairs

14.19.01.18 Inspect or test fusible links, circuit breakers, and fuses

14.19.01.19 Replace fusible links, circuit breakers, and fuses

**14.19.02.00 Troubleshoot battery**

(Refer to shop manual or technical bulletins for proper procedure)

14.19.02.01 Perform battery state-of-charge test

14.19.02.02 Perform battery capacity tests (load, high-rate discharge)

14.19.02.03 Identify needed repairs based on battery capacity tests (load, high-rate discharge)

14.19.02.04 Perform battery charge test

14.19.02.05 Identify needed repairs based on results of battery charge test

14.19.02.06 Inspect battery cables connectors and clamps

**14.19.03.00 Service battery**

(Refer to shop manual or technical bulletins for proper procedure)

14.19.03.01 Clean battery

14.19.03.02 Fill battery

14.19.03.03 Replace battery

14.19.03.04 Reinstall battery

14.19.03.05 Perform slow or fast battery charge

14.19.03.06 Clean battery cables, connectors, and clamps

14.19.03.07 Repair or replace battery cables, connectors, and clamps

14.19.03.08 Use jumper cables and booster battery or auxiliary power supply

**14.19.04.00 Troubleshoot starting system**

(Refer to shop manual or technical bulletins for proper procedure)

14.19.04.01 Perform starter current draw test

14.19.04.02 Identify needed repairs based on starter current draw test diagnosis

14.19.04.03 Perform starter circuit voltage drop tests

14.19.04.04 Identify needed repairs based on starter circuits voltage drop tests

14.19.04.05 Inspect or test switches, connectors, and wires of starter control circuits

14.19.04.06 Inspect or test starter relays and solenoids

14.19.04.07 Test starter components

14.19.04.08 Perform bench test

**14.19.05.00 Restore starting system**

(Refer to shop manual or technical bulletins for proper procedure)

14.19.05.01 Repair or replace switches, connectors, and wires of starter control circuits

14.19.05.02 Replace starter relays and solenoids

14.19.05.03 Remove starter

14.19.05.04 Reinstall starter

14.19.05.05 Disassemble starter components

14.19.05.06 Clean starter components

14.19.05.07 Inspect starter components

14.19.05.08 Replace starter components

**14.19.06.00 Troubleshoot charging system**

(Refer to shop manual and technical bulletins for proper procedure)

14.19.06.01 Diagnose undercharge, no-charge, or overcharge condition

14.19.06.02 Inspect alternator drive belts, pulleys, and fans

14.19.06.03 Perform charging circuit voltage drop tests

14.19.06.04 Perform alternator oscilloscope pattern tests

**14.19.07.00 Restore charging system**

(Refer to shop manual and technical bulletins for proper procedure)

14.19.07.01 Adjust or replace alternator drive belts, pulleys, and fans

14.19.07.02 Replace regulator

14.19.07.03 Inspect connectors and wires of charging circuits

14.19.07.04 Repair or replace connectors and wires of charging circuits

14.19.07.05 Remove or replace alternator

14.19.07.06 Disassemble alternator components

14.19.07.07 Clean alternator components

14.19.07.08 Inspect alternator components

14.19.07.09 Replace alternator components

**14.19.08.00 Troubleshoot headlights, parking lights, taillights, dash lights, and courtesy lights**

(Refer to shop manual or technical bulletins for proper procedure)

14.19.08.01 Inspect headlights and bulbs

14.19.08.02 Inspect or test headlight and dimmer switches, relays, sockets, sensors, and wires of headlight circuits

14.19.08.03 Diagnose headlight assembly malfunction

14.19.08.04 Inspect or test motors, switches, relays, connectors, and wires of retractable headlight assembly circuits

14.19.08.05 Diagnose taillight malfunction

14.19.08.06 Inspect or test switches, relays, bulbs, sockets, connectors, and wires or parking light and taillight circuits

14.19.08.07 Diagnose dash light circuit malfunction

14.19.08.08 Test switches, relays, bulbs, sockets, connectors, wires, and printed circuit boards of dash light circuits

14.19.08.09 Diagnose courtesy light malfunction

14.19.08.10 Inspect or test switches, relays, bulbs, sockets, connectors, and wires in courtesy light circuits

**14.19.09.00 Restore headlights, parking lights, taillights, dash lights, and courtesy lights**

(Refer to shop manual or technical bulletin for proper procedure)

14.19.09.01 Replace headlights and bulbs

14.19.09.02 Aim headlights

14.19.09.03 Repair or replace headlight and dimmer switches, relays, sockets, connectors, sensors, and wires of headlight circuits

14.19.09.04 Repair or replace motors, switches, relays, connectors, and wires of retractable headlight assembly circuits

14.19.09.05 Repair or replace switches, relays, bulbs, sockets, connectors, and wires of parking light and taillight circuits

14.19.09.06 Repair or replace switches, relays, bulbs, sockets, connectors, and wires in courtesy light circuits

**14.19.10.00 Troubleshoot shoplights, turn signals, harzard lights, and backup lights**

(Refer to shop manual or technical bulletins for proper procedure)

14.19.10.01 Diagnose stoplight malfunction

14.19.10.02 Inspect or test stoplight switch

14.19.10.03 Inspect bulbs, sockets, connectors, and wires of stoplight circuits

14.19.10.04 Diagnose turn signal and hazard light malfunctions

14.19.10.05 Inspect or test turn signal and hazard light switches and flasher units

14.19.10.06 Inspect or test bulbs, sockets, connectors, and wires of turn signal and hazard light circuits

14.19.10.07 Inspect or test switches, bulbs, sockets, connectors, and wires of backup light circuits

**14.19.11.00 Restore stoplights, turn signals, hazard lights, and backup lights**

(Refer to shop manual or technical bulletins for proper procedure)

14.19.11.01 Adjust stoplight switch

14.19.11.02 Replace stoplight switch

14.19.11.03 Repair or replace bulbs, sockets, connectors, and wires of stoplight circuits

14.19.11.04 Replace turn signal and hazard light switches and flasher units

14.19.11.05 Repair or replace sockets, connectors, and wires of turn signal and hazard light circuits

14.19.11.06 Repair or replace switches, sockets, connectors, and wires of backup light circuits

**14.19.12.00 Troubleshoot gauges, warning devices, and driver information systems**

(Refer to shop manual or technical bulletins for proper procedure)

14.19.12.01 Diagnose abnormal gauge readings (Note: Diagnosing abnormal charging system gauge reading is limited to dash units and their electrical connections)

14.19.12.02 Test gauge circuit voltage regulators (limiters)

14.19.12.03 Inspect or test gauges and gauge sending units

14.19.12.04 Inspect or test connectors, wires, and printed circuit boards of gauge circuits

14.19.12.05 Diagnose driver-information system malfunctions (Note: Diagnosing abnormal charging system warning light operation is limited to dash units and their electrical connections)

14.19.12.06 Inspect or test bulbs, sockets, connectors, wires, and electronic components of warning light or driver-information system circuits

14.19.12.07 Diagnose malfunctions of audible warning devices

14.19.12.08 Inspect or test switches, relays, timers, electronic components, printed circuits, connectors, and wires of audible warning device circuits

14.19.12.09 Diagnose malfunctions of electronic digital instrument cluster

14.19.12.10 Inspect or test sensors, sending units, connectors, and wires of electronic digital instrument circuits

**14.19.13.00 Restore gauges, warning devices, and driver information systems**

(Refer to shop manual or technical bulletins for proper procedure)

14.19.13.01 Avoid static electrical discharge to electronic components

14.19.13.02 Replace gauge circuit voltage regulators (limiters)

14.19.13.03 Replace gauges and gauge sending units

14.19.13.04 Repair or replace connectors, wires, and printed circuit boards of gauge circuits

14.19.13.05 Repair or replace sockets, connectors, wires, and electronic components of warning light or driver-information systems circuits

14.19.13.06 Repair or replace switches, relays, timers, electronic components, printed circuits, connectors, and wires of audible warning device circuits

**14.19.14.00 Troubleshoot horn(s), wiper, and washer**

(Refer to shop manual or technical bulletins for proper procedure)

14.19.14.01 Test horn(s), horn relay, horn button (switch), connectors, and wires of horn circuits

14.19.14.02 Diagnose wiper malfunction

14.19.14.03 Diagnose wiper speed control and park malfunctions

14.19.14.04 Diagnose windshield-washer malfunction

**14.19.15.00 Restore horn(s), wiper(s), and washer**

(Refer to shop manual or technical bulletins for proper procedure)

14.19.15.01 Repair or replace horn(s), horn relay, horn button (switch), connectors, and wires of horn circuits

14.19.15.02 Replace delay (pulsing) wiper speed controls

14.19.15.03 Replace wiper motor, wiper motor resistor, and park switch or relay

14.19.15.04 Repair or replace switches, connectors, and wires of wiper circuits

14.19.15.05 Replace washer motor, pump, and/or relay assembly

14.19.15.06 Repair or replace switches, connectors, and wires of washer circuits

**14.19.16.00 Troubleshoot accessory components**

(Refer to shop manual or technical bulletin for proper procedure)

14.19.16.01 Diagnose malfunctions of power-driven window(s) and/or sunroof

14.19.16.02 Diagnose power seat malfunctions

14.19.16.03 Diagnose malfunctions of rear window defogger

14.19.16.04 Diagnose circuit malfunctions of electric door and hatch and trunk lock circuit malfunction

14.19.16.05 Diagnose malfunctions of keyless lock and unlock device

14.19.16.06 Diagnose malfunctions of electrically operated convertible tops

14.19.16.07 Diagnose malfunctions of electrically operated and electrically heated components (e.g., mirror, seats, windshields)

14.19.16.08 Diagnose radio malfunction

14.19.16.09 Inspect or test speaker

14.19.16.10 Inspect or test radio antenna and lead

14.19.16.11 Inspect or test switches, motor, connectors, and wires of power antenna circuits

14.19.16.12 Inspect or test case, integral fuse, connectors, and wires of cigarette lighter circuit

14.19.16.13 Inspect or test clock, connectors, and wires of clock circuits

14.19.16.14 Diagnose cruise control system malfunction

14.19.16.15 Diagnose antitheft system malfunction

14.19.16.16 Diagnose air bag warning light malfunction

14.19.16.17 Inspect or test air bag, air bag module, sensors, connectors, and wires of air bag system circuits

**14.19.17.00 Restore accessory components**

(Refer to shop manual or technical bulletins for proper procedure)

14.19.17.01 Adjust or repair or replace power-driven windows and sunroof regulators (linkages)

14.19.17.02 Repair or replace switches, relays, motors, connectors, and wires of power seat circuits

14.19.17.03 Adjust or replace power seat gear box, cables, and slave units

14.19.17.04 Repair or replace switches, relays, window grid, blower motors, connectors, and wires or rear window defogger circuits

14.19.17.05 Repair or replace components, connectors, and wires of keyless lock and unlock device circuits

14.19.17.06 Repair or replace motors, switches, relays, connectors, and wires of electrically operated convertible top circuits

14.19.17.07 Repair or replace motors, heating units, switches, relays, connectors, and wires of electrically operated and electrically heated component circuits

14.19.17.08 Repair or replace grounds, connectors, and wires of sound system circuits

14.19.17.09 Replace speakers

14.19.17.10 Replace radio antenna and lead

14.19.17.11 Repair or replace switches, motor connectors, and wires of power antenna circuits

14.19.17.12 Replace noise suppression components

14.19.17.13 Trim (adjust) radio antenna

14.19.17.14 Repair or replace case, integral fuse, connectors, and wires of cigarette lighter circuit

14.19.17.15 Replace case, integral fuse, connectors, and wires of cigarette lighter circuit

14.19.17.16 Repair or replace clock, connectors, and wires of clock circuits

14.19.17.17 Repair or replace switches, relays, electronic control units, speed signal generators, connectors, and wires of cruise control circuits

14.19.17.18 Adjust or repair or replace cruise control speedometer cables, regulator, servo, and hoses

14.19.17.19 Repair or replace components, switches, relays, connectors, and wires or antitheft system circuits

14.19.17.20 Repair or replace air bag, air bag module, sensors, connectors, and wires of air bag system circuits

**14.20.00 HEATING AND AIR-CONDITIONING**

**14.20.01.00 Troubleshoot AC system**

(Refer to shop manual or technical bulletins for proper procedure)

14.20.01.01 Diagnose noises in AC system

14.20.01.02 Performance-test AC system

14.20.01.03 Identify needed repairs to AC system based on performance-test results

14.20.01.04 Leak-test AC system

14.20.01.05 Identify needed repairs to AC system based on leak-test results

14.20.01.06 Discharge AC system using recovery and recycling and charging equipment

14.20.01.07 Evaluate AC system using recover and recycling and charging equipment

14.20.01.08 Charge AC system using recovery and recycling and charging equipment

14.20.01.09 Inspect oil condition

14.20.01.10 Measure oil in AC system

14.20.01.11 Add oil to AC system

**14.20.02.00 Troubleshoot compressor and clutch**

(Refer to shop manual or technical bulletins for proper procedure)

14.20.02.01 Diagnose needed repairs to AC system based on results of pressure device tests

14.20.02.02 Inspect AC compressor drive belts and pulleys

14.20.02.03 Inspect AC compressor clutch components and assembly

14.20.02.04 Test AC compressor clutch components and assembly

14.20.02.05 Inspect AC compressor shaft seal assemblies

14.20.02.06 Inspect AC compressor valve assemblies and gaskets and O-rings

**14.20.03.00 Restore compressor and clutch**

(Refer to shop manual or technical bulletins for proper procedure)

14.20.03.01 Replace AC system pressure protection devices

14.20.03.02 Adjust or replace AC compressor drive belts and pulleys

14.20.03.03 Repair or replace AC compressor clutch components and assembly

14.20.03.04 Remove or replace AC compressor and mountings

14.20.03.05 Replace AC compressor shaft seal assemblies

14.20.03.06 Replace AC compressor valve assemblies, gaskets, and O-rings

**14.20.04.00 Troubleshoot evaporator, receiver/drier, and condenser**

(Refer to shop manual or technical bulletins for proper procedure)

14.20.04.01 Diagnose AC system problems caused by too much moisture in refrigerant

14.20.04.02 Inspect AC system mufflers, hoses, lines, fittings, and seals

14.20.04.03 Inspect AC condenser for airflow restrictions

14.20.04.04 Inspect or test AC system condenser and mountings

14.20.04.05 Inspect receiver/drier and accumulator/drier

14.20.04.06 Inspect or test expansion valve and orifice (expansion) tube

14.20.04.07 Inspect or test evaporator

14.20.04.08 Inspect or test evaporator pressure control systems and devices

14.20.04.09 Inspect AC system service (gauge connection) valves

**14.20.05.00 Restore evaporator, receiver/drier, and condenser**

(Refer to shop manual or technical bulletins for proper procedure)

14.20.05.01 Install AC system filter

14.20.05.02 Repair or replace AC system mufflers, hoses, lines, fittings, and seals

14.20.05.03 Clean fins

14.20.05.04 Straighten fins

14.20.05.05 Replace AC system condenser and mountings

14.20.05.06 Replace receiver/drier and accumulator/drier

14.20.05.07 Replace expansion valve and orifice (expansion) tube

14.20.05.08 Replace evaporator

14.20.05.09 Repair or replace evaporator housing

14.20.05.10 Replace evaporator pressure control systems and devices

14.20.05.11 Replace AC system service (gauge connection) valves

**14.20.06.00 Troubleshoot heating and engine cooling systems**

(Refer to shop manual or technical bulletins for proper procedure)

14.20.06.01 Diagnose temperature control problems

14.20.06.02 Diagnose window-fogging problems

14.20.06.03 Perform cooling system tests (pressure, combustion leakage, and temperature)

14.20.06.04 Inspect engine cooling and heating system hoses and belts

14.20.06.05 Inspect or test radiator, pressure cap, and coolant recovery system

14.20.06.06 Inspect or test thermostat, bypass, and housing

14.20.06.07 Inspect coolant

14.20.06.08 Inspect or test fan, electrical and mechanical fan clutches, and fan shroud

14.20.06.09 Inspect or test heater/coolant control valves (manual, vacuum, and electrical types)

**14.20.07.00 Restore heating and engine cooling systems**

(Refer to shop manual or technical bulletins for proper procedure)

14.20.07.01 Replace engine cooling and heating system hoses and belts

14.20.07.02 Replace radiator, pressure cap, and coolant recovery system

14.20.07.03 Replace thermostat, bypass, and housing

14.20.07.04 Drain coolant

14.20.07.05 Flush coolant from system

14.20.07.06 Refill system with recommended coolant

14.20.07.07 Bleed coolant system

14.20.07.08 Clean fan, electrical and mechanical fan clutches, and fan shroud

14.20.07.09 Replace fan, electrical and mechanical fan clutches, and fan shroud

14.20.07.10 Replace heater/coolant control valves (manual, vacuum, and electrical types)

14.20.07.11 Replace heater core

**14.20.08.00 Troubleshoot operating systems and related electrical controls**

(Refer to shop manual or technical bulletins for proper procedure)

14.20.08.01 Diagnose malfunctions in electrical controls

14.20.08.02 Inspect or test AC heater blower motors, resistors, switches, relay, wiring, and protection devices

14.20.08.03 Inspect or test AC-controlled engine idle systems

14.20.08.04 Inspect or test AC compressor load cutoff systems

14.20.08.05 Inspect or test fan motors, relays, switches, sensors, wiring, and protection devices of engine coolant or AC condenser

**14.20.09.00 Restore operating systems and related electrical controls**

(Refer to shop manual or technical bulletins for proper procedure)

14.20.09.01 Repair or replace AC heater blower motors, resistors, switches, relays, wiring, and protection devices

14.20.09.02 Adjust, repair or replace AC-controlled engine idle systems

14.20.09.03 Adjust, repair or replace AC compressor load cutoff systems

14.20.09.04 Repair or replace fan motors, relays, switches, sensors, wiring, and protection devices of engine coolant or AC condenser

**14.20.10.00 Troubleshoot vacuum and mechanical controls**

(Refer to shop manual or technical bulletins for proper procedure)

14.20.10.01 Diagnose failures in vacuum and mechanical controls

14.20.10.02 Inspect or test AC/heater control panel assembly

14.20.10.03 Inspect or test AC/heater control cables and linkages

14.20.10.04 Inspect or test AC/heater vacuum control switches, hoses, diaphragms (motors), vacuum reservoir, check valve, and restrictors

14.20.10.05 Inspect or test AC/heater ducts, doors, hoses, and outlets

**14.20.11.00 Restore vacuum and mechanical controls**

(Refer to shop manual or technical bulletins for proper procedure)

14.20.11.01 Repair or replace AC/heater control panel assembly

14.20.11.02 Adjust AC/heater control cables and linkages

14.20.11.03 Repair or replace AC/heater vacuum control switches, hoses, diaphragms (motors), vacuum reservoir, check valve, and restrictors

14.20.11.04 Repair or replace AC/heater ducts, doors, hoses, and outlets

**14.20.12.00 Troubleshoot automatic and semiautomatic temperature control systems**

(Refer to shop manual or technical bulletins for proper procedure)

14.20.12.01 Check automatic and semiautomatic heating, ventilation and air-conditioning (HVAC) control systems

14.20.12.02 Inspect or test in-vehicle ambient sensor systems

14.20.12.03 Inspect or test power servo (vacuum and electric) system

14.20.12.04 Inspect or test temperature blower control system

14.20.12.05 Inspect or test heater valve and controls

14.20.12.06 Diagnose air distribution system problems

14.20.12.07 Inspect or test electric and vacuum motors, solenoids, and switches

**14.20.13.00 Restore automatic and semiautomatic temperature control systems**

(Refer to shop manual or technical bulletins for proper procedure)

