

NATEF PROGRAM ACCREDITATION STANDARDS

Medium/Heavy Truck

Administered By:

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POLICIES

MEDIUM/HEAVY TRUCK TECHNICIAN TRAINING ACCREDITATION PROGRAM

The Board of Trustees of the National Automotive Technicians Education Foundation (NATEF) is responsible for accreditation of automotive (automobile, collision repair & refinish, medium/heavy truck) programs at secondary and post-secondary levels. NATEF will grant accreditation to programs that comply with the evaluation procedure, meet established standards, and adhere to the policies in this document. Program accreditation is under the direct supervision of the NATEF Board of Trustees and such personnel designated or employed by NATEF.

History

Effective January 1, 2011, NATEF assumed the role of accreditation of automotive programs as an extension of the role of evaluating programs for certification by the National Institute for Automotive Service Excellence (ASE). ASE standards for automobile program certification were introduced in 1982. Standards for collision repair & refinish programs were launched in 1989 and truck standards followed in 1992. NATEF's role in the process was to work with industry and education to update the standards on a regular basis and evaluate programs against those standards. Based on a positive evaluation, programs were "certified" by ASE for a period of five (5) years.

Effective January 1, 2011, all programs that held current program certification, were grandfathered as accredited by NATEF until such time that they must renew their accreditation. At that time, these programs must follow the procedures and meet standards for reaccreditation by NATEF.

The cost to each program for accreditation will be as reasonable as possible to encourage program participation. This cost will include self-evaluation materials, application (processing) fee, on-site team evaluation materials, and the honorarium and expenses of the Evaluation Team Leader (ETL).

The Truck areas that may be accredited are:

- 1. Diesel Engines**
- 2. Suspension & Steering**
- 3. Brakes**
- 4. Electrical/Electronic Systems**
- 5. Preventive Maintenance Inspection**
6. Drive Train
7. Heating, Ventilation, & Air Conditioning
8. Hydraulics

The five required areas for accreditation are: Diesel Engines, Suspension & Steering, Brakes, Electrical/Electronic Systems, and Preventive Maintenance Inspection. Programs wishing to become Master Accredited must be accredited in Drive Train and Heating, Ventilation, and Air Conditioning in addition to the five required areas. Hydraulics is not required for Master Accreditation status.

OPTIONAL
MEDIUM/HEAVY TRUCK PROGRAM FOR ALTERNATIVE FUELS
(See Alternative Fuels Supplement for details)

The Medium/Heavy-Duty Compressed Natural Gas (CNG), Liquefied Natural Gas (LNG), and Liquefied Petroleum Gas (LPG) accreditation areas are optional--supplemental--areas to the existing ASE/NATEF Medium/Heavy Truck Program. "Master Truck Program" accreditation is not affected by the addition of these alternative fuels areas. Accreditation in CNG/LNG/LPG are dependent on a program meeting the minimum program requirements for accreditation for Medium/Heavy Truck, as well as those requirements specified in the Alternative Fuels Supplement.

Optional Areas for Program Accreditation and Hours Required

To become accredited in CNG, LNG, or LPG, the program must meet the task and hour requirements for Gaseous Fuels Engine Performance (area 9), and at least one of the other optional areas.

9. Gaseous Fuels Engine Performance

- 10. CNG On-Board Fuel Storage And Delivery
- 11. LNG On-Board Fuel Storage And Delivery
- 12. LPG On-Board Fuel Storage And Delivery

ACCREDITATION PROCESS

Program Self Evaluation

The accreditation process begins with an extensive self-evaluation performed by training program instructors, administrators, and advisory committee members. Members of this group compare the program to national standards, and have the opportunity to make improvements before submitting evaluation documents to NATEF.

NATEF Review

Self-evaluation materials are then sent to NATEF, where they are reviewed to determine if the program qualifies for an on-site team evaluation.

Programs will have a maximum of 18 months to complete the accreditation process from the date that their Application for Accreditation or Application for Renewal of Accreditation is received by the NATEF office (this timeframe may be shortened when applying under standards that are in the process of being phased out).

On-Site Evaluation

If the program qualifies, an Evaluation Team Leader (ETL), an educator certified by ASE and trained by NATEF, is assigned to the program and an on-site visit is conducted.

Recommendation for Accreditation

When industry requirements are met, the program will become accredited for a period of five years.

Expired programs that have let their accreditation lapse for two or more years will be required to follow the procedures for initial accreditation when they apply for renewal of their accreditation.

Please note: Expired programs will be allowed to submit the 'renewal of accreditation' forms versus 'initial' accreditation forms up to 18 months past their expiration date (applications for renewal of accreditation submitted after 18 months of program expiration will be returned). Furthermore, expired programs must complete the entire renewal process within two years of their expiration date.

Programs having difficulty in meeting the hours or tools & equipment accreditation requirements should consider the following options:

- A) Initiating an Articulation Agreement with another secondary or post-secondary training institution (see NATEF Policies on Articulation Agreements).
- B) Borrowing equipment needed for instruction from a manufacturer, dealership, or independent repair shop.
- C) Arranging for instruction on tasks requiring equipment not available in the school program at a dealership or independent repair shop.

Programs choosing option B or C are required to show documentation on where the tasks are taught, by whom, and how students are evaluated.

MEDIUM/HEAVY TRUCK STANDARDS STATEMENTS

STANDARD 1 – PURPOSE

The truck technician training program should have clearly stated program goals, related to the needs of the students and employers served.

STANDARD 2 – ADMINISTRATION

Program administration should ensure that instructional activities support and promote the goals of the program.

STANDARD 3 – LEARNING RESOURCES

Support material, consistent with both program goals and performance objectives, should be available to staff and students.

STANDARD 4 – FINANCES

Funding should be provided to meet the program goals and performance objectives.

STANDARD 5 – STUDENT SERVICES

Systematic skills assessment, interviews, counseling services, placement, and follow-up procedures should be used.

STANDARD 6 – INSTRUCTION

Instruction must be systematic and reflect truck program goals. A task list and specific performance objectives with criterion referenced measures must be used.

STANDARD 7 – EQUIPMENT

Equipment and tools used must be of the type and quality found in the repair industry and must also be the type needed to provide training to meet the program goals and performance objectives.

STANDARD 8 – FACILITIES

The physical facilities must be adequate to permit achievement of the program goals and performance objectives.

STANDARD 9 – INSTRUCTIONAL STAFF

The instructional staff must have technical competency and meet all state and local requirements for accreditation.

STANDARD 10 – COOPERATIVE AGREEMENTS

Written policies and procedures should be used for cooperative and apprenticeship training Programs. (This applies only to programs that offer cooperative/apprenticeship training.)

MEDIUM/HEAVY TRUCK MINIMUM REQUIREMENTS

1. The minimum program requirements are identical for initial accreditation and for renewal of accreditation.
2. A program providing instruction in all of the truck areas must have a minimum total of 955 hours (705 hours if accredited in the five required areas only) of combined laboratory/shop (co-op) and classroom instruction. Tasks related to the eight truck areas may be taught at different times during the course of study. Therefore, the hours for an individual area are the sum total of all the hours of instruction related to the tasks. Individual areas must have the minimum hours:

a. Diesel Engines	195
b. Suspension & Steering	90
c. Brakes	105
d. Electrical/Electronic Systems	210
e. Preventive Maintenance	105
f. Drive Train	90
g. Heating, Ventilation, & Air Conditioning	90
h. Hydraulics	<u>70</u>
TOTAL HOURS	955

3. All areas except Hydraulics are required for Master Accreditation designation.
4. **The average rating on each of Standards 6, 7, 8, and 9 must be a four (4)** on the five-point scale. The program will not be approved for an on-site evaluation if the average is less than 4 on any of those Standards. The program should make improvements before submitting the application to NATEF for review. **A program will be denied accreditation if the on-site evaluation team average on Standards 6, 7, 8, and 9 is less than four.**

5. A program may not be approved for an on-site evaluation if the average rating on Standards 1 - 5 and 10 is less than a four (4) on the five-point scale. **A program may be denied accreditation if the on-site evaluation team average on Standards 1 - 5 and 10 is less than four.** Approval for on-site evaluation or accreditation will be made by NATEF, based on the number of standards rated at 4 or 5 as well as the individual rating on any Standard rated less than four.
6. All instructors must hold current ASE certification in the Medium/Heavy Truck area(s) in which he/she teaches except for any Medium/Heavy Truck area for which there is no ASE test.
7. All instructors must attend a minimum of 20 hours per year of recognized industry update training relevant to the areas in which their program is accredited.
8. The program Advisory Committee must conduct at least two working meetings a year and must have a minimum of 5 people (excluding school personnel) on the committee. Minutes of the meetings must be provided for review by the on-site evaluation team and must reflect relevant areas of the standards as having been considered by the Advisory Committee.
9. The NATEF Standards recognize that program content requirements vary by program type and by regional employment needs. Therefore, flexibility has been built into the NATEF task list by assigning each task a priority number. The priority number indicates the minimum percentage of those tasks, by area, a program must include in their program in order to be accredited in that area. The following guidelines must be followed:

95% of all Priority 1 (P-1) items must be taught in the curriculum.
70% of all Priority 2 (P-2) items must be taught in the curriculum.
25% of all Priority 3 (P-3) items must be taught in the curriculum.

10. A program that does not meet the minimum hour requirements may be eligible for accreditation if both of the following conditions are met in the program areas requesting accreditation:
 - a. show evidence that all graduates from the previous academic year have taken the ASE certification examination, and
 - b. show documentation that 75% of those graduates passed the ASE certification tests.
11. The concern for safety is paramount to the learning environment. Each program area has the following safety task preceding all related tasks:

Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with federal, state, and local regulations.

INFORMATION ABOUT EVALUATION TEAM LEADERS (ETLs)

Evaluation Team Leaders (ETLs) are educators who have been trained by NATEF to lead the on-site evaluation. The NATEF office will assign an ETL once a program has been approved for an on-site evaluation. Every effort will be made to assign an ETL located close to the school to reduce the cost for the evaluation. Three additional team members, selected by the program and approved by the ETL, are required for a truck program on-site evaluation (see the following page for additional information about team members and on-site teams).

Persons selected as ETLs must have:

1. a minimum of six years of combined experience as a truck technician and truck instructor (at least three years experience as a truck technician is required);
2. a B.A. or B.S. in Education from a college or university recognized for teacher training by the state; and
3. current ASE certifications in all truck areas (T1 - T8).

OR, if a state does not employ truck instructors with the preceding requirements, the following qualifications will apply:

1. six years experience as a truck technician,
2. four years truck teaching experience at the secondary, post-secondary or community college level, and
3. current ASE certifications in all truck areas (T1 - T8).

ETL candidates who are active instructors must be directly associated with an accredited program. ETL candidates who are inactive instructors must have formerly been directly associated with an accredited program. **Inexperienced ETLs must serve as an evaluation team member or observer for an initial on-site evaluation prior to acting in the capacity of an ETL.**

ETL training is valid for three years. However, automatic three-year renewal is granted every time an ETL conducts an on-site evaluation. ETLs are required to attend additional training sessions or serve as a team member if they have not conducted an on-site evaluation within three years. This additional training is required even though the individual holds current ASE certification.

Anyone interested in becoming an Evaluation Team Leader should contact the NATEF office at (703) 669-6650 or their state Trade & Industrial Supervisor for more details.

INFORMATION ABOUT ON-SITE EVALUATION TEAM MEMBERS

The program requesting accreditation is responsible for recruiting and recommending on-site evaluation team members. The ETL must approve individuals recommended by the program. The on-site evaluation team members must be practicing truck technicians, service managers or shop owners from businesses in the area served by the training program. For initial accreditation only, one team member may be a truck instructor from another school district or system.*

Team members must have:

1. a high school diploma or the equivalent (industry or military training may be considered as the equivalent), and
2. at least seven years full-time experience as a general truck technician.

ASE truck certification is recommended but not required.

* A truck instructor from another school district/system must have a minimum total of seven years experience, which must include three or more years full-time experience as a truck technician and three or more years of post high school training.

The **initial** accreditation evaluation team is composed of four individuals: the ETL and three team members. Two team members must be from industry (one from a dealership and one from an independent repair facility). The third member may be from one of the following: a dealership, an independent repair facility or a truck training program.

The **renewal of accreditation** evaluation team is composed of three individuals: the ETL and two team members. One team member must be from a dealership and one team member must be from an independent repair facility.

Each program requesting initial accreditation or renewal of accreditation must identify their choices for evaluation team members on the On-Site Evaluation Team Member List. An alternate team member choice must be identified on the On-Site Evaluation Team Member List in the event that one of the team members is unable to conduct the on-site evaluation. **The alternate team member must be from either a dealership or from an independent repair facility.**

Team members must not be advisory committee members, former instructors or graduates of the program within the past ten years.

** NATEF reserves the right to add an additional team member to an on-site evaluation team to fulfill ETL training requirements (inexperienced ETLs are required to serve as a team member before serving as an ETL).*

TASK LIST INFORMATION

An essential element of any curriculum or training program is a valid task list. Truck technician instructors need a well-developed task list that serves as a solid base for course of study outlines and facilitates communication and articulation of their training programs with other institutions in the region.

It is NATEF policy that the task list developed by the National Institute for Automotive Service Excellence (ASE) serves as the basis for the NATEF task list. Panels of technical service experts from the automotive service industry and career technical education are called upon to develop and validate the ASE and NATEF task lists. The ASE task list is also used to develop the ASE certification examination, a nationally recognized symbol of competence in diagnosing and repairing vehicle problems. Additional information on the development of the NATEF task list can be found in the Task List section.

All tasks have a Priority designation. NATEF Standards recognize that program content requirements vary by program type and regional employment needs. Therefore, flexibility has been built into the NATEF task list by assigning each task a priority number. The priority number simply indicates the minimum percentage of those tasks, by area, that a program must include in their curriculum in order to be accredited in that area.

- **Ninety-five percent (95%) of Priority 1 (P-1) items must be taught in the curriculum.**
- **Seventy percent (70%) of Priority 2 (P-2) items must be taught in the curriculum.**
- **Twenty-five percent (25%) of the Priority 3 (P-3) items must be taught in the curriculum.**

TOOLS AND EQUIPMENT INFORMATION

The basic tools and equipment that must be available for use in the truck program are listed in the Tools and Equipment section. Many tools and much of the equipment are the same for some or all of the program areas. However, some equipment is specialized and must be available for use in the selected program areas. These individual program area lists are included in the Tools and Equipment section.

The student hand tool list covers all program areas. This list indicates the tools a student will need to own to be successful in each of the specialty areas.

Although no brand names are listed, the equipment and tools must address the following programmatic issues:

1. Safety - Equipment and tools must have all shields, guards, and other safety devices in place, operable, and used.
2. Type and Quality - The tools and equipment used in an accredited program must be of the type and quality found in industry. They must also be adequate and in sufficient quantity to meet the program goals and student performance objectives.
3. Consumable Supplies - Supplies should be in sufficient quantity to assure continuous instruction. Consumable supplies, such as solvents, sand paper, etc. are not listed in the tools and equipment section.
4. Maintenance - A preventive maintenance schedule should be used to minimize equipment down-time.
5. Replacement - A systematic schedule for replacement should be used to maintain up-to-date tools and equipment at industry and safety standards. Information gained from student program evaluations as well as advisory committee input should be used in the replacement process.
6. Inventory - An inventory system should be used to account for tools, equipment, parts, and supplies.
7. Parts Purchasing - A systematic parts purchasing system should be used from work order to supplier.
8. Hand Tools - Each student should be encouraged to purchase a hand tool set during the period of instruction.
9. Storage - Adequate storage of tools should be provided. Space for storage of the students' hand tools should be provided.

MEDIUM/HEAVY TRUCK PROGRAM EVALUATION

NATEF Standards for Initial Accreditation and Renewal of Accreditation are identical. Eight items are critical for accreditation and are in **bold** print in the Medium/Heavy Truck Program Self-Evaluation materials. These eight items are:

- 2.5 A** Does the Advisory Committee, with at least five (5) in attendance, convene a minimum of two working meetings per year?
- 5.5 F** Does the Advisory Committee review information from the annual follow-up procedure and provide input for modifications to the training program?
- 6.5 A** Do the (truck) areas provide theory and “hands-on” training for 95% of the P-1, 70% of the P-2, and 25% of the P-3 tasks, as evidenced by cross-referencing the course of study, lesson plans, job sheets, and student progress charts (in each area to be accredited)?
- 6.5 B** Are the tools and equipment available for the tasks taught in each program area?
- 7.1 A** Are all shields, guards, and other safety devices in place, operable, and used?
- 7.1 B** Do all students, instructors, and visitors wear safety glasses in the lab/shop area while lab is in session?
- 9.1 D** Do instructors hold current ASE certification in the truck area(s) they teach?
- 9.3 B** Do instructors attend a minimum of 20 hours per year of recognized [industry update training](#) relevant to the areas in which their program is accredited?

Programs must be able to support a yes response for all eight items. Programs must also meet the hour requirements listed in item 2 on page 5 in the areas identified for accreditation unless they meet both the requirements listed in item 10 on page 6. **If these responses are not achieved, do not apply for accreditation at this time.**

In addition, an on-site evaluation will not be scheduled unless the average score on each of Standards 6, 7, 8, and 9 is at least a 4 on the Truck Program Self-Evaluation. Please refer to the Medium/Heavy Truck Program Requirements for more information.

Instructors must be ASE certified in the areas they teach. Please refer to item 6 on page 6.

NATEF POLICIES ON ARTICULATION AGREEMENTS FOR PROGRAM ACCREDITATION

In a number of states and localities, technician training programs are able to meet NATEF standards for accreditation only by establishing an articulation effort between secondary and post-secondary programs. NATEF Trustee action, as well as language in the Carl D. Perkins Vocational Education Act, encourages articulation between programs at the secondary and post-secondary levels.

Articulation agreements encourage, but cannot require, graduates of secondary programs to go on to post-secondary education. Financial and social considerations suggest that many, perhaps most, graduates must seek employment upon graduation from high school.

Articulation agreements for truck technician training programs may involve two or more training centers at secondary and post-secondary levels. Programs must select a minimum of two of the required truck specialty areas in which to accredit, and articulate with another NATEF accredited technician training program that provides instruction in the other required specialty areas. Articulated training centers may both accredit in one or more of the same specialty areas as long as they meet the minimum required areas (Diesel Engines, Suspension & Steering, Brakes, Electrical/Electronic Systems, and Preventive Maintenance Inspection) jointly.

***The input and advice of each school's program advisory committee is critical to the decision about which accreditation option is most appropriate for that program and its students.**

Articulation agreements must be in writing and approved by the administration of each institution. The agreement shall:

- a. List the areas to be offered by each training center.
- b. Stipulate how *credit** will be granted for successful completion of instruction. This should also include the criteria for evaluating successful completion.
- c. Describe procedures for applying for *credit** at the post-secondary level for instruction received at the secondary level.

* Credit is defined as a form of recognition for work that has been completed at the secondary level. It includes, but is not limited to, granting: academic credit, advanced placement, task completion, etc.

**** IN EVERY CASE A SIGNED COPY OF THE ARTICULATION AGREEMENT
MUST BE SUBMITTED WITH THE SELF-EVALUATION MATERIALS. ****

RECOGNITION FOR ACCREDITATION

A program approved for accreditation will receive a plaque that bears the ASE/NATEF seal and the school's name. Individual plates will be attached to the plaque to identify the areas in which the program is accredited. These will also include the expiration date of accreditation. Any program accredited in all areas will receive a Master Accreditation plaque. A statement below the seal will read:

THE INSTRUCTION, COURSE OF STUDY, FACILITIES AND EQUIPMENT
OF THIS INSTITUTION HAVE BEEN EVALUATED BY THE NATIONAL
AUTOMOTIVE TECHNICIANS EDUCATION FOUNDATION AND MEET
STANDARDS OF QUALITY FOR THE TRAINING OF TRUCK TECHNICIANS
IN THE FOLLOWING AREAS:

Institutions receiving NATEF Accreditation are encouraged to put the following statement on the graduate's diploma or certificate:

“The person holding this diploma has participated in a truck technician training program that was accredited by the National Automotive Technicians Education Foundation and has completed instruction for entry-level employment in the following areas:

”

A screened ASE/NATEF logo may be overprinted with the above statement and placed on the graduate's diploma. A camera-ready logo is provided in the promotional material a program receives upon accreditation.