14.20.13.01 Repair or replace in-vehicle ambient sensor system

14.20.13.02 Repair or replace power servo (vacuum and electric) system

14.20.13.03 Repair or replace temperature blower control system

14.20.13.04 Repair or replace heater valve and controls

14.20.13.05 Repair or replace air distribution system

14.20.13.06 Repair or replace electric and vacuum motors, solenoids, and switches

**14.20.14.00 Use alternative refrigerants**

(Refer to shop manual or technical bulletins for proper procedure)

14.20.14.01 Handle alternative refrigerants according to EPA guidelines

14.20.14.02 Dispose of alternative refrigerants according to EPA guidelines

14.20.14.03 Practice safety procedures when handling refrigerants

**14.20.15.00 Use alternative cooling AC systems**

(Refer to shop manual or technical bulletins for proper procedure)

14.20.15.01 Practice safety procedures

**14.21.00 ENGINE PERFORMANCE**

**14.21.01.00 Evaluate overall engine performance**

(Refer to shop manual or technical bulletins for proper procedure)

14.21.01.01 Interpret complaint

14.21.01.02 Verify customer complaint

14.21.01.03 Identify needed repairs based on road test of vehicle

14.21.01.04 Inspect engine assembly for fuel, oil, coolant, and other leaks

14.21.01.05 Diagnose unusual exhaust color, odor, and sound

14.21.01.06 Perform engine vacuum tests

14.21.01.07 Perform cylinder power balance test

14.21.01.08 Perform cylinder compression test

14.21.01.09 Perform cylinder leakage test

14.21.01.10 Diagnose mechanical, ignition, and fuel problems using oscilloscope and engine analyzer

14.21.01.11 Perform analytic and diagnostic procedures on vehicle with on-board and self-diagnostic computer systems

14.21.01.12 Inspect or test sensor and actuator components and circuits of electronic engine management systems

14.21.01.13 Adjust or replace sensor and actuator components and circuits of electronic engine management systems

**14.21.02.00 Troubleshoot ignition system**

(Refer to shop manual or technical bulletins for proper procedure)

14.21.02.01 Diagnose no-starting, hard starting, engine misfire, poor drivability, abnormal combustion, power loss, and poor mileage on vehicle with electronic ignition systems

14.21.02.02 Inspect or test ignition primary circuit wiring and components

14.21.02.03 Inspect or test distributor

14.21.02.04 Inspect ignition system, secondary circuit wiring, and components

14.21.02.05 Test ignition system, secondary circuit wiring, and components

14.21.02.06 Inspect or test ignition coil

14.21.02.07 Inspect or test electronic ignition wiring harness and connectors

14.21.02.08 Inspect or test electronic ignition system, pick-up sensor, and trigger devices

14.21.02.09 Inspect or test electronic ignition system control unit (module)

14.21.02.10 Diagnose problems in distributorless ignition system (DIS)

14.21.02.11 Diagnose problems in glow plug system

**14.21.03.00 Restore ignition system**

(Refer to shop manual or technical bulletins for proper procedure)

14.21.03.01 Repair or replace ignition primary circuit wiring and components

14.21.03.02 Remove distributor

14.21.03.03 Repair or replace distributor

14.21.03.04 Reinstall distributor

14.21.03.05 Repair or replace ignition system, secondary circuit wiring, and components

14.21.03.06 Replace ignition coil

14.21.03.07 Check ignition system timing

14.21.03.08 Adjust ignition system timing

14.21.03.09 Verify timing advance

14.21.03.10 Replace electronic ignition wiring harness and connectors

14.21.03.11 Replace electronic ignition system, pick-up sensor, and trigger devices

14.21.03.12 Replace electronic ignition system control unit (module)

**14.21.04.00 Troubleshoot fuel and exhaust systems**

(Refer to shop manual or technical bulletins for proper procedure)

14.21.04.01 Diagnose no-starting, hard starting, poor idle, flooding, hesitation, surging, engine misfire, power loss, poor mileage, and disallowing problems on vehicle with carburetor-type fuel systems

14.21.04.02 Diagnose no-starting, hard starting, poor idle, flooding, hesitation, surging, engine misfire, power loss, poor mileage, and disallowing problems on vehicle with injection-type fuel systems

14.21.04.03 Inspect fuel systems

14.21.04.04 Inspect fuel tank, fuel tank filter, and fuel cap

14.21.04.05 Inspect fuel lines and hoses

14.21.04.06 Check fuel for contaminants

14.21.04.07 Inspect or test (pressure, vacuum, and volume) fuel pumps and pump controls

14.21.04.08 Inspect fuel filters

14.21.04.09 Inspect or test cold-enrichment systems

14.21.04.10 Inspect carburetor mounting plates, fuel-injection air induction system, intake manifold, and gaskets

14.21.04.11 Inspect or test components of carburetor/fuel-injection closed-loop fuel control systems

14.21.04.12 Inspect air cleaner and element

14.21.04.13 Test turbocharger or supercharger system

14.21.04.14 Inspect turbocharger and supercharger system components

14.21.04.15 Test diesel-injector spray pattern

14.21.04.16 Test oxygen (02) sensor

14.21.04.17 Inspect exhaust manifold, exhaust pipes, mufflers, resonators, tail pipes, and heat shields

**14.21.05.00 Restore fuel and exhaust systems**

(Refer to shop manual or technical bulletins for proper procedure)

14.21.05.01 Replace fuel lines and hoses

14.21.05.02 Replace fuel pumps and pump controls

14.21.05.03 Replace fuel filters

14.21.05.04 Clean cold-enrichment systems

14.21.05.05 Adjust cold-enrichment systems

14.21.05.06 Repair or replace cold-enrichment systems

14.21.05.07 Remove carburetor/fuel injection throttle body

14.21.05.08 Replace linkages related to carburetor/fuel injection throttle body

14.21.05.09 Adjust carburetor/fuel injection

14.21.05.10 Rebuild carburetor

14.21.05.11 Clean carburetor mounting plates, fuel-injection air induction system, intake manifold, and gaskets

14.21.05.12 Repair or replace carburetor mounting plates, fuel-injection air induction system, intake manifold, and gaskets

14.21.05.13 Adjust carburetor idle speed and fuel mixture

14.21.05.14 Adjust carburetor/fuel-injection idle speed and fuel mixture on closed-loop fuel control systems

14.21.05.15 Clean components of carburetor/fuel-injection closed-loop fuel control systems

14.21.05.16 Adjust or replace components of carburetor/fuel-injection closed-loop fuel control systems

14.21.05.17 Service air cleaner and element

14.21.05.18 Remove fuel injectors

| | |
|---|---|
| 14.21.05.19 | Replace fuel injectors |
| 14.21.05.20 | Perform fuel injector tests (i.e., resistance, spray pattern, and pressure drop) |
| 14.21.05.21 | Clean fuel-injection system on vehicle according to manufacturers' recommendations |
| 14.21.05.22 | Remove turbocharger and supercharger system components |
| 14.21.05.23 | Clean turbocharger and supercharger system components |
| 14.21.05.24 | Repair or replace turbocharger and supercharger system components |
| 14.21.05.25 | Diagnose turbocharger and supercharger malfunctions |
| 14.21.05.26 | Remove fuel tank |
| 14.21.05.27 | Replace fuel tank |
| 14.21.05.28 | Remove fuel gauge sending unit |
| 14.21.05.29 | Replace fuel gauge sending unit |
| 14.21.05.20 | Remove diesel injectors, lines, and pump |
| 14.21.05.21 | Replace diesel injectors, lines, and pump |
| 14.21.05.22 | Bleed fuel system |
| 14.21.05.23 | Time fuel system |
| 14.21.05.24 | Service diesel fuel filters |
| 14.21.05.25 | Remove oxygen (02) sensor |
| 14.21.05.26 | Replace or install oxygen (02) sensor |
| 14.21.05.27 | Replace or reinstall exhaust manifold, exhaust pipes, mufflers, resonators, tail pipes, and heat shields |

**14.21.06.00 Troubleshoot positive crankcase ventilation (PCV) system**

(Refer to shop manual or technical bulletins for proper procedure)

14.21.06.01 Test PCV system

14.21.06.02 Inspect or test PCV valve, filter, tubes, and hoses

**14.21.07.00 Restore positive crankcase ventilation (PCV) system**

(Refer to shop manual or technical bulletins for proper procedure)

14.21.07.01 Repair or replace PCV valve, filter, tubes, and hoses

14.21.07.02 Verify proper PCV application

**14.21.08.00 Troubleshoot spark-timing control system**

(Refer to shop manual or technical bulletins for proper procedure)

14.21.08.01 Test spark-timing control system

14.21.08.02 Inspect or test electrical/electronic components and circuits of spark-timing control system

14.21.08.03 Inspect or test thermal, mechanical, or vacuum components and hoses of spark-timing control system

**14.21.09.00 Restore spark-timing control system**

(Refer to shop manual for technical bulletins for proper procedure)

14.21.09.01 Repair or replace electrical/electronic components and circuits of spark-timing control system

14.21.09.02 Repair or replace thermal, mechanical, or vacuum components and hoses of spark-timing control system

**14.21.10.00 Troubleshoot idle-speed control system**

(Refer to shop manual for technical bulletins for proper procedure)

14.21.10.01 Test idle-speed control system

14.21.10.02 Inspect or test sensors, solenoids, vacuum valves, motors, switches, circuits, and hoses of idle-speed control system

14.21.10.03 Test deceleration control system

14.21.10.04 Identify needed repairs based on test of deceleration control system

14.21.10.05 Inspect or test electrical components, circuits, vacuum components, and hoses of deceleration control system

**14.21.11.00 Restore idle-speed control system**

(Refer to shop manual for technical bulletins for proper procedure)

14.21.11.01 Adjust or replace sensors, solenoids, vacuum valves, motors, switches, circuits and hoses of idle-speed control system

14.21.11.02 Adjust or replace electrical components, circuits, vacuum components, and hoses of deceleration control system

**14.21.12.00 Troubleshoot exhaust gas recirculation (EGR) system**

(Refer to shop manual for technical bulletins for proper procedure)

14.21.12.01 Test EGR system

14.21.12.02 Inspect or test valve, valve manifold, and exhaust passages of EGR system

14.21.12.03 Inspect or test vacuum/pressure controls, filter, and hoses of EGR system

14.21.12.04 Inspect or test electrical/electronic controls and wiring of EGR system

**14.21.13.00 Restore exhaust gas recirculation (EGR) system**

(Refer to shop manual for technical bulletins for proper procedure)

14.21.13.01 Repair or replace valve, valve manifold, and exhaust passages of EGR system

14.21.13.02 Repair or replace vacuum/pressure controls, filter, and hoses of EGR system

14.21.13.03 Repair or replace electrical/electronic controls and wiring of EGR system

**14.21.14.00 Troubleshoot exhaust gas treatment/air injection reaction**

(Refer to shop manual for technical bulletins for proper procedure)

14.21.14.01 Test pump-type air injection system

14.21.14.02 Inspect or test pump, pressure relief valve, filter, pulley, and belt of pump-type air injection system

14.21.14.03 Inspect or test vacuum-operated air control valves and vacuum hoses of pump-type air injection system

14.21.14.04 Inspect hoses, check valves, air manifolds, and nozzles of pump-type air injection system

14.21.14.05 Test exhaust pulse-type air injection system

14.21.14.06 Inspect or test pulse air valve(s) and hoses of exhaust pulse-type air injection system

14.21.14.07 Inspect heat shields

**14.21.15.00 Restore exhaust gas treatment/air injection reaction (AIR) and catalytic converter**

(Refer to shop manual for technical bulletins for proper procedure)

14.21.15.01 Repair or replace pump, pressure relief valve, filter, pulley, and belt of pump-type air injection system

14.21.15.02 Repair or replace vacuum-operated air control valves and vacuum hoses of pump-type air injection system

14.21.15.03 Repair or replace electrically/electronically-operated air control valves and circuits of pump-type air injection system

14.21.15.04 Repair or replace hoses, check valves, air manifolds, and nozzles of pump-type air injection system

14.21.15.05 Repair or replace pulse air valve(s) and hoses of exhaust pulse-type of air injection system

14.21.15.06 Repair or replace converter catalyst or converter(s) according to EPA requirements

14.21.15.07 Repair or replace heat shields

**14.21.16.00 Troubleshoot inlet air-temperature control system**

(Refer to shop manual for technical bulletins for proper procedure)

14.21.16.01 Test inlet air-temperature control system and determine needed repairs

14.21.16.02 Inspect or test sensors, diaphragm, and hoses of inlet air-temperature control system

14.21.16.03 Inspect or test heat stove shroud, hot air pipe, and damper on inlet air-temperature control system

**14.21.17.00 Restore inlet air-temperature control system**

(Refer to shop manual for technical bulletins for proper procedure)

14.21.17.01 Repair or replace sensors, diaphragm, and hoses of inlet air-temperature control system

14.21.17.02 Repair or replace heat stove shroud, hot air pipe, and damper of inlet air-temperature control system

**14.21.18.00 Troubleshoot intake manifold heat control system**

(Refer to shop manual for technical bulletins for proper procedure)

14.21.18.01 Inspect and repair or replace manifold heat control (heat riser) valve(s)

14.21.18.02 Test electrical, vacuum, and coolant-type manifold heat control systems and determine needed repairs

14.21.18.03 Inspect or test components of electrical, vacuum, and coolant-type manifold heat control systems

**14.21.19.00 Restore intake manifold heat control system**

(Refer to shop manual for technical bulletins for proper procedure)

14.21.19.01 Repair or replace components of electrical, vacuum, and coolant-type manifold heat control systems

**14.21.20.00 Troubleshoot fuel vapor control system**

(Refer to shop manual for technical bulletins for proper procedure)

14.21.20.01 Test fuel vapor control system and determine needed repairs

14.21.20.02 Inspect fuel tank cap, liquid/vapor separator, liquid check valve, and hoses of fuel vapor control system

14.21.20.03 Inspect canister, purge lines, and filter of fuel vapor control system

14.21.20.04 Inspect or test thermal, vacuum, and electrical controls of fuel vapor control system

**14.21.21.00 Restore fuel vapor control system**

(Refer to shop manual for technical bulletins for proper procedure)

14.21.21.01 Replace fuel tank cap, liquid/vapor separator, liquid check valve, lines, and hoses of fuel vapor control system

14.21.21.02 Repair or replace canister, purge lines, and filter of fuel vapor control system

14.21.21.03 Replace thermal, vacuum, and electrical controls of fuel vapor control system

**14.21.22.00 Perform engine-related service**

(Refer to shop manual for technical bulletins for proper procedure)

14.21.22.01 Adjust valves

14.21.22.02 Verify correct valve timing

14.21.22.03 Verify engine operation temperature

14.21.22.04 Perform cooling system pressure test

14.21.22.05 Check coolant

14.21.22.06 Inspect or test radiator, pressure cap, and coolant recovery tank hoses

14.21.22.07 Replace thermostat, bypass, and housing

14.21.22.08 Inspect or test mechanical and electrical fans, fan clutch, fan shroud/ ducting, and fan control devices

14.21.22.09 Replace mechanical and electrical fans, fan clutch, fan shroud/ducting, and fan control devices

**14.22.00 TECHNOLOGY LITERACY**

14.22.01.01 Demonstrate a system view of technology based on the interdependence of social, political, economic, and ecological systems

14.22.01.02 Assess the career, family, and personal development implications of technological change

14.22.01.03 Demonstrate continuous learning via technology

14.22.01.04 Demonstrate global appreciation for technology's potential effects on cultures, geographic areas, and the environment

14.22.01.05 Apply historical perspective on technology to the development and use of new technologies

14.22.01.06 Apply diverse technologies to store, access, process, create, and communicate information needed to solve problems

14.22.01.07 Apply legal principles and ethical conduct to the use of technology

14.22.01.08 Demonstrate competency in mathematics, science, social sciences, communication, and computer skills through the analysis, design, and evaluation of technological systems

14.22.01.09 Analyze the potential of alternative technological systems to solve problems and/or to extend human capabilities

14.22.01.10 Use a variety of tools, materials, and equipment in solving problems and extending human capabilities

14.22.01.11 Assess risks and benefits of technological developments from an ecological, economic, social and political perspective

14.22.01.12 Value human diversity as part of a team in suggesting, designing, and testing solutions to technological problems

**14.23.00 COMPUTER LITERACY**

**14.23.01.00 Describe personal computer operations**

14.23.01.01 Explain how data is stored in main computer memory

14.23.01.02 Explain how computer system executes program instruction

14.23.01.03 Explain computer storage capacity

14.23.01.04 Explain how data is represented

14.23.01.05 Describe data storage techniques

14.23.01.06 Identify types of memory

**14.23.02.00 Explain information processing cycle**

14.23.02.01 Define operating systems (e.g., DOS, Windows)

14.23.02.02 Describe difference between data files and program files

14.23.02.03 Explain PC layout

**14.23.03.00 Describe interface devices and software techniques**

14.23.03.01 Identify elements of user interface

14.23.03.02 Identify hardware components and their advantages and disadvantages

**14.23.04.00 Operate computer hardware**

14.23.04.01 Practice proper media handling techniques

14.23.04.02 Identify hardware and its use

14.23.04.03 Use hardware (e.g.. mouse, diskettes, drive, modems, touch screen, CD-ROMS, printers, digitizer, scanners)

14.23.04.04 Keyboard efficiently

14.23.04.05 Demonstrate basic care of hardware

**14.23.05.00 Use software**

14.23.05.01 Define software types and functions

14.23.05.02 Describe basic disk operations and care

14.23.05.03 Perform functions necessary to operate software

14.23.05.04 List advantages and disadvantages of integrated and dedicated software

14.23.05.05 Demonstrate basic proficiency in spreadsheet use

14.23.05.06 Demonstrate basic proficiency in word processing

14.23.05.07 Demonstrate basic proficiency in database use

14.23.05.08 Demonstrate basic proficiency in CD-ROM use

14.23.05.09 Demonstrate system commands

14.23.05.10 Demonstrate proficiency in network use

**14.24.00 TEAMWORK**

**14.24.01.00 Demonstrate knowledge of teamwork**

14.24.01.01 Define employee empowerment

14.24.01.02 Differentiate work groups and teams

14.24.01.03 Explain influence of company culture on teamwork

14.24.01.04 Identify appropriate situations for using teams

14.24.01.05 Define team structures (e.g., cross functional, quality improvement, task force, quality circles)

14.24.01.06 Identify team building concepts

14.24.01.07 Describe characteristics and dynamics of teams

14.24.01.08 Identify characteristics of effective team leaders and members

14.24.01.09 Identify responsibilities of a valuable team member

14.24.01.10 Identify methods of involving each member of a team

14.24.01.11 Explain how individuals from various backgrounds contribute to work-related situations (e.g., technical training, cultural heritage)

14.24.01.12 Explain the purpose of facilitators

14.24.01.13 Define consensus

**14.24.02.00 Demonstrate teamwork**

14.24.02.01 Identify (mission) purpose of team and intended goal (include time frames)

14.24.02.02 Structure team around purpose

14.24.02.03 Define responsibilities of team members

14.24.02.04 Contribute to efficiency and success of team

14.24.02.05 Work toward individual team milestones

14.24.02.06 Analyze results of team project

14.24.02.07 Facilitate a team meeting

14.24.02.08 Assist team member(s) with problem

14.24.02.09 Monitor time frame

**14.24.03.00 Use teamwork to solve problems**

14.24.03.01 Identify appropriate situations for using teams

14.24.03.02 Use problem-solving process in a team setting

14.24.03.03 Identify quality management processes/techniques

14.24.03.04 Identify quality assurance processes/techniques

14.24.03.05 Prepare presentations

**14.25.00 EMPLOYABILITY SKILLS**

**14.25.01.00 Develop a career plan**

14.25.01.01 Identify current interests and aptitudes

14.25.01.02 Identify common barriers to employment

14.25.01.03 Describe strategies to overcome employment barriers

14.25.01.04 Locate resources for finding employment

14.25.01.05 Research job trends

14.25.01.06 Identify career options

14.25.01.07 Identify advantages and disadvantages of career options

14.25.01.08 Identify job requirements

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| 14.25.01.09 | Investigate education/training opportunities |
| **14.25.02.00** | **Prepare for employment** |
| 14.25.02.01 | Identify traditional and non-traditional employment sources |
| 14.25.02.02 | Identify present and future employment opportunities |
| 14.25.02.03 | Research job opportunities, including non-traditional careers |
| 14.25.02.04 | Compare salary ranges and benefit packages |
| 14.25.02.05 | Compile occupational profile |
| 14.25.02.06 | Identify rights and responsibilities of equal employment opportunity laws |
| 14.25.02.07 | Design resume and cover letter |
| 14.25.02.08 | Target resume |
| 14.25.02.09 | Secure references |
| 14.25.02.10 | Investigate generic and specific employment tests (e.g., civil service exam, drug screening) |
| 14.25.02.11 | Use follow-up techniques to enhance employment potential |
| 14.25.02.12 | Demonstrate legible written communication skills using correct grammar, spelling, punctuation, and concise wording |
| 14.25.02.13 | Describe methods for handling illegal questions on job application forms and during interviews |
| 14.25.02.14 | Write letter of application |
| 14.25.02.15 | Investigate prospective employer |
| 14.25.02.16 | Explain critical importance of personal appearance, hygiene, and demeanor |
| 14.25.02.17 | Interpret job description |
| 14.25.02.18 | Demonstrate appropriate interview question and answer techniques |

14.25.02.19 Demonstrate methods for handling difficult interview questions

14.25.02.20 Evaluate job offers

14.25.02.21 Write letter of acceptance

14.25.02.22 Write letter of declination

**14.25.03.00 Evaluate positive self-esteem**

14.25.03.01 Identify factors that affect self-esteem

14.25.03.02 Compare effects of low self-esteem and high self-esteem

14.25.03.03 Identify strategies to promote positive self-esteem

**14.25.04.00 Demonstrate job retention skills**

14.25.04.01 Identify employer expectations regarding job performance, work habits, attitudes, personal appearance, and hygiene

14.25.04.02 Exhibit appropriate work habits and attitude

14.25.04.03 Demonstrate ability to set priorities

14.25.04.04 Identify behaviors to establish successful working relationships

14.25.04.05 Identify alternatives for dealing with harassment, bias, and discrimination based on race, color, national origin, sex, religion, handicap, or age

14.25.04.06 Identify opportunities for advancement

14.25.04.07 List reasons for termination

14.25.04.08 List consequences of being absent frequently from job

14.25.04.09 List consequences of frequently arriving late for work

14.25.04.10 Demonstrate interpersonal relation skills

14.25.04.11 Demonstrate negotiational skills

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| 14.25.04.12 | Demonstrate teamwork |
| 14.25.04.13 | Follow chain-of-command |
| **14.25.05.00** | **Demonstrate knowledge of work ethic** |
| 14.25.05.01 | Define work ethic |
| 14.25.05.02 | Identify factors that influence work ethic |
| 14.25.05.03 | Differentiate between law and ethics |
| 14.25.05.04 | Describe how personal values are reflected in work ethic |
| 14.25.05.05 | Describe how interactions in the workplace affect personal work ethic |
| 14.25.05.06 | Describe how life changes affect personal work ethic |
| **14.25.06.00** | **Exhibit characteristics that reflect appropriate work ethic** |
| 14.25.06.01 | Use time management techniques |
| 14.25.06.02 | Avoid personal activity during work hours |
| 14.25.06.03 | Attend work as scheduled |
| 14.25.06.04 | Adhere to company and/or governmental policies, procedures, rules, and regulations |
| 14.25.06.05 | Exercise confidentiality |
| 14.25.06.06 | Demonstrate appropriate human relations skills |
| 14.25.06.07 | Adhere to rules of conduct |
| 14.25.06.08 | Accept constructive criticism |
| 14.25.06.09 | Offer constructive criticism |
| 14.25.06.10 | Take pride in work |
| 14.25.06.11 | Resolve conflict |

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| 14.25.06.12 | Manage stress |
| 14.25.06.13 | Avoid sexual connotations and harassment |
| 14.25.06.14 | Adjust to changes in the workplace |
| 14.25.06.15 | Demonstrate punctuality |
| 14.25.06.16 | Assume responsibility for personal decisions and actions |
| 14.25.06.17 | Take responsibility for assignments |
| **14.25.07.00** | **Apply decision-making techniques in the workplace** |
| 14.25.07.01 | Identify decision to be made |
| 14.25.07.02 | Identify ownership of decision to be made |
| 14.25.07.03 | Identify possible alternatives and their consequences |
| 14.25.07.04 | Make decisions based on facts, legality, ethics, goals, and/or corporate culture |
| 14.25.07.05 | Apply time factor(s) |
| 14.25.07.06 | Present decision to be implemented |
| 14.25.07.07 | Evaluate decision made |
| 14.25.07.08 | Take responsibility for decision |
| **14.25.08.00** | **Apply problem-solving techniques in the workplace** |
| 14.25.08.01 | Identify problem |
| 14.25.08.02 | Select appropriate problem solving tools/techniques |
| 14.25.08.03 | Identify problem causes |
| 14.25.08.04 | Identify possible solutions and their consequences |
| 14.25.08.05 | Utilize resources to explore possible solutions to problem |

14.25.08.06 Contrast advantages and disadvantages of each solution

14.25.08.07 Identify appropriate action

14.25.08.08 Evaluate results

**14.25.09.00 Exhibit characteristics for job advancement**

14.25.09.01 Display positive attitude

14.25.09.02 Demonstrate knowledge of position

14.25.09.03 Perform quality work

14.25.09.04 Adapt to changing situations and technology

14.25.09.05 Demonstrate capability for different positions

14.25.09.06 Identify characteristics of effective leaders

14.25.09.07 Identify opportunities for leadership in work place/community

14.25.09.08 Display creative abilities and initiative to affect change in workplace

14.25.09.09 Participate in continuing education/training program

14.25.09.10 Explain purpose of supervision, self-discipline and performance evaluation

14.25.09.11 Identify appropriate response(s) to criticism from employer, supervisor, or other employees

14.25.09.12 Display awareness of corporate culture

14.25.09.13 Prepare for job setbacks

**14.26.00 PROFESSIONALISM**

**14.26.01.00 Project professional image**

14.26.01.01 Define professionalism

14.26.01.02 Exhibit professional appearance

14.26.01.03 Exhibit professional manners

14.26.01.04 Project professional attitude

14.26.01.05 Identify individuals' vital role in organization

14.26.01.06 Exhibit proper etiquette in professionally-related situations

**14.26.02.00 Achieve individual and professional goals**

14.26.02.01 Set flexible, realistic, and measurable goals

14.26.02.02 Identify potential barriers to achieve goals

14.26.02.03 Identify strategies for addressing barriers to goal achievement

14.26.02.04 Break down long-term goals into short-term goals

14.26.02.05 Prioritize goals

14.26.02.06 Make commitment to goals

14.26.02.07 Adjust goals

14.26.02.08 Obtain support for goals

14.26.02.09 Reward goals achievement

**14.26.03.00 Support community well-being**

14.26.03.01 Evaluate personality types of self and others

14.26.03.02 Identify various management styles

14.26.03.03 Support employer expectations

14.26.03.04 Support employer decisions

14.26.03.05 Accept constructive criticism

14.26.03.06 Give constructive feedback

14.26.03.07 Adapt to changes in work place

14.26.03.08 List factors to consider before resigning

14.26.03.09 Write letter of resignation

**14.26.04.00 Manage stressful situations**

14.26.04.01 Accept stress as part of daily life

14.26.04.02 Identify personal and professional factors contributing to stress

14.26.04.03 Describe physical and emotional responses to stress

14.26.04.04 Evaluate positive and negative effects of stress on productivity

14.26.04.05 Identify strategies for reducing stress

14.26.04.06 Implement strategies to manage stress

14.26.04.07 Create strategies for developing and maintain support systems

**14.26.05.00 Analyze effects of family on work and work on family**

14.26.05.01 Identify how family values, goals, and priorities are reflected in work place

14.26.05.02 Identify responsibilities and rewards associated with paid and non-paid work

14.26.05.03 Identify responsibilities and rewards associated with families

14.26.05.04 Explain how family responsibilities can conflict with work

14.26.05.05 Explain how work can conflict with family responsibilities

14.26.05.06 Explain how work-related stress can affect work

14.26.05.07 Identify family support systems and resources

14.26.05.08 Identify work-related support systems and resources

14.26.05.09 Identify work-related support systems and resources

14.26.05.10 Communicate with family regarding work

**14.26.06.00 Apply lifelong learning skills**

14.26.06.01 Define lifelong learning

14.26.06.02 Identify factors that cause need for lifelong learning

14.26.06.03 Analyze effects of change

14.26.06.04 Identify reasons why goals change

14.26.06.05 Describe importance of flexibility and adaptability

14.26.06.06 Evaluate need for continuing education/training

**14.26.07.00 Manage professional development**

14.26.07.01 Identify career opportunities

14.26.07.02 Modify career plan

14.26.07.03 Participate in continuing education/training opportunities

14.26.07.04 Document continuing education/training

14.26.07.05 Read profession-related manuals, technical journals, and periodicals

14.26.07.06 Attend meetings, workshops, seminars, conferences, and demonstrations

14.26.07.07 Participate in professional organizations

14.26.07.08 Build personal/professional mentor relationship

14.26.07.09 Build personal/professional support system

14.26.07.10 Build professional network

14.26.07.11 Strengthen communication skills

14.26.07.12 Strengthen leadership skills

14.26.07.13 Strengthen management skills

# COMMUNICATIONS LITERACY
(Eng 100)

Effective Reading Skills

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| **1.01.01.00** | **Differentiate between fact, opinion, and inference** |
| **1.01.03.00** | **Recognize the intent and use of propaganda** |
| **1.01.04.00** | **Identify and summarize ideas, information, and events that are explicitly stated in written material** |
| **1.01.05.00** | **Explain the sequence of time, places, events, and ideas** |
| **1.01.06.00** | **Identify and explain the main and subordinate ideas (stated or implied) in a written work** |
| 1.01.06.01 | Differentiate between details that support or do not support main ideas in a written work |
| **1.01.08.00** | **Find, understand, and apply information from a variety of sources (books, manuals, newspapers, periodicals, directories, referenceworks, computer printouts, and electronic sources)** |
| **1.01.09.00** | **Use the features of books and reference materials, such as table of contents, preface, introduction, titles and subtitles, index, glossary, appendix, and bibliography** |
| **1.01.10.00** | **Define and use unfamiliar words and specialized vocabulary (including abbreviations, acronyms, concepts, and jargon) by using structural analysis, decoding, contextual cues, dictionaries, and computers** |
| **1.01.11.00** | **Read and understand short notes, memos, letters, and forms** |
| **1.01.12.00** | **Read and follow complex directions** |

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| 1.01.13.00 | Determine the author's purpose |
| 1.01.14.00 | Read, evaluate, and respond critically to various literature forms, genres, and printed medias |
| 1.01.15.00 | Recognize and interpret organizational patterns of writing (e.g., cause and effect, comparison and contrast, and simple listing) |
| 1.01.16.00 | Identify the structural elements of literature (e.g., plot, theme, character, mood, setting, and point of view) |
| 1.01.17.00 | Identify literary devices (e.g., metaphor, foreshadowing, flashback, allusion, satire, and irony) |
| 1.01.19.00 | Take accurate notes from written sources |
| 1.01.20.00 | Recognize, analyze, and discuss the rhetorical strategies and writing techniques used in various student and professional writings |
| 1.01.21.00 | Summarize or paraphrase a written selection to confirm one's own understanding of what was read |
| 1.01.22.00 | Understand and use appropriate techniques for taking different types of tests |

Effective Speaking and Presentation Skills

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| 1.02.01.00 | Give oral directions and clear explanations |
| 1.02.02.00 | Participate critically and constructively in the exchange of ideas, particularly during class discussions and conferences with individuals |

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| **1.02.03.00** | **Demonstrate correct usage of vocabulary** |
| **1.02.05.00** | **Speak effectively using non-verbal communication such as eye contact, posture, and gestures** |
| **1.02.06.00** | **Select topics suitable to audience, situation, and purpose** |
| **1.02.08.00** | **Give formal and informal talks and speeches** |
| 1.02.08.01 | Explain and demonstrate the basic elements of public speaking |
| 1.02.08.02 | Present speeches using an extemporaneous delivery style, with minimal use of note cards or text, maximum eye contact, appropriate voice intonations and body language, and minimal verbal mannerisms |
| **1.02.09.00** | **Demonstrate the differences between informing and persuading and use the appropriate techniques of content and delivery for each purpose** |
| 1.02.09.01 | Present an informative speech by limiting the scope of the topic and selecting a workable pattern of organization with an effective beginning and ending |
| 1.02.09.02 | Present a persuasive speech that will demonstrate the student's awareness of and sensitivity to the audience through the use of appropriate language and audience data |
| **1.02.10.00** | **Use visual media** |
| **1.02.11.00** | **Demonstrate proper telephone etiquette** |

Effective Writing Skills

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| **1.03.01.00** | **Demonstrate ability to use different forms of writing (e.g., literary response, business and technical communicative modes, personal responses, journals, research and recording)** |
| 1.03.01.01 | Demonstrate understanding of good letter writing principles |
| **1.03.02.00** | **Demonstrate appropriate selection of mode, purpose, audience, point of view, and organization of information in written assignments** |
| 1.03.02.01 | Produce a completed narrative essay |
| 1.03.02.02 | Produce a completed descriptive/observational essay |
| 1.03.02.03 | Produce a completed informational paper |
| 1.03.02.04 | Produce a completed persuasive essay |
| **1.03.03.00** | **Demonstrate proficiency in word processing, graphics, and/or desktop publishing aids for writing** |
| **1.03.04.00** | **Apply writing process techniques: 1) Prewriting 2) Drafting 3) Revising 4) Editing/proofreading 5) Publishing** |
| 1.03.04.01 | Use journal writing as a pre-writing and learning tool |
| 1.03.04.02 | Revise and accurately edit both their own and other's written work |
| **1.03.07.00** | **Create written summaries of information** |
| **1.03.08.00** | **Use appropriate techniques for documentation of sources** |

Effective Listening Skills

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| 1.04.01.00 | Follow spoken directions |
| 1.04.02.00 | Distinguish between fact and opinion |
| 1.04.03.00 | Make inferences and draw conclusions from verbal and non-verbal messages |
| 1.04.04.00 | Identify and comprehend the main and subordinate ideas in lecture and discussions, questions to clarify information heard, and report accurately what others have said |
| 1.04.05.00 | Restate or paraphrase a conversation to confirm one's own understanding of what was said |
| 1.04.06.00 | Take accurate notes which summarize material presented from spoken conversations, including telephone messages |
| 1.04.08.00 | Critique speeches and other verbal presentations |

Critical Viewing/Graphic/Observation Skills

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| 1.05.01.00 | Read and understand graphs, charts, and tables to obtain factual information |
| 1.05.02.00 | Produce and utilize effective communication skills in the development of graphs, tables, and charts to communicate ideas |
| 1.05.03.00 | Critically view historical or contemporary events, via TV or video tape, and make appropriate observations |
| 1.05.05.00 | Communicate through use of video tape and computer presentations |

# MATHEMATICS

(Math 104)

Algebra

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| **3.01.01.00** | **Solve linear equations** |
| 3.01.01.01 | Combine like terms |
| 3.01.01.02 | Use the Distributive Property to remove grouping symbols and the Addition/Subtraction Property to combine like terms to simplify expressions |
| 3.01.01.03 | Solve equations in one variable utilizing one operation |
| 3.01.01.04 | Solve equations in one variable utilizing two or more operations |
| 3.01.01.05 | Describe and use the logic of equivalence in working with equations, inequalities, and functions |
| 3.01.01.06 | Identify variables, constants, terms, expressions, and coefficients |
| 3.01.01.07 | Define absolute value |
| 3.01.01.08 | Evaluate algebraic expressions |
| 3.01.01.09 | Solve the literal equation or formula for a specified variable |
| 3.01.01.10 | Recognize the properties of equalities |
| 3.01.01.11 | Solve a 2x2 system of linear equations by elimination |
| 3.01.01.12 | Solve a 2x2 system of linear equations by substitution |
| 3.01.01.13 | Apply the rules for solving linear equations in one variable |
| 3.01.01.14 | Use formulas |
| 3.01.01.15 | Use handheld graphic calculators to solve linear equations and graph simple functions |
| 3.01.01.16 | Solve linear equations in one variable containing an absolute value symbol |

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| **3.01.02.00** | **Use properties of exponents** |
| 3.01.02.01 | Define exponent |
| 3.01.02.02 | Compare and compute using scientific notation |
| 3.01.02.03 | Determine values for the square root of any natural number |
| 3.01.02.04 | Determine the principal square root and recognize square roots of negatives as being non-real |
| 3.01.02.05 | Divide terms having factors with exponents |
| 3.01.02.06 | Multiply and divide polynomial expressions |
| 3.01.02.07 | Operate with radicals and leave the result in simplified form |
| 3.01.02.08 | Apply the properties of exponents to simplify polynomial expressions |
| 3.01.02.09 | Multiply terms having factors with exponents |
| 3.01.02.10 | Solve radical equations |
| **3.01.03.00** | **Factor a polynomial of two or more terms** |
| 3.01.03.01 | Apply the distributive law in removing common factors |
| 3.01.03.02 | Factor difference of two squares |
| 3.01.03.03 | Factor quadratic trinomials |
| **3.01.04.00** | **Solve linear inequalities and show the solution on a number line** |
| 3.01.04.01 | Combine like terms |
| 3.01.04.02 | Use the Substitution Property to evaluate expressions and formulas |
| 3.01.04.03 | Evaluate algebraic expressions |
| 3.01.04.04 | Use the Distributive Property to remove grouping symbols and the Addition/Subtraction Property to combine like terms to simplify expressions |

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| 3.01.04.05 | Identify variables, constants, terms, expressions, and coefficients |
| 3.01.04.06 | Solve equations in one variable utilizing two or more operations |
| 3.01.04.07 | Describe and use the logic of equivalence in working with equations, inequalities, and functions |
| 3.01.04.08 | Solve a linear inequality in one variable using two or more operations |
| 3.01.04.09 | Define absolute value |
| 3.01.04.10 | Solve problems involving statements of inequality |
| 3.01.04.11 | Use interval notation to describe inequalities on a number line |
| 3.01.04.12 | Define and describe the union and intersection of intervals |
| 3.01.04.13 | Graph inequalities in two variables |
| **3.01.05.00** | **Recognize, relate, and use the equivalent ideas of zeros of a function, roots of an equation, and solutions of an equation in terms of graphical and symbolic representations** |
| 3.01.05.01 | Apply the distributive law in removing common factors |
| 3.01.05.02 | Factor the difference of two squares |
| 3.01.05.03 | Factor quadratic trinomials |
| 3.01.05.04 | Combine like terms |
| 3.01.05.05 | Use the Distributive Property to remove grouping symbols and the Addition/Subtraction Property to combine like terms to simplify expressions |
| 3.01.05.06 | Solve equation in one variable utilizing one operation |
| 3.01.05.07 | Solve equations in one variable utilizing two or more operations |
| 3.01.05.08 | Describe and use the logic of equivalence in working with equations, inequalities, and functions |
| 3.01.05.09 | Identify variables, constants, terms, expressions, and coefficients |