Accredited programs will also receive a 24"x30" sign indicating that the training program is NATEF accredited.

APPLIED ACADEMICS RECOGNITION

The NATEF Board of Trustees and the ASE Board of Directors have initiated a process to recognize NATEF accredited programs that are integrating academics and technical skills into the curricula. This effort should be a collaborative effort between the truck instructors and the academic instructors in language arts, mathematics, and science.

ASE and NATEF will issue a certificate of excellence to those programs that provide documentation including, but not limited to, student assignments or activities, classroom/lab instructional materials, student performance records, and interviews with academic instructors.

Programs that wish to receive recognition must complete the Applied Academics Recognition form and return it with the application for accreditation or renewal of accreditation. Documentation on applied academics activities must be available for the ETL at the time of the on-site evaluation.

Programs may receive recognition in Language Arts, Mathematics, Science, or any combination of the three areas.

To receive a copy of the *Applied Academics and Workplace Skills for Medium/Heavy Truck Technicians* manual, please contact the NATEF office.

APPEALS AND ACTION FOR REVOCATION

APPEALS: PROGRAMS APPLYING FOR ACCREDITATION

A complaint received from any school concerning the procedures, evaluation or accreditation of the truck technicians training program must be made in writing to the ASE office in Leesburg, Virginia. It will be immediately referred to the Grievance Examiner, who will acknowledge receipt of the complaint in writing to the complainants. Thereafter, the Grievance Examiner will investigate the complaint and prepare a report. A copy of the report will be given to the complainants and to an Appeals Committee within thirty (30) days of the receipt of the complaint.

The Appeals Committee will review the findings and recommendations of the Grievance Examiner, together with the complaint and any data supplied in connection therewith. The Appeals Committee will be empowered to dismiss the matter or to initiate such action as it may deem appropriate.

If the complainants desire to review the Appeals Committee's evaluation, they may do so at the office of the Grievance Examiner in Leesburg, Virginia. However, they will not be permitted to make copies of the results.

ACTION FOR REVOCATION: NATEF ACCREDITED PROGRAMS

The Appeals Committee will also advise the NATEF President of its judgments and recommendations for action in any cases of malpractice or misrepresentation involving the misuse of NATEF accreditation for a truck technician training program. Upon receipt of a complaint alleging misuse or misrepresentation by an accredited program, the Grievance Examiner will be notified. The Grievance Examiner will notify the parties against whom the complaint has been filed, in writing, indicating the alleged wrongdoing. The parties will be further advised that they may submit a written explanation concerning the circumstances of the complaint within thirty (30) days. After the Grievance Examiner has considered the complaint and received the explanation, if any, the Grievance Examiner will determine whether there is a reasonable basis for a possible wrongdoing. If the Grievance Examiner finds such a basis, the Grievance Examiner will inform the parties of the findings. At that time, the Grievance Examiner will inform the parties of their right to a hearing before the Appeals Committee. The parties will have fifteen (15) days to notify the Grievance Examiner, in writing, of their decision.

In the event the involved parties elect to be bound by the findings of the Grievance Examiner without a hearing, the Grievance Examiner will submit a written report with recommendations to the Chair of the Appeals Committee. This report will be submitted within sixty (60) days of the receipt of the waiver of a hearing. The Chair of the Appeals Committee will mail a copy of the Grievance Examiner's findings and recommendations to the parties involved. In the event that the involved parties elect to appear at a hearing, the Chair of the Appeals Committee will call a Board of Inquiry. This Board will consist of four ASE Board members, one from each of the following categories: Education, Public Interest, Service.

Employers, and Vehicle and Service Products Manufacturers. The Board of Inquiry will be convened in Leesburg, Virginia at a date and time determined by the Chair. The Board will notify the involved parties in writing regarding the time and place of the hearing.

The Grievance Examiner will be responsible for investigating and presenting all matters pertinent to the alleged wrongdoing to the Board of Inquiry. The involved parties will be entitled to be at the hearings with or without counsel. The parties will be given an opportunity to present such evidence or testimony as they deem appropriate.

The Board of Inquiry will notify the Chair of the Appeals Committee of its findings and recommendations in writing within ten (10) days after the hearing is completed.

The Appeals Committee will review the findings and recommendations of either the Grievance Examiner if a hearing was waived or the Board of Inquiry if a hearing was held. The Appeals Committee will determine if the record on the complaint supports a finding of conduct contrary to or in violation of reasonable practices. If two-thirds of the Appeals Committee so find, the Committee will recommend to the President of ASE appropriate sanctions or courses of action against the parties charged.

DEFINITIONS – EDUCATIONAL TERMS

1. CURRICULUM: All the objectives, content, and learning activities arranged in a sequence for a particular instructional area. An orderly arrangement of integrated subjects, activities, time allocations, and experiences that students pursue for the attainment of a specific education goal.
2. COMPETENCY: (Hands On) – Performance of task to the level or degree specified in the performance standard for the task.
3. CRITERION REFERENCED MEASURE(S): An exercise based on a performance objective for a task, and designed to measure attainment of that objective. (Also called performance test or criterion referenced test.)
4. GOAL: A statement of the intended outcome of participation in the training program.
5. MASTERY: (See Competency – Hands On).
6. OBJECTIVE, PERFORMANCE: A written statement describing an intended outcome (competent task performance) in terms of student performance. (Also called “behavioral” objective or instructional objective) R.F. Mager Associates, 13245 Rhoda Drive, Los Altos Hill, California.
7. ON-VEHICLE SERVICE AND REPAIR WORK: The processing, assignment and student performance of the appropriate tasks on vehicles donated by manufacturers or other sources, customer-owned, and other training vehicles.
8. PERSONAL CHARACTERISTIC: Attributes that are not readily measurable, and are generally in the affective or cognitive domains.
9. AREA(S): Relates to one or more of the following: (1) Diesel Engines, (2) Suspension & Steering, (3) Brakes, (4) Electrical/Electronic Systems, (5) Preventive Maintenance Inspection, (6) Drive Train, (7) Heating, Ventilation, & Air Conditioning, (8) Hydraulics, (9) Gaseous Fuels Engine Performance, (10) CNG On-Board Fuel Storage and Delivery, (11) LNG On-Board Fuel Storage and Delivery, and (12) LPG On-Board Fuel Storage and Delivery
10. STANDARD: “...Something established for use as a rule or basis of comparison in measuring or judging capacity, quantity, content, extent, value, quality, etc.” Webster’s New World Dictionary (1991)
11. STANDARD – PERFORMANCE: A written specification of the results or acceptable task performance.

12. STANDARD – PERSONAL: An attribute or characteristic of an individual that facilitates entry into and advancement in an occupation.
13. STANDARD – PROGRAM: A specific quality or desired characteristic or a training program designed to prepare individuals for employment.
14. TASK: A unit of work activity that has an identifiable beginning and ending point in its accomplishment, and consists of two or more observable steps.
15. TRAINING STATION: An area with appropriate tools and equipment, large enough to allow safety and competency development in task performance.

Must or shall is an imperative need, duty or requirement; an essential or indispensable item; mandatory.

Should is used to express a recommendation, not mandatory but attainment would increase program quality.

May or could expresses freedom to follow a suggested alternative.

PROCEDURES FOR ACCREDITATION/RENEWAL OF ACCREDITATION

Process Overview

NOTE: NATEF recommends that programs maintain a file containing copies of all reference and documentation materials developed during all phases of the accreditation process.

1. Purchase application materials

The program requesting accreditation must purchase self-evaluation materials from NATEF in Leesburg, Virginia. To begin the accreditation process, the program must return the following items from the evaluation materials packet:

- a. Application for Accreditation or Renewal of Accreditation
- b. Self-Evaluation Summary Sheet
- c. On-site Evaluation Team Member List
- d. Instructor Qualifications Forms and [Instructor Training Forms](#)
- e. Advisory Committee List
- f. Articulation Agreement (if applicable)
- g. Applied Academics Recognition Forms (optional)
- h. Purchase Order, Check, or Credit Card Authorization for Application Fee and On-Site Evaluation Team Packets (self-evaluations will be returned if received without payment)
- i. Facilities Evaluation (CNG/LNG/LPG programs only)

2. NATEF review of application

The national office will review the materials within 30 days. Following the review, the Program Administrator and the state Trade & Industrial Supervisor will be notified about the status of the program. The program will be identified as one of the following:

- a. Qualified for on-site evaluation for all the specialty areas listed on the application.
- b. Qualified for on-site evaluation for some but not all specialty areas listed on the application. The program administrator may proceed with the on-site evaluation for the specialty areas that qualify at that time OR make improvements and resubmit the application at a later date.
- c. Not qualified for an on-site evaluation at that time. NATEF will indicate specific improvements that must be made before the on-site evaluation can be scheduled.

3. Evaluation Team Leader (ETL) assigned, Program Coordinator makes contacts

In cooperation with state officials, NATEF will assign an Evaluation Team Leader (ETL) to the program. NATEF will send the program the Application for On-site Evaluation. With a legitimate reason, the program coordinator may contact the NATEF office to request a different ETL. A request for a different ETL must be in writing and specific as to the reason for the request. (The ETL assigned must NOT be a present or former teacher or administrator of the program to be evaluated.) The program coordinator must contact the ETL to arrange a date for the on-site evaluation.

The Application for the On-site Evaluation will be sent with instructions that outline the plans for the local administration and the costs for the ETL's honorarium and expenses. These costs will be paid by the institution requesting accreditation.

4. Send on-site application, course of study, Advisory Committee minutes, and list of on-site evaluation team members to ETL

The Application for On-site Evaluation, signed by the program administrator, must be sent to the ETL. A copy of the course of study, Advisory Committee minutes (one year's worth for initial accreditation; five year's worth for renewal of accreditation) and this application must be received by the ETL at least two weeks prior to the on-site evaluation or the on-site must be rescheduled. The course of study should include the following items:

- a. Syllabus for each class
- b. Tasks to be taught under each area, specified according to Priority designations P-1, P-2, or P-3. (Tasks may be taught at different times in the program or in more than one area. However, the hours for the tasks may be counted only once.)
- c. Number of contact hours for each area
- d. Areas and sequence of instruction to be included in the program
- e. List of training materials and audio-visual materials used in training
- f. Sample evaluation form used to track student progress

Include the On-site Evaluation Team Member List for the ETL to review and approve. Once a date has been set and the on-site evaluation team members have been approved by the ETL, the program coordinator must contact the on-site evaluation team members to make arrangements for the evaluation day(s).

5. On-site evaluation

Initial accreditation requires 2 consecutive days while students are in class for the on-site evaluation review of all the standards.

Renewal of accreditation requires a 1-day on-site evaluation while students are in class, and Standards 6-9 are reviewed by the on-site evaluation team. However, if the Advisory Committee average on Standards 1-5 or Standard 10 is less than 4, these Standards must be reviewed by the on-site evaluation team. The NATEF office will determine whether an additional day or additional team members will be required to complete the evaluation.

6. ETL reports results to NATEF

The ETL will submit all on-site evaluation materials and a final report to NATEF with a recommendation for or against program accreditation.

7. Program accreditation

The national office will review the final report and all additional evaluation materials to determine whether the program meets the requirements for accreditation, and will make their recommendation to the ASE Board. The NATEF President will approve accreditation as sanctioned by the Board of Directors.

Programs that do not earn accreditation will be given a written report specifying improvements that must be made to qualify for accreditation. The decision at the national level will be final unless appealed to the ASE Board of Directors. Appeals will be heard only at regular meetings of the Board.

The program administrator and the state Trade & Industrial Supervisor will be notified of all decisions regarding the accreditation status of all programs applying for NATEF accreditation.

8. Display and reporting of accreditation materials

A wall plaque identifying the accredited areas will be forwarded from the national office to the program administrator. Schools must accurately report areas of NATEF accreditation.

9. Accredited Truck Technician Training Program List

The NATEF office maintains a current listing of all NATEF accredited programs. The list is made available on the NATEF website.

10. Compliance report

A program will be accredited for five years. A compliance report is required after 2 ½ years. The compliance report will be used to verify that a program is maintaining its standards. NATEF will notify the program administrator of the compliance date and will send the appropriate compliance review forms at that time. The Advisory Committee must complete the report and the program administrator must return the forms to the NATEF office.

NATEF may randomly select programs at the 2 ½ year period for an on-site compliance review by an ETL and NATEF Trustees, staff, consultants, or other designated representatives. Selected programs will be notified by the NATEF office in advance of the on-site review. Programs should be prepared to provide documentation on how they are maintaining the standards. All costs for this on-site review will be paid by NATEF.

11. Renewal of Accreditation

The NATEF office will contact the program coordinator eleven (11) months prior to the accreditation expiration date. Programs must formally request renewal materials and follow the process outlined above.

On-site Evaluation Cost Sheet

TRUCK

	ACCREDITATION	RENEWAL OF ACCREDITATION
Accreditation Documents (Applied Academics general statements and workplace skills list are included)	\$94.00	\$82.00
Application Fee	\$315.00	\$315.00
On-site Evaluation Team Manuals (minimum of 4 sets for initial accreditation and 3 sets for renewal @ \$65 each.)	\$260.00	\$195.00
Honorarium for Evaluation Team Leader (ETL) @ \$250/day *Please see below	\$500.00	\$250.00
<u>Estimated</u> mileage, hotel, and meal expenses for the ETL **Please see below	<u>\$150.00</u>	<u>\$100.00</u>
<u>ESTIMATED</u> TOTAL COSTS	\$1319.00	\$942.00

NOTE: It is anticipated that team members recruited from local independent repair facilities and dealerships will serve without charge to the institution.

The NATEF office must receive the application fee and payment for the on-site evaluation team packets with the completed application. Applications received without these payments will be returned to the program for resubmission with payment.

***ETLs are to receive an additional honorarium of \$100 (per additional program) when evaluating multiple programs at one location.** Example: An ETL evaluates one general program and one manufacturer-specific program during an initial accreditation on-site evaluation. The honorarium paid to the ETL would be \$500 for the standard two-day honorarium, and \$100 for the additional program, for a total honorarium of \$650.

ETLs are paid as independent contractors, not as school employees.

****Mileage is to be reimbursed at the rate specified by the IRS for business purposes. Please visit IRS.gov for the current mileage reimbursement rate.**

Costs of accreditation/renewal of accreditation are subject to change. Contact the NATEF office for current information.

MEDIUM/HEAVY TRUCK PROGRAM STANDARDS

STANDARD 1 - PURPOSE

THE TRUCK TECHNICIAN TRAINING PROGRAM SHOULD HAVE CLEARLY STATED PROGRAM GOALS, RELATED TO THE NEEDS OF THE STUDENTS AND EMPLOYERS SERVED.

Standard 1.1 - Employment Potential

The employment potential for truck technicians, trained to the level for the specialty or general areas outlined in the program goals, should exist in the geographic area served by the program.

Standard 1.2 - Program Description/Goals

The written description/goals of the program should be shared with potential students and should include admission requirements, employment potential, area(s) of specialty training offered, and the cost of all tuition and fees. Technical qualifications of the faculty and the overall goal(s) of the program should also be included.

STANDARD 2 - ADMINISTRATION

PROGRAM ADMINISTRATION SHOULD ENSURE THAT INSTRUCTIONAL ACTIVITIES SUPPORT AND PROMOTE THE GOALS OF THE PROGRAM.

Standard 2.1 - Student Competency Certification

The certificate or diploma a student receives upon program completion should clearly specify the area(s) of demonstrated competency.

Standard 2.2 - Chain of Command

An organizational chart should be used to indicate the responsibilities for instruction, administration, and support services.

Standard 2.3 - Administrative Support

Positive administrative support from institutional and local governing bodies should be demonstrated. Indicators of administrative support would include: support for staff in-service training; provision of appropriate facilities; up-to-date tools, equipment, training support materials, and curriculum.

Standard 2.4 - Written Policies

Written policies should be adopted by the administration and policy board for use in decision-making situations and to provide guidance in achieving the program goals. Policies regarding safety, liability, and lab/shop operation should be written and prominently displayed as well as provided to all students and instructors.

Standard 2.5 - Advisory Committee

An Advisory Committee, consisting of at least five members (not including school personnel), must convene at least two times a year and be utilized to provide counsel, assistance, and information from the community served by the training program. This Committee should be broadly based and include former students, employed technicians, employers, and representatives for consumers' interests.

Standard 2.6 - Public/Community Relations

An organized plan should be used to provide the community at large information regarding the training program, its graduates, its plans, and any services provided to the community.

Standard 2.7 – Customer Vehicle Work

A systematic method of collecting, documenting, and disbursing customer vehicle work repair receipts should be used. Instructional staff should not be required to collect payment for customer vehicle work repairs. (This applies only to programs that accept customer vehicles for instruction.)

STANDARD 3 - LEARNING RESOURCES

SUPPORT MATERIAL, CONSISTENT WITH BOTH PROGRAM GOALS AND PERFORMANCE OBJECTIVES, SHOULD BE AVAILABLE TO STAFF AND STUDENTS.

Standard 3.1 - Service Information

Service information with current manufacturer's service procedures and specification data for vehicles manufactured within the last ten (10) years should be available. This information should be accessible to students while working in the lab/shop area.

Standard 3.2 - Multimedia

Appropriate up-to-date multimedia materials such as video equipment, transparencies, CD ROM, etc. should be readily available and utilized in the training process.

Standard 3.3 - Instructional Development Services

The service of professional instructional development personnel should be used when available. At a minimum, equipment and supplies should be available for duplication or copying printed materials and transparencies. Instructional development personnel should conduct in-service and/or training in curriculum and media development.

Standard 3.4 - Periodicals

Current general and technical truck magazines and newspapers should be available for student and instructor use.

Standard 3.5 - Student Materials

Necessary instructional texts or pertinent material should be available for each student to satisfy the objectives of the mode of instruction used. Basic and specialty textbooks should have copyright dates that are not over six (6) years old.

STANDARD 4 - FINANCES

FUNDING SHOULD BE PROVIDED TO MEET THE PROGRAM GOALS AND PERFORMANCE OBJECTIVES.

Standard 4.1 - Program Training Cost

The enrollment in the program or program area should be sufficient to keep the per-student training costs to a realistic figure.

Standard 4.2 - Budget

An adequate annual budget should be developed, allocated, and used for the operation of the program.

Standard 4.3 - Budget Preparation

The budget should be prepared by the institutional administration in conjunction with the program faculty.

Standard 4.4 - Status Reports

Budget status reports should be made available to program staff at least quarterly.

STANDARD 5 - STUDENT SERVICES

SYSTEMATIC SKILLS ASSESSMENT, INTERVIEWS, COUNSELING SERVICES, PLACEMENT, AND FOLLOW-UP PROCEDURES SHOULD BE USED.

Standard 5.1 – Skills Assessment

For students to develop the skills and knowledge required to service today's trucks, each student must possess, or be given the opportunity to develop, essential foundation skills in reading, mathematics, science, and mechanical aptitude. To this end, a formal skills assessment instrument (process) for these fundamental skills should be used to evaluate students to ensure that each student has a reasonable probability of success as a truck technician. Testing procedures and how the test results will be used (e.g. placement, assessment of student's developmental needs, etc.) should be stated in program explanatory material, and justification for all requirements should be available.

Standard 5.2 - Pre-admission Counseling

Prior to program admission, a student should be counseled regarding automotive careers.

Standard 5.3 - Student Records

Permanent records of all students, former and current, should be available, preferably in one central location, and kept confidential.

Standard 5.4 - Placement

A systematic student placement system should be used to assist program graduates to obtain employment in the truck industry.

Standard 5.5 – Annual Follow-up

An annual follow-up system should be used to determine students' employment location and for feedback regarding the efficiency, effectiveness, and appropriateness of training. The follow-up procedure should be designed to assure feedback regarding needed additions to or deletions from the training curriculum, program, and tools and equipment. Follow-up of graduates employed outside of the truck industry should indicate reasons for non-truck employment. When applicable, this information should be used to modify the training quality and/or content.

Standard 5.6 - Legal Requirements

The training program should meet all applicable local, state, and federal requirements.