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| 3.01.05.10 | Explore and describe characterizing features of functions |
| 3.01.05.11 | Find X and Y intercepts of a line |
| 3.01.05.12 | Decide whether or not a relation is a function. Use function notation. Find domains and ranges |
| 3.01.05.13 | Use set notation to describe and discuss domain and range of a function |
| 3.01.05.14 | Factor perfect square trinomials |
| **3.01.06.00** | **Graph equations** |
| 3.01.06.01 | Develop graphical techniques of solution for problem situations involving functions |
| 3.01.06.02 | Explore and describe characterizing features of functions |
| 3.01.06.03 | Describe problem situations by using and relating numerical, symbolic, and graphical representations |
| 3.01.06.04 | Use the language and notation of functions in symbolic and graphing settings |
| 3.01.06.05 | Find X and Y intercepts of a line |
| 3.01.06.06 | Write equations for a line |
| 3.01.06.07 | Use a graphing calculator or computer to generate the graph of a function |
| 3.01.06.08 | Graph a linear equation using the slope-intercept method |
| 3.01.06.09 | Translate among tables, algebraic expressions, and graphs of functions |
| 3.01.06.10 | Estimate shape of graphs of various functions and algebraic expressions |
| 3.01.06.11 | Use handheld graphic calculators to solve linear equations and graph simple functions |
| 3.01.06.12 | Graph basic functions using the Cartesian coordinate system |

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| 3.01.06.13 | Derive the equation of a line given two points of the line, one point and the slope, or slope and Y intercept |
| **3.01.07.00** | **Demonstrate the ability to translate statements and equations from written to algebraic form and algebraic to written form** |
| **3.01.08.00** | **Determine slope, midpoint, and distance** |
| 3.01.08.01 | Solve problems related to sets of points on a Cartesian coordinate system |
| 3.01.08.02 | Calculate the slope of a line using the coordinates of two points of the line or a graph of the line |
| **3.01.09.00** | **Model real-world phenomena with polynomial and exponential functions** |
| 3.01.09.01 | Use curve fitting to predict from data |
| 3.01.09.02 | Graph exponential functions which model real world statistics (e.g., population growth, radioactive decay) |

Geometry

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| **3.02.01.00** | **Find perimeters, surface areas and volumes of geometric figures** |
| 3.02.01.01 | Recognize and classify two-and three-dimensional figures (e.g., circles, triangles, rectangles, cylinders, prism) |
| 3.02.01.02 | Create and interpret drawings of three-dimensional objects |
| 3.02.01.03 | Classify, label, and describe polygons and solids |
| 3.02.01.05 | Use handheld graphic calculators to solve area and volume problems |
| 3.02.01.06 | Given the dimensions of various geometric shapes common to the technological industries, determine areas and volumes in English and metric units |

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| 3.02.01.07 | Estimate the area of irregular plane figures |
| 3.02.01.09 | Convert between radians and degrees |
| **3.02.03.00** | **Recognize, classify, and use properties of lines and angles** |
| 3.02.03.01 | Demonstrate an understanding of angles and parallel and perpendicular lines |
| 3.02.03.02 | Define terms related to angles |
| 3.02.03.04 | Demonstrate an understanding of special angles |
| 3.02.03.05 | Understand the various units of measure of angles |
| 3.02.03.06 | Identify points, lines, and planes |
| 3.02.03.07 | Use the concept of betweeness |
| 3.02.03.08 | Measure angles correctly |
| 3.02.03.09 | Convert between radians and degrees |
| **3.02.04.00** | **Describe and apply the properties of similar and/or congruent figures** |
| 3.02.04.01 | Be able to make scale drawings |
| **3.02.05.00** | **Solve right triangle problems** |
| 3.02.05.01 | Apply the Pythagorean Theorem |
| 3.02.05.02 | Identify basic functions of sine, cosine and tangent |
| 3.02.05.03 | Compute and solve problems using basic trigonometric functions |
| **3.02.06.00** | **Demonstrate inductive and deductive reasoning through application to various subject areas** |
| 3.02.06.01 | Demonstrate an understanding of and ability to use proof |

Numbers and Number Relations

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| **3.03.01.00** | **Estimate answers, compute, and solve problems involving real numbers** |
| 3.03.01.01 | Round off decimals to one or more places |
| 3.03.01.02 | Round and/or truncate numbers to designated place value |
| 3.03.01.03 | Round off single and multiple digit whole numbers |
| 3.03.01.04 | Estimate measurements |
| 3.03.01.05 | Use mental computation when computer and calculator are inappropriate |
| 3.03.01.06 | Find the least common denominator of two fractions |
| **3.03.02.00** | **Compare and contrast the real number system, the rational number system, and the whole number system** |
| **3.03.03.00** | **Determine if a solution to a mathematical problem is reasonable (estimate)** |
| **3.03.04.00** | **Select and compute using appropriate units of measure** |
| 3.03.04.01 | Convert, compare, and compute with common units of measurement within and/or across measurement systems |
| 3.03.04.02 | Use and convert between measurements in the Apothecaries' System of Measurement |
| 3.03.04.03 | Use the correct notations from the Apothecaries' System of Measurement |

Data Analysis and Probability

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| **3.04.01.00** | **Collect and organize data into tables, charts, and graphs** |
| 3.04.01.01 | Take a random sample from a population |
| **3.04.03.00** | **Understand and apply measures of central tendency, variability, and correlation** |
| 3.04.03.01 | Compute and interpret means (averages) |
| 3.04.03.02 | Compute and interpret median and/or mode |
| 3.04.03.03 | Understand what a normal distribution is |
| 3.04.03.04 | Understand what a uniform distribution is |

Technical Algebra

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|---|---|
| **3.05.01.00** | **Evaluate and graph functions using rectangular coordinates** |
| 3.05.01.01 | Graph inequalities in two variables |
| **3.05.02.00** | **Solve systems of linear equations and inequalities using matrices, graphs, and algebraic methods** |
| 3.05.02.01 | Solve systems of linear equations with up to 3 variables |
| 3.05.02.02 | Solve a 2x2 system of linear equations using matrices |
| **3.05.03.00** | **Understand the complex number system and exhibit facility with its operation** |
| 3.05.03.01 | Solve problems having complex solutions |
| 3.05.03.02 | Examine complex numbers as zeros of a function |

| | |
|---|---|
| 3.05.03.08 | Add, subtract, multiply and divide complex numbers in rectangular form |
| **3.05.04.00** | **Analyze exponential functions** |
| 3.05.04.02 | Do calculations involving exponential expressions and functions |
| 3.05.04.04 | Graph exponential functions |
| 3.05.04.06 | Use graphing calculators to generate tables to plot exponential curves |
| **3.05.05.00** | **Simplify and solve quadratic equations** |
| 3.05.05.01 | Simplify algebraic expressions, multiply and divide polynomials, and solve quadratic equations |
| 3.05.05.02 | Solve a quadratic equation by factoring, by completing the square, and by using the quadratic formula |
| 3.05.05.03 | Calculate the discriminant of a quadratic equation |
| 3.05.05.04 | Put a quadratic equation in standard form and identify a, b, and c |
| 3.05.05.05 | Draw conclusions about the solutions of a quadratic equation based upon the value of the discriminant |
| 3.05.05.06 | Use a handheld graphic calculator to find the real solutions of a quadratic function to within stated limits of accuracy |
| **3.05.06.00** | **Analyze rational functions** |
| 3.05.06.01 | Simplify rational expressions |
| 3.05.06.02 | Find the least common denominator of two rational expressions |
| 3.05.06.03 | Add, subtract, multiply and divide rational expressions |
| 3.05.06.04 | Solve rational equations |
| 3.05.06.05 | Identify and describe domain and range of rational functions |

| | |
|---|---|
| 3.05.06.06 | Define asymptote |
| 3.05.06.07 | Identify and describe the asymptotes of a rational function and recognize their significance |
| 3.05.06.08 | Graph rational functions using a handheld graphic calculator |
| 3.05.06.09 | Use a handheld graphic calculator to find any intercepts of a rational function to within stated limits of accuracy |

Technical Trigonometry

| | |
|---|---|
| **3.06.02.00** | **Recognize and identify graphs of the trigonometric functions** |
| 3.06.02.01 | Recognize and graph basic trig curves |

# HEART of OHIO TECH PREP CONSORTIUM

1997

## Automotive Diagnostic Technologies Model

## PART II.B:
## Secondary Tech Prep
## Academic Competencies (Unleveled)

HEART of OHIO TECH PREP CONSORTIUM

# SECONDARY ACADEMIC COMPETENCIES

Reviewed & approved, October 1997

## TABLE OF CONTENTS

# PREFACE
## How to Use This Competency List

The competencies listed in this document are exit competencies for the secondary component of Tech Prep programs. They represent what Tech Prep high school students are expected to be able to do by the end of grade 12.

Information offered in this preface includes:

- Philosophy underpinning Tech Prep academics
- Mathematics education as an example
- Bottom line for Tech Prep academics instruction
- Matrix indicating core and program-specific academic competencies
- Notes on organization of the competency list
- Acknowledgements

### Background: What's Different about Tech Prep Academic Competencies?

Tech Prep is a systemic educational reform movement intended to prepare students for the technology-based occupations of the coming century. Here are some key points to know about Tech Prep secondary academics:

- ✔ Tech Prep academics are college preparatory academics for concrete learners. (That's 90% of all of us.)
- ✔ The goal is to prepare Tech Prep students to enter the college of their choice without the need for academic remediation.
- ✔ What makes Tech Prep academics different from traditional college prep academics is not the content. It is the way in which it is taught.

The following section uses *mathematics* as an example to illustrate the necessity for this approach, and some related methodologies.

### Mathematics: A Prime Example

If we accept the premise that Tech Prep programs will demonstrate systemic educational change by providing new, creative, and innovative options for students, then we must agree that what has passed for mathematics education in the past will not and can not continue as mathematics education in the future.

The follow excerpts from current literature support this position:

> Evidence from many sources shows that the least effective mode for mathematics learning is the one that prevails in most of America's classrooms: lecturing and listening. Despite daily homework, for most students and most teachers mathematics continues to be primarily a passive activity: teachers prescribe; students transcribe. Students simply do not retain for long what they learn by imitation from lectures, worksheets, or routine homework. Presentation and repetition help students do well on standardized tests and lower-order skills, but they are generally ineffective as teaching strategies for long-term learning, for higher-order thinking, and for versatile problem solving. (National Research Council. Everybody Counts — A Report to the Nation on the Future of Mathematics Education. 1989, p. 57.)

The National Council of Teachers of Mathematics have proposed five general goals for all K-12 students:

1. That students learn to value mathematics,
2. That students become confident in their ability to do mathematics,
3. That students become mathematics problem-solvers,
4. That students learn to communicate mathematically, and
5. That students learn to reason mathematically....

> Toward this end, we see classrooms as places where interesting problems are regularly explored using important mathematical ideas. Our premise is that ***what*** a student learns depends to a great degree on ***how*** he or she has learned it.... This vision sees students studying much the same mathematics currently taught, but with quite a different emphasis. (NCTM. Curriculum and Evaluation Standards for School Mathematics. 1989, p. 5.)

For NCTM's vision for mathematics education to be realized, the vision of how students learn mathematics must shift "toward investigating, formulating, representing, reasoning, and applying a variety of strategies to the solution of problems . . . and away from being shown or told, memorizing and repeating.... {And the} role of teachers toward 'questioning and listening' . . . and away from 'telling' students what to do..." (NCTM, Assessment Standards for School Mathematics,1995, p. 2).

*Alternative methods for delivery of mathematics education* should address the following:

1. Students should experience mathematics as active, engaging, and dynamic.
2. Mathematics instruction should at all times make appropriate use of technology, especially graphing calculators and computers.
3. Mathematics courses should make extensive use of writing assignments, open-ended projects, and cooperative learning groups.
4. Faculty should use a variety of teaching strategies and should employ a broad range of examples.

(Mathematical Sciences Education Board. Expectations for Mathematics Education from High School through Career.)

## The Bottom Line for Teaching

As shown above, we can not continue to teach mathematics — or for that matter, any high school academics — the way they have always been taught. The Heart of Ohio Tech Prep Consortium officially encourages the kind of systemic change spelled out in the example just presented using mathematics education.

In other words, TECH PREP HIGH SCHOOL ACADEMIC INSTRUCTION SHOULD --

- ☞ **Focus on developing critical thinking and problem-solving skills**
- ☞ **Incorporate cooperative learning techniques**
- ☞ **Include written group projects, developed in conjunction with business and industry, that address real-world problems**
- ☞ **Actively embrace career development and school-to-work opportunities**
- ☞ **Encourage global thinking and learning through multidisciplinary instruction, projects, and experiences**

## Core Academic Competencies and Program-Specific Competencies

The matrix on the next page shows--

1. Core competencies required of ALL TECH PREP STUDENTS by the time they complete high school.
2. Program-specific competencies required by the end of grade 12 FOR STUDENTS WHO SELECT A PARTICULAR TECH PREP SECONDARY PROGRAM that is linked with one or more college Tech Prep programs.

Important notes:

- ✔ The grade and sequence in which Tech Prep academic competencies are taught are up to the local school (though in some cases, this is determined naturally by progression of prerequisite skills).
- ✔ Regardless of the sequence, every student completing a high school Tech Prep program should have attained the academic competencies

(both core and program-specific) by the time he or she completes the high school Tech Prep program.

- ✔ The core competencies and program-specific competencies required by the end of grade 12 are the minimum requirements for successful completion of the high school Tech Prep program and subsequent matriculation into a college Tech Prep program. If time and resources allow, any school may choose to enrich its Tech Prep programs by teaching additional competencies that enhance the students' college and/or employment readiness.

- ✔ Instructors will notice that competencies listed in their discipline are generally equivalent to the college prep content they already teach (e.g., Algebra I, Geometry, Biology, Global History, etc.).

- ✔ Schools are advised to retain traditional names for academic courses (e.g., Algebra II, English IV) on the student's official transcript, to support their acceptance by selective-admissions colleges and universities, as well as for scholarship eligibility (e.g., NCAA). Although schools may organize and sequence Tech Prep academic course content differently from traditional college preparatory courses, students should have attained all of the requisite competencies by the end of grade 12, thereby addressing the expectations of these organizations.

# MATRIX NO. 1:
# CORE ACADEMIC COMPETENCIES
# REQUIRED OF ALL TECH PREP STUDENTS
# BY THE END OF GRADE 12

| ACADEMIC COMPETENCIES | | | | Individual Development Competencies | Technology Literacy Competencies | Professional Options (Technical & Employability Competencies) |
|---|---|---|---|---|---|---|
| Communications Literacy* | Mathematics Literacy* | Science Literacy* | Social/Cultural Literacy* | | | |
| All competencies listed | • Algebra<br>• Numbers & number relations<br>• Data analysis & probability | • Lab safety procedures<br>• Scientific process<br>• Biology/ecology | All competencies listed | All competencies listed | All competencies listed | See specific program model (separate document) |
| *Four years of college-prep English | *Minimum three years of college prep mathematics -- see Matrix No. 2 for additional program-specific requirements | *Minimum two years of lab science, one of which is biology — see Matrix No. 2 for additional program-specific requirements | *Four years of college-prep humanities | | | |

## MATRIX NO. 2:
## ADDITIONAL ACADEMIC COMPETENCIES
## REQUIRED FOR SPECIFIC TECH PREP PROGRAMS
## IN GRADES 11-12*

(*In addition to core competencies required of all students)

| TECH PREP PROGRAM MODEL (Gr. 11-12) | Mathematics Literacy Competencies* | Science Literacy Competencies* | Professional Options Competencies (Technical & Employability) |
|---|---|---|---|
| Automotive/Diagnostic Technologies | • Geometry<br>• Technical Algebra | • Chemistry<br>• Physics | See separate program model documentation |
| Business Technologies Core Model: | | | |
| ■ Computerized Business Technology (CBT) Career Major | • Geometry<br>• Technical Algebra | • Chemistry or Physics *(recommended but not required)* | See separate program model documentation |
| ■ Business Management Career Major *(in process)* | TBA | TBA | TBA |
| Construction Technologies | • Technical Algebra<br>• Geometry and/or Technical Trigonometry *(recommended but not required)* | • Physics<br>• Chemistry *(recommended by not required)* | See separate program model documentation |
| Engineering Technologies Core Model: | | | |
| ■ Architecture/ Construction Career Major | Select two:<br>• Technical Algebra<br>• Geometry<br>• Technical Trigonometry | • Chemistry<br>• Physics | See separate program model documentation |

## MATRIX NO. 2:
## ADDITIONAL ACADEMIC COMPETENCIES
## REQUIRED FOR SPECIFIC TECH PREP PROGRAMS
## IN GRADES 11-12*

(*In addition to core competencies required of all students)

| TECH PREP PROGRAM MODEL (Gr. 11-12) | Mathematics Literacy Competencies* | Science Literacy Competencies* | Professional Options Competencies (Technical & Employability) |
|---|---|---|---|
| Engineering Core Model program, continued:<br>■ Design Engineering Career Major<br>■ Electronics Technology Career Major<br>■ Graphic Communications Career Major<br>■ Landscape Career Major<br>■ Manufacturing Career Major | Select two:<br>• Technical Algebra<br>• Geometry<br>• Technical Trigonometry | • Chemistry<br>• Physics | See separate program model |
| Environmental Technologies | • Geometry<br>• Technical Algebra | • Chemistry<br>• Environmental Geology *(specific to this program; see separate program model documentation)* | See separate program model documentation |
| Information Engineering Technologies | • Geometry<br>• Technical Algebra | • Chemistry<br>• Physics | See separate program model documentation |
| Multi-Competency Health Technologies ("Allied Health") | • Technical Algebra | • Chemistry | See separate program model documentation |

## Notes on Organization of the Competency List

- Numbering format:
  Category
    Subcategory
      Competency (*9.03.12.00)
        Competency Builder (9.03.12.11)

- An asterisk (*) indicates that the statement is a competency. Others are competency builders. Competency statements always end with ".00" in the builder columns.

- Categories:
  1 = Communications Literacy . . . . . 47 competencies
  2 = Individual Development . . . . . 11 competencies
  3 = Mathematics Literacy . . . . . 30 competencies
  4 = Science Literacy . . . . . 16 competencies
  5 = Social/Cultural Literacy . . . . . 21 competencies
  6 = Technology Literacy . . . . . 26 competencies
  151 total

- Professional Options (technical) competencies are not included. The set of specific technical competencies used will depend on the particular Tech Prep program model. These are contained in separate documents available from each school's representative to the Tech Prep Consortium Implementation Committee.

- Communications Literacy competencies do not include builders.

- Individual Development category does not include subcategories.

## Acknowledgements

The original version of this competencies list (1992-94) was developed and reviewed by over 80 representatives of K-12 and higher education institutions as well as members of business, industry, and labor organizations who donated their time to help Tech Prep get on its feet in Central Ohio. The current version was reviewed and approved by representatives of Ohio University, Columbus State Community College, and the Curriculum Pathways Committee of the Heart of Ohio Tech Prep Consortium. The preface was prepared by Leigh Trapp, Larry Lance, and Connie Faddis. A special thank you goes to Dr. John Furlow of OU-Lancaster, Dr. David Hockenbery of Columbus State, and Larry Lance of Columbus State.