STANDARD 6 - INSTRUCTION

INSTRUCTION MUST BE SYSTEMATIC AND MUST REFLECT TRUCK PROGRAM GOALS. A TASK LIST AND SPECIFIC PERFORMANCE OBJECTIVES WITH CRITERION REFERENCED MEASURES MUST BE USED.

Standard 6.1 - Program Plan

The training plan should progress in logical steps, provide for alternate sequences where applicable, and be made available to each student.

Standard 6.2 - Student Training Plan

A training plan for each student should be developed and used, indicating the student's training goal(s) and specific steps needed to meet that goal. Students should be given a copy of their training plan.

Standard 6.3 - Preparation Time

Adequate time should be provided for teacher preparation and program development.

Standard 6.4 - Teaching Load

The instructor/student ratio and class contact hours should allow time for interaction on a one-to-one basis.

Standard 6.5 - Curriculum

All tasks have been given a priority rating. Ninety-five percent (95%) of the tasks designated as Priority 1 (P-1) must be taught in the curriculum. Seventy percent (70%) of the tasks designated as Priority 2 (P-2) must be taught in the curriculum. Twenty-five percent (25%) of the tasks designated as Priority 3 (P-3) must be taught in the curriculum. Additional tasks may be included to meet the needs of local employers. All additional tasks should be approved by the Advisory Committee.

Instruction on the legal aspects and responsibilities of the truck technician in areas such as Environmental Protection Agency regulations, safety regulations, OSHA regulations, and other appropriate requirements should be included in the curriculum. Instruction and practice in filling out work order forms, ordering parts, and basic record keeping should be a part of the training program.

Tools and equipment must be available to perform the tasks in each of the areas for which accreditation is requested.

Standard 6.6 - Student Progress

A record of each student's progress should be maintained through the use of a progress chart or other recording device. The record should indicate tasks required for program completion and those tasks the student has mastered.

Standard 6.7 - Performance Standards

All instruction should be performance based, with an acceptable performance standard stated for each task. These standards should be shared with students and potential employers. Students should demonstrate "hands-on competency" of a task before the instructor verifies a student's performance.

Standard 6.8 - Safety Standards

Safety instruction should be given prior to lab/shop work and be an integral part of the training program. A safety test should be included in the training program. Students and instructors should comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.

Standard 6.9 - Personal Characteristics

All training activities and instructional material should emphasize the importance of maintaining high personal standards.

Standard 6.10 - Work Habits/Ethics

The training program should be organized in such a manner that work habits and ethical practices required on the job are an integral part of the instruction.

Standard 6.11 - Provision for Individual Differences

The training program should be structured in such a manner that students with different levels of cognitive and psychomotor skills can be accommodated.

Standard 6.12 - Related Instruction

Instruction in related mathematics, science, communications, and interpersonal relations should be provided and coordinated with ongoing instruction in the training program. This instruction should be provided by a qualified instructor.

Standard 6.13 - Testing

Both written and performance based tests should be used to validate student competency. Students should be encouraged to take certification tests that are publicly recognized indicators of capabilities.

Standard 6.14 - Evaluation of Instruction

Instructional procedures should be evaluated in a systematic manner. This evaluation should be through regular reviews by students and the administration. Self-evaluation of instruction should also be utilized on a systematic and regular basis. This system should include input from former students and the Advisory Committee members. Instructional procedures should show responsiveness to the feedback from these evaluations.

Standard 6.15 – On-Vehicle Service and Repair Work

On-vehicle service and repair work should be scheduled to benefit the student and supplement ongoing instruction on items specified in the NATEF task list. A student should have had instruction and practice on a specific repair task before on-vehicle service and repair work requiring that task is assigned. Vehicles donated by the manufacturers or other sources, customer-owned vehicles, and other training vehicles may be used as the primary sources of on-vehicle service and repair work. Training program student-owned vehicles, school buses, and other vehicles owned and operated by the governing body of the school should not be the primary source of on-vehicle service and repair work. All vehicles in the lab/shop should have a completed industry-type work order attached to or on the vehicle.

Standard 6.16 - Articulation

Agreements between programs with equivalent competencies should be used to eliminate unnecessary duplication of instruction and foster continued study.

STANDARD 7 - EQUIPMENT

EQUIPMENT AND TOOLS USED MUST BE OF THE TYPE AND QUALITY FOUND IN THE REPAIR INDUSTRY AND MUST ALSO BE THE TYPE NEEDED TO PROVIDE TRAINING TO MEET THE PROGRAM GOALS AND PERFORMANCE OBJECTIVES.

Standard 7.1 - Safety

Equipment and tools used in the training program must have all shields, guards, and other safety devices in place, operable, and used. Safety glasses must be worn by all students, instructors, and visitors in the lab/shop area while lab is in session.

Standard 7.2 - Quantity and Quality

The tools and equipment used in the training program should reflect the program goals and performance objectives. Sufficient tools and equipment should be available for the training offered. The tools and equipment should meet industry quality standards.

Standard 7.3 - Consumable Supplies

Sufficient consumable supplies should be readily available to assure continuous instruction.

Standard 7.4 - Maintenance

A preventive maintenance schedule should be used to minimize equipment down-time.

Standard 7.5 - Replacement

An annual review process should be used to maintain up-to-date tools and equipment at industry and safety standards. Student follow-up and Advisory Committee input should be used in this process.

Standard 7.6 - Inventory

An inventory system should be used to account for tools, equipment, parts, and supplies.

Standard 7.7 - Parts Purchasing

A systematic parts purchasing system, from work order - to parts specialist - to jobber, should be used. Task performance should not be unreasonably delayed due to lack of replacement parts.

Standard 7.8 - Hand Tools

Each student should have access to basic hand tools comparable to tools required for employment. Students should be encouraged to purchase a hand tool set during the period of instruction.

STANDARD 8 - FACILITIES

THE PHYSICAL FACILITIES MUST BE ADEQUATE TO PERMIT ACHIEVEMENT OF THE PROGRAM GOALS AND PERFORMANCE OBJECTIVES.

Standard 8.1 - Training Stations

Training stations (bench and on-vehicle service and repair work) should be available in the type and number required for the performance of tasks outlined in the program goals and performance objectives.

Standard 8.2 - Safety

The facilities should meet all applicable safety standards and an emergency plan should be in place and posted in all classrooms and lab/shop areas.

Standard 8.3 - Maintenance

A written facilities maintenance program should be used to ensure facilities are suitable when required for instruction.

Standard 8.4 - Housekeeping

The classroom(s), lab/shop, and support area(s) should be kept clean and orderly.

Standard 8.5 - Office Space

An area separate from the lab/shop should be available and convenient for instructor's use as an office.

Standard 8.6 - Instructional Area

A classroom convenient to, but separate from, the lab/shop area should be available for instruction and other non-lab/shop activities.

Standard 8.7 - Storage

Storage areas for tools, parts, supplies, and trucks should be sufficient to support the activities outlined in the program goals and performance objectives. Security should be provided to prevent pilferage and vandalism.

Standard 8.8 - Support Facilities

Restrooms and clean-up areas should be provided for both male and female students and should be convenient to the instructional area.

Standard 8.9 - Ventilation

An adequate exhaust fume removal system should be in place and operational. When appropriate, heating and cooling systems should be used to provide sufficient comfort for learning.

Standard 8.10 - First Aid

A first aid kit should be in place and should comply with local regulations and school policy.

Standard 8.11 - Facility Evaluation

The Advisory Committee should conduct an annual evaluation of the facilities to assure adequacy to meet program goals.

STANDARD 9 - INSTRUCTIONAL STAFF

THE INSTITUTIONAL STAFF MUST HAVE TECHNICAL COMPETENCY AND MEET ALL STATE AND LOCAL REQUIREMENTS FOR ACCREDITATION.

Standard 9.1 - Technical Competency

Instructors must hold current ASE certification in the truck areas they teach and which are being evaluated for program accreditation.

Standard 9.2 - Instructional Competency/Certification

Instructors should meet all state certifying requirements.

Standard 9.3 - Technical Updating

Faculty members should be provided technical materials required to maintain their competency. Instructors must attend a minimum of 20 hours of technical update training each year.

Standard 9.4 - First Aid

The program should have a written policy, approved by the administrator of the school, on First Aid procedures.

Standard 9.5 - Substitutes

A systematic method of obtaining "substitute" instructors should be used to assure instructional continuity. An orientation session for substitutes should be held on a regular basis. The substitute should be a competent truck instructor.

STANDARD 10 - COOPERATIVE AGREEMENTS

WRITTEN POLICIES AND PROCEDURES SHOULD BE USED FOR COOPERATIVE AND APPRENTICESHIP TRAINING PROGRAMS. (This applies only to programs that offer cooperative/apprenticeship training.)

Standard 10.1 - Standards

The student training plan and performance standards should be developed and coordinated by the truck instructor.

Standard 10.2 - Agreements

All agreements should be written and legally binding.

Standard 10.3 - Supervision

A supervising truck instructor or supervising co-op coordinator should be assigned responsibility, authority, and time to coordinate and monitor truck program cooperative/apprenticeship activities.

TASK LIST

TASK LIST AND ASSUMPTIONS

The NATEF task list was reviewed and updated in November 2007. A national committee was assembled in Herndon, Virginia to review the standards used in the Medium/Heavy Truck accreditation program. The committee consisted of individuals representing the major truck manufacturers, truck repair shop owners and technicians, truck instructors and trainers, and truck equipment and parts suppliers.

The committee reviewed the task list, tools and equipment list, program hours, and instructor qualifications. The committee also had the most current National Institute for Automotive Service Excellence (ASE) truck task lists for reference purposes.

All the tasks are assigned a priority number: P-1, P-2, or P-3. Please refer to the Task List Information in the Policies section and Standard 6.5 for additional information on the requirements for instruction on tasks.

Theory instruction and hands-on performance of all the basic tasks will provide initial training for **entry-level** employment in the Medium/Heavy Truck service field or further training in any, or all of the specialty areas. Competency in these tasks will indicate to employers that the graduate is skilled in that area.

1. It is assumed that:

- * in all areas, appropriate theory, safety, and support instruction will be required in the performance of each task;
- * this instruction includes identification and use of the appropriate tools and testing and measurement equipment required to accomplish certain tasks;
- * the student has received the necessary training to locate and use current reference and training materials from accepted industry resources (paper and electronic formats).

2. It is assumed that:

- * all diagnostic and repair tasks described in this document will be accomplished and verified in accordance with manufacturers' recommended procedures and industry accepted standards/practices.

3. It is assumed that:

- * individual training programs being evaluated for accreditation will have written and detailed performance standards for each task covered and taught in the curriculum (Standard 6.7);
- * the learning progress of students will be monitored and evaluated against these performance standards;
- * a system is in place which informs all students of their individual progress through all phases of the training program (Standard 6.6).

4. It is assumed that:

- * individual courses of study will differ across medium/heavy truck technician training programs;
- * development of appropriate learning delivery systems and tests which monitor student progress will be the responsibility of the individual training program.

5. It is assumed that:

- * all students will receive instruction in the storage, handling, and use of Hazardous Materials in accordance with Hazard Communication Title 29, Code of Federal Regulation Part 1910.1200, the 'Right to Know Law', and state and local requirements;
- * hazardous and toxic materials will be handled, removed, and recycled or disposed of according to federal, state, and local regulations.

6. It is assumed that:

- * any tool requiring calibration will be calibrated according to the manufacturer's specifications periodically or as needed.

7. It is assumed that:

- * students are given instruction in communication techniques with the customer.

8. It is assumed that:

- * all students will be instructed in and will practice recommended precautions when handling electro-static sensitive devices.

Note: The Technology and Maintenance Council (TMC) of the American Trucking Association (ATA) publishes a "Recommended Maintenance Practices Manual" as a resource for industry practices. Contact the TMC at www.trucking.org for more information.

DEFINITIONS – TECHNICAL TERMS

ADD – To increase fluid or pressure to the correct level or amount.

ADJUST – To bring components to specified operational settings.

AIR TEST – To use air pressure to determine proper action of components.

ALIGN – To bring to precise alignment or relative position of components.

ANALYZE – To examine the relationship of components of an operation.

ASSEMBLE (REASSEMBLE) – To fit together the components of a device.

BALANCE – To establish correct linear, rotational or weight relationship.

BLEED – To remove air from a closed system.

CHARGE – To bring to "full" state; e.g., battery or air conditioning system.

CHECK – To verify condition by performing an operational or comparative examination.

CLEAN – To rid component of extraneous matter for the purpose of reconditioning, repairing, measuring or reassembling.

DATA – Factual information, especially organized for analysis or used to reason or make decisions. Also, numerical or other information represented in a form suitable for processing by computer.

DEGLAZE – To restore correct surface finish.

DETERMINE – To establish the procedure to be used to effect the necessary repair.

DETERMINE NECESSARY ACTION – Indicates that the diagnostic routine(s) is the primary emphasis of a task. The student is required to perform the diagnostic steps and communicate the diagnostic outcomes and corrective actions required addressing the concern or problem. The training program determines the communication method (worksheet, test, verbal communication, or other means deemed appropriate) and whether the corrective procedures for these tasks are actually performed.

DIAGNOSE – To locate the root cause or nature of a problem by using the specified procedure.

DISASSEMBLE – To separate a component's parts as a preparation for cleaning, inspection, or service.

DISCHARGE – To empty a storage device or system; e.g. static electricity release, battery, or air conditioning system.

DRAIN – To use gravity to empty a container.

EVACUATE – To remove air, fluid or vapor from a closed system by use of a vacuum pump.

FILL (REFILL) – To bring fluid level to specified point or volume.

FIND – To locate a particular problem, e.g. shorts, grounds or opens in an electrical circuit.

FLUSH – To use a fluid to clean an internal system.

HONE – To restore, resize or bore by using rotating cutting stones.

IDENTIFY – To establish the identity of a vehicle or component prior to service; to determine the nature or degree of a problem.

INDICATE – To show as by measuring or recording such as a thermometer. Also, to point out or direct attention to a condition.

INSPECT – (See CHECK)

INSTALL (REINSTALL) – To place a component in its proper position in a system.

INTERFACE – To establish a communications link between an electronic control module and a diagnostic tool or computer.

ISOLATE – A technique where a component or system may be separated from the rest of the component or system.

JUMP START – To use an auxiliary power supply, i.e. battery, battery charger, etc. to assist a vehicle's battery to crank an engine.

LEAK TEST – To locate the source of leaks in a component or system.

LISTEN – To use audible clues in the diagnostic process; to hear the customer's description of a particular problem.

LOAD TEST – The process of creating demand on a system or device and measuring its Response.

LUBRICATE – To employ the correct procedures and materials in performing the prescribed lubrication service.

MEASURE – To compare existing dimensions to specified dimensions by the use of calibrated instruments and gauges.

MOUNT – To attach or place tool or component in proper position.

OBSERVE – To watch, view, or note for a specific purpose.

PERFORM – To accomplish a procedure presented in a single task, at least one of the scenarios must be accomplished.

PERFORM NECESSARY ACTION – Indicates that the student is to perform the diagnostic routine(s) and perform the corrective action item. Where various scenarios (conditions or situations) are presented in a single task, at least one of the scenarios must be accomplished.

PRESSURE TEST – To use air or fluid pressure to determine the condition or operation of a component or system.

PRIORITY RATINGS – Indicates the minimum percentage of tasks, by area, a program must include in its curriculum in order to be accredited in that area.

PURGE – To eliminate an undesired air or fluid from a closed system.

READY – To prepare a system or component for service, installation or operation.

REASSEMBLE – (SEE ASSEMBLE)

RECOVER – To remove a substance, in any condition, from a system and store it in an external container.

REFILL – (SEE FILL)

REINSTALL – (SEE INSTALL)

REMOVE – To disconnect and separate a component from a system.

REPAIR – To restore a malfunctioning component or system to operating condition.

REPLACE – To exchange an unserviceable component with a new or rebuilt component; to reinstall a component.

RESET (SET) – To adjust a variable component to a given, usually initial, specification.

SCAN – To read (data) for use by a computer or computerized device.

SELECT – To choose the correct part or setting during assembly or adjustment.

SERVICE – To perform a specified procedure when called for in the owner's or service manual.

TEST – To verify condition through the use of meters, gauges or instruments.

TIME – To adjust the timed relationship between the injection and/or ignition cycle(s) and engine cycle; or to set the operating relationship between two or more components or systems.

TRIM – (SEE ADJUST)

TORQUE – To tighten a fastener to specified degree or tightness (in a given order or pattern if multiple fasteners are involved on a single component).

VACUUM TEST – To determine the integrity and operation of a vacuum (negative pressure) operated component and/or system.

VERIFY – To establish that a problem exists after hearing the customer's complaint and performing a preliminary diagnosis; or to confirm that completed repairs address the customer complaint or problem.

NATEF TASK LIST

DIESEL ENGINES

For every task in Diesel Engines, the following safety task must be strictly enforced:

Comply with personal and environmental safety practices associated with clothing; eye protection; hand protection; proper lifting practices; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of fuels/chemicals/materials in accordance with federal, state, and local regulations.

The first task in Diesel Engines is to listen to and verify the operator's concern, review past maintenance and repair documents, and determine necessary action.

I. DIESEL ENGINES

A. General

1. Inspect fuel, oil, and coolant levels, and condition, ; determine needed action. P-1
2. Identify the causes of engine fuel, oil, coolant, air, and other leaks; determine needed action. P-1
3. Listen for engine noises; determine needed action. P-3
4. Observe engine exhaust smoke color and quantity; determine needed action. P-3
5. Identify causes of no cranking, cranks but fails to start, hard starting, and starts but does not continue to run problems; determine needed action. P-1
6. Identify causes of surging, rough operation, misfiring, low power, slow deceleration, slow acceleration, and shutdown problems; determine needed action. P-1
7. Identify engine vibration problems; determine needed action. P-2
8. Check and record electronic diagnostic codes and trip/operational data; monitor electronic data; verify customer programmable parameters; clear codes; determine further diagnosis. P-1

B. Cylinder Head and Valve Train

1. Remove, clean, inspect for visible damage, and replace cylinder head(s) assembly. P-1

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| 2. | Clean and inspect threaded holes, studs, and bolts for serviceability; determine needed action. | P-1 |
| 3. | Inspect cylinder head for cracks/damage; check mating surfaces for warpage; check condition of passages; inspect core/expansion and gallery plugs; determine needed action. | P-1 |
| 4. | Disassemble head and inspect valves, guides, seats, springs, retainers, rotators, locks, and seals; determine needed action. | P-3 |
| 5. | Measure valve head height relative to deck and valve face-to-seat contact; determine needed action. | P-3 |
| 6. | Inspect injector sleeves and seals; measure injector tip or nozzle protrusion; determine needed action. | P-3 |
| 7. | Inspect valve train components; determine needed action. | P-1 |
| 8. | Reassemble cylinder head. | P-3 |
| 9. | Inspect, measure, and replace/reinstall overhead camshaft; measure/adjust end play and backlash. | P-2 |
| 10. | Inspect electronic wiring harness and brackets for wear, bending, cracks, and looseness; determine needed action. | P-1 |
| 11. | Adjust valve bridges (crossheads); adjust valve clearances and injector settings. | P-1 |

C. Engine Block

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| 1. | Perform crankcase pressure test; determine needed action. | P-1 |
| 2. | Remove, inspect, service, and install pans, covers, gaskets, seals, wear rings, and crankcase ventilation components. | P-2 |

3. Disassemble, clean, and inspect engine block for cracks/damage; measure mating surfaces for warpage; check condition of passages, core/expansion and gallery plugs; inspect threaded holes, studs, dowel pins, and bolts for serviceability; determine needed action. P-2
4. Inspect cylinder sleeve counterbore and lower bore; check bore distortion; determine needed action. P-2
5. Clean, inspect, and measure cylinder walls or liners for wear and damage; determine needed action. P-2
6. Replace/reinstall cylinder liners and seals; check and adjust liner height (protrusion). P-2
7. Inspect in-block camshaft bearings for wear and damage; determine needed action. P-3
8. Inspect, measure, and replace/reinstall in-block camshaft; measure/adjust end play. P-3
9. Clean and inspect crankshaft for surface cracks and journal damage; check condition of oil passages; check passage plugs; measure journal diameter; determine needed action. P-2
10. Inspect main bearings for wear patterns and damage; replace as needed; check bearing clearances; check and correct crankshaft end play. P-2
11. Inspect, install, and time gear train; measure gear backlash; determine needed action. P-2
12. Inspect connecting rod and bearings for wear patterns; measure pistons, pins, retainers, and bushings; perform needed action. P-2
13. Determine piston-to-cylinder wall clearance; check ring-to-groove fit and end gap; install rings on pistons. P-3
14. Assemble pistons and connecting rods; install in block; install rod bearings and check clearances. P-2
15. Check condition of piston cooling jets (nozzles); determine needed action. P-2
16. Inspect and measure crankshaft vibration damper; determine needed action. P-3
17. Install and align flywheel housing; inspect flywheel housing(s) to transmission housing/engine mating surface(s) and measure flywheel housing face and bore runout; determine needed action. P-3

18. Inspect flywheel/flexplate (including ring gear) and mounting surfaces for cracks and wear; measure runout; determine needed action. P-2

D. Lubrication Systems

1. Test engine oil pressure and check operation of pressure sensor, gauge, and/or sending unit; test engine oil temperature and check operation of temperature sensor; determine needed action. P-1
2. Check engine oil level, condition, and consumption; determine needed action. P-1
3. Inspect and measure oil pump, drives, inlet pipes, and pick-up screens; check drive gear clearances; determine needed action. P-3
4. Inspect oil pressure regulator valve(s), by-pass and pressure relief valve(s), oil thermostat, and filters; determine needed action. P-3
5. Inspect, clean, and test oil cooler and components; determine needed action. P-3
6. Inspect turbocharger lubrication and cooling systems; determine needed action. P-2
7. Determine proper lubricant and perform oil and filter change. P-1

E. Cooling System

1. Check engine coolant type, level, condition, and consumption; test coolant for freeze protection and additive package concentration; determine needed action. P-1
2. Test coolant temperature and check operation of temperature and level sensors, gauge, and/or sending unit; determine needed action. P-1
3. Inspect and reinstall/replace pulleys, tensioners and drive belts; adjust drive belts and check alignment. P-1

4. Inspect thermostat(s), by-passes, housing(s), and seals; replace as needed. P-2
5. Recover, flush, and refill with recommended coolant/additive package; bleed cooling system. P-1
6. Inspect coolant conditioner/filter assembly for leaks; inspect valves, lines, and fittings; replace as needed. P-1
7. Inspect water pump and hoses; replace as needed. P-1
8. Inspect, clean, and pressure test radiator, pressure cap, tank(s), and recovery systems; determine needed action. P-1
9. Inspect thermostatic cooling fan system (hydraulic, pneumatic, and electronic) and fan shroud; replace as needed. P-1

F. Air Induction and Exhaust Systems

1. Perform air intake system restriction and leakage tests; determine needed action. P-1
2. Perform intake manifold pressure (boost) test; determine needed action. P-1
3. Perform exhaust back pressure test; determine needed action. P-2
4. Inspect turbocharger(s), wastegate, and piping systems; determine needed action. P-2
5. Inspect and test turbocharger(s) (variable ratio/geometry VGT), pneumatic, hydraulic, electronic controls, and actuators. P-3
6. Check air induction system: piping , hoses, clamps, and mounting; service or replace air filter as needed . P-1
7. Remove and reinstall turbocharger/wastegate assembly. P-3
8. Inspect intake manifold, gaskets, and connections; replace as needed. P-3
9. Inspect, clean, and test charge air cooler assemblies; inspect aftercooler assemblies; replace as needed. P-2
10. Inspect exhaust manifold, piping, mufflers, and mounting hardware; repair or replace as needed. P-2
11. Inspect exhaust after treatment devices; determine necessary action. P-3
12. Inspect and test preheater/inlet air heater, or glow plug system and controls; perform needed action. P-2

13. Inspect and test exhaust gas recirculation (EGR) system including EGR valve, cooler, piping, filter, electronic sensors, controls, and wiring; determine needed action. P-3

G. Fuel System

1. Fuel Supply System

1. Check fuel level, and condition; determine needed action. P-1
2. Perform fuel supply and return system tests; determine needed action. P-1
3. Inspect fuel tanks, vents, caps, mounts, valves, screens, crossover system, supply and return lines and fittings; determine needed action. P-1
4. Inspect, clean, and test fuel transfer (lift) pump, pump drives, screens, fuel/water separators/indicators, filters, heaters, coolers, ECM cooling plates, and mounting hardware; determine needed action. P-1
5. Inspect and test low pressure regulator systems (check valves, pressure regulator valves, and restrictive fittings); determine needed action. P-1
6. Check fuel system for air; determine needed action; prime and bleed fuel system; check primer pump. P-1

2. Electronic Fuel Management System

1. Inspect and test power and ground circuits and connections; measure and interpret voltage, voltage drop, amperage, and resistance readings using a digital multimeter (DMM); determine needed action. P-1
2. Interface with vehicle's on-board computer; perform diagnostic procedures using recommended electronic diagnostic equipment and tools (to include PC based software and/or data scan tools); determine needed action. P-1
3. Check and record electronic diagnostic codes and trip/operational data; monitor electronic data; clear codes; determine further diagnosis. P-1
4. Locate and use relevant service information (to include diagnostic procedures, flow charts, and wiring diagrams). P-1
5. Inspect and replace electrical connector terminals, seals, and locks. P-1
6. Inspect and test switches, sensors, controls, actuator components, and circuits; adjust or replace as needed. P-1
7. Using recommended electronic diagnostic tools (to include PC based software and/or data scan tools), access and interpret customer programmable parameters. P-2

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| 8. | Inspect, test, and adjust electronic unit injectors (EUI); determine needed action. | P-2 |
| 9. | Remove and install electronic unit injectors (EUI) and related components; recalibrate ECM (if applicable). | P-2 |
| 10. | Perform cylinder contribution test utilizing recommended electronic diagnostic tool. | P-1 |
| 11. | Perform on-engine inspections and tests on hydraulic electronic unit injectors and system electronic controls; determine needed action. | P-2 |
| 12. | Perform on-engine inspections and tests on hydraulic electronic unit injector high pressure oil supply and control systems; determine needed action. | P-2 |
| 13. | Perform on-engine inspections and tests on common rail type injection systems; determine needed action. | P-3 |
| 14. | Inspect high pressure injection lines, hold downs, fittings and seals; determine needed action. | P-3 |

H. Engine Brakes

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| 1. | Inspect and adjust engine compression/exhaust brakes; determine needed action. | P-3 |
| 2. | Inspect, test, and adjust engine compression/exhaust brake control circuits, switches, and solenoids; repair or replace as needed. | P-3 |
| 3. | Inspect engine compression/exhaust brake housing, valves, seals, lines, and fittings; repair or replace as needed. | P-3 |

DRIVE TRAIN

For every task in Drive Train, the following safety task must be strictly enforced:

Comply with personal and environmental safety practices associated with clothing; eye protection; hand protection; proper lifting practices; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of fuels/chemicals/materials in accordance with federal, state, and local regulations.

The first task in Drive Train is to listen to and verify the operator's concern, review past maintenance and repair documents, and determine necessary action.

II. DRIVE TRAIN

A. Clutch

1. Identify causes of clutch noise, binding, slippage, pulsation, vibration, grabbing, dragging, and chatter problems; determine needed action. P-1
2. Inspect and adjust clutch linkage, cables, levers, brackets, bushings, pivots, springs, and clutch safety switch (includes push and pull-type assemblies); check pedal height and travel; perform needed action. P-1
3. Inspect, adjust, repair, or replace hydraulic clutch slave and master cylinders, lines, and hoses; bleed system. P-2
4. Inspect, adjust, lubricate, or replace release (throw-out) bearing, sleeve, bushings, springs, housing, levers, release fork, fork pads, rollers, shafts, and seals. P-1
5. Inspect, adjust, and replace single-disc clutch pressure plate and clutch disc. P-1
6. Inspect, adjust, and replace two-plate clutch pressure plate, clutch discs, intermediate plate, and drive pins/lugs. P-1
7. Inspect and/or replace clutch brake assembly; inspect input shaft and bearing retainer; perform needed action. P-1
8. Inspect, adjust, and replace self-adjusting/continuous-adjusting clutch mechanisms. P-1
9. Inspect and replace pilot bearing. P-2

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| 10. | Inspect flywheel mounting area on crankshaft, rear main oil seal, and measure crankshaft end play; determine needed action. | P-2 |
| 11. | Inspect flywheel, starter ring gear and measure flywheel face and pilot bore runout; determine needed action. | P-2 |
| 12. | Inspect flywheel housing(s) to transmission housing/engine mating surface(s) and measure flywheel housing face and bore runout; determine needed action. | P-2 |

B. Transmission

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| 1. | Identify causes of transmission noise, shifting, lockup, jumping-out-of-gear, overheating, and vibration problems; determine needed action. | P-1 |
| 2. | Inspect, test, repair, or replace air shift controls, lines, hoses, valves, regulators, filters, and cylinder assemblies. | P-2 |
| 3. | Inspect and replace transmission mounts, insulators, and mounting bolts. | P-1 |
| 4. | Inspect for leakage and replace transmission cover plates, gaskets, seals, and cap bolts; inspect seal surfaces and vents; repair as needed. | P-1 |
| 5. | Check transmission fluid level and condition; determine needed service; add proper type of lubricant. | P-1 |
| 6. | Inspect, adjust, and replace transmission shift lever, cover, rails, forks, levers, bushings, sleeves, detents, interlocks, springs, and lock bolts/safety wires. | P-2 |
| 7. | Remove and reinstall transmission. | P-1 |
| 8. | Inspect input shaft, gear, spacers, bearings, retainers, and slingers; determine needed action. | P-3 |
| 9. | Inspect transmission oil filters and coolers; replace as needed. | P-2 |
| 10. | Inspect speedometer components; determine needed action. | P-2 |
| 11. | Inspect and adjust power take-off (P.T.O.) assemblies, controls, and shafts; determine needed action. | P-3 |
| 12. | Inspect and test function of reverse light, neutral start, and warning device circuits; determine needed action. | P-1 |
| 13. | Inspect and test transmission temperature gauge and sensor/sending unit; determine needed action. | P-2 |

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| 14. | Inspect and test operation of automated mechanical transmission and manual electronic shift controls, shift, range and splitter solenoids, shift motors, indicators, speed and range sensors, electronic/transmission control units (ECU/TCU), neutral/in gear and reverse switches, and wiring harnesses; determine needed action. | P-2 |
| 15. | Inspect and test operation of automated mechanical transmission electronic shift selectors, air and electrical switches, displays and indicators, wiring harnesses, and air lines; determine needed action | P-2 |
| 16. | Use appropriate diagnostic tools and procedures to diagnose automated mechanical transmission problems; check and record diagnostic codes, clear codes, and interpret digital multimeter (DMM) readings; determine needed action. | P-1 |
| 17. | Inspect and test operation of automatic transmission electronic shift controls, shift solenoids, shift motors, indicators, speed and range sensors, electronic/transmission control units (ECU/TCU), neutral/in gear and reverse switches, and wiring harnesses. | P-3 |
| 18. | Inspect and test operation of automatic transmission electronic shift selectors, switches, displays and indicators, wiring harnesses. | P-3 |
| 19. | Use appropriate diagnostic tools and procedures to diagnose automatic transmission problems; check and record diagnostic codes, clear codes, and interpret digital multimeter (DMM) readings; determine needed action. | P-3 |

C. Driveshaft and Universal Joint

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| 1. | Identify causes of driveshaft and universal joint noise and vibration problems; determine needed action. | P-1 |
| 2. | Inspect, service, or replace driveshaft, slip joints, yokes, drive flanges, and universal joints, driveshaft boots and seals, and retaining hardware; check phasing of all shafts. | P-1 |
| 3. | Inspect driveshaft center support bearings and mounts; determine needed action. | P-1 |
| 4. | Measure driveline angles; determine needed action. | P-2 |

D. Drive Axle

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| 1. | Identify causes of drive axle(s) drive unit noise and overheating problems; determine needed action. | P-2 |
| 2. | Check and repair fluid leaks; inspect and replace drive axle housing cover plates, gaskets, sealants, vents, magnetic plugs, and seals. | P-1 |

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| 3. | Check drive axle fluid level and condition; determine needed service; add proper type of lubricant. | P-1 |
| 4. | Remove and replace differential carrier assembly. | P-2 |
| 5. | Inspect and replace differential case assembly including spider gears, cross shaft, side gears, thrust washers, case halves, and bearings. | P-3 |
| 6. | Inspect and replace components of locking differential case assembly. | P-3 |
| 7. | Inspect differential carrier housing and caps, side bearing bores, and pilot (spigot, pocket) bearing bore; determine needed action. | P-3 |
| 8. | Measure ring gear runout; determine needed action. | P-3 |
| 9. | Inspect and replace ring and drive pinion gears, spacers, sleeves, bearing cages, and bearings. | P-3 |
| 10. | Measure and adjust drive pinion bearing preload. | P-3 |
| 11. | Measure and adjust drive pinion depth. | P-3 |
| 12. | Measure and adjust side bearing preload and ring gear backlash. | P-3 |
| 13. | Check and interpret ring gear and pinion tooth contact pattern; determine needed action. | P-3 |
| 14. | Inspect, adjust, or replace ring gear thrust block/screw. | P-3 |
| 15. | Inspect power divider (inter-axle differential) assembly; determine needed action. | P-3 |
| 16. | Inspect, adjust, repair, or replace air operated power divider (inter-axle differential) lockout assembly including diaphragms, seals, springs, yokes, pins, lines, hoses, fittings, and controls. | P-2 |

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| 17. | Inspect, repair, or replace drive axle lubrication system: pump, troughs, collectors, slingers, tubes, and filters. | P-3 |
| 18. | Inspect and replace drive axle shafts. | P-1 |
| 19. | Remove and replace wheel assembly; check rear wheel seal and axle flange gasket for leaks; perform needed action. | P-1 |
| 20. | Identify causes of drive axle wheel bearing noise and check for damage; perform needed action. | P-1 |
| 21. | Inspect and test drive axle temperature gauge and sending unit/sensor; determine needed action. | P-2 |
| 22. | Clean, inspect, lubricate and replace wheel bearings; replace seals and wear rings; inspect and replace retaining hardware; adjust drive axle wheel bearings. | P-1 |

BRAKES

For every task in Brakes, the following safety task must be strictly enforced:

Comply with personal and environmental safety practices associated with clothing; eye protection; hand protection; proper lifting practices; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of fuels/chemicals/materials in accordance with federal, state, and local regulations.

The first task in Brakes is to listen to and verify the operator's concern, review past maintenance and repair documents, and determine necessary action.

III. BRAKES

A. Air Brakes

1. Air Supply and Service Systems

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| 1. | Identify poor stopping, air leaks, premature wear, pulling, grabbing, dragging, or balance problems caused by supply and service system malfunctions; determine needed action. | P-1 |
| 2. | Check air system build-up time; determine needed action. | P-1 |

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| 3. | Drain air reservoir/tanks; check for oil, water, and foreign material; determine needed action. | P-1 |
| 4. | Inspect compressor drive gear and coupling; replace as needed. | P-3 |
| 5. | Inspect air compressor inlet;; inspect oil supply and coolant lines, fittings, and mounting brackets; repair or replace as needed. | P-2 |
| 6. | Inspect and test air system pressure controls: governor, unloader assembly valves, filters, lines, hoses, and fittings; adjust or replace as needed. | P-1 |
| 7. | Inspect air system lines, hoses, fittings, and couplings; repair or replace as needed. | P-1 |
| 8. | Inspect and test air tank relief (safety) valves, one-way (single) check valves, two-way (double) check valves, manual and automatic drain valves; replace as needed. | P-1 |
| 9. | Inspect and clean air drier systems, filters, valves, heaters, wiring, and connectors; repair or replace as needed. | P-1 |
| 10. | Inspect and test brake application (foot) valve, fittings, and mounts; check pedal operation; replace as needed. | P-1 |
| 11. | Inspect and test stop light circuit switches, wiring, and connectors; repair or replace as needed. | P-1 |
| 12. | Inspect and test hand brake (trailer) control valve, lines, fittings, and mountings; repair or replace as needed. | P-1 |
| 13. | Inspect and test brake relay valves; replace as needed. | P-1 |
| 14. | Inspect and test quick release valves; replace as needed. | P-1 |
| 15. | Inspect and test tractor protection valve; replace as needed. | P-1 |
| 16. | Inspect and test emergency (spring) brake control/modulator valve(s); replace as needed. | P-1 |
| 17. | Inspect and test low pressure warning devices, wiring, and connectors; repair or replace as needed. | P-1 |
| 18. | Inspect and test air pressure gauges, lines, and fittings; replace as needed. | P-2 |

2. Mechanical/Foundation

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| 1. | Identify poor stopping, brake noise, premature wear, pulling, grabbing, or dragging problems caused by the foundation brake, slack adjuster, and brake chamber problems; determine needed action. | P-1 |
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| 2. | Inspect and test service brake chambers, diaphragm, clamp, spring, pushrod, clevis, and mounting brackets; repair or replace as needed. | P-1 |
| 3. | Inspect and service slack adjusters; perform needed action. | P-1 |
| 4. | Inspect camshafts, rollers, bushings, seals, spacers, retainers, brake spiders, shields, anchor pins, and springs; replace as needed. | P-1 |
| 5. | Inspect, clean, and adjust air disc brake caliper assemblies; determine needed repairs. | P-3 |
| 6. | Inspect and measure brake shoes or pads; perform needed action. | P-1 |
| 7. | Inspect and measure brake drums or rotors; perform needed action. | P-1 |

3. Parking Brakes

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| 1. | Inspect and test parking (spring) brake chamber diaphragm and seals; replace parking (spring) brake chamber; dispose of removed chambers in accordance with local regulations. | P-1 |
| 2. | Inspect and test parking (spring) brake check valves, lines, hoses, and fittings; replace as needed. | P-1 |
| 3. | Inspect and test parking (spring) brake application and release valve; replace as needed. | P-2 |
| 4. | Manually release (cage) and reset (uncage) parking (spring) brakes in accordance with manufacturers' recommendations. | P-1 |

B. Hydraulic Brakes

1. Hydraulic System

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| 1. | Identify poor stopping, premature wear, pulling, dragging, balance, or pedal feel problems caused by the hydraulic system; determine needed action. | P-2 |
| 2. | Check brake pedal pushrod length; adjust as needed. | P-3 |
| 3. | Inspect and test master cylinder for internal/external leaks and damage; replace as needed. | P-2 |
| 4. | Inspect hydraulic system brake lines, flexible hoses, and fittings for leaks and damage; replace as needed. | P-2 |
| 5. | Inspect and test metering (hold-off), load sensing/proportioning, proportioning, and combination valves; replace as needed. | P-3 |

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| 6. | Inspect and test brake pressure differential valve and warning light circuit switch, bulbs, wiring, and connectors; repair or replace as needed. | P-2 |
| 7. | Inspect disc brake caliper assemblies; replace as needed. | P-2 |
| 8. | Inspect/test brake fluid; bleed and/or flush system; determine proper fluid type. | P-2 |

2. Mechanical/Foundation

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|----|--|-----|
| 1. | Identify poor stopping, brake noise, premature wear, pulling, grabbing, dragging, or pedal feel problems caused by mechanical components; determine needed action. | P-2 |
| 2. | Inspect and measure rotors; perform needed action. | P-2 |
| 3. | Inspect and measure disc brake pads; inspect mounting hardware; perform needed action. | P-2 |
| 4. | Check parking brake operation; inspect parking brake application and holding devices; adjust and replace as needed. | P-2 |

3. Power Assist Units

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| 1. | Identify stopping problems caused by the brake assist (booster) system; determine needed action. | P-3 |
| 2. | Inspect, test, repair, or replace hydraulic brake assist (booster), hoses, and control valves; determine proper fluid type. | P-3 |
| 3. | Check emergency (back-up, reserve) brake assist system. | P-3 |

C. Air and Hydraulic Antilock Brake Systems (ABS) and Automatic Traction Control (ATC)

1. Observe antilock brake system (ABS) warning light operation (includes dash mounted trailer ABS warning light); determine needed action. P-1
2. Diagnose antilock brake system (ABS) electronic control(s) and components using self-diagnosis and/or specified test equipment (scan tool, PC computer); determine needed action. P-1
3. Identify poor stopping and wheel lock-up problems caused by failure of the antilock brake system (ABS); determine needed action. P-1
4. Test and check operation of antilock brake system (ABS) air, hydraulic, electrical, and mechanical components; perform needed action. P-1
5. Test antilock brake system (ABS) wheel speed sensors and circuits ; adjust or replace as needed. P-1
6. Bleed the ABS hydraulic circuits following manufacturers' procedures. P-2
7. Observe automatic traction control (ATC) warning light operation; determine needed action. P-3
8. Diagnose automatic traction control (ATC) electronic control(s) and components using self-diagnosis and/or specified test equipment (scan tool, PC computer); determine needed action. P-3

D. Wheel Bearings

1. Clean, inspect, lubricate and replace wheel bearings and races/cups; replace seals and wear rings; inspect spindle/tube; inspect and replace retaining hardware; adjust wheel bearings. P-1
2. Inspect or replace extended service wheel bearing assemblies. P-3

SUSPENSION AND STEERING

For every task in Suspension and Steering, the following safety task must be strictly enforced:

Comply with personal and environmental safety practices associated with clothing; eye protection; hand protection; proper lifting practices; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of fuels/chemicals/materials in accordance with federal, state, and local regulations.