## COMMUNICATIONS LITERACY COMPETENCIES

### Effective Reading Skills

*1.01.01.00 Differentiate between fact, opinion, and inference.

*1.01.02.00 Cite details that support or do not support predictions.

*1.01.03.00 Recognize the intent and use of propaganda.

*1.01.04.00 Identify and summarize ideas, information, and events that are explicitly stated in written material.

*1.01.05.00 Explain the sequence of time, places, events, and ideas.

*1.01.06.00 Identify and explain the main and subordinate ideas (stated or implied) in a written work.

*1.01.07.00 Apply interpretive level comprehension skills to generate ideas and/or hypotheses about the content.

*1.01.08.00 Find, understand, interpret, and apply information from a variety of sources (books, manuals, newspapers, periodicals, directories, reference works, computer printouts, and electronic sources).

*1.01.09.00 Use the features of books and reference materials, such as table of contents, preface, introduction, titles and subtitles, index, glossary, appendix, and bibliography.

*1.01.10.00 Define and use unfamiliar words and specialized vocabulary (including abbreviations, acronyms, concepts, and jargon) by using structural analysis, decoding, contextual cues, dictionaries, and computers.

*1.01.11.00 Read and understand short notes, memos, letters, and forms.

*1.01.12.00 Read and follow complex directions.

*1.01.13.00 Determine the author's purpose.

*1.01.14.00 Read, evaluate, and respond critically to various literature forms, genres, and printed media.

*1.01.15.00 Recognize and interpret organizational patterns of writing (e.g., cause and effect, comparison and contrast, and simple listing).

*1.01.16.00 Identify the structural elements of literature (e.g., plot, theme, character, mood, setting, and point of view).

*1.01.17.00 Identify literary devices (e.g., metaphor, foreshadowing, flashback, allusion, satire, and irony).

*1.01.18.00 Explore and analyze a variety of cultural elements, attitudes, beliefs, and value structures through reading.

**Effective Speaking and Presentation Skills**

*1.02.01.00 Give oral directions and clear explanations.

*1.02.02.00 Participate critically and constructively in the exchange of ideas, particularly during class discussions and conferences with individuals.

*1.02.03.00 Demonstrate correct usage of vocabulary.

*1.02.04.00 Demonstrate an awareness and understanding of interpersonal communication skills (verbal and nonverbal) in one-to-one and small group settings (role playing).

*1.02.05.00 Speak effectively using nonverbal communication such as eye contact, posture, and gestures.

*1.02.06.00 Select topics suitable to audience, situation, and purpose.

*1.02.07.00 Demonstrate effective speaking skills in seeking employment and in utilizing management skills on the job.

*1.02.08.00 Give formal and informal talks and speeches.

*1.02.09.00 Demonstrate the difference between informing and persuading and use the appropriate techniques of content and delivery for each purpose.

*1.02.10.00 Use visual media.

*1.02.11.00 Demonstrate proper telephone etiquette.

## Effective Writing Skills

*1.03.01.00 Demonstrate ability to use different forms of writing (e.g., literary response, business and technical communicative modes, personal responses, journals, research and recording).

*1.03.02.00 Demonstrate appropriate selection of mode, purpose, audience, point of view, and organization of information in written assignments.

*1.03.03.00 Demonstrate expertise in word processing, graphics, and/or desktop publishing aids for writing.

*1.03.04.00 Apply writing process techniques: 1) Prewriting, 2) Drafting, 3) Revising, 4) Editing/proofreading, 5) Publishing.

*1.03.05.00 Demonstrate ability to evaluate written assignments using a diagnostic rubric.

*1.03.06.00 Develop and maintain a professional writing portfolio.

## Listening Skills

*1.04.01.00 Follow spoken directions.

*1.04.02.00 Distinguish between fact and opinion.

*1.04.03.00 Make inferences and draw conclusions from verbal and nonverbal messages.

*1.04.04.00 Identify and comprehend the main-and subordinate ideas in lecture and discussions, questions to clarify information heard, and report accurately what others have said.

*1.04.05.00 Restate or paraphrase a conversation to confirm one's own understanding of what was said.

*1.04.06.00 Take accurate notes which summarize material presented from spoken conversations, including telephone messages.

*1.04.07.00 Recognize multi-cultural differences when listening.

Critical Viewing/Graphic/Observation Skills

*1.05.01.00 Read and understand graphs, charts, and tables to obtain factual information.

*1.05.02.00 Produce and utilize effective communication skills in the development of graphs, tables, and charts to communicate ideas.

*1.05.03.00 Critically view historical or contemporary events, via TV or video tape, and make appropriate observations.

*1.05.04.00 Analyze the effects of advertising and other visual media for direct and hidden messages, including propaganda devices.

*1.05.05.00 Communicate through use of video tape and computer presentations.

## INDIVIDUAL DEVELOPMENT

*2.00.01.00 Apply critical thinking skills to personal, family, and work problems for the well-being of self and others

2.00.01.01 Differentiate between facts and assumptions.

2.00.01.02 Develop inferences from data.

2.00.01.03 Demonstrate an ability to evaluate arguments.

2.00.01.04 Utilize deductive logic by predicting specific phenomena from general statements.

*2.00.02.00 Apply problem-solving process to personal, family, and work-related problems for well-being of self and others

2.00.02.01 Analyze and clarify own value structure.

2.00.02.02 Evaluate the relationship between values and goals

2.00.02.03 Establish priorities for short and long-term goals

2.00.02.04 Describe the importance of flexibility when reevaluating goals

2.00.02.05 Manage resources to achieve goals

2.00.02.06 Identify adequate reliable information and resources for personal, family, and work-related problem solving.

2.00.02.07 Create solutions to problems using technical means

2.00.02.08 Compare and contrast the advantages and disadvantages of several solutions to a problem.

2.00.02.09 Evaluate outcomes of a decision.

2.00.02.10 Apply decision-making techniques in the workplace

2.00.02.11 Apply technical problem solving abilities and creative talents to situations in the workplace

*2.00.03.00 Assume a leadership role as a responsible family member and citizen

- 2.00.03.01 Evaluate leadership styles appropriate for the workplace and/or home
- 2.00.03.02 Identify ways to be a responsible citizen at home, at school, at work, and in community settings
- 2.00.03.03 Develop effective communication skills.
- 2.00.03.04 Determine ways to motivate others
- 2.00.03.05 Demonstrate initiative to facilitate cooperation

*2.00.04.00 Build and maintain constructive interpersonal relationships

- 2.00.04.01 Assess and be sensitive to others' feelings and point of view
- 2.00.04.02 Examine how individuals from various backgrounds contribute to work and personal situations
- 2.00.04.03 Identify ways to work cooperatively with others of diverse background
- 2.00.04.04 Analyze strategies to manage conflict
- 2.00.04.05 Cooperate and compromise through teamwork and group participation
- 2.00.04.06 Develop communication patterns that enhance family relationships
- 2.00.04.07 Identify characteristics of love and commitment with family, friends, and others
- 2.00.04.08 Understand ways to build and maintain strong, functional families
- 2.00.04.09 Understand ways to build positive parent-child relationships
- 2.00.04.10 Enhance personal development of self and others throughout the lifespan
- 2.00.04.12 Develop a life-management plan

*2.00.05.00 Develop skills to successfully cope with changes taking place in society.

- 2.00.05.01 Analyze the effects of change
- 2.00.05.02 Identify strategies for dealing with family change and stress

2.00.05.03 Identify family and work support resources and services

2.00.05.04 Evaluate the need for continuing education and training

2.00.05.05 Implement strategies to manage the effects of stress

*2.00.06.00 Identify management strategies for balancing work and family roles and responsibilities

2.00.06.01 Analyze the effects of work on family

2.00.06.02 Analyze the effects of family on work

2.00.06.03 Describe personal and family roles and issues

2.00.06.04 Identify present and future family structures and responsibilities

2.00.06.05 Analyze concerns of working parent(s)

2.00.06.06 Evaluate importance of responsible parenting for individuals, families, and society

2.0.0.06.07 Coordinate personal and career responsibilities for well-being of self and others

*2.00.07.00 Develop strategies for lifelong career planning

2.00.07.01 Assess knowledge, attitudes, skills, and aspirations

2.00.07.02 Develop an awareness of careers and skills in a technological society.

2.00.07.03 Complete and process job application forms

2.00.07.04 Design a resume

2.00.07.05 Demonstrate interviewing skills

2.00.07.06 Compare and evaluate job opportunities

2.00.07.07 Analyze organizational structures of the workplace

2.00.07.08 Assess factors influencing wages, annual incomes, and job opportunities

2.00.07.09 Identify strategies for keeping a job, advancing in a job, and increasing wages

2.00.07.10 Evaluate factors involved when assuming a new position within or outside an occupation/ organization

2.00.07.11 Identify strategies for dealing with career successes, changes, and/or disappointments

2.00.07.12 State the approximate number of years a person can expect to work after leaving high school.

2.00.07.13 Compare the advantages and disadvantages of multiple incomes

2.00.07.14 Analyze opportunities for personal and career growth

2.00.07.15 Evaluate career choices in relation to life-management plan

2.00.07.16 Formulate plan to achieve career goals

*2.00.08.00 Develop habits and attitudes that reflect an appropriate work ethic.

2.00.08.01 Analyze the value of work ethic in relation to personal and family values and goals

2.00.08.02 Evaluate the relationship of self-esteem to work ethic

2.00.08.03 Follow directions.

2.00.08.04 Identify strategies to improve workplace policies and attitudes that support individuals and families.

2.00.08.05 Develop a positive attitude

2.00.08.06 Develop time management skills.

*2.00.09.00 Establish a plan for using resources to meet individual and family needs and goals

2.00.09.01 Analyze consumer rights and responsibilities

2.00.09.02 Make informed consumer choices for the well-being of self and others

2.00.09.03 Discuss the role of competitiveness in a global society.

2.00.09.04 Make decisions related to selecting, obtaining, and maintaining clothing for self and family

2.00.09.05 Evaluate financial institutions and services (e.g., savings, investments, credit).

2.00.09.06 Plan strategies to facilitate self-responsibility in managing a financial plan

*2.00.10.00 Evaluate entrepreneurship as a career option

2.00.10.01 Evaluate the role of small business in the economy

2.00.10.02 Analyze opportunities for new business.

2.00.10.03 Examine considerations of starting a business

2.00.10.04 Analyze responsibilities involved in managing a business .

2.00.10.05 Examine factors involved in obtaining financing.

2.00.10.06 Examine importance of effective record keeping.

2.00.10.07 Examine factors involved in selecting a business location.

2.00.10.08 Analyze importance of a customer service policy.

2.00.10.09 Analyze how laws affect small business operations.

2.00.10.10 Examine components of a marketing plan.

2.00.10.11 Analyze importance of a business plan.

*2.00.11.00 Make choices that promote wellness and good health for self and others

2.00.11.01 Describe the significance of a healthy lifestyle

2.00.11.02 Analyze interrelationship between food choices and wellness

2.00.11.03 Identify strategies to promote optimal nutrition and wellness of individuals and families

2.00.11.04 Prepare and serve nutritious foods

2.00.11.05 Demonstrate proper use of equipment

2.00.11.06 Maintain safe work and home environment

2.00.11.07 Identify substance use, abuse, and its effects on individuals, families, work and society.

2.00.11.08 Enhance self-esteem of self and others

2.00.11.09 Distinguish between responsible and irresponsible ways to express emotional and physical intimacy

2.00.11.10 Examine the role of the arts in cultural expression and identity.

2.00.11.11 Explore the significance of a variety of art forms.

## MATHEMATICS LITERACY

### Algebra

*3.01.01.00 Solve linear equations.

- 3.01.01.01 Combine like terms.
- 3.01.01.02 Use the Distributive Property to remove grouping symbols and the Addition/Subtraction Property to combine like terms to simplify expressions.
- 3.01.01.03 Solve equation in one variable utilizing one operation.
- 3.01.01.04 Solve equations in one variable utilizing two or more operations.
- 3.01.01.05 Describe and use the logic of equivalence in working with equations, inequalities, and functions.
- 3.01.01.06 Identify variables, constants, terms, e expressions, and coefficients.
- 3.01.01.07 Define absolute value.
- 3.01.01.08 Evaluate algebraic expressions.
- 3.01.01.09 Solve the literal equation or formula for a specified variable.
- 3.01.01.10 Recognize the properties of equalities.
- 3.01.01.11 Solve a 2x2 system of linear equations by elimination.
- 3.01.01.12 Solve a 2x2 system of linear equations by substitution.
- 3.01.01.13 Apply the rules for solving linear equations in one variable.
- 3.01.01.14 Use formulas.
- 3.01.01.15 Use handheld graphic calculators to solve linear equations and graph simple functions.
- 3.01.01.16 Solve linear equations in one variable containing an absolute value symbol.

*3.01.02.00 Use properties of exponents.

- 3.01.02.01 Define exponent.
- 3.01.02.02 Compare and compute using scientific notation.
- 3.01.02.03 Determine values for the square root of any natural number.
- 3.01.02.04 Determine the principal square root and recognize square roots of negatives as being non-real.
- 3.01.02.05 Divide terms having factors with exponents.
- 3.01.02.06 Multiply and divide polynomial expressions.
- 3.01.02.07 Operate with radicals and leave the result in simplified form.
- 3.01.02.08 Apply the properties of exponents to simplify polynomial expressions.
- 3.01.02.09 Multiply terms having factors with exponents.
- 3.01.02.10 Solve radical equations.

*3.01.03.00 Factor a polynomial of two or more terms.

- 3.01.03.01 Apply the distributive law in removing common factors.
- 3.01.03.02 Factor difference of two squares.
- 3.01.03.03 Factor quadratic trinomials.
- 3.01.03.04 Factor the sum and differences of perfect cubes.

*3.01.04.00 Solve linear inequalities and show the solution on a number line.

- 3.01.04.01 Combine like terms.
- 3.01.04.02 Use the Substitution Property to evaluate expressions and formulas.
- 3.01.04.03 Evaluate algebraic expressions.
- 3.01.04.04 Use the Distributive Property to remove grouping symbols and the Addition/Subtraction Property to combine like terms to simplify expressions.

3.01.04.05 Identify variables, constants, terms, expressions, and coefficients.

3.01.04.06 Solve equations in one variable utilizing two or more operations.

3.01.04.07 Describe and use the logic of equivalence in working with equations, inequalities, and functions.

3.01.04.08 Solve a linear inequality in one variable using two or more operations.

3.01.04.09 Define absolute value.

3.01.04.10 Solve problems involving statements of inequality.

*3.01.05.00 Recognize, relate, and use the equivalent ideas of zeros of a function, roots of an equation, and solution of an equation in terms of graphical and symbolic representations.

3.01.05.01 Apply the distributive law in removing common factors.

3.01.05.02 Factor the difference of two squares.

3.01.05.03 Factor quadratic trinomials.

3.01.05.04 Combine like terms.

3.01.05.05 Use the Distributive Property to remove grouping symbols and the Addition/Subtraction Property to combine like terms to simplify expressions.

3.01.05.06 Solve equation in one variable utilizing one operation.

3.01.05.07 Solve equations in one variable utilizing two or more operations.

3.01.05.08 Describe and use the logic of equivalence in working with equations, inequalities, and functions.

3.01.05.09 Identify variables, constants, terms, expressions, and coefficients.

3.01.05.10 Explore and describe characterizing features of functions.

3.01.05.11 Find X and Y intercepts of a line.

3.01.05.12 Decide whether or not a relation is a function. Use function notation. Find domains and ranges.

*3.01.06.00 Graph equations.

3.01.06.01 Develop graphical techniques of solution for problem situations involving functions

3.01.06.02 Explore and describe characterizing features of functions.

3.01.06.03 Describe problem situations by using and relating numerical, symbolic, and graphical representations

3.01.06.04 Use the language and notation of functions in symbolic and graphing settings.

3.01.06.05 Find X and Y intercepts of a line.

3.01.06.06 Write equations for a line.

3.01.06.07 Use a graphing calculator or computer to generate the graph of EL function.

3.01.06.08 Graph a linear equation using the slope-intercept method.

3.01.06.09 Translate among tables, algebraic expressions, and graphs of functions

3.01.06.10 Estimate shape of graphs of various functions and algebraic expressions.

3.01.06.11 Use handheld graphic calculators to solve linear equations and graph simple functions.

3.01.06.12 Graph basic functions using Cartesian coordinate system.

*3.01.07.00 Demonstrate the ability to translate statements and equations from written to algebraic form and algebraic to written form.

*3.01.08.00 Determine slope midpoint, and distance.

3.01.08.01 Solve problems related to sets of points on a Cartesian coordinate system.

*3.01.09.00 Model real-world phenomena with polynomial and exponential functions.

3.01.09.01 Use curve fitting to predict from data.

**Geometry**

*(Note: It is appropriate to teach geometry to Tech Prep students with some theorems and proofs, but for maximum student engagement and success, the major focus should be on the more practical aspects of geometry, such as calculating volumes, surfaces, etc.)*

*3.02.01.00 Find perimeters, surface areas and volumes of geometric figures.

3.02.01.01 Recognize and classify two- and three-dimensional figures (e.g., circles, triangles, rectangles, cylinders, prism).

3.02.01.02 Create and interpret drawings of three-dimensional objects.

3.02.01.03 Classify, label, and describe polygons and solids.

3.02.01.04 Represent problem situations with geometric models and apply properties of figures.

3.02.01.05 Use handheld graphic calculators to solve area and volume problems.

3.02.01.06 Given the linear dimensions of various geometric shapes common to the techno-- logical industries, determine areas and volumes in English and metric units.

*3.02.02.00 Explore compass and straight edge constructions in the context of geometric theorems.

*3.02.03.00 Recognize, classify, and use properties of lines and angles.

3.02.03.01 Demonstrate an understanding of angles and parallel and perpendicular lines.

3.02.03.02 Define terms related to angles.

3.02.03.03 Make constructions related to angles.

3.02.03.04 Demonstrate an understanding of special angles.

3.02.03.05 Understand the various units of measure of angles.

3.02.03.06 Identify points, lines, and planes.

3.02.03.07 Use the concept of between-ness.

3.02.03.08 Measure angles correctly.

*3.02.04.00 Describe and apply the properties of similar and/or congruent figures.

3.02.04.01 Be able to make scale drawings.

*3.02.05.00 Solve right-triangle problems.

3.02.05.01 Apply the Pythagorean theorem.

3.02.05.02 Identify basic functions of sine, cosine, and tangent

3.02.05.03 Compute and solve problems using basic trig functions.

*3.02.06.00 Demonstrate inductive and deductive reasoning through application to various subject areas.

3.02.06.01 Demonstrate an understanding of and ability to use proof.

Numbers and Number Relations

*3.03.01.00 Estimate answers, compute, and solve problems involving real numbers.

3.03.01.01 Round off decimals to one or more places

3.03.01.02 Round and/or truncate numbers to designated place value.

3.03.01.03 Round off single and multiple digit whole numbers.

3.03.01.04 Estimate measurements.

3.03.01.05 Use mental computation when computer and calculator are inappropriate.

*3.03.02.00 Compare and contrast the real number system, the rational number system' and the whole number system.

*3.03.03.00 Determine if a solution to a mathematical problem is reasonable (estimate).

*3.03.04.00 Select and compute using appropriate units of measure.

3.03.04.01 Convert, compare, and compute with common units of measurement within and/or across measurement systems.

## Data Analysis and Probability

*3.04.01.00 Collect and organize data into tables, charts, and graphs.

3.04.01.01 Take a random sample from a population.

*3.04.02.00 Determine the probability of an event.

3.04.02.01 Determine the probability of more than one event.

3.04.02.02 Use computer simulations and random number generation to estimate probability.

*3.04.03.00 Understand and apply measures of central tendency, variability, and correlation.