The first task in Suspension and Steering is to listen to and verify the operator's concern, review past maintenance and repair documents, and determine necessary action.

IV. SUSPENSION AND STEERING

A. Steering Systems

1. Steering Column

1. Identify causes of fixed and driver adjustable steering column and shaft noise, looseness, and binding problems; determine needed action. P-1
2. Inspect and service steering shaft U-joint(s), slip joints, bearings, bushings, and seals; phase shaft.. P-1
3. Check and adjust cab mounting and ride height. P-3
4. Center the steering wheel as needed. P-1
5. Disable and enable supplemental restraint system (SRS) in accordance with manufacturers' procedures. P-1

2. Steering Units

1. Identify causes of power steering system noise, steering binding, darting/oversteer, reduced wheel cut, steering wheel kick, pulling, non-recovery, turning effort, looseness, hard steering, overheating, fluid leakage, and fluid aeration problems; determine needed action. P-1
2. Determine recommended type of power steering fluid; check level and condition; determine needed action. P-1
3. Flush and refill power steering system; purge air from system. P-2
4. Perform power steering system pressure, temperature, and flow tests; determine needed action. P-2

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| 5. | Inspect, service, or replace power steering reservoir including filter, seals, and gaskets. | P-2 |
| 6. | Inspect power steering pump drive gear and coupling; replace as needed. | P-3 |
| 7. | Inspect, adjust, or replace power steering pump, mountings, and brackets. | P-3 |
| 8. | Inspect and replace power steering system cooler, lines, hoses, clamps/mountings, hose routings, and fittings. | P-2 |
| 9. | Inspect, adjust, repair, or replace integral type power steering gear(s) (single and/or dual) and mountings. | P-1 |

3. Steering Linkage

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|----|---|-----|
| 1. | Inspect and align pitman arm; replace as needed. | P-1 |
| 2. | Check and adjust steering (wheel) stops. | P-1 |
| 3. | Inspect and lubricate steering arms and linkages. | P-1 |

B. Suspension Systems

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| 1. | Inspect front axles and attaching hardware; determine needed action. | P-1 |
| 2. | Inspect and service kingpin, steering knuckle bushings, locks, bearings, seals, and covers; determine needed action. | P-1 |
| 3. | Inspect shock absorbers, bushings, brackets, and mounts; replace as needed. | P-1 |
| 4. | Inspect leaf springs, center bolts, clips, pins and bushings, shackles, slippers, insulators, brackets, and mounts; determine needed action. | P-1 |
| 5. | Inspect axle aligning devices such as radius rods, track bars, stabilizer bars, torque arms, related bushings, mounts, shims, and cams; determine needed action. | P-1 |
| 6. | Inspect tandem suspension equalizer components; determine needed action. | P-3 |
| 7. | Inspect and test air suspension pressure regulator and height control valves, lines, hoses, dump valves, and fittings; adjust, repair or replace as needed. | P-1 |
| 8. | Inspect air springs, mounting plates, springs, suspension arms, and bushings; replace as needed. | P-1 |
| 9. | Measure ride height; determine needed action. | P-1 |

10. Identify rough ride problems; determine needed action. P-3

C. Wheel Alignment Diagnosis, Adjustment, and Repair

1. Identify causes of vehicle wandering, pulling, shimmy, hard steering, and off-center steering wheel problems; adjust or repair as needed. P-1
2. Check camber; determine needed action. P-2
3. Check caster; adjust as needed. P-2
4. Check toe; adjust as needed. P-1
5. Check rear axle(s) alignment (thrustline/centerline) and tracking; adjust or repair as needed. P-2
6. Identify turning/Ackerman angle (toe-out-on-turns) problems; determine needed action. P-3
7. Check front axle alignment (centerline); adjust or repair as needed. P-2

D. Wheels and Tires

1. Identify tire wear patterns, check tread depth and pressure determine needed action. P-1
2. Identify wheel/tire vibration, shimmy, pounding, hop (tramp) problems; determine needed action. P-2
3. Remove and install steering and drive axle wheel/tire assemblies. P-1
4. Inspect tire for proper application, (size, load range, position, and tread design); determine needed action. P-3
5. Inspect wheel/rims for proper application, load range, size, and design; determine needed action. P-3
6. Check operation of tire pressure monitoring system; determine needed action. P-3

E. Frame and Coupling Devices

1. Inspect, service, and/or adjust fifth wheel, pivot pins, bushings, locking mechanisms, and mounting hardware. P-2
2. Inspect and service sliding fifth wheel, tracks, stops, locking systems, air cylinders, springs, lines, hoses, and controls. P-2
3. Inspect frame and frame members for cracks, breaks, corrosion, distortion, elongated holes, looseness, and damage; determine needed repairs. P-1

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| 4. | Inspect, install, or repair frame hangers, brackets, and cross members in accordance with manufacturers' recommended procedures. | P-3 |
| 5. | Inspect, repair, or replace pintle hooks and draw bars. | P-3 |

ELECTRICAL/ELECTRONIC SYSTEMS

For every task in Electrical/Electronic Systems, the following safety task must be strictly enforced:

Comply with personal and environmental safety practices associated with clothing; eye protection; hand protection; proper lifting practices; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of fuels/chemicals/materials in accordance with federal, state, and local regulations.

The first task in Electrical/Electronic Systems is to listen to and verify the operator's concern, review past maintenance and repair documents, and determine necessary action.

V. ELECTRICAL/ELECTRONIC SYSTEMS

A. General Electrical Systems

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|----|---|-----|
| 1. | Read and interpret electrical/electronic circuits using wiring diagrams. | P-1 |
| 2. | Check continuity in electrical/electronic circuits using appropriate test equipment. | P-1 |
| 3. | Check applied voltages, circuit voltages, and voltage drops in electrical/electronic circuits using appropriate test equipment. | P-1 |
| 4. | Check current flow in electrical/electronic circuits and components using appropriate test equipment. | P-1 |
| 5. | Check resistance in electrical/electronic circuits and components using appropriate test equipment. | P-1 |
| 6. | Locate shorts, grounds, and opens in electrical/electronic circuits. | P-1 |
| 7. | Identify parasitic (key-off) battery drain problems; perform tests; determine needed action. | P-1 |
| 8. | Inspect and test fusible links, circuit breakers, relays, solenoids, and fuses; replace as needed. | P-1 |
| 9. | Inspect and test spike suppression devices; replace as needed. | P-3 |

10. Check frequency and pulse width signal in electrical/electronic circuits using appropriate test equipment. P-3

B. Battery

1. Perform battery load test; determine needed action. P-1
2. Determine battery state of charge using an open circuit voltage test. P-1
3. Inspect, clean, and service battery; replace as needed. P-1
4. Inspect and clean battery boxes, mounts, and hold downs; repair or replace as needed. P-1
5. Charge battery using slow or fast charge method as appropriate. P-1
6. Inspect, test, and clean battery cables and connectors; repair or replace as needed. P-1
7. Jump start a vehicle using jumper cables and a booster battery or appropriate auxiliary power supply using proper safety procedures. P-1
8. Perform battery capacitance test; determine needed action. P-2

C. Starting System

1. Perform starter circuit cranking voltage and voltage drop tests; determine needed action. P-1
2. Inspect and test components (key switch, push button and/or magnetic switch) and wires in the starter control circuit; replace as needed. P-2
3. Inspect and test, starter relays and solenoids/switches; replace as needed. P-2
4. Remove and replace starter; inspect flywheel ring gear or flex plate. P-2

D. Charging System Diagnosis and Repair

1. Test instrument panel mounted volt meters and/or indicator lamps; determine needed action. P-1
2. Identify causes of a no charge, low charge, or overcharge problems; determine needed action. P-1
3. Inspect and replace alternator drive belts, pulleys, fans, tensioners, and mounting brackets; adjust drive belts and check alignment. P-1

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| 4. | Perform charging system voltage and amperage output tests; perform AC ripple test; determine needed action. | P-1 |
| 5. | Perform charging circuit voltage drop tests; determine needed action. | P-1 |
| 6. | Remove and replace alternator. | P-2 |
| 7. | Inspect, repair, or replace cables, wires, and connectors in the charging circuit. | P-2 |

E. Lighting Systems

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| 1. | Interface with vehicle's on-board computer; perform diagnostic procedures using recommended electronic diagnostic equipment and tools (including PC based software and/or data scan tools); determine needed action. | P-1 |
| 2. | Identify causes of brighter than normal, intermittent, dim, or no headlight and daytime running light (DRL) operation. | P-1 |
| 3. | Test, aim, and replace headlights. | P-1 |
| 4. | Test headlight and dimmer circuit switches, relays, wires, terminals, connectors, sockets, and control components/modules; repair or replace as needed. | P-1 |
| 5. | Inspect and test switches, bulbs/LEDs, sockets, connectors, terminals, relays, wires, and control components/modules of parking, clearance, and taillight circuits; repair or replace as needed. | P-1 |
| 6. | Inspect and test instrument panel light circuit switches, relays, bulbs/LEDs, sockets, connectors, terminals, wires, and printed circuits/control modules; repair or replace as needed. | P-2 |
| 7. | Inspect and test interior cab light circuit switches, bulbs, sockets, connectors, terminals, wires, and control components/modules; repair or replace as needed. | P-2 |
| 8. | Inspect and test tractor-to-trailer multi-wire connector(s); repair or replace as needed. | P-1 |
| 9. | Inspect, test, and adjust stoplight circuit switches, bulbs/LEDs, sockets, connectors, terminals, wires and control components/modules; repair or replace as needed. | P-1 |
| 10. | Inspect and test turn signal and hazard circuit flasher(s), switches, relays, bulbs/LEDs, sockets, connectors, terminals, wires and control components/modules; repair or replace as needed. | P-1 |

11. Inspect and test reverse lights and warning device circuit switches, bulbs/LEDs, sockets, horns, buzzers, connectors, terminals, wires and control components/modules; repair or replace as needed. P-2

F. Gauges and Warning Devices

1. Interface with vehicle's on-board computer; perform diagnostic procedure using recommended electronic diagnostic equipment and tools (including PC based software and/or data scan tools); determine needed action. P-1
2. Identify causes of intermittent, high, low, or no gauge readings; determine needed action. P-2
3. Identify causes of data bus-driven gauge malfunctions; determine needed action. P-3
4. Inspect and test gauge circuit sensor/sending units, gauges, connectors, terminals, and wires; repair or replace as needed. P-2
5. Inspect and test warning devices (lights and audible) circuit sensor/sending units, bulbs/LEDs, sockets, connectors, wires, and control components/modules; repair or replace as needed. P-2
6. Inspect, test, replace, and calibrate (if applicable) electronic speedometer, odometer, and tachometer systems. P-2

V. ELECTRICAL/ELECTRONIC SYSTEMS

G. Related Electrical Systems

1. Interface with vehicle's on-board computer; perform diagnostic procedures using recommended electronic diagnostic equipment and tools (including PC based software and/or data scan tools); determine needed action. P-1
2. Identify causes of constant, intermittent, or no horn operation; determine needed action. P-2
3. Inspect and test horn circuit relays, horns, switches, connectors, wires, and control components/modules; repair or replace as needed. P-2
4. Identify causes of constant, intermittent, or no wiper operation; diagnose the cause of wiper speed control and/or park problems; determine needed action. P-2
5. Inspect and test wiper motor, resistors, park switch, relays, switches, connectors, wires and control components/modules; repair or replace as needed. P-2
6. Inspect wiper motor transmission linkage, arms, and blades; adjust or replace as needed. P-2

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| 7. | Inspect and test windshield washer motor or pump/relay assembly, switches, connectors, terminals, wires, and control components/modules; repair or replace as needed. | P-3 |
| 8. | Inspect and test side view mirror motors, heater circuit grids, relays, switches, connectors, terminals, wires and control components/modules; repair or replace as needed. | P-3 |
| 9. | Inspect and test heater and A/C electrical components including: A/C clutches, motors, resistors, relays, switches, connectors, terminals, wires, and control components/modules; repair or replace as needed. | P-3 |
| 10. | Inspect and test auxiliary power outlet, integral fuse, connectors, terminals, wires, and control components/modules; repair or replace as needed. | P-3 |
| 11. | Identify causes of slow, intermittent, or no power side window operation; determine needed action. | P-3 |
| 12. | Inspect and test motors, switches, relays, connectors, terminals, wires, and control components/modules of power side window circuits; repair or replace as needed. | P-3 |
| 13. | Inspect and test block heaters; determine needed repairs. | P-2 |
| 14. | Inspect and test cruise control electrical components; repair or replace as needed. | P-3 |
| 15. | Inspect and test switches, relays, controllers, actuator/solenoids, connectors, terminals, and wires of electric door lock circuits. | P-3 |
| 16. | Check operation of keyless and remote lock/unlock devices; determine needed action. | P-3 |
| 17. | Inspect and test engine cooling fan electrical control components/modules; repair or replace as needed. | P-2 |
| 18. | Identify causes of data bus communication problems; determine needed action. | P-2 |

HEATING, VENTILATION, & AIR CONDITIONING

For every task in Heating, Ventilation, and Air Conditioning, the following safety task must be strictly enforced:

Comply with personal and environmental safety practices associated with clothing; eye protection; hand protection; proper lifting practices; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of fuels/chemicals/materials in accordance with federal, state, and local regulations.

The first task in Heating, Ventilation, & Air Conditioning is to listen to and verify the operator's concern, review past maintenance and repair documents, and determine necessary action.

VI. HEATING, VENTILATION, & AIR CONDITIONING

All practices and procedures must be performed according to current mandates, standards, and regulations.

A. HVAC Systems

1. Verify the need for service or repair of HVAC systems based on unusual operating noises; determine needed action. P-1
2. Verify the need for service or repair of HVAC systems based on unusual visual, smell, and touch conditions; determine needed action. P-1
3. Identify system type and components (cycling clutch orifice tube – CCOT, expansion valve) and conduct performance test(s) on HVAC systems; determine needed action. P-1
4. Retrieve diagnostic codes; determine needed action. P-3

B. A/C System and Components

1. A/C System - General

1. Identify causes of temperature control problems in the A/C system; determine needed action. P-1
2. Identify refrigerant and lubricant types; check for contamination; determine needed action. P-1
3. Identify A/C system problems indicated by pressure gauge and temperature readings; determine needed action. P-1
4. Identify A/C system problems indicated by visual, audible, smell, and touch procedures; determine needed action. P-1

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| 5. | Perform A/C system leak test; determine needed action. | P-1 |
| 6. | Recover, evacuate, and recharge A/C system using appropriate equipment. | P-1 |
| 7. | Identify contaminated A/C system components and hoses; determine needed action. | P-3 |

2. Compressor and Clutch

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| 1. | Identify A/C system problems that cause protection devices (pressure, thermal, and electronic) to interrupt system operation; determine needed action. | P-1 |
| 2. | Inspect, test, and replace A/C system pressure, thermal, and electronic protection devices. | P-2 |
| 3. | Inspect and replace A/C compressor drive belts, pulleys, and tensioners; adjust belt tension and check alignment. | P-1 |
| 4. | Inspect, test, service, or replace A/C compressor clutch components or assembly. | P-2 |
| 5. | Inspect and correct A/C compressor lubricant level (if applicable). | P-2 |
| 6. | Inspect, test, or replace A/C compressor. | P-2 |
| 7. | Inspect, repair, or replace A/C compressor mountings and hardware. | P-2 |

3. Evaporator, Condenser, and Related Components

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| 1. | Correct system lubricant level when replacing the evaporator, condenser, receiver/drier or accumulator/drier, and hoses. | P-1 |
| 2. | Inspect A/C system hoses, lines, filters, fittings, and seals; determine needed action. | P-1 |
| 3. | Inspect A/C condenser for proper air flow. | P-1 |
| 4. | Inspect and test A/C system condenser and mountings; determine needed action. | P-2 |
| 5. | Inspect and replace receiver/drier or accumulator/drier. | P-1 |
| 6. | Inspect and test cab/sleeper refrigerant solenoid, expansion valve(s); check placement of thermal bulb (capillary tube); determine needed action. | P-3 |
| 7. | Remove and replace orifice tube. | P-1 |
| 8. | Inspect and test cab/sleeper evaporator core; determine needed action. | P-3 |

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| 9. | Inspect, clean, or repair evaporator housing and water drain; inspect and service/replace evaporator air filter. | P-1 |
| 10. | Identify and inspect A/C system service ports (gauge connections); determine needed action. | P-1 |
| 11. | Identify the cause of system failures resulting in refrigerant loss from the A/C system high pressure relief device; determine needed action. | P-2 |

C. Heating and Engine Cooling Systems

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|-----|---|-----|
| 1. | Identify causes of outlet air temperature control problems in the HVAC system; determine needed action. | P-1 |
| 2. | Identify window fogging problems; determine needed action. | P-2 |
| 3. | Perform engine cooling system tests for leaks, protection level, contamination, coolant level, coolant type, temperature, and conditioner concentration; determine needed action. | P-1 |
| 4. | Inspect engine cooling and heating system hoses, lines, and clamps; determine needed action. | P-1 |
| 5. | Inspect and test radiator, pressure cap, and coolant recovery system (surge tank); determine needed action. | P-1 |
| 6. | Inspect water pump for leaks and bearing play; determine needed action. | P-2 |
| 7. | Inspect and test thermostats, by-passes, housings, and seals; determine needed repairs. | P-2 |
| 8. | Recover, flush, and refill with recommended coolant/additive package; bleed cooling system. | P-1 |
| 9. | Inspect thermostatic cooling fan system (hydraulic, pneumatic, and electronic) and fan shroud; replace as needed. | P-2 |
| 10. | Inspect and test heating system coolant control valve(s) and manual shut-off valves; determine needed action. | P-2 |
| 11. | Inspect and flush heater core; determine needed action. | P-3 |

D. Operating Systems and Related Controls

1. Electrical

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| 1. | Identify causes of HVAC electrical control system problems; determine needed action. | P-1 |
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| 2. | Inspect and test HVAC blower motors, resistors, switches, relays, modules, wiring, and protection devices; determine needed action. | P-2 |
| 3. | Inspect and test A/C compressor clutch relays, modules, wiring, sensors, switches, diodes, and protection devices; determine needed action. | P-2 |
| 4. | Inspect and test A/C related electronic engine control systems; determine needed action. | P-2 |
| 5. | Inspect and test engine cooling/condenser fan motors, relays, modules, switches, sensors, wiring, and protection devices; determine needed action. | P-2 |
| 6. | Inspect and test electric actuator motors, relays/modules, switches, sensors, wiring, and protection devices; determine needed action. | P-3 |
| 7. | Inspect and test HVAC system electrical/electronic control panel assemblies; determine needed action. | P-3 |

2. Air/ Mechanical

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| 1. | Identify causes of HVAC air and mechanical control problems; determine needed action. | P-3 |
| 2. | Inspect and test HVAC system air and mechanical control panel assemblies; determine needed action. | P-3 |
| 3. | Inspect, test, and adjust HVAC system air and mechanical control cables and linkages; determine needed action. | P-3 |
| 4. | Inspect and test HVAC system actuators and hoses; determine needed action. | P-3 |
| 5. | Inspect, test, and adjust HVAC system ducts, doors, and outlets; determine needed action. | P-3 |

E. Refrigerant Recovery, Recycling, and Handling

NOTE: Tasks 1 through 5 should be accomplished in accordance with appropriate EPA regulations and SAE “J” standards.

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| 1. | Maintain and verify correct operation of certified equipment. | P-1 |
| 2. | Identify and recover A/C system refrigerant. | P-1 |
| 3. | Recycle or properly dispose of refrigerant. | P-1 |
| 4. | Handle, label, and store refrigerant. | P-1 |
| 5. | Test recycled refrigerant for non-condensable gases. | P-1 |

PREVENTIVE MAINTENANCE AND INSPECTION

For every task in Preventive Maintenance and Inspection, the following safety task must be strictly enforced:

Comply with personal and environmental safety practices associated with clothing; eye protection; hand protection; proper lifting practices; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of fuels/chemicals/materials in accordance with federal, state, and local regulations.

The tasks included in the Preventive Maintenance and Inspection area are entry-level technician inspection tasks designed to introduce the student to correct procedures and practices of vehicle inspection in a teaching/learning environment. They are not intended to satisfy the Annual Federal Vehicle Inspection requirement as prescribed in the *Federal Motor Carrier Safety Regulations, Part 396, Appendix G to Subchapter B, Minimum Periodic Inspection Standards*.

The first task in Preventive Maintenance is to listen to and verify operator's concern, review past maintenance documents, and record condition on appropriate document.

VII. PREVENTIVE MAINTENANCE and INSPECTION

A. Engine System

1. Engine

1. Check engine starting/operation (including unusual noises, vibrations, exhaust smoke, etc.); record idle and governed rpm. P-1
2. Inspect vibration damper. P-1
3. Inspect belts, tensioners, and pulleys; check and adjust belt tension; check belt alignment. P-1
4. Check engine oil level and condition; check dipstick seal. P-1
5. Inspect engine mounts for looseness and deterioration. P-1
6. Check engine for oil, coolant, air, fuel, and exhaust leaks (Engine Off and Running). P-1
7. Check engine compartment wiring harnesses, connectors, and seals for damage and proper routing. P-1

2. Fuel System

1. Check fuel tanks, mountings, lines, caps, and vents. P-1
2. Drain water from fuel system. P-1

3. Service water separator/fuel heater; replace fuel filter(s); prime and bleed fuel system. P-1

3. Air Induction and Exhaust System

1. Check exhaust system mountings for looseness and damage. P-1
2. Check engine exhaust system for leaks, proper routing, and damaged or missing components to include exhaust gas recirculation (EGR) system and after treatment devices, if equipped. P-1
3. Check air induction system: piping, charge air cooler, hoses, clamps, and mountings; check for air restrictions and leaks. P-1
4. Inspect turbocharger for leaks; check mountings and connections. P-1
5. Check operation of engine compression/exhaust brake. P-1
6. Service or replace air filter as needed; check and reset air filter restriction indicator. P-1
7. Inspect and service crankcase ventilation system. P-1

4. Cooling System

1. Check operation of fan clutch. P-1
2. Inspect radiator (including air flow restriction, leaks, and damage) and mountings. P-1
3. Inspect fan assembly and shroud. P-1
4. Pressure test cooling system and radiator cap. P-1
5. Inspect coolant hoses and clamps. P-1
6. Inspect coolant recovery system. P-1
7. Check coolant for contamination, additive package concentration, and protection level (freeze point). P-1
8. Service coolant filter. P-1
9. Inspect water pump for leaks and bearing play. P-1

5. Lubrication System

1. Change engine oil and filters; visually check oil for coolant or fuel contamination; inspect and clean magnetic drain plugs. P-1
2. Take an engine oil sample. P-1

B. Cab and Hood

1. Instruments and Controls

1. Inspect key condition and operation of ignition switch. P-1
2. Check warning indicators. P-1
3. Check instruments; record oil pressure and system voltage. P-1
4. Check operation of electronic power take off (PTO) and engine idle speed controls (if applicable). P-1
5. Check HVAC controls. P-1
6. Check operation of all accessories. P-1
7. Using diagnostic tool or on-board diagnostic system; retrieve engine monitoring information; check and record diagnostic codes and trip/operational data (including engine, transmission, ABS, and other systems). P-1

2. Safety Equipment

1. Check operation of electric/air horns and reverse warning devices. P-1
2. Check condition of spare fuses, triangles, fire extinguisher, and all required decals. P-1
3. Inspect seat belts and sleeper restraints. P-1
4. Inspect wiper blades and arms. P-1

3. Hardware

1. Check operation of wiper and washer. P-1
2. Inspect windshield glass for cracks or discoloration; check sun visor. P-1
3. Check seat condition, operation, and mounting. P-1
4. Check door glass and window operation. P-1
5. Inspect steps and grab handles. P-1

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| 6. | Inspect mirrors, mountings, brackets, and glass. | P-1 |
| 7. | Record all observed physical damage. | P-1 |
| 8. | Lubricate all cab and hood grease fittings. | P-1 |
| 9. | Inspect and lubricate door and hood hinges, latches, strikers, lock cylinders, safety latches, linkages, and cables. | P-1 |
| 10. | Inspect cab mountings, hinges, latches, linkages and ride height; service as needed. | P-1 |

4. Heating, Ventilation, & Air Conditioning (HVAC)

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| 1. | Inspect A/C condenser and lines for condition and visible leaks; check mountings. | P-1 |
| 2. | Inspect A/C compressor and lines for condition and visible leaks; check mountings. | P-1 |
| 3. | Check A/C system condition and operation; check A/C monitoring system, if applicable. | P-1 |
| 4. | Check HVAC air inlet filters and ducts; service as needed. | P-1 |

C. Electrical/Electronics

1. Battery and Starting Systems

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| 1. | Inspect battery box(es), cover(s), and mountings. | P-1 |
| 2. | Inspect battery hold-downs, connections, cables, and cable routing; service as needed. | P-1 |
| 3. | Check/record battery state-of-charge (open circuit voltage) and condition. | P-1 |
| 4. | Perform battery test (load and/or capacitance). | P-1 |
| 5. | Inspect starter, mounting, and connections. | P-1 |
| 6. | Engage starter; check for unusual noises, starter drag, and starting difficulty. | P-1 |

2. Charging System

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| 1. | Inspect alternator, mountings, cable, wiring, and wiring routing; determine needed action. | P-1 |
| 2. | Perform alternator output tests. | P-1 |

3. Lighting System

1. Check operation of interior lights; determine needed action. P-1
2. Check all exterior lights, lenses, reflectors, and conspicuity tape; check headlight alignment; determine needed action. P-1
3. Inspect and test tractor-to-trailer multi-wire connector(s), cable(s), and holder(s); determine needed action. P-1

D. Frame and Chassis

1. Air Brakes

1. Check operation of parking brake. P-1
2. Record air governor cut-out setting (psi). P-1
3. Check operation of air reservoir/tank drain valves. P-1
4. Check air system for leaks (brakes released). P-1
5. Check air system for leaks (brakes applied). P-1
6. Test one-way and double-check valves. P-1
7. Check low air pressure warning devices. P-1
8. Check air governor cut-in pressure. P-1
9. Check emergency (spring) brake control/modulator valve, if applicable. P-1
10. Check tractor protection valve. P-1
11. Test air pressure build-up time. P-1
12. Inspect coupling air lines, holders, and gladhands. P-1
13. Check brake chambers and air lines for secure mounting and damage. P-1
14. Check operation of air drier. P-1
15. Inspect and record brake shoe/pad condition, thickness, and contamination. P-1
16. Inspect and record condition of brake drums/rotors. P-1
17. Check antilock brake system wiring, connectors, seals, and harnesses for damage and proper routing. P-1

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| 18. | Check operation and adjustment of brake automatic slack adjusters (ASA); check and record push rod stroke. | P-1 |
| 19. | Lubricate all brake component grease fittings. | P-1 |
| 20. | Check condition and operation of hand brake (trailer) control valve. | P-1 |
| 21. | Perform antilock brake system (ABS) operational system self-test. | P-1 |
| 22. | Drain air tanks and check for contamination. | P-1 |
| 23. | Check condition of pressure relief (safety) valves. | P-1 |

2. Hydraulic Brakes

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| 1. | Check master cylinder fluid level and condition. | P-1 |
| 2. | Inspect brake lines, fittings, flexible hoses, and valves for leaks and damage. | P-1 |

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|----|---|-----|
| 3. | Check parking brake operation; inspect parking brake application and holding devices; adjust as needed. | P-1 |
| 4. | Check operation of hydraulic system: pedal travel, pedal effort, pedal feel (drift). | P-1 |
| 5. | Inspect calipers for leakage and damage. | P-1 |
| 6. | Inspect brake assist system (booster), hoses and control valves; check reservoir fluid level and condition. | P-1 |
| 7. | Inspect and record brake lining/pad condition, thickness, and contamination. | P-1 |
| 8. | Inspect and record condition of brake rotors. | P-1 |
| 9. | Check antilock brake system wiring, connectors, seals, and harnesses for damage and proper routing. | P-1 |

3. Drive Train

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|-----|--|-----|
| 1. | Check operation of clutch, clutch brake, and gearshift. | P-1 |
| 2. | Check clutch linkage/cable for looseness or binding, if applicable. | P-1 |
| 3. | Check hydraulic clutch slave and master cylinders, lines, fittings, and hoses, if applicable. | P-1 |
| 4. | Check clutch adjustment; adjust as needed. | P-1 |
| 5. | Check transmission case, seals, filter, hoses, and cooler for cracks and leaks. | P-1 |
| 6. | Inspect transmission breather. | P-1 |
| 7. | Inspect transmission mounts. | P-1 |
| 8. | Check transmission oil level, type, and condition. | P-1 |
| 9. | Inspect U-joints, yokes, driveshafts, boots/seals, center bearings, and mounting hardware for looseness, damage, and proper phasing. | P-1 |
| 10. | Inspect axle housing(s) for cracks and leaks. | P-1 |
| 11. | Inspect axle breather(s). | P-1 |
| 12. | Lubricate all drive train grease fittings. | P-1 |
| 13. | Check drive axle(s) oil level, type, and condition. | P-1 |

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|-----|--|-----|
| 14. | Change drive axle(s) oil and filter; check and clean magnetic plugs. | P-1 |
| 15. | Check transmission wiring, connectors, seals, and harnesses for damage and proper routing. | P-1 |
| 16. | Change transmission oil and filter; check and clean magnetic plugs. | P-1 |
| 17. | Check interaxle differential lock operation. | P-1 |
| 18. | Check range shift operation. | P-1 |

4. Suspension and Steering Systems

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|-----|---|-----|
| 1. | Check steering wheel operation for free play or binding. | P-1 |
| 2. | Check power steering pump, mounting, and hoses for leaks, condition, and routing; check fluid level. | P-1 |
| 3. | Change power steering fluid and filter. | P-1 |
| 4. | Inspect steering gear for leaks and secure mounting. | P-1 |
| 5. | Inspect steering shaft U-joints, pinch bolts, splines, pitman arm-to-steering sector shaft, tie rod ends, and linkages. | P-1 |
| 6. | Check kingpin for wear. | P-1 |
| 7. | Check wheel bearings for looseness and noise. | P-1 |
| 8. | Check oil level and condition in all non-drive hubs; check for leaks. | P-1 |
| 9. | Inspect springs, pins, hangers, shackles, spring U-bolts, and insulators. | P-1 |
| 10. | Inspect shock absorbers for leaks and secure mounting. | P-1 |
| 11. | Inspect air suspension springs, mounts, hoses, valves, linkage, and fittings for leaks and damage. | P-1 |
| 12. | Check and record suspension ride height. | P-1 |
| 13. | Lubricate all suspension and steering grease fittings. | P-1 |
| 14. | Check toe setting. | P-1 |
| 15. | Check tandem axle alignment and spacing. | P-1 |
| 16. | Check axle locating components (radius, torque, and/or track rods). | P-1 |

5. Tires and Wheels

1. Inspect tires for wear patterns and proper mounting. P-1
2. Inspect tires for cuts, cracks, bulges, and sidewall damage. P-1
3. Inspect valve caps and stems; replace as needed. P-1
4. Measure and record tread depth; probe for imbedded debris. P-1
5. Check and record air pressure; adjust air pressure in accordance with manufacturers' specifications. P-1
6. Check for loose lugs; check mounting hardware condition; service as needed. P-1
7. Retorque lugs in accordance with manufacturers' specifications. P-1
8. Inspect wheels for cracks or damage. P-1
9. Check tire matching (diameter and tread) on dual tire installations. P-1

6. Frame and Fifth Wheel

1. Inspect fifth wheel mounting, bolts, air lines, and locks. P-1
2. Test operation of fifth wheel locking device; adjust if necessary. P-1
3. Check quarter fenders, mud flaps, and brackets. P-1
4. Check pintle hook assembly and mounting. P-1
5. Lubricate all fifth wheel grease fittings and plate. P-1
6. Inspect frame and frame members for cracks and damage. P-1

HYDRAULICS

For every task in Hydraulics, the following safety task must be strictly enforced:

Comply with personal and environmental safety practices associated with clothing; eye protection; hand protection; proper lifting practices; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of fuels/chemicals/materials in accordance with federal, state, and local regulations.

The first task in Hydraulics is to listen to and verify the operator's concern, review past maintenance and repair documents, and determine necessary action.

VIII. HYDRAULICS

A. General System Operation

1. Identify system type (closed and open) and verify proper operation. P-1
2. Read and interpret system diagrams and schematics. P-1
3. Perform system temperature, pressure, flow, and cycle time tests; determine needed action. P-1
4. Verify placement of equipment /component safety labels and placards; determine needed action. P-1

B. Pumps

1. Identify system fluid type. P-1
2. Identify causes of pump failure, unusual pump noises, temperature, flow, and leakage problems; determine needed action. P-2
3. Determine pump type, rotation, and drive system. P-2
4. Remove and install pump; prime and/or bleed system. P-2
5. Inspect pump inlet for restrictions and leaks; determine needed action. P-2
6. Inspect pump outlet for restrictions and leaks; determine needed action. P-2

C. Filtration/ Reservoirs (Tanks)

1. Identify type of filtration system; verify filter application and flow direction. P-1
2. Service filters and breathers. P-1
3. Identify causes of system contamination; determine needed action. P-2
4. Take a hydraulic oil sample. P-2
5. Check reservoir fluid level and condition; determine needed action. P-1
6. Inspect and repair or replace reservoir, sight glass, vents, caps, mounts, valves, screens, supply and return lines. P-2

D. Hoses, Fittings, and Connections

1. Diagnose causes of component leakage, damage, and restriction; determine needed action. P-2

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|----|---|-----|
| 2. | Inspect hoses and connections (length, size, routing, bend radii, and protection); repair or replace as needed. | P-1 |
| 3. | Assemble hoses, tubes, connectors, and fittings in accordance with manufacturers' specifications; use proper procedures to avoid contamination. | P-2 |
| 4. | Inspect and replace fitting seals and sealants. | P-2 |

E. Control Valves

- | | | |
|----|---|-----|
| 1. | Pressure test system safety relief valve; determine needed action. | P-2 |
| 2. | Perform control valve operating pressure and flow tests; determine needed action. | P-2 |
| 3. | Inspect, test, and adjust valve controls (electrical/electronic, mechanical, and pneumatic). | P-2 |
| 4. | Identify causes of control valve leakage problems (internal/external); determine needed action. | P-2 |
| 5. | Inspect pilot control valve linkages, cables, and PTO controls; adjust, repair, or replace as needed. | P-1 |

F. Actuators

Comply with manufacturers' and industry accepted safety practices associated with equipment lock out/tag out; pressure line release; implement/support (blocked or resting on ground); and articulated cylinder devices/machinery safety locks.

1. Identify actuator type (single/double acting, multi-stage/telescopic, and motors).. P-1
2. Identify the cause of seal failure; determine needed repairs. P-2
3. Identify the cause of incorrect actuator movement and leakage (internal and external); determine needed repairs. P-2
4. Inspect actuator mounting, frame components, and hardware for looseness, cracks, and damage; determine needed action. P-2
5. Remove, repair, and/or replace actuators in accordance with manufacturers' recommended procedures. P-2
6. Inspect actuators for dents, cracks, damage, and leakage; determine needed action. P-2
7. Purge and/or bleed system in accordance with manufacturers' recommended procedures. P-1

Task List Priority Item Totals (by area)

I.	Diesel Engines		V.	Electrical/Electronic Systems	
	P-1 = 39	95% = 37 tasks		P-1 = 31	95% = 29 tasks
	P-2 = 26	70% = 18 tasks		P-2 = 21	70% = 15 tasks
	P-3 = 24	25% = 6 tasks		P-3 = 12	25% = 3 tasks
II.	Drive Train		VI.	Heating, Ventilation, & Air Conditioning	
	P-1 = 23	95% = 22 tasks		P-1 = 29	95% = 28 tasks
	P-2 = 17	70% = 12 tasks		P-2 = 16	70% = 11 tasks
	P-3 = 17	25% = 4 tasks		P-3 = 12	25% = 3 tasks
III.	Brakes		VII.	Preventative Maintenance Inspection	
	P-1 = 30	95% = 29 tasks		P-1 = 145	95% = 138 tasks
	P-2 = 14	70% = 10 tasks		P-2 = 0	
	P-3 = 10	25% = 3 tasks		P-3 = 0	
IV.	Suspension & Steering		VIII.	Hydraulics	
	P-1 = 23	95% = 22 tasks		P-1 = 12	95% = 11 tasks
	P-2 = 11	70% = 8 tasks		P-2 = 20	70% = 14 tasks
	P-3 = 11	25% = 3 tasks		P-3 = 0	

TOOLS AND EQUIPMENT

Local employer needs and the availability of funds are key factors for determining each program's structure and operation. The NATEF Standards recognize that not all programs have the same needs, nor do all programs teach 100 % of the NATEF tasks. Therefore, the basic philosophy for the tools and equipment requirement is as follows: *for all tasks which are taught in the program, the training should be as thorough as possible with the tools and equipment necessary for those tasks.* In other words, if a program does not teach a particular task, the tool from the tool list associated with that task is not required (unless of course it is required for a task that is taught in another area).

The NATEF tool lists are organized into three basic categories: *Hand Tools*, *General Lab/Shop Equipment*, and *Specialty Tools and Equipment*. The specialty tools section is further separated into the eight NATEF task categories. When referring to the tools and equipment list, please note the following:

1. The organization of the tool list is not intended to dictate how a program organizes its tool crib or student tool sets (i.e., which tools should be in a student set, if utilized, and which should be in the tool crib or shop area).
2. Quantities for each tool or piece of equipment are determined by the program needs; however, sufficient quantities to provide quality instruction should be on hand.
3. For *Specialty Tools and Equipment*, the program need only have those tools for the areas being accredited.
4. Programs may meet the equipment requirements by borrowing special equipment or providing for off-site instruction (e.g., in a dealership or independent repair shop). Use of borrowed or off-site equipment *must* be appropriately documented.
5. No specific brand names for tools and equipment are specified or required.
6. Although the NATEF Standards recommend that programs encourage their students to begin to build their own individual tools sets prior to entry into the industry, there is no requirement to do so. NOTE: Industry surveys indicate that most (90%) employers require that a candidate for employment provide his/her own basic hand tool set in order to be hired as an entry-level automobile technician.