3.04.03.01 Compute and interpret means (averages).

3.04.03.02 Compute and interpret median and/or mode.

3.04.03.03 Understand what a normal distribution is.

3.04.03.04 Understand what a uniform distribution is.

## Technical Algebra

*3.05.01.00 Evaluate and graph functions using rectangular coordinates.

3.05.01.01 Graph inequalities in two variables.

3.05.01.02 Analyze the effects of parameter changes on graphs.

*3.05.02.00 Solve systems of linear equations and inequalities using matrices, graphs, and algebraic methods.

3.05.02.01 Solve systems of linear equations with up to three variables.

3.05.02.02 Solve a 2x2 system of linear equations using matrices.

3.05.02.03 Describe and solve algebraic situations with matrices.

*3.05.03.00 Understand the complex number system and exhibit facility with its operation.

3.05.03.01 Solve problems having complex solutions.

3.05.03.02 Examine complex numbers as zeros of functions.

3.05.03.03 Graph basic functions using polar coordinate system.

3.05.03.04 Graph using polar coordinates.

3.05.03.05 Contrast and compare algebras of rational, real, and complex numbers with characteristics of a matrix algebra system.

3.05.03.06 Determine factors and roots of a polynomial with complex roots.

3.05.03.07 Graph complex numbers.

3.05.03.08 Add, subtract, multiply and divide complex numbers in rectangular and polar form.

3.05.03.09 Convert complex numbers from rectangular form to the exponential.

*3.05.04.00 Analyze exponential and logarithmic functions.

3.05.04.01 Identify and define inverse functions.

3.05.04.02 Do calculations involving exponential and logarithmic expressions and functions.

3.05.04.03 Use definitions to show the relationship between exponential and logarithmic functions.

3.05.04.04 Graph the logarithmic and exponential functions.

3.05.04.05 Describe and use inverse relationship between functions including exponential and logarithmic.

3.05.04.06 Use graphing calculators to generate tables to plot exponential and logarithmic curves.

3.05.04.07 Use properties of logarithms to solve problems.

3.05.04.08 Use graphing calculators to calculate logarithms in bases other than 10.

3.05.04.09 Solve elementary logarithmic and exponential equations.

*3.05.05.00 Simplify and solve quadratic equations.

3.05.05.01 Simplify algebraic expressions and multiply and divide polynomials along with solving quadratic equations.

3.05.05.02 Solve a quadratic equation by factoring by completing the square, and by using the quadratic formula.

Technical Trigonometry

*3.06.01.00 Solve problems using the trigonometric functions.

3.06.01.01 Know the sign of each circular function in any quadrant.

3.06.01.02 Know the circular functions of the special angles, pi/6, pi/4, pi/3 (30, 60, 90)

3.06.01.03 Define the circular functions on a circle of radius r with the center at the origin.

3.06.01.04 Understand the relationship of the circular functions and the trig functions.

3.06.01.05 Identify and use the trig functions for the sum of angles.

3.06.01.06 Solve right-triangle problems.

3.06.01.07 State the value of the trig functions of an angle using the reference angle.

3.06.01.08 Apply the law of sines to find measures of sides of angles of a triangle.

3.06.01.09 Apply the law of cosines in finding measures of sides and angles of triangles.

3.06.01.10 Convert between radians and degrees.

3.06.01.11 Solve problems with negative rotations.

3.06.01.12 Solve right triangle problems including application problems.

*3.06.02.00 Recognize and identify graphs of the trigonometric functions.

3.06.02.01 Recognize and graph basic trig curves.

3.06.02.02 Explore graphs in three dimensions.

3.06.02.03 Identify and define inverse functions.

3.06.02.04 Solve trigonometric equations and verify trigonometric identities.

3.06.02.05 Use the fundamental trig identities in performing operations.

*3.06.03.00 Demonstrate an understanding in the use of vectors.

3.06.03.01 Apply vectors in problem solutions

3.06.03.02 Deduce properties of figures using vectors.

3.06.03.03 Develop and use vectors to represent distance and magnitude including operations.

3.06.03.04 Explore relationships between complex numbers and vectors.

3.06.03.05 Add and subtract vectors geometrically.

3.06.03.06 Use graphing calculators in the study of vectors.

## SCIENCE LITERACY

### Chemistry

*4.01.01.00 Explore atomic theory and present findings using various representational formats.

- 4.01.01.01 Describe a mechanism of bond formation and identify the type of chemical bond formed as ionic, covalent, or metallic.
- 4.01.01.02 Relate the concept of periodicity to atomic properties and the periodic table of elements.
- 4.01.01.03 Describe charge and ionic compounds in the context of electrochemical theories.
- 4.01.01.04 Recognize that the atomic model is only a model and, like any model, is subject to change.
- 4.01.01.05 State an atomic theory which includes atomic structure, components and their properties, interactions (electron/nuclear) and theory models.
- 4.01.01.06 Demonstrate knowledge of chemical symbolism which will include symbols, formulas, and equations.

*4.01.02.00 Perform investigations that require observations over varying periods of time concerning the interrelationship of matter and energy.

- 4.01.02.01 State a scheme of matter which includes elements, compounds, and mixtures.
- 4.01.02.02 Relate a chemical equation to the concept of chemical change.
- 4.01.02.03 Classify matter according to properties and composition.
- 4.01.02.04 Predict the properties of matter based on data provided in pictures, drawings, charts, graphs, tables, mathematical expressions, and scientific literature.
- 4.01.02.05 Describe the conservation laws and correctly use the standard units for these laws in relation to conservation of mass/energy and conservation of charge.
- 4.01.02.06 Describe properties of carbon and organic molecules.

4.01.02.07 State the laws of chemical combinations (conservation of mass, definite composition, multiple proportions).

4.01.02.08 List assumptions of the kinetic theory of matter.

4.01.02.09 Understand chemical changes during combustion, and the relationship between these changes and the carbon cycle, and relationship to the greenhouse effect.

4.01.02.10 Manipulate data in problem solving, including: mole problems, concentration problems, gas law problems, atomic/molecular structure problems and equation balancing.

4.01.02.11 Discuss the concept of mole.

4.01.02.12 State the properties of gases and the laws that apply to gases.

4.01.02.13 Identify applications of Avogadro's hypothesis such as Avogadro's number, molar volume, and gram molecular weight/molar mass.

4.01.02.14 Use the kinetic molecular theory to explain states of matter, rates of reaction, and chemical equilibrium.

4.01.02.15 Describe Stoichiometric relationships

Biology/Ecology

*4.02.01.00 Using models and explorations, examine cellar components and their relationships.

4.02.01.01 Describe the cell theory; structure and function.

4.02.01.02 Describe the role of nucleic acids in cell functions and heredity.

4.02.01.03 Describe the events of mitosis and meiosis.

4.02.01.04 State Mendel's laws of heredity.

4.02.01.05 List causes and effects of gene mutations and chromosomal aberrations.

4.02.01.06 Describe current advances in genetic engineering and possible applications in agriculture and medicine.

*4.02.02.00 Recognizing and contrasting biological characteristics, derive a scheme to classify living organisms.

4.02.02.01 List characteristics of living organisms.

4.02.02.02 Classify common organisms by observable characteristics.

4.02.02.03 Describe how living organisms are classified.

4.02.02.04 List characteristics of organisms in each kingdom.

4.02.02.05 Explain the difference between viruses and bacteria.

*4.02.03.00 Formulate an understanding of the relationship about organisms, their physical surroundings and their change processes.

4.02.03.01 Describe the interrelationship of an organism with its environment, including: pollution, populations, community, conservation, habitat, and ecosystem.

4.02.03.02 Define natural selection and list evidence for its existence.

4.02.03.03 Discuss the development of Darwin's theory of evolution.

4.02.03.04 Discuss hypotheses of the origin of life.

4.02.03.05 Identify ways to take responsibility for living in a global environment

4.02.03.06 Explain and present examples of the importance of water to sustain life in terms of available water sources, water quality, and uses and quantification.

4.02.03.07 Explain interrelationship of wastewater collection, treatment, and public health in terms of organic and inorganic pollutant concentrations and pathogenic organisms.

4.02.03.08 Describe how human activities interfere with biological diversity.

*4.02.04.00 Using an understanding of life processes, formulate explanations of the influences and the effects of other organisms on the living condition.

4.02.04.01 Explain the relationship between microorganisms and disease .

4.02.04.02 Describe the following life processes: digestion, transpiration, respiration, circulation, reproduction, locomotion, excretion, sensory, regulation by endocrine glands, metabolism, and photosynthesis

4.02.04.03 Distinguish between myths and realities of the HIV virus and AIDS.

4.02.04.04 Explain the relationship between anatomical structure and function.

4.02.04.05 Identify structures in human physiology

**Physics**

*4.03.01.00 Analyze changes within a system when inputs, outputs, and interactions are altered to explain the behavior of charges.

4.03.01.01 Describe electrical energy, including the interaction of matter and energy and energy transformation.

4.03.01.02 Describe the properties of magnetic fields, electrical fields, and electrical charges.

4.03.01.03 Identify and describe basic electrical systems components and theories.

*4.03.02.00 Using measuring and mathematical techniques, apply the laws of motion and conservation to real physical systems.

4.03.02.01 Describe energy transfers and transformations of a system utilizing conservation laws.

4.03.02.02 Describe motion in the context of Newton's Law: linear and rotational.

4.03.02.03 Define work and energy and relate these concepts to kinetic energy, potential energy, and conservation of energy.

4.03.02.04 Define temperature and heat in units commonly used for each.

4.03.02.05 Identify the causes and effects of motion.

4.03.02.06 Use vector analysis (mathematical and graphical) to represent and solve force system problems.

*4.03.03.00 Analyze the heat energy changes within a system as related to the laws of thermodynamics.

4.03.03.01 State first and second laws of thermodynamics.

4.03.03.02 Define specific heat capacity and latent heat.

4.03.03.03 Discuss the concept of entropy.

*4.03.04.00 Using the knowledge gained through experimentation of the characteristics of waves, predict how waves will behave as they interact with each other and various materials.

4.03.04.01 Describe sound systems, including the interaction of matter and energy and energy transformation.

4.03.04.02 Identify the general areas of the electromagnet ice spectrum.

4.03.04.03 Describe reflection and refraction as applied to mirrors and optical instruments (lenses).

4.03.04.04 Describe the particle and wave theories of light.

**Laboratory Safety Procedures**

*4.04.01.00 Identify and be able to manipulate lab apparatus and materials safely.

*4.04.02.00 Demonstrate familiarity with lab safety equipment (e.g., eyewash, fire blanket & extinguisher, shower, etc.).

**Scientific Process**

*4.05.01.00 Using sound experimental designs, formulate hypotheses and models that account for observable events.

4.05.01.01 Describe the role of observation and experimentation in the development of scientific theories.

4.05.01.02 Describe the importance of the use of models in scientific thought.

4.05.01.03 Recognize that scientific models are only representations of phenomena and may in fact be faulty or deficient.

4.05.01.04 Investigate some of the ethical dilemmas of the scientist.

4.05.01.05 Identify and define a scientific problem.

4.05.01.06 Ask appropriate scientific questions and recognize what is involved in experimental approaches to the solutions of such questions through familiarity with laboratory and field work.

4.05.01.07 Identify problems rooted in science and technology (effects of hazardous materials on health and safety, effects of drugs on health, troubleshooting problems on a machine).

*4.05.02.00 Use sound experimental designs and models to test hypotheses.

4.05.02.01 Distinguish among fact, hypothesis, and opinion; the relevant from the irrelevant; and the model from the observations the model was derived to describe.

4.05.02.02 Check the logical consistency of hypothesis with relevant laws, facts, observations, or experiments.

4.05.02.03 Read scientific materials critically.

4.05.02.04 Gather scientific information through library work.

4.05.02.05 Investigate areas of specialization in science.

4.05.02.06 Apply basic scientific/technical solutions to selected problems.

4.05.02.07 Employ scientific laws and principles in familiar or unfamiliar situations.

4.05.02.08 Make predictions from data using concepts, laws, and theories.

4.05.02.09 Use facts, concepts, laws, and theories to explain phenomena.

4.05.02.10 Predict the effects of changing variables in a given situation.

4.05.02.11 Suggest or recognize a scientific hypothesis.

4.05.02.12 Construct a hypothetical model.

4.05.02.13 Make direct measurements using laboratory apparatus.

4.05.02.14 Design, conduct, and evaluate an experiment.

4.05.02.15 Use sampling techniques.

4.05.02.16 Propose or select validating procedures (both logical and empirical).

4.05.02.17 Analyze experimental designs.

4.05.02.18 Demonstrate concern for issues related to measurement (e.g., reliability and validity).

*4.05.03.00 Using observations derived from experimental data, draw conclusions or make inferences.

4.05.03.01 Interpret data; i.e., comprehend the meaning of data and recognize, formulate, and evaluate conclusions and generalizations on the basis of information known or given.

4.05.03.02 Interpret information presented in pictures, drawings, charts, graphs, mathematical expressions, and scientific literature.

4.05.03.03 Reason quantitatively and symbolically.

4.05.03.04 Interpret observations of experiments and analyze these to determine patterns, state inferences, and/or draw conclusions.

4.05.03.05 Interpret experimental observations using facts, concepts, laws, and theories.

*4.05.04.00 Organize and communicate the results obtained by observation and experimentation.

4.05.04.01 Sequence events according to the order of occurrence.

4.05.04.02 Describe ways scientists communicate their results.

4.05.04.03 Demonstrate the ability to summarize empirical findings clearly and concisely in written form.

SOCIAL/CULTURAL LITERACY

Growth of Social Political, and Economic Institutions

*5.01.01.00 Describe the role of individuals within their political system, process of voter registration, the election process and responsibility and privileges of citizenship and how law protects individuals.

*5.01.02.00 Explain reasons for European settlement in the New World, the development of divergent political ideology and development of a new nation.

*5.01.03.00 Examine important historical documents in context with the American experience including socio-political and ideological influences that shaped their design. (NW Ordinance, Declaration of Independence, Bill of Rights, and Constitution)

5.01.03.01 Explain the purpose and contents of the Bill of Rights.

5.01.03.02 Demonstrate an understanding of federalism (local, state, national).

5.01.03.03 Identify the main function of each branch (legislative, executive, judicial) at different levels.

5.01.03.04 Describe the process for making, amending or removing laws.

5.01.03.05 Identify representative symbols: flag, national anthem, Pledge of Allegiance, Independence Day, etc.

*5.01.04.00 Describe the political process.

5.01.04.01 Understand the role of political parties in a democracy.

5.01.04.02 Understand the role of public officials and how policy is carried out.

5.01.04.03 Describe strengths and weaknesses of the American System.

5.01.04.04 Describe how resources are gathered to support the process and policies.

*5.01.05.00 Compare and contrast political systems.

5.01.05.01 Distinguish characteristics and essential features of representative democracy, monarchy, and dictatorships.

5.01.05.02 Identify international governing bodies (e.g., United Nations, League of Nations, World Bank, European Economic Community, Organization of American States, etc.) and their impact.

*5.01.06.00 Compare the culture, customs, and traditions of different ethnic and minority groups in America.

5.01.06.01 Be aware of the diverse social, psychological, political, and economic factors which influence lifestyles.

5.01.06.02 Evaluate methods and procedures applied by individuals, groups and social agencies to overcome social and economic barriers.

5.01.06.03 Determine the role of, and conflict between, American values such as order, freedom, equality and individualism as they operate in the American Political System.

5.01.06.04 Assess the impact of social class and social structure on economic development in specific countries in the First World and in the Third World.

*5.01.07.00 Know that individuals and societies make choices to satisfy wants with limited resources.

5.01.07.01 Develop an understanding of economic systems.

5.01.07.02 Develop an understanding of the structure and functions of the American economy.

5.01.07.03 Recognize the uneven distribution of world resources.

5.01.07.04 Describe the role of technological growth in economic development and the impact of technology on the physical and human environment.

Human Diversity and Historical/Current Issues

*5.02.01.00 Describe the causes and effects of selected wars.

*5.02.02.00 Describe the diversity of populations encompassing the Civil Rights movement, racism, ethnocentrism, and minority group movements.

5.02.02.01 Recognize diversity among significant individuals

5.02.02.02 Recognize diversity among significant organizations

5.02.02.03 Recognize diversity surrounding immigration

5.02.02.04 Recognize diverse ethnic and minority groups

5.02.02.05 Recognize major world religions

5.02.02.06 Describe the relationship between diversity and historical development and contributions

*5.02.03.00 Describe how an individual interacts with the various societal, economic, and political systems.

5.02.03.01 Be aware of the diverse social, psychological, political and economic factors which influence lifestyles.

5.02.03.02 Recognize individuals and societal practices which result in exceptional treatment of people from various backgrounds.

5.02.03.03 Identify and define the basic concepts of community and community development, and the role of individuals within their political systems and opportunities for civic involvement.

5.02.03.04 Describe and discuss contemporary domestic and international political issues and events, and evaluate the way they impact on self and society.

5.02.03.05 Identify and discuss career opportunities.

Analyzing Information

*5.03.01.00 Differentiate between primary and secondary sources of information.

*5.03.02.00 Illustrate that information can be influenced by cultural bias or propaganda.

*5.03.03.00 Analyze and explain social, cultural and political problems and suggest remedies to those problems.

*5.03.04.00 Compare and contrast culture, customs and traditions of ethnic and minority groups.

*5.03.05.00 Analyze social forces that influence family life.

*5.03.06.00 Demonstrate the ability to use information that enables citizens to make informed choices.

*5.03.07.00 Communicate and cooperate with people of different cultural backgrounds.

*5.03.08.00 Collect and analyze information from charts, graphs, maps, and pictures.

*5.03.09.00 Identify and explain how world problems and future trends will impact his or her life.

*5.03.10.00 Describe and discuss world patterns of population, geographic landforms, climate regions, and economic activities.

*5.03.11.00 Identify opportunities for involvement in civic activities.

## TECHNOLOGY LITERACY

### Impact of Technology

*6.01.01.00 Develop an awareness of the need and function of technology in society.

- 6.01.01.01 Explore cause and effect linkages between technology and the environment.
- 6.01.01.02 Explain how technological change can affect all technology.
- 6.01.01.03 Evaluate the impact of technology on people, the environment, culture, the economy, and community.
- 6.01.01.04 Explain how business and industry are related to the larger context of technology, industry, and society.
- 6.01.01.05 Describe the way in which technological systems have affected social changes and patterns in our society.
- 6.01.01.06 Explore how people use technology to solve problems.

*6.01.02.00 Develop an awareness of the significance of technology in the past, present, and future.

*6.01.03.00 Explain the interrelationships between business, industry, and society.

- 6.01.03.01 Evaluate the impact of infrastructure deterioration on people, the environment, and the economy.

*6.01.04.00 Analyze the role of ethics in technological decision making.

- 6.01.04.01 Research the social effects of technology and identify ethical implications that develop.
- 6.01.04.02 Recognize that all technological endeavors yield positive and negative side effects.
- 6.01.04.03 Describe the impact of government on the use of technology.
- 6.01.04.04 Describe copyright laws and issues as they apply to software.
- 6.01.04.05 Describe security/privacy issues related to the use of computers.

*6.01.05.00 Explain the interrelationship between business, industry, and community.

Technology in the Workplace

*6.02.01.00 Describe the importance of product quality control.

6.02.01.01 Participate in project-oriented quality control exercises.

*6.02.02.00 Describe the importance of the quality control process.