HAND TOOLS
(contained in individual sets or tool crib
in sufficient quantities to permit efficient instruction)

Hex Key Wrench Set - Standard
 (.050" - 3/8")
 (7/16" - 1/2" optional)

Hex Key Wrench Set - Metric (2mm - 12mm)

Stud-to-Post or Charging/Test Adapter

Chisels - Cold 5/8", 3/4"

Combination Wrenches - Standard (3/8" - 1") (up to 1 and 1/4" optional)
 Metric (6mm - 19mm) (up to 24mm optional)

Digital Multimeter - minimum 10 meg. ohms impedance

Electrical Pliers - Crimper/Stripper

Files and Handles - 12" Fine
 12" Coarse
 12" Half Round

Flare Nut Wrench Set - Standard (3/8" - 3/4")
 Metric (7mm - 19mm)

Flashlight

Goggles - (per OSHA requirements)

Hack Saw

Hammers - Ball Peen - 16 oz. and 24 oz.
 Soft Face

Hearing Protection - (per OSHA requirements)

Inspection Mirror

Magnetic Pickup Tool

Mechanic's Steel Ruler - Machinist Rule

Pliers - Adjustable Joint
 Locking Pliers
 Needle Nose
 Side Cutters
 Slip-joint

Punches - Pin 3/16" - 3/8"
 Starter 3/16" - 3/8"
 Aligning Punch Set
 Brass punch
 Center punch

Safety Glasses (Side Panels) - (per OSHA requirements)

Scraper - 1" wide or larger

Screwdriver - Blade Type: 1"
 6"
 9"
 12"
 Offset

Screwdriver - Phillips: 1" #2
 6" #1, #2
 12" #3

Socket Set - 1/4" Drive: 3/16" - 1/2" U.S. Standard Depth

3/16" - 1/2" U.S. Deep
 4mm - 13mm Metric Standard Depth
 4mm - 13mm Metric Deep
 Extensions - Short, Medium, and Long
 Ratchet Handle
 Universal Joint
 Socket Set - 3/8" Drive: 3/8" - 3/4" U.S. Standard Depth (12 point), Impact or Chrome
 3/8" - 3/4" U.S. Deep (6 point), Impact or Chrome
 10mm - 19mm Metric Standard Depth (6 point), Impact or Chrome
 10mm - 19mm Metric Deep (6 point), Impact or Chrome
 Extensions - Short, Medium, and Long
 Ratchet Handle
 Universal Joint
 Socket Set - 1/2" Drive: 1/2" - 1 1/8" Shallow, Impact or Chrome
 7/16" - 1 1/8" Deep, Impact or Chrome
 13mm - 32mm Shallow, Impact or Chrome
 13mm - 32mm Deep, Impact or Chrome
 Breaker Bar
 Extensions - Short, Medium, and Long
 Ratchet Handle
 Universal Joint
 Tape Measure (25')
 Tire Tread Depth Gauge
 Tire Pressure Gauge - Truck
 Tool Box
 Wire Brush

GENERAL LAB/SHOP EQUIPMENT

The tools and equipment on this list are used in general lab/shop work, but are not generally considered to be individually owned hand tools. A well equipped, accredited program should have all of these general tools and equipment readily available and in sufficient quantity to provide quality instruction.

Adjustable Wrenches - (up to 18")
Air Blow Gun - Rubber Tip (per OSHA requirements)
Air Ratchet Wrench - 3/8" Drive with Impact Socket Set
Standard and Metric
Back Support Belt
Belt Tension Gauge
Bushing Driver Set
C-Clamps
Cleaning Tank
Combination Wrench Set - 3/8" – 1 1/2" and 6mm - 24mm
3/8" - 3/4" Offset (optional)
7mm - 15mm Offset (optional)
Coolant Conditioner Test Kit (Test Strips)
Cooling System Pressure Tester
Creepers
Diagnostic Information Reader - PC with appropriate software and/or internet-access drive for
reading electronic service information
Diagnostic Tool - PC or Data Scan Tool with appropriate software
Dial or Digital Caliper - Standard and Metric
Dial Indicator Set - Magnetic Base
Drain Pans
Drill - 3/8" variable speed, reversible
1/2" variable speed, reversible
Drill Bits - 1/16" - 1/2"
Extractor Set (broken bolt)
Face Shield
Feeler Gauge - Blade Type: .005" - .050"
.005mm - .070mm
Filter Wrenches - Small and Large
Fin Comb
Floor Jack - (10 Ton)
Funnels
Gear Oil Dispenser
Grease Gun
Grinder – Bench
Hammers - 48 oz. Ball Peen
24 oz. Brass
12 lb. Hand Sledge
Hand Held Infrared Thermometer

Wheel Dolly
Wheel Socket Set

SPECIALTY TOOLS AND EQUIPMENT

This section covers the tools and equipment a lab/shop should have for training in any given specialty area. This equipment is specialized and it must be available in the lab/shop. No specific type or brand names are identified because they will vary in each local situation.

Note: All shops are assumed to have an air compressor, air hoses, adequate electrical capability, fender covers, seat covers, and workbenches with vises.

DIESEL ENGINES

- Ball/Small Hole Gauges
- Cooling System Vacuum Fill Machine (optional)
- Dial Bore Gauge or Telescoping Gauges
- Engine Stands
- Fan Hub Wrenches
- Injector Removal Tool(s)
- Liner Installer (universal)
- Liner Puller (universal)
- Manometer - (Water) or Magnehelic Gauge
- Precision Straight Edge
- Protrusion Gauge (Cylinder Liner Height)
- Ring Compressor
- Ring Expander(s)
- Rod Bolt Protectors
- Soft Jaw Vise or Adapters
- Valve Spring Compressor
- Vibration Damper Puller

SUSPENSION & STEERING

- Air Hammer with Chisels
- Alignment Equipment: Minimum to perform tasks (including tandem alignment)
- Flow Meter - Power Steering
- Pitman Arm Puller
- Tape Measure (50')

BRAKES

Bearing Packer (optional)
Bearing Race Installer
Brake Bleeder
Brake Fluid Tester or Test Strips
Brake Lining Thickness Gauge
Brake Rotor (Disc) Micrometer
Brake Spring Tool
Disc Caliper Tool for Compressing Caliper Pistons
Drum Brake Gauge
Method for removing asbestos contamination (Parts Cleaner) meeting EPA Standards
Seal Installers
Slack Adjuster Installation Index Tool (Templates)

ELECTRICAL/ELECTRONIC SYSTEMS

Battery Charger (200 AMP Minimum)
Battery Terminal Adapters
Die Type Terminal Crimper (optional)
Capacitance Battery Tester
GMM Labscope or DMM with scope capability
Inductive (Clamp-on) Ammeter
Jumper Cable Set (Heavy-Duty)
Load Tester - Starting, Charging, and Battery (1,000 AMP Minimum)
Low AMP Automatic Charger or equivalent device to maintain shop batteries.
Test Lead Kit
Terminal Repair Kits

PREVENTIVE MAINTENANCE

Fifth Wheel Test Pin
Stop Watch
Tire Square
Trailer Cord Tester

DRIVE TRAIN

3/4" Drive Pinion Nut Sockets
Aligning Studs - 3/8", 1/2", & 5/8"
Axle Shaft Removal Tool
Blind Hole/Pilot Bearing Puller
Clutch Adjusting Tools (Pull Type)
Clutch Disc Aligning Tool
Clutch Jack and/or Transmission Jack Attachments
Protractor (Angle Gauge)
Transmission Jack

U-Joint Puller
Yoke Puller

HEATING, VENTILATION, AND AIR CONDITIONING

A/C Compressor Clutch Pullers
Gloves
Halogen Leak Detector (for HFCs)*
Heater Hose Clamp-Off Tool
Manifold Gauge Set*
Measuring Cup
Micron Meter (Electronic Vacuum Gauge) – (optional)
Orifice Tube Remover
Portable Vacuum Pump (maybe included with Recovery/Recycling/Recharging Station Equipment)
Recovery/Recharging and/or Recycling Station*
Spring Lock Coupler Removers
Thermometer
Valve Core (Shrader Type) Replacement Tool
* Meeting EPA Regulations and SAE “J” Standards

HYDRAULICS

Fittings and adapters for specific applications
Hose Crimper Tool and Pump (either air over hydraulic or hand pump)-(optional)
1000 PSI Liquid Filled or Electronic Gauge and Hose Assembly
5000 PSI Liquid Filled or Electronic Gauge and Hose Assembly
Pressure/Flow Meter
Thermometer (up to 250 degrees) Standard or Infrared

APPLIED ACADEMICS AND WORKPLACE SKILLS

The following Applied Academic Skills general statements were developed in cooperation with the Vocational-Technical Education Consortium of States (V-TECS). The process involved using the NATEF task list and the Basic/Essential Skills Taxonomy developed at Arizona State University by Dr. Lester Snyder.

Committee meetings were held in the following four cities: Beaverton, Oregon; Bessemer, Alabama; Clayton, Ohio; and Melrose Park, Illinois. At each of the meetings, ASE Certified truck technicians were used as experts in the automotive service industry. V-TECS used experts in three academic areas (language arts, mathematics, and science) to help the committees understand the specific definitions of the concepts used in the taxonomy.

The committees were asked to identify the academic skills required to perform each task listed in the eight truck areas. Their responses were recorded using the Basic/Essential Skills Taxonomy codes and were put into a database. After all the meetings were completed, a composite or unduplicated list of the codes was generated for language arts, mathematics, and science. Specific statements related to the use of the academic skill in the automotive industry were then written. A matrix was built to show the relationship between the composite list and each of the eight truck areas. The general statements included in this manual were developed from the specific statements. Several cross-checks and reviews were conducted to ensure the accuracy of the statement and the relationship to the NATEF task list.

The Workplace Skills List was generated by having the committees identify the workplace skills from the V-TECS/ILLINOIS WORKPLACE SKILLS LIST that are important for employment as a truck technician.

** Please contact the NATEF office to order the *Applied Academics and Workplace Skills for Truck Technicians* book. This book includes the unduplicated list of applied academic skills in all eight truck areas, complete with statements of their use by truck technicians; the matrix; the definitions of the Basic/Essential Skills codes; the general narrative statements; the Workplace Skills List; and the NATEF Task List.

The information in the book will provide a common vocabulary for instructors and administrators to use in achieving academic and vocational skill standards. This information can be used by programs to document the academic skills taught in automotive technical classes. The examples for teaching an academic concept in an applied context will also be useful for schools when planning, designing, or writing curricula. **

Language Arts & Communications

NARRATIVE FOR LANGUAGE ARTS RELATED ACADEMIC SKILLS for all NATEF Medium/Heavy Truck Technician Task Lists

The medium/heavy truck technician must be proficient in the following Language Arts and Communications Related Academic Skills that are embedded in the occupation. Using these skills the technician must be able to:

- Request, collect, comprehend, evaluate, and apply oral and written information gathered from customers, associates, and supervisors regarding symptoms and potential solutions to problems.
- Identify the purpose for all written and oral communication and then choose the most effective strategies for listening, reading, speaking, and writing to facilitate the communication process.
- Adapt a reading strategy for all written materials, e.g. customer's notes, service manuals, shop manuals, technical bulletins, etc., relevant to problem identification, diagnosis, solution, and repair.
- Attend to verbal and nonverbal cues in discussions with customers, supervisors, and associates to verify, identify, and solve problems.
- Use study habits and techniques, i.e. previewing, scanning, skimming, taking notes, etc., when reviewing publications (shop manuals, references, databases, operator's manuals, and text resources) for problem solving, diagnosis, and repair.
- Use prior knowledge learned from solving similar problems to diagnose and repair the immediate problem.
- Write clear, concise, complete, and grammatically accurate sentences and paragraphs.
- Write warranty reports and work orders to include information regarding problem resolution and the results of the work performed for the customer or manufacturer.
- Comprehend and apply industry definitions and specifications to diagnose and solve problems in all truck components and systems.
- Follow all oral/written directions that relate to the task or system under study.
- Comprehend and use problem-solving techniques and decision trees that are contained in service manuals to determine cause-and-effect relationships.
- Scan service manuals and databases to locate specific information for problem-solving purposes.
- Use the service manual to identify the manufacturer's specifications for system parameters, operation, and potential malfunctions.

- Interpret charts, tables, or graphs to determine the manufacturer's specifications for system operation to identify out-of-tolerance systems and subsystems.
- Supply clarifying information in oral and written form to customers, associates, parts suppliers, and supervisors.

Mathematics

NARRATIVE FOR MATHEMATICS RELATED ACADEMIC SKILLS for all NATEF Medium/Heavy Truck Technician Task Lists

The medium/heavy truck technician must be proficient in the following Mathematics Related Academic Skills that are embedded in the occupation. Given these skills the technician must be able to:

- Determine the proper sequence of arithmetic operations to arrive at a solution to a problem that can be compared to other specifications when comparing system measurements to the manufacturer's specifications.
- Add two or more whole numbers, fractions, or decimals to determine component conformance of multiple measurements with the manufacturer's specifications of the truck or trailer.
- Subtract whole numbers, fractions, or decimals to arrive at a difference for comparison with the truck manufacturer's specifications.
- Divide decimals to determine measurement conformance with the truck manufacturer's specifications.
- Convert variables presented orally to a mathematical form that provides for an algebraic solution.
- Estimate the results of basic arithmetic operations, and accurately round up or down depending on the appropriate rule for the situation.
- Analyze and solve problems requiring the use of fractions, decimals, ratios, or percentages by a direct or indirect variation of the numerical elements of the problem.
- Determine the irrelevant or missing data needed to solve a problem.
- Determine and interpret place value (tenths, hundredths, thousandths) when conducting precision measurements.
- Use Centigrade or Fahrenheit measurement scales to determine the existing temperature of substances such as a coolant or lubricant.
- Use English and metric volume measurement techniques to determine the volume of a system, component, or cylinder.

- Use conventional symbols (E for voltage, etc.) to solve circuit parameter calculations using formulas such as Ohm's Law, $E=IR$.
- Understand that if the described problem has certain conditions (symptoms), then a limited number of solutions to the problem apply.
- Understand the relationship between the frequency of the occurrence of a problem (symptom) and the probability of accurately predicting the problem.
- Calculate the average (mean) of several measurements to determine the variance from the manufacturer's specifications.
- Use English and metric angle and distance measurements and techniques to determine angle variances from the truck manufacturer's specifications.
- Solve problems that involve determining the relative proportion of desired versus undesired ingredients or elements of a mixture, and determine if that proportion is within the manufacturer's specifications.
- Comprehend and use standards defined by each manufacturer for the system being analyzed.
- Convert test readings that are in decimal or fraction form to a ratio or percent for comparison with the manufacturer's specifications for the sub-system.
- Know when to use an estimated performance value versus an exact value, basing the decision on the system being analyzed or repaired.
- Visually perceive the geometric relationship of systems and sub-systems that require alignment.
- Construct or interpret a chart, table, graph, or symbol that depicts a range of performance characteristics that can be used for comparing various system operational conditions.
- Use precision measurement devices to determine the parallelism or perpendicularity of chassis, suspension, and other vehicle components requiring geometric alignment.
- Use formulas to indirectly confirm systems that are outside of the manufacturer's specifications.
- Verify that the relationship between parallel lines and angles concurs with the manufacturer's specifications when diagnosing a system's malfunction.

- Visually formulate an angle (e.g. belt/suspension/drive) and verify conformance to the manufacturer's specified angle.
- Measure timed or sequenced operating parameters to determine conformance with the manufacturer's specifications of the truck.
- Use English and metric scales to determine the conformance of components to the manufacturer's specified weight of the truck.
- Determine the degree of conformance to the manufacturer's specifications for length, volume, and other appropriate measurements in the English and metric system.
- Distinguish the congruence of the measured tolerances with those specified by the manufacturer.
- Measure and test with tools designed for English or metric measurements, then convert the result to the manufacturer's system used for specifying the correct measurement or tolerance.
- Compute mentally whether the observed measurement is out-of-tolerance when comparing the observed measurement to the manufacturer's specifications.
- Solve problems that involve determining whether the proportion of the existing volume compares to the manufacturer's specifications and is within the recommended tolerance.
- Distinguish whether a measurement or tolerance is equal or not equal to the manufacturer's specifications.
- Solve basic and complex algebraic expressions.

Science

NARRATIVE FOR SCIENCE RELATED ACADEMIC SKILLS for all NATEF Medium/Heavy Truck Technician Task Lists

The medium/heavy truck technician must be proficient in the following Science Related Academic Skills that are embedded in the occupation. Using these skills the technician must be able to:

- Analyze and evaluate waste products from the repair task and dispose of the parts, residue, or trash according to applicable federal, state, and local rules and regulations.
- Follow all safety regulations and procedures while performing any task.
- Use the information provided in service manuals, charts, tables, or graphs to determine the manufacturer's specifications for system(s) operation(s) and the appropriate repair/replacement procedure.
- Develop a hypothesis regarding the cause of the problem and test the hypothesis to determine the solution to the problem.
 1. identify the problem
 2. gather information
 3. develop hypothesis
 4. take action
 5. check results
- Convert measurements taken using the English or metric system to specifications stated in terms of either system.
- Explain and demonstrate an understanding of the chemical reaction that occurs in various systems of a truck regarding the combustion of fuels, catalytic converters, and contamination when introduced into a given system.
- Explain the purpose of additives in truck fuels and lubricants.
- Demonstrate an understanding and determine efficiency of the kinetic and potential energy relationships that occur in valve systems, ignition systems, and other stored energy systems, such as springs and fuels.
- Demonstrate an understanding of the role of balanced and unbalanced forces on linear and rotating truck assemblies.
- Explain the relationship of centrifugal/centripetal force to the failure of rotating systems.

- Explain the ignition characteristics of gasoline and diesel fuels resulting from varying levels of fractional distillation.
- Demonstrate an understanding of how gasoline and diesel fuel characteristics affect combustion in a truck engine.
- Demonstrate an understanding of the effect of heat on various truck systems.
- Explain the concept of heat transfer in terms of conduction, convection, and radiation in truck systems.
- Demonstrate an understanding of the expansion and contraction of system parts as a result of heat generated during use and the cooling of the system when not in operation.
- Demonstrate an understanding of the effect that adding heat will cause in a state of matter, such as solid to liquid to gas.
- Explain the role of insulation in maintaining stable temperatures and in the deadening of sound.
- Demonstrate an understanding of the principles of light and light refraction and reflection.
- Demonstrate an understanding of refraction in fiber optic systems.
- Explain that when dye is added to engine oil or other lubricants an ultraviolet light can be used to detect leaks by shining light in suspected areas.
- Demonstrate an understanding of the process of acceleration and deceleration as a function of weight and available power.
- Demonstrate how fluid can be used to produce motion in a valve or piston assembly.
- Demonstrate an understanding of the circular motion of a truck component as it relates to such concepts as toe-out on turns and tracking.
- Demonstrate an understanding of the types of vibrations caused by out-of-balance or excessively worn components.
- Explain to a customer how sound can be amplified due to resonant cavities and other physical characteristics of the vehicle.

- Explain and demonstrate an understanding of how sound generated in one place in the body, chassis, or engine can be carried to other parts of the truck through metal or other materials.
- Explain the need for sound deadening and vibration damping materials to control the level of sound in the passenger compartment.
- Demonstrate an understanding of the relationship of the perceived intensity to the decibel level of a noise.
- Explain the relationship of the frequency of the sound to a normal or abnormally operating system.
- Explain and demonstrate an understanding of the role of listening to sounds as part of the trouble-shooting process.
- Explain that the presence of overtones may indicate changes in the vibrations of various truck components.
- Demonstrate an understanding of the relationship of barometric pressure to engine performance (horsepower).
- Explain the relationship of engine torque to overall truck performance.
- Explain how levers and pulleys can be used to increase an applied force or distance.
- Identify the characteristics that define a system that is operating within the manufacturer's specifications.
- Use precision measuring devices to determine if wear and adjustments are within the manufacturer's specifications, and to assure that repair or replacement parts meet the manufacturer's specifications.
- Use a torque wrench to measure the force or tension required to tighten connections to the manufacturer's specifications.
- Use a scale to measure component weight to balance rotating systems.
- Use pressure measuring tools to determine pressures in hydraulic or pneumatic systems and compare to the manufacturer's specifications.
- Use direct and indirect methods to measure system temperatures and then convert to Fahrenheit/Centigrade as required.

- Use direct and indirect methods to measure time and compare the results to the truck manufacturer's specifications.
- Use direct and indirect methods to measure the volume of liquids in a system and compare to the truck manufacturer's specifications.
- Use computer databases for information retrieval and input devices to process information for customers, billing purposes, warranty work, and other record-keeping purposes.
- Explain how an applied force at one location can be transmitted via fluid pressure to provide a force at a remote location.
- Explain catalytic converter principles which modify emission gases at the atomic level to provide a low level of HC, CO, and NO_x in the final exhaust.
- Explain the role that friction plays in acceleration and deceleration of objects as illustrated by transmitting motion to a part not physically connected to the powered part.
- Explain the need for lubrication of adjacent parts to minimize friction as a result of movement at the junction of the parts.
- Explain the necessity of knowing that the hardness of a metal determines, in part, its function and location in the vehicle.
- Explain the dynamic control properties of a hydraulic system.
- Explain the surface processes that occur on system seals due to the absorption of the contained materials.
- Demonstrate an understanding of how the deterioration in an engine's performance can be caused by a chemical reaction that occurs in a liquid that has been contaminated.
- Demonstrate an understanding of how torque relates to force and angular acceleration.
- Demonstrate an understanding of how cams, pulleys, and levers are used to multiply force or transfer directions of force.
- Explain how rotational motion is changed to linear motion and the need for balance in rotating systems.
- Demonstrate an understanding of how variances in flow rate in air flow sensors or cooling systems can affect engine performance.