6.02.02.01 Explain how improved quality leads to improved productivity, competitive position, and profitability.

6.02.02.02 Define the principles of team management.

6.02.02.03 Describe the importance of statistical process control.

6.02.02.04 Plan team meetings.

6.02.02.05 Cite examples of companies that have benefitted from quality efforts.

*6.02.03.00 Solve problems utilizing a systems approach.

6.02.03.01 Apply brainstorming as a method for generating ideas.

6.02.03.02 Apply cause and effect analysis.

6.02.03.03 Evaluate results and make modification to improve a solution.

6.02.03.04 Compile and analyze experimental or design data.

6.02.03.05 Seek new knowledge, synthesize this information, and formulate it into a report or use it in solving a defined problem.

6.02.03.06 Use a research and development process common to industry to solve problems (integrating a variety of productivity analysis skills).

6.02.03.07 Learn how to reach a group consensus.

6.02.03.08 Distinguish between open and closed loop systems.

*6.02.04.00 Define productivity and its relationship to management concepts.

6.02.04.01 Develop an action plan that details what, when, and by whom, action will be taken for performance improvement.

6.02.04.02 Demonstrate the ability to apply management and planning tools such as flow charts, check sheets, cause and effect diagrams, control charts, etc.

6.02.04.03 Describe and use the Plan-Do-Check-Act process.

6.02.04.04 Describe input, process, output systems.

*6.02.05.00 Given an industry or a company, identify "customers."

*6.02.06.00 Develop the ability to function as a member of small or large groups.

6.02.06.01 Learn how to reach a group consensus.

6.02.06.02 Participate in at least one decision-making responsibility role of a hypothetical enterprise.

6.02.06.03 Demonstrate effective negotiation skills.

6.02.06.04 Demonstrate effective delegation skills.

6.02.06.05 Describe the purpose of unions.

*6.02.07.00 Describe the free enterprise system.

6.02.07.01 Describe a simplified version of a patent application process to ensure protection of ideas and control of disclosure.

<u>Technological Tools and Techniques</u>

*6.03.01.00 Describe basic computer operations.

*6.03.02.00 Operate computer hardware.

6.03.02.01 Demonstrate keyboarding proficiency.

6.03.02.02 Demonstrate the ability to utilize various peripherals.

6.03.02.03 Access information networks of a variety of types.

6.03.02.04 Identify and describe the function of the major hardware components comprising a personal computer.

*6.03.03.00 Utilize a variety of software.

6.03.03.01 Prepare reports, resumes, or memoranda using a word processing package.

6.03.03.02 Describe what a database is and what it is used for.

6.03.03.03 Demonstrate general knowledge of CAD and CAM technologies.

6.03.03.04 Describe the major types and applications of software.

6.03.03.05 Determine the availability of resources through information networks.

6.03.03.06 Operate desktop publishing systems.

6.03.03.07 Access external computers using a modem.

6.03.03.08 Utilize information management systems.

6.03.03.09 Utilize a spreadsheet package.

6.03.03.10 Apply basic commands to format disks, copy files, create directories, delete files, change default drives, and access software packages for a variety of computer systems.

*6.03.04.00 Use basic technological language accurately across a variety of technologies.

6.03.04.01 Demonstrate familiarity with different types of language forms used in various technologies, i.e., graphic, symbolic, and verbal.

6.03.04.02 Recognize that different technologies use jargon specific to those technologies.

6.03.04.03 Describe the resources necessary for technology resource people: i.e., information, materials, tools/machines, capital, energy, and time.

*6.03.05.00 Visualize and describe two- and three-dimensional space.

6.03.05.01 Demonstrate familiarity with the basic types of engineering drawings.

6.03.05.02 Illustrate and/or describe 3-D objects from different points of view (front, back, side, etc.)

6.03.05.03 Develop a three-dimensional mental and physical representation of an object from a two-dimensional drawing.

6.03.05.04 Visualize and present product ideas

*6.03.06.00 Utilize two- and three-dimensional drawings.

6.03.06.01 Represent a three-dimensional object in a two-dimensional drawing.

6.03.06.02 Refine and communicate project ideas.

*6.03.07.00 Create a three-dimensional drawing.

*6.03.08.00 Develop responsible attitudes toward safety around technology.

6.03.08.01 Demonstrate the safe and correct handling of hazardous materials and processes.

6.03.08.02 Demonstrate proper use of common hand and power tools.

*6.03.09.00 Use measuring devices.

6.03.09.01 Perform linear measuring procedures.

6.03.09.02 Perform volume measuring procedures.

6.03.09.03 Demonstrate the accurate use of architectural and engineering scales.

6.03.09.04 Perform temperature measuring procedures.

*6.03.10.00 Demonstrate factors affecting the selection and use of material resources.

6.03.10.01 Explore the utilization of tools and materials in engineering applications.

6.03.10.02 Describe the major properties of materials.

6.03.10.03 Safely perform some common secondary materials processing activities (e.g., drilling, milling, turning, and grinding).

*6.03.11.00 Choose appropriate resources.

6.03.11.01 Perform selected tests to determine materials properties and appropriateness for various uses.

*6.03.12.00 Use multimedia equipment.

6.03.12.01 Create multimedia presentations.

*6.03.13.00 Demonstrate an understanding of the roles and importance of electronics in contemporary technology

6.03.13.01 Describe what is meant by electronics technology.

6.03.13.02 List where electronics technology is used.

6.03.13.03 Describe why electronics technology is used.

# HEART of OHIO TECH PREP CONSORTIUM

1997

## Automotive Diagnostic Technologies Model

## PART III:
## Tech Prep Secondary Competencies (Leveled)

## (Paul C. Hayes Technical High School)

SOUTH-WESTERN CITY SCHOOLS

AUTOMOTIVE DIAGNOSTICS TECHNOLOGIES

Competency Outline

| **ACADEMIC COURSES** | | CSCC ARTICULATION |
|---|---|---|
| Junior Year | English III (either College Technical English or College Prep English according to Curriculum Pathway)<br>Transitions to College Math<br>Social Studies (Government)<br>Skills for the Work Place<br>Elective | |
| Senior Year | English IV (either College Technical English or College Prep English according to Curriculum Pathway)<br>Conceptual Physics<br>Algebra II<br>Elective | |

**VOCATIONAL/TECHNICAL COURSES**

| **Junior Core Curriculum Pathway** | | CSCC Auto Diagnostics Pathway |
|---|---|---|
| All Year | Work Place Safety<br>Quality Assurance | Auto 061 and<br>Auto 062 |
| | Automotive Principles | Auto 062 |
| | Fundamentals of Electricity | Auto 160 |
| | Equipment Maintenance | Auto 061/ Auto 062 |
| | Basic Hydraulic Theory & Pneumatics | Auto 150 |
| | Engine Repair | Auto 110 |
| | Basic Suspension & Steering | Auto 140 |
| | Brakes | |

| Senior Core Curriculum Pathway | CSCC Auto Diagnostics Pathway |
|---|---|
| Transmissions - Automatic | Auto 120 |
| Transmissions - Manual | Auto 130 |
| Intermediate Steering and Suspension | Auto 140 |
| Heating & Air Conditioning | Auto 170 |
| Engine Performance | Auto 180 |

**CURRICULUM NOTE:**

Technology and computer literacy will be integrated both years. During the junior year students will participate in mentorship activities, and the senior year students will participate in internships at worksites.

Students exiting this ASE (Automotive Service Excellence) certified program will take the national ASE test as recommended by the Ohio Department of Education, Vocational and Adult Education Division.

# HEART of OHIO TECH PREP CONSORTIUM

1997

## Automotive Diagnostic Technologies Model

## PART IV:
## Postsecondary Competencies

## Columbus State Community College

## COLUMBUS STATE COMMUNITY COLLEGE
## ASSESSMENT MATRIX
## AUTOMOTIVE TECHNOLOGY

| STUDENT OUTCOMES | ENGL 101 | MATH 104 | AUTO 061 | AUTO 062 | CPT 101 | AUTO 110 | AUTO 130 | ENGL 102 | NSCI 101 | AUTO 160 | AUTO 120 | AUTO 140 | AUTO 180 | AUTO 170 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Solve automotive problems in a systematic, logical, and efficient manner. | | F | F | F | | F | F | | F | F | F | F | F | F |
| 2. Diagnose and repair driveability problems on early and current car models, including those with fuel injection and computerized engine controls. | | F | F | F | | | | | F | F | | | F | |
| 3. Diagnose and repair simple and complex electrical problems. | | F | F | F | | | | | | F | F | | F | F |
| 4. Diagnose and repair engine mechanical problems (including machining on all parts with the exception of grinding crank shafts.) | | F | F | F | | F | | | | | | | | |
| 5. Diagnose and repair automatic transmissions and transaxles, as well as other driveline components such as driveshafts, drive axles, and differentials. | | F | F | F | | | | | | F | F | | | |
| 6. Diagnose and repair manual transmissions and transaxles, as well as other driveline components such as driveshafts, drive axles, and differentials. | | F | F | F | | | F | | | | | | | |
| 7. Precisely measure engine and other automotive parts, using the appropriate measuring instruments. | | F | F | F | | F | F | | | F | F | F | F | F |
| 8. Diagnose brake systems problems and perform a complete brake service (including necessary machining.) | | F | F | F | | | | | F | F | | | | |
| 9. Diagnose and repair steering and suspension problems and properly align the suspension of all types of automobiles and light trucks, using either two- or four-wheel alignment machines. | | F | F | F | | | | | F | | | F | | |
| 10. Diagnose and repair automotive air-conditioning systems. | | F | F | F | | | | | | F | | | | F |
| 11. Demonstrate an understanding of basic principles needed for quick understanding of new technologies as they become incorporated into automobile designs. | | | F | F | | F | F | | | F | F | F | F | F |
| 12. Make repair estimates and complete the necessary paperwork for customer service and warranty repairs. | | F | | | F | | | | | | | | | |
| 13. Apply basic business practices, including cultivation of good customer and employee relations. | F | | F | F | | F | F | F | | F | F | F | F | F |
| 14. Think critically. | F | F | F | F | F | F | F | F | F | F | F | F | F | F |
| 15. Solve problems. | F | F | F | F | F | F | F | F | F | F | F | F | F | F |
| 16. Communicate effectively. | F | F | F | F | F | F | F | F | F | F | F | F | F | F |
| 17. Demonstrate interpersonal skills. | F | | F | F | | F | F | F | F | F | F | F | F | F |
| 18. Recognize the value of human diversity. | F | | F | F | | F | F | F | F | F | F | F | F | F |
| 19. Demonstrate life management skills. | F | | F | F | F | F | F | F | F | F | F | F | F | F |
| | | | | | | | | | | | | | | |

## COLUMBUS STATE COMMUNITY COLLEGE
## ASSESSMENT MATRIX
## AUTOMOTIVE TECHNOLOGY

| STUDENT OUTCOMES | ENGL 204 | AUTO 150 | SSCI 10X | AUTO 115 | AUTO 125 | AUTO 135 | AUTO 145 | AUTO 155 | AUTO 165 | COMM 105 | AUTO 175 | AUTO 185 | HUM 1XX | AUTO 300 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Solve automotive problems in a systematic, logical, and efficient manner. | | F | | F | F | F | F | F | F | | F | F | | F/S |
| 2. Diagnose and repair driveability problems on early and current car models, including those with fuel injection and computerized engine controls. | | | | | | | | | | | | F | | F/S |
| 3. Diagnose and repair simple and complex electrical problems. | | F | | | F | | | F | F | | F | F | | F/S |
| 4. Diagnose and repair engine mechanical problems (including machining on all parts with the exception of grinding crank shafts.) | | | | F | | | | | | | | | | F/S |
| 5. Diagnose and repair automatic transmissions and transaxles, as well as other driveline components such as driveshafts, drive axles, and differentials. | | | | | F | | | | | | | | | F/S |
| 6. Diagnose and repair manual transmissions and transaxles, as well as other driveline components such as driveshafts, drive axles, and differentials. | | | | | | F | | | | | | | | F/S |
| 7. Precisely measure engine and other automotive parts, using the appropriate measuring instruments. | | F | | F | F | F | F | F | F | | F | F | | F/S |
| 8. Diagnose brake systems problems and perform a complete brake service (including necessary machining.) | | F | | | | | | F | | | | | | F/S |
| 9. Diagnose and repair steering and suspension problems and properly align the suspension of all types of automobiles and light trucks, using either two- or four-wheel alignment machines. | | | | | | | F | | | | | | | F/S |
| 10. Diagnose and repair automotive air-conditioning systems. | | | | | | | | | | | F | | | F/S |
| 11. Demonstrate an understanding of basic principles needed for quick understanding of new technologies as they become incorporated into automobile designs. | | F | | F | F | F | F | F | F | | F | F | | F/S |
| 12. Make repair estimates and complete the necessary paperwork for customer service and warranty repairs. | F | | | | | | | | | F | | | | F/S |
| 13. Apply basic business practices, including cultivation of good customer and employee relations. | F | F | F | F | F | F | F | F | F | F | F | F | | F/S |
| 14. Think critically. | F | F | F/S | F | F | F | F | F | F | F | F | F | F | F/S |
| 15. Solve problems. | F | F | F/S | F | F | F | F | F | F | F | F | F | | F/S |
| 16. Communicate effectively. | F | F | F/S | F | F | F | F | F | F | F | F | F | F | F/S |
| 17. Demonstrate interpersonal skills. | F | F | F | F | F | F | F | F | F | F | F | F | | F/S |
| 18. Recognize the value of human diversity. | F | F | F/S | F | F | F | F | F | F | F | F | F | F | F/S |
| 19. Demonstrate life management skills. | F | F | F | F | F | F | F | F | F | F | F | F | | F/S |
| | | | | | | | | | | | | | | |

## COLUMBUS STATE COMMUNITY COLLEGE
## ASSESSMENT MATRIX
## AUTOMOTIVE TECHNOLOGY

| STUDENT OUTCOMES | AUTO 190 | BMGT XXX | AUTO 191 | AUTO 192 | AUTO 210 | AUTO 220 | AUTO 230 | AUTO 240 | AUTO 250 | AUTO 260 | AUTO 270 | AUTO 280 | AUTO 195 | AUTO 196 | AUTO 197 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Solve automotive problems in a systematic, logical, and efficient manner. | F | F | F | F | F | F | F | F | F | F | F | F | F | F | F |
| 2. Diagnose and repair driveability problems on early and current car models, including those with fuel injection and computerized engine controls. | | | | | | | | | | | | F | | | |
| 3. Diagnose and repair simple and complex electrical problems. | | | | | | F | | | F | F | F | F | | | |
| 4. Diagnose and repair engine mechanical problems (including machining on all parts with the exception of grinding crank shafts.) | | | | | F | | | | | | | | | | |
| 5. Diagnose and repair automatic transmissions and transaxles, as well as other driveline components such as driveshafts, drive axles, and differentials. | | | | | | F | | | | | | | | | |
| 6. Diagnose and repair manual transmissions and transaxles, as well as other driveline components such as driveshafts, drive axles, and differentials. | | | | | | | F | | | | | | | | |
| 7. Precisely measure engine and other automotive parts, using the appropriate measuring instruments. | | | | | F | F | F | F | F | F | F | F | | | |
| 8. Diagnose brake systems problems and perform a complete brake service (including necessary machining.) | | | | | | | | | F | | | | | | |
| 9. Diagnose and repair steering and suspension problems and properly align the suspension of all types of automobiles and light trucks, using either two- or four-wheel alignment machines. | | | | | | | | F | | | | | | | |
| 10. Diagnose and repair automotive air-conditioning systems. | | | | | | | | | | | F | | | | |
| 11. Demonstrate an understanding of basic principles needed for quick understanding of new technologies as they become incorporated into automobile designs. | FF | | | | F | F | F | F | F | F | F | F | F | | |
| 12. Make repair estimates and complete the necessary paperwork for customer service and warranty repairs. | | | F | F | | | | | | | | | | F | F |
| 13. Apply basic business practices, including cultivation of good customer and employee relations. | F | F | F | F | F | F | F | F | F | F | F | F | F | F | F |
| 14. Think critically. | F | F | F | F | F | F | F | F | F | F | F | F | F | F | F |
| 15. Solve problems. | F | F | F | F | F | F | F | F | F | F | F | F | F | F | F |
| 16. Communicate effectively. | F | F | F | F | F | F | F | F | F | F | F | F | F | F | F |
| 17. Demonstrate interpersonal skills. | F | F | F | F | F | F | F | F | F | F | F | F | F | F | F |
| 18. Recognize the value of human diversity. | F | F | F | F | F | F | F | F | F | F | F | F | F | F | F |
| 19. Demonstrate life management skills. | F | F | F | F | F | F | F | F | F | F | F | F | F | F | F |
| | | | | | | | | | | | | | | | |

**Columbus State Community College**
**Assessment Matrix**
**Automotive Technology - Service Management Major**

| STUDENT OUTCOMES | AUTO 061 | AUTO 062 | MATH 104 | ENGL 101 | CPT 101 | AUTO 110 | AUTO 150 | AUTO 160 | BMGT 101 | AUTO 170 | AUTO 120 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Solve automotive problems in a systematic, logical, and efficient manner. | F | F | F | | | F | F | F | F | F | F |
| 2. Diagnose driveability problems on early and current car models, including those with fuel injection and computerized engine controls. | F | F | F | | | | | F | | | |
| 3. Diagnose simple and complex electrical problems. | F | F | F | | | | F | F | | F | F |
| 4. Diagnose engine mechanical problems (including machining on all parts with the exception of grinding crank shafts.) | F | F | F | | | F | | | | | |
| 5. Diagnose automatic transmissions and transaxles, as well as other driveline components such as driveshafts, drive axles, and differentials. | F | F | F | | | | | F | | | F |
| 6. Diagnose manual transmissions and transaxles, as well as other driveline components such as driveshafts, drive axles, and differentials. | F | F | F | | | | | | | | |
| 7. Precisely measure engine and other automotive parts, using the appropriate measuring instruments. | F | F | F | | | F | F | F | | F | F |
| 8. Diagnose brake systems problems and perform a complete brake service (including necessary machining.) | F | F | F | | | | F | F | | | |
| 9. Diagnose steering and suspension problems on all types of automobiles and light trucks. | F | F | F | | | | | | | | |
| 10. Diagnose automotive air-conditioning systems. | F | F | F | | | | | F | | F | |
| 11. Demonstrate an understanding of basic principles needed for quick understanding of new technologies as they become incorporated into automobile designs. | F | F | | | | F | F | F | | F | F |
| 12. Make repair estimates and complete the necessary paperwork for customer service and warranty repairs. | | | F | | F | | | | F | | |
| 13. Apply basic business practices, including cultivation of good customer and employee relations. | F | F | | F | | F | F | F | | F | F |
| 14. Demonstrate the ability to develop marketing & merchandising strategies and develop a marketing plan. | | | | | | | | | | | |
| 15. Apply basic business practices related to expense control and financial forecasting | | | | | | | | | | | |
| 16. Apply business practices in managing purchasing and inventory control. | | | | | | | | | F | | |
| 17. Think critically. | F | F | F | F | F | F | F | F | F | F | F |
| 18. Solve problems. | F | F | F | F | F | F | F | F | F | F | F |
| 19. Communicate effectively.. | F | F | F | F | F | F | F | F | F | F | F |
| 20. Demonstrate interpersonal skills. | F | F | | F | | F | F | F | F | F | F |
| 21. Recognize the value of human diversity. | F | F | | F | | F | F | F | F | F | F |
| 22. Demonstrate life management skills. | F | F | | F | F | F | F | F | F | F | F |

**Columbus State Community College**
**Assessment Matrix**
**Automotive Technology - Service Management Major**

| STUDENT OUTCOMES | AUTO 180 | ENGL 102 | AUTO 140 | AUTO 130 | ENGL 200 | AUTO 190 | AUTO 191 | HUM XXX | COMM 105 | AUTO 192 | NSCI 101 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Solve automotive problems in a systematic, logical, and efficient manner. | F | | F | F | | F | F | | | F | F |
| 2. Diagnose driveability problems on early and current car models, including those with fuel injection and computerized engine controls. | F | | | | | | | | | | F |
| 3. Diagnose simple and complex electrical problems. | F | | | | | | | | | | |
| 4. Diagnose engine mechanical problems (including machining on all parts with the exception of grinding crank shafts.) | | | | | | | | | | | |
| 5. Diagnose automatic transmissions and transaxles, as well as other driveline components such as driveshafts, drive axles, and differentials. | | | | | | | | | | | |
| 6. Diagnose manual transmissions and transaxles, as well as other driveline components such as driveshafts, drive axles, and differentials. | | | | F | | | | | | | |
| 7. Precisely measure engine and other automotive parts, using the appropriate measuring instruments. | F | | F | F | | | | | | | |
| 8. Diagnose brake systems problems and perform a complete brake service (inciuding necessary machining.) | | | | | | | | | | | F |
| 9. Diagnose steering and suspension problems on all types of automobiles and light trucks. | | | F | | | | | | | | F |
| 10. Diagnose automotive air-conditioning systems. | | | | | | | | | | | |
| 11. Demonstrate an understanding of basic principles needed for quick understanding of new technologies as they become incorporated into automobile designs. | F | | F | F | | | | | | | |
| 12. Make repair estimates and complete the necessary paperwork for customer service and warranty repairs. | | | | | F | F | F/S | | F | | |
| 13. Apply basic business practices, including cultivation of good customer and employee relations. | F | F | F | F | F | F | F | | F | | |
| 14. Demonstrate the ability to develop marketing & merchandising strategies and develop a marketing plan. | | | | | | F | | | | | |
| 15. Apply basic business practices related to expense control and financial forecasting | | | | | | F | | | | F/S | |
| 16. Apply business practices in managing purchasing and inventory control. | | | | | | F | | | | F | |
| 17. Think critically. | F | F | F | F | F | F | F | F | F | F | F |
| 18. Solve problems. | F | F | F | F | F | F | F | | F | F | F |
| 19. Communicate effectively. | F | F | F | F | F | F | F | F | F | F | F |
| 20. Demonstrate interpersonal skills. | F | F | F | F | F | F | F | | F | F | F |
| 21. Recognize the value of human diversity. | F | F | F | F | F | F | F | F | F | F | F |
| 22. Demonstrate life management skills. | F | F | F | F | F | F | F | | F | F | F |

**Columbus State Community College**
**Assessment Matrix**
**Automotive Technology - Service Management Major**

| STUDENT OUTCOMES | AUTO 193 | SSCI 10X | QUAL 240 | AUTO 197 | BMGT 216 | AUTO 195 | AUTO 196 | AUTO 101 |
|---|---|---|---|---|---|---|---|---|
| 1. Solve automotive problems in a systematic, logical, and efficient manner. | F | | F/S | F | F | F | F | |
| 2. Diagnose driveability problems on early and current car models, including those with fuel injection and computerized engine controls. | | | | | | | | |
| 3. Diagnose simple and complex electrical problems. | | | | | | | | |
| 4. Diagnose engine mechanical problems (including machining on all parts with the exception of grinding crank shafts.) | | | | | | | | |
| 5. Diagnose automatic transmissions and transaxles, as well as other driveline components such as driveshafts, drive axles, and differentials. | | | | | | | | |
| 6. Diagnose manual transmissions and transaxles, as well as other driveline components such as driveshafts, drive axles, and differentials. | | | | | | | | |
| 7. Precisely measure engine and other automotive parts, using the appropriate measuring instruments. | | | | | | | | |
| 8. Diagnose brake systems problems and perform a complete brake service (including necessary machining.) | | | | | | | | |
| 9. Diagnose steering and suspension problems on all types of automobiles and light trucks. | | | | | | | | |
| 10. Diagnose automotive air-conditioning systems. | | | | | | | | |
| 11. Demonstrate an understanding of basic principles needed for quick understanding of new technologies as they become incorporated into automobile designs. | | | | | | | | |
| 12. Make repair estimates and complete the necessary paperwork for customer service and warranty repairs. | | | | | | | | |
| 13. Apply basic business practices, including cultivation of good customer and employee relations. | | F | | | F/S | | F | |
| 14. Demonstrate the ability to develop marketing & merchandising strategies and develop a marketing plan. | F/S | | F | | | F | | |
| 15. Apply basic business practices related to expense control and financial forecasting | | | | | | | | |
| 16. Apply business practices in managing purchasing and inventory control. | | | | F/S | | | F | |
| 17. Think critically. | F | F/S | F | F | F | F | F | F |
| 18. Solve problems. | F | F/S | F | F | F | F | F | F |
| 19. Communicate effectively. | F | F/S | F | F | F | F | F | F |
| 20. Demonstrate interpersonal skills. | F | F/S | F | F | F | F | F | F |
| 21.. Recognize the value of human diversity. | F | F/S | F | F | F | F | F | F |
| 22. Demonstrate life management skills. | F | F | F | F | F | F | F | F |

Columbus State Community College
Assessment Matrix
Ford ASSET Program

| STUDENT OUTCOMES | CPT 101 | FORD 100 | FORD 106 | FORD 103 | ENGL 101 | FORD 201 | FORD 211 | NSCI 101 | FORD 101 | FORD 108 | FORD 107 | ENGL 102 | FORD 202 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Solve automotive problems in a systematic, logical, and efficient manner. | | F | F | F | | F/S | F | F | F | F | F | | F/S |
| 2. Diagnose and repair driveability problems on early and current car models, including those with fuel injection and computerized engine controls. | | F | F | | | F | | F | | F | | | F |
| 3. Diagnose and repair simple and complex electrical problems. | | F | F | | | F | F | | | F | F | | F |
| 4. Diagnose and repair engine mechanical problems (including machining on all parts with the exception of grinding crank shafts.) | | F | | | | F | | | F | | | | F |
| 5. Diagnose and repair automatic transmissions and transaxles, as well as other driveline components such as driveshafts, drive axles, and differentials. | | F | F | | | F | | | | | | | |
| 6. Diagnose and repair manual transmissions and transaxles, as well as other driveline components such as driveshafts, drive axles, and differentials. | | F | | F/S | | F/S | | | | | | | |
| 7. Precisely measure engine and other automotive parts, using the appropriate measuring instruments. | | F | F | F | | F | | | F | F | F | | F |
| 8. Diagnose brake systems problems and perform a complete brake service including necessary machining.) | | F | F | | | F | | F | | | | | |
| 9. Diagnose and repair steering and suspension problems and properly align the suspension of all types of automobiles and light trucks, using either two- or four-wheel alignment machines. | | F | | | | F | | F | | | | | |
| 10. Diagnose and repair automotive air-conditioning systems. | | F | F | | | F | | | | | F | | F/S |
| 11. Demonstrate an understanding of basic principles needed for quick understanding of new technologies as they become incorporated into automobile designs. | | F | F | F | | F | F | | F | F | F | | F |
| 12. Make repair estimates and complete the necessary paperwork for customer service and warranty repairs. | F | | | | | F | | | | | | | F |
| 13. Apply basic business practices, including cultivation of good customer and employee relations. | | F | F | F | F | F | | | F | F | F | F | F |
| 14. Think critically. | F | F | F | F | F | F | F | F | F | F | F | F | F |
| 15. Solve problems. | F | F | F | F | F | F | F | F | F | F | F | F | F |
| 16. Communicate effectively. | F | F | F | F | F | F | F | F | F | F | F | F | F |
| 17. Demonstrate interpersonal skills. | | F | F | F | F | F | F | F | F | F | F | F | F |
| 18. Recognize the value of human diversity. | | F | F | F | F | F | F | F | F | F | F | F | F |
| 19. Demonstrate life management skills. | F | F | F | F | F | F | F | F | F | F | F | F | F |

Columbus State Community College
Assessment Matrix
Ford ASSET Program

| STUDENT OUTCOMES | FORD 212 | ENGL 200 | SSCI 10X | FORD 116 | FORD 105 | FORD 104 | MATH 104 | FORD 203 | FORD 213 | BMGT 2XXX | HUM 2XXX | FORD 102 | FORD 111 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Solve automotive problems in a systematic, logical, and efficient manner. | F | | | F | F | F | F | F/S | F | F | | F | F |
| 2. Diagnose and repair driveability problems on early and current car models, including those with fuel injection and computerized engine controls. | | | | | | | F | | | | | | |
| 3. Diagnose and repair simple and complex electrical problems. | F | | | F | F | | F | F/S | F | | | F | |
| 4. Diagnose and repair engine mechanical problems (including machining on all parts with the exception of grinding crank shafts.) | | | | | | | F | | | | | | F |
| 5. Diagnose and repair automatic transmissions and transaxles, as well as other driveline components such as driveshafts, drive axles, and differentials. | | | | | | | F | | | | | F | |
| 6. Diagnose and repair manual transmissions and transaxles, as well as other driveline components such as driveshafts, drive axles, and differentials. | | | | | | | F | | | | | | |
| 7. Precisely measure engine and other automotive parts, using the appropriate measuring instruments. | | | | F | F | F | F | F | | | | F | F |
| 8. Diagnose brake systems problems and perform a complete brake service including necessary machining.) | | | | | F | | F | F/S | | | | | |
| 9. Diagnose and repair steering and suspension problems and properly align the suspension of all types of automobiles and light trucks, using either two- or four-wheel alignment machines. | | | | | | F | F | F/S | | | | | |
| 10. Diagnose and repair automotive air-conditioning systems. | | | | | | | F | F | F | | | | |
| 11. Demonstrate an understanding of basic principles needed for quick understanding of new technologies as they become incorporated into automobile designs. | F | | | F | F | F | | F | | | | F | F |
| 12. Make repair estimates and complete the necessary paperwork for customer service and warranty repairs. | | F | | | | | F | | | F | | | |
| 13. Apply basic business practices, including cultivation of good customer and employee relations. | F | F | F | F | F | F | | F | F | F | | F | F |
| 14. Think critically. | F | F | F/S | F | F | F | F | F | F | F | F | F | F |
| 15. Solve problems. | F | F | F/S | F | F | F | F | F | F | F | | F | F |
| 16. Communicate effectively. | F | F | F/S | F | F | F | F | F | F | F | F | F | F |
| 17. Demonstrate interpersonal skills. | F | F | F/S | F | F | F | | F | F | F | | F | F |
| 18. Recognize the value of human diversity. | F | F | F/S | F | F | F | | F | F | F | F | F | F |
| 19. Demonstrate life management skills. | F | F | F | F | F | F | | F | F | F | | F | F |

Columbus State Community College
Assessment Matrix
Ford ASSET Program

| STUDENT OUTCOMES | FORD 126 | COMM 105 | FORD 204 | FORD 214 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Solve automotive problems in a systematic, logical, and efficient manner. | F | | F/S | F | | | | | | | | | |
| 2. Diagnose and repair driveability problems on early and current car models, including those with fuel injection and computerized engine controls. | F | | | | | | | | | | | | |
| 3. Diagnose and repair simple and complex electrical problems. | F | | F/S | | | | | | | | | | |
| 4. Diagnose and repair engine mechanical problems (including machining on all parts with the exception of grinding crank shafts.) | | | F/S | | | | | | | | | | |
| 5. Diagnose and repair automatic transmissions and transaxles, as well as other driveline components such as driveshafts, drive axles, and differentials. | | | F/S | | | | | | | | | | |
| 6. Diagnose and repair manual transmissions and transaxles, as well as other driveline components such as driveshafts, drive axles, and differentials. | | | | | | | | | | | | | |
| 7. Precisely measure engine and other automotive parts, using the appropriate measuring instruments. | F | | F/S | | | | | | | | | | |
| 8. Diagnose brake systems problems and perform a complete brake service (including necessary machining.) | | | | | | | | | | | | | |
| 9. Diagnose and repair steering and suspension problems and properly align the suspension of all types of automobiles and light trucks, using either two- or four-wheel alignment machines. | | | | | | | | | | | | | |
| 10. Diagnose and repair automotive air-conditioning systems. | | | | | | | | | | | | | |
| 11. Demonstrate an understanding of basic principles needed for quick understanding of new technologies as they become incorporated into automobile designs. | F | | F/S | F | | | | | | | | | |
| 12. Make repair estimates and complete the necessary paperwork for customer service and warranty repairs. | | F | F/S | F | | | | | | | | | |
| 13. Apply basic business practices, including cultivation of good customer and employee relations. | F | F | F/S | F | | | | | | | | | |
| 14. Think critically. | F | F | F/S | F | | | | | | | | | |
| 15. Solve problems. | F | F | F/S | F | | | | | | | | | |
| 16. Communicate effectively. | F | F | F/S | F | | | | | | | | | |
| 17. Demonstrate interpersonal skills. | F | F | F/S | F | | | | | | | | | |
| 18. Recognize the value of human diversity. | F | F | F/S | F | | | | | | | | | |
| 19. Demonstrate life management skills. | F | F | F/S | F | | | | | | | | | |

# HEART of OHIO TECH PREP CONSORTIUM

1997

## Automotive Diagnostic Technologies Model

## PART V:
## Labor Market Data

TABLE 1
COLUMBUS MSA TECH PREP EMPLOYMENT PROJECTIONS*
(SELECTED OCCUPATIONS), 1991-2000

| Sample of Relevant Technical Occupations | 1991 Annual Employment | 2000 Projected Employment | Change in Employment 1991-2000 | Total Annual Openings |
|---|---|---|---|---|
| Physical & Life Science Technicians (Environmental Technology Model) | 1,120 | 1,240 | 120 | 44 |
| Automotive Mechanics (Automotive/Diagnostic Model) | 4,790 | 5,500 | 760 | 223 |
| Computer & Related Occupations (Business Technologies Core Model) | 8,160 | 11,130 | 2,970 | 444 |
| Drafters (Engineering Technologies Core Model) | 2,540 | 2,880 | 340 | 128 |

* The Columbus MSA consists of Delaware, Fairfield, Franklin, Licking, Madison, Pickaway, and Union Counties; the only county currently served by the Heart of Ohio Consortium and not included here is Ross County.

Goal 6, Delivery of Professional Development

The Consortium's new Development Coordinator, housed at Ohio University-Lancaster, will take primary responsibility for leading the Professional Development Committee in the development and delivery of professional development opportunities for Consortium partners. In addition, this new project staff member will distribute information received about relevant professional development opportunities originating outside the Consortium. See the Activities and Timeline section for details on anticipated professional development offerings. Costs for professional development activities, including any stipends for Committee members, will be covered by the Expansion III-A operating grant.

# HEART of OHIO TECH PREP CONSORTIUM

1997

## Automotive Diagnostic Technologies Model

## PART VI:
## Advisory/Review Committee Members

*AUTOMOTIVE/DIAGNOSTIC TECHNOLOGIES*

# HEART OF OHIO TECH PREP CONSORTIUM
# INDUSTRY REVIEW MEETING AND DINNER PARTICIPANTS LIST

***BUSINESS PARTNERS***

Jeff Adams/Pat Jordan
Ricart Automotive
Columbus, OH

Jim Bartholomew
Automotive Experts
Westerville, OH

Rex Birkinbine
Honda East
Columbus, OH

Toby Clark
Hunter Engineering Co.
Powell, OH

Marlene Compton
Auto Service Assoc. of OH
Lewis Center, OH

Scott Daubenmire
Bob Boyd Ford
Lancaster, OH

Jim Elgin
Reynoldsburg, OH

Nancy Evans
Sears Automotive Center
Lancaster, OH

Andy Finegan
Andy's Garage
Carroll, OH

Danny Foor
Pickerington, OH

Gary Hilliard
Dave Gill Pontiac/GMC
Columbus, OH

Scott Hoff
Tuffy Muffler
Lancaster, OH

Bob Kistler
Bob-Boyd Lincoln Mercury
Columbus, OH

Bill Langford
Trader Bud's Westside Dodge
Columbus, OH

Rick Lines
Taylor Chevrolet Buick Nissan
Lancaster, OH

William Linsenmeyer
American Automobile Assoc.
Worthington, OH

Paul Liska
Infinity of Columbus
Columbus, OH

John MacIntosh
Mac's Auto Parts
Canal Winchester, OH

Richard Miller
Crown Chrs.-Plym. Jeep Eagle
Dublin, OH

Dave Morris
Buckeye Nissan, Inc.
Hilliard, OH

Chuck Murray
Murray's Auto Parts
Lancaster, OH

Wally Ooten
Columbus Cadillac Co.
Columbus, OH

Hubert Overman
Westside Dodge
Columbus, OH

Bert Pack
Germain Toyota
Columbus, OH

Jerry Peters
Krieger Lincoln-Mercury
Columbus, OH

Len Proper
OBES
Columbus, OH

Jeff Rarick
Layman Hendren Pontiac
Lancaster, OH

Ron Stein
Clintonville Auto
Columbus, OH

Rick Tresenrider
Goodyear Svc. Center
Grove City, OH

Bob Verdone
J&MTire &Service Inc.
Pickerington, OH

Don Zaiser
Petty's Auto Service
Columbus, OH

Dan Davis
Bobby Layman Chevrolet
Columbus, OH

***SCHOOL PARTNERS***

Columbus State Community College

Eastland Vocational School District
Eastland Career Center
Fairfield Career Center

Northwest Career Center

South-Western City Schools
Hayes Technical High School

# HEART of OHIO TECH PREP CONSORTIUM

1997

## Automotive Diagnostic Technologies Model

## PART VII:
## Program Application

## TECH PREP PROGRAM APPLICATION

Tech Prep Consortium Heart of Ohio Tech Prep Consortium Date 1997

Proposed Tech Prep Program Automotive Diagnostic Technologies

1. Provide labor market information substantiating employment opportunities in your area.

   Program approved per FY 1997 proposal for operating funds. Labor market data included the following excerpt from the Ohio Bureau of Employment Services, 1991-2000 Labor Market Projections:

| OCCUPATIONAL AREA | 1991 Annual Employment | 2000 Projected Employment | Change in Employment 1991-2000 | Total Annual Openings |
|---|---|---|---|---|
| Automotive Mechanics | 4,790 | 5,500 | 760 | 223 |

2. List the potential associate degree/apprenticeship exit occupations for this Tech Prep program.

   Automotive Technician
   Automotive Heavy Repair Technician
   Automotive Diagnostic Technician

3. List the potential high school exit occupations for this Tech Prep program.

Automotive Light Repair Technician
Automotive Maintenance Technician

4. Describe your consortium's plan for delivery of this Tech Prep program.

South-Western City Schools opened the program at Paul C. Hayes Technical High School at grade 11 in school year 1997-98 as a vocationally funded unit. The program is open to students from any of the district's three comprehensive high schools.

At this time, Columbus State Community College is the only postsecondary partner offering a Tech Prep college pathway to complete this model. The college will enable the Tech Prep high school to receive college credit for competency areas they have mastered; students will be strongly encouraged to complete the entire Tech Prep college pathway of their choice, which includes advanced skills coursework.

The Consortium has distributed copies of the program model to all partner schools and colleges. Schools that currently do not offer the model have been encouraged to consider doing so.

The model will be reviewed annually at the local level, and every three years by the Consortium's Program Advisory Committee for the model.

(2) CE075374

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| Organization/Address: Heart of Ohio Tech Prep Consortium c/o Columbus State Community College 550 E. Spring St., Columbus, OH 43215 | Telephone: 614/227-2452 FAX: 614/227-2558 |
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