- **Electrical/Tolerances**

- Explain and demonstrate an understanding of the properties of electricity that impact the lighting, engine management, and other electrical systems in the truck.
- Demonstrate an understanding of the characteristics of a quality electrical ground and explain the problems associated with an inadequate electrical circuit ground.
- Explain voltage and current flow in series and parallel circuits.
- Demonstrate an understanding of the processes used to locate a short circuit in the electrical/electronic system.
- Demonstrate an understanding of the role of the alternator in maintaining battery and system voltage.
- Explain and demonstrate an understanding of the ignition coil's role in generating the high voltages required to fire the sparkplug.
- Demonstrate an understanding of the correct procedure used to measure the electrical parameters of voltage, current, or resistance.
- Explain and demonstrate an understanding of the role of a fuse or fusible link as a protective device in an electrical or electronic circuit.
- Explain and demonstrate an understanding of the use of Ohm's Law in verifying circuit parameters (resistance, voltage, amperage).
- Explain and demonstrate an understanding of the relationship of resistance to heat, voltage drop, and circuit parameters.
- Explain and demonstrate an understanding of system voltage generation, uses, and characteristics.
- Demonstrate an understanding of the electron transfer process that occurs in a truck battery.
- Explain the conductivity problems in a circuit when connectors corrode due to electrochemical reactions.
- Explain the relationship between electrical current in a conductor and the magnetic field produced in a coil such as the starter solenoid.

- Explain the ability of a coil to increase battery voltage to the level required to fire a sparkplug.
- Explain the effect of magnetic fields on unshielded circuits in selected control modules.
- Explain the need for a specific gravity test of battery electrolyte to determine charge.
- Use precision electrical test equipment to measure current, voltage, resistance, continuity, or power.
- Demonstrate an understanding of the role of capacitance in timer circuits, such as RC timers or MAP sensors, where the changing manifold pressure causes two metal discs to act like a capacitor by sending varying voltage to the electronic engine control system.
- Demonstrate an understanding of the capacity of semiconductor devices to modify rapidly engine operation parameters depending on multiple inputs from engine operational sensors.
- Explain how the movement of a conductor in a magnetic field can generate electricity.
- Demonstrate an understanding of the role of mechanical transducers in sending electrical control signals to modify system operating characteristics.
- Demonstrate an understanding of the purpose of photocells and measurement processes relative to determining output.

WORKPLACE SKILLS

IDENTIFIED AS BEING IMPORTANT BY THE NATEF MEDIUM/HEAVY TRUCK TECHNICIANS RELATED ACADEMIC SKILLS COMMITTEE FROM THE V-TECS/ILLINOIS WORKPLACE SKILLS LIST.

A. DEVELOPING AN EMPLOYMENT PLAN

1. Match interests to employment area.
2. Match aptitudes to employment area.
3. Match attitudes to a job area.
4. Match physical capabilities to a job area.
5. Demonstrate a drug-free status.

B. SEEKING AND APPLYING FOR EMPLOYMENT OPPORTUNITIES

1. Locate employment opportunities.
2. Identify job requirements.
3. Evaluate job opportunities.
4. Prepare a resume.
5. Write job application letter.
6. Complete job application form.
7. Prepare for job interview.
8. Dress for job interview.

C. ACCEPTING EMPLOYMENT

1. Apply for social security number.
2. Complete state and federal tax forms.
3. Complete employees withholding allowance certificate Form W-4.

D. COMMUNICATING ON THE JOB

1. Communicate orally with others.
2. Ask questions about task.
3. Follow written and oral directions.
4. Prepare written communication.
5. Use telephone etiquette.

E. INTERPRETING THE ECONOMICS OF WORK

1. Describe responsibilities of employee.
2. Describe responsibilities of employer or management.

F. MAINTAINING PROFESSIONALISM

1. Participate in employment orientation.
2. Treat people with respect.
3. Exhibit positive behavior.
4. Comply with organizational expectations.
5. Comply with company dress and appearance standards.
6. Use job-related terminology.
7. Participate in meetings in a positive and constructive manner.

G. ADAPTING/COPING WITH CHANGE

1. Identify the elements of the job transition.
2. Exhibit ability to handle stress.
3. Recognize need to change or quit a job.

H. SOLVING PROBLEMS AND CRITICAL THINKING

1. Clarify purposes and goals.
2. Identify the problem.
3. Employ reasoning skills.
4. Assess employer and employee responsibility in solving a problem.
5. Evaluate options.
6. Estimate results of implemented options.
7. Set priorities.
8. Identify solutions to the problem and their impact.
9. Select and implement a solution to a problem.
10. Prioritize and organize workloads.

I. MAINTAINING A SAFE AND HEALTHY ENVIRONMENT

1. Follow conservation/environmental practices and policies.
2. Comply with safety and health rules/procedures.
3. Identify hazardous substances in the work place.
4. Use and maintain proper tools and equipment.
5. Maintain work area.
6. Act during emergencies.

J. DEMONSTRATING WORK ETHICS AND BEHAVIOR

1. Follow rules, regulations and policies as established.
2. Implement responsibilities of job position.
3. Maintain regular attendance.
4. Assume responsibility for decisions and actions.
5. Demonstrate willingness to learn.
6. Practice time management.
7. Practice cost effectiveness.
8. Apply ethical reasoning.
9. Display initiative.
10. Display assertiveness.
11. Exhibit pride.

K. DEMONSTRATING TECHNOLOGY LITERACY

1. Demonstrate basic knowledge of computing.
2. Recognize impact of technological changes on tasks and people.
3. Demonstrate basic keyboarding skills.

L. MAINTAINING INTERPERSONAL RELATIONSHIPS

1. Value individual diversity.
2. Respond to praise or criticism.
3. Provide constructive praise or criticism.
4. Channel and control emotional reactions.
5. Resolve conflicts.
6. Display a positive attitude.
7. Identify and react to sexual intimidation/harassment.

M. DEMONSTRATING TEAMWORK

1. Identify style of leadership used in teamwork.
2. Match team member's skills and group activity.
3. Work with team members.
4. Complete a team task.
5. Evaluate outcomes.

SUPPLEMENT FOR ALTERNATIVE FUELS

MEDIUM/HEAVY TRUCK PROGRAM SUPPLEMENT FOR ALTERNATIVE FUELS

The Medium/Heavy-Duty Compressed Natural Gas (CNG), Liquefied Natural Gas (LNG), and Liquefied Petroleum Gas (LPG) accreditation areas are optional--supplemental--areas to the existing ASE/NATEF Medium/Heavy Truck Program. "Master Truck Program" accreditation is not affected by the addition of these alternative fuels areas. Accreditation in CNG/LNG/LPG are dependent on a program meeting the minimum program requirements for accreditation for Medium/Heavy Truck, as well as those requirements specified in this Alternative Fuels Supplement.

Optional Areas for Program Accreditation and Hours Required

To become accredited in CNG, LNG, or LPG, the program must meet the task and hour requirements for Gaseous Fuels Engine Performance (area 9), and at least one of the other optional areas.

	Min. Hours Required
9. Gaseous Fuels Engine Performance	60
10. CNG On-Board Fuel Storage And Delivery	30
11. LNG On-Board Fuel Storage And Delivery	30
12. LPG On-Board Fuel Storage And Delivery	30

Task Priority Rating

The task rating system for CNG/LNG/LPG is identical to that used for Medium/Heavy Truck.

- **Ninety-five percent (95%) of Priority-1 (P-1) items must be taught in the curriculum.**
- **Seventy percent (70%) of Priority-2 (P-2) items must be taught in the curriculum.**
- **Twenty-five percent (25%) of Priority-3 (P-3) items must be taught in the curriculum.**

Instructor Requirements

1. For initial program accreditation, the AFV instructor must have the following:
 - a. Instructor must have received a minimum of 80 contact hours of professional development training in AFV technology (CNG, LNG, or LPG as appropriate for the subject taught). The following is recommended:
 - 40 hours - general AFV training
 - 40 hours - product specific training
 - b. Instructor must have received a minimum of 80 hours of AFV internship experience; **OR** have at least three years of relevant AFV work experience--within the last five years.

2. Within the first two and one-half years of program accreditation, the AFV instructor must accomplish the following continuing education requirements (to be reported on the mid-point evaluation):
 - a. Minimum 32 hours of professional development (AFV training)
 - b. Minimum 40 hours of AFV internship (required only for those instructors who do not have three years related work experience - Instructor Requirements, 1.b)

Team Member Requirements

1. At least one member of the on-site evaluation team (may include the ETL) must have a minimum of three years field experience with the alternative fuel(s) included for program accreditation.
2. A minimum of two team members plus the ETL is required for the on-site visit. Additional members may be required if more than one alternative fuel area is being evaluated.

DISCLAIMER

Facility issues related to gaseous fuel vehicle service are perhaps the least known and understood by those just entering the field of training and vehicle service. There are a limited number of references and specific codes for CNG, LNG, and LPG that can be used to evaluate a building that is used for servicing/training on those vehicles (codes are currently under development by the National Fire Protection Association). However, there are numerous consultants (engineers, certified fire professionals, insurance providers, gas utility personnel, etc.) who are experienced and are capable of evaluating such facilities. Schools that are seeking accreditation by the National Automotive Technician Education Foundation (NATEF) for their CNG/LNG/LPG Technician Training Programs must seek out the appropriate local authority to assist them in making facility evaluations/modifications. NATEF and those designated by NATEF to accredit training programs do not assume any responsibility for the appropriateness of the facilities or the safety procedures adopted by the program. Such responsibility shall remain with the instructional staff and the program administrators.

REPORTING REQUIREMENT

To ensure that facilities have been evaluated by an appropriate authority, each program requesting NATEF Program Accreditation must provide to NATEF documentation indicating that such an evaluation has been performed and all issues raised by the evaluation have been satisfactorily addressed. A letter from the Program Administrator must be included in such documentation that indicates that the school's administration or other appropriate authority accepts responsibility for the facilities utilized in CNG/LPG/LNG training.

RELATED SUPPORT INSTRUCTION FOR ALL GASEOUS FUELS PROGRAMS

Although NATEF defines the tasks that must be included in a program's curriculum, the desired background theoretical instruction has never been specifically identified. The assumption has been that in all areas, appropriate theory, safety, and support instruction will be required for performing each task. For the new program areas of CNG, LNG, and LPG, it is thought that since there are currently few instructors with significant experience with these fuels, it would be helpful to specify some of the background theory/knowledge that should be a part of each gaseous fuels program.

General Instructional Support For All Fuels

The combustion processes and control strategies employed by the gaseous fueled engine differ significantly from the diesel or gasoline engine. Instruction in the following should give the student a foundation of knowledge that will enhance their ability to diagnose and repair these engines.

Instruction should include:

1. Physical properties and comparison of hydrocarbon fuels
 - molecular structure
 - vapor density
 - auto-ignition temperature
 - octane number
 - heat of combustion in Btu/lb. (high and low heating values)
 - density
 - energy density (Btu/gallon)
 - flammability limits
 - flash points
 - boiling points

2. Gas Laws
 - differential pressure theories
 - mass/volume
 - absolute pressures
 - pressure measurements units - e.g. psia; psig; in.Hg; in.H₂O, etc.
 - metric equivalents

3. Combustion process and factors that influence combustion

- exhaust constituent formation (chemistry of combustion)
- comparison of the Otto cycle to diesel
- comparison of stoichiometric A/F ratio to lean-burn
- diesel versus dual-fuel (e.g. diesel and natural gas or LPG)
- theoretical air/fuel ratios of different automotive fuels (stoichiometry)
- surface ignition versus pre-ignition
- auto-ignition/knock
- ignition systems

4. Air fuel metering strategies/systems

- mechanical fuels systems
- speed density systems
- mass air flow sensors
- gas mass sensors
- actuators
- oxygen sensors - standard and wide range
- air induction strategies
- charge air systems
- closed loop/feedback system

Compressed Natural Gas (CNG) Product Familiarization and Safety

All motor fuels have specific characteristics that require variations in the disciplines of personal safety. CNG is unique as a motor fuel partially because it is lighter than air and is typically stored at very high pressures (e.g. 3,000 - 3,600 psig). CNG fuel system classes must include information concerning natural gas as well as the fundamentals of working with high pressure systems. As a minimum, the CNG related training must include instruction on the following:

1. Definition of CNG
2. Working With High Pressure Gas Systems - Lines, Fittings, Tanks, Etc.
3. CNG Composition and Properties
4. Temperature/Pressure Relationships
5. Materials - Proper/Improper, Reactivity
6. Safe Fueling and De-Fueling Procedures
7. Venting To Atmosphere - Safety, Economics, Environmental Impact, Laws, and Control Methods
8. Facility Risk Assessment and Emergency Plan
9. Overview of Gas Leak Detection Systems - Explain the Use of Fuel Odorant
10. Potential Hazards For Personnel
11. Effects of Rapid Fuel Release - Thermal and Static Charge Build-Up
12. Potential Fire Hazards - Ignition, Fire Suppression Techniques
13. Personal Protective Equipment Usage
14. NFPA, Local, State, and Federal Rules, Regulations, and Recommendations

Liquefied Natural Gas (LNG) Product Familiarization and Safety

All motor fuels have specific characteristics that require variations in the disciplines of personal safety. LNG is unique as a motor fuel partially because it is a cryogenic liquid that is stored at very cold temperatures. LNG fuel system classes must include information concerning natural gas as well as the fundamentals of cryogenics. As a minimum, the LNG related training must include instruction on the following:

1. Definition of LNG
2. Cryogenic Characteristics
3. LNG Composition
4. LNG Weathering and Impact On Composition
5. Physical Constants, Characteristics and Properties of LNG
6. Saturation - Temperature/Pressure Relationships
7. Materials - Proper/Improper, Reactivity
8. Safe Fueling Procedures (Vent/No-Vent) and De-Fueling
9. Venting To Atmosphere - Safety, Economics, Laws and Control Methods
10. Facility Risk Assessment and Emergency Plan
11. Overview of Gas Leak Detection Systems - Explain Lack of Odorant
12. Potential Cryogenic Hazards For Personnel
13. Potential Fire Hazards - Ignition, Fire Suppression Techniques
14. Personal Protective Equipment Usage
15. NFPA, Local, State, and Federal Rules, Regulations, and Recommendations

Liquefied Petroleum Gas (LPG/Propane) Product Familiarization and Safety

All motor fuels have specific characteristics that require variations in the disciplines of personal safety. LPG is unique as a motor fuel partially because it is stored at moderate pressures and vaporizes readily under normal temperatures and atmospheric pressure. LPG fuel system classes must include information concerning liquefied petroleum gas as well as the fundamentals of working with pressurized fuel systems. As a minimum, the LPG related training must include instruction on the following:

1. Definition of LPG
2. Working With Pressurized Fuel Systems - Lines, Fittings, Tanks, Valves, Etc.
3. LPG Composition, Properties, and Characteristics
4. Temperature/Pressure Relationships
5. Materials - Proper/Improper, Reactivity
6. Safe Fueling and De-Fueling Procedures
7. Venting To Atmosphere - Safety, Economics, Laws and Control Methods
8. Facility Risk Assessment and Emergency Plan
9. Overview of Gas Leak Detection Systems - Explain the Use of Fuel Odorant
10. Potential Hazards For Personnel
11. Thermal Effects of Fuel Release
12. Potential Fire Hazards - Ignition, Fire Suppression Techniques
13. Personal Protective Equipment Usage
14. NFPA, Local, State, and Federal Rules, Regulations, and Recommendations

TASK LIST

GASEOUS FUELS ENGINE PERFORMANCE * **(CNG, LNG, LPG)**

For every task in Gaseous Fuels Engine Performance, the following safety requirement must be strictly enforced:

Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.

IX. GASEOUS FUELS ENGINE PERFORMANCE - CNG, LNG, LPG

A. DIAGNOSIS AND REPAIR

A.1 General

1. Interpret and verify complaint; establish a strategy for diagnosis and repair, document findings. P-1
2. Interface with vehicle's on-board computer, perform diagnostic procedure using manufacturer's recommended electronic diagnostic equipment and tools (to include PC based software, DVOM, and/or data scan tools); determine needed repair. P-1
3. Perform engine vacuum test; determine needed repair. P-2
4. Perform cylinder balance test; determine needed repair. P-2
5. Perform cylinder compression test; determine needed repair. P-2
6. Perform cylinder leakage test; determine needed repair. P-2
7. Diagnose ignition or fuel problem with an exhaust gas analyzer, an oscilloscope, and/or engine analyzer; determine needed repair. P-1

A.2 Ignition System Diagnosis and Repair

1. Diagnose no-starting, hard starting, engine misfire, poor driveability, spark knock, power loss, poor mileage, and emissions problems on vehicles with electronic ignition (distributorless) systems; determine needed repairs. P-1

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| 2. | Diagnose no-starting, hard starting, engine misfire, poor driveability, spark knock, power loss, poor mileage, and emissions problems on vehicles with distributor ignition (DI) systems; determine needed repairs. | P-2 |
| 3. | Inspect and test ignition primary circuit wiring and components; repair or replace as needed. | P-2 |
| 4. | Remove distributor, inspect, test, and service as needed; reinstall. | P-2 |
| 5. | Inspect and test distributor ignition system secondary circuit wiring and components; replace as needed. | P-2 |
| 6. | Inspect and test electronic ignition (distributorless) system secondary circuit wiring and components; replace as needed. | P-1 |
| 7. | Inspect and test ignition coil(s); replace as needed. | P-1 |
| 8. | Check and adjust (adjust where applicable) ignition system timing and timing advance/retard. | P-1 |
| 9. | Inspect and test ignition wiring harness and connectors; replace as needed. | P-2 |
| 10. | Inspect and test ignition system triggering/input devices; replace as needed. | P-1 |
| 11. | Inspect and test ignition control module; replace as needed. | P-1 |
| 12. | Remove, inspect, and replace spark plugs according to manufacturer's procedures (procedures differ for alternative fuel vehicles). | P-1 |

A.3 Fuel Systems - Gasoline (Bi-fuel)

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| 1. | Diagnose no-starting, hard starting, poor idle, flooding, hesitation, surging, engine misfire, excessive emissions, power loss, poor mileage, and/or dieseling problems on vehicles with injection-type fuel systems; determined needed repairs. | P-1 |
| 2. | Inspect and test fuel pump and pump controls; replace as needed. | P-1 |
| 3. | Perform fuel injector tests (resistance, current, spray pattern, flow, and pressure drop); clean or replace as needed. | P-1 |
| 4. | Service air and fuel filters. | P-1 |

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| 5. | Verify proper operation of fuel pressure regulator; determine needed repair. | P-1 |
| 6. | Check minimum idle speed. | P-2 |
| 7. | Inspect the operation of the thermostatic air cleaner; determine need repair. | P-3 |
| 8. | Test the operation of the fuel evaporation control system; determine needed repair. | P-2 |
| 9. | Inspect and test PCV system; determine needed repair. | P-1 |
| 10. | Test the operation of the EGR; determine needed repair. | P-2 |

A.4 Fuels Systems - Alternative Fuels (CNG, LNG, LPG)

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| 1. | Interpret and verify complaint; establish a strategy for diagnosis and repair, document findings. | P-1 |
| 2. | Diagnose hot or cold no-starting, hard starting, poor driveability, incorrect idle speed, poor idle, flooding, hesitation, surging, engine misfire, power loss, stalling, rich or lean mixture conditions and excessive emissions; determine needed repair. | P-1 |
| 3. | Retrieve and record Diagnostic Trouble Codes (DTC) through the use of recommended PC base software, DVOM and/or data scan tool. | P-1 |
| 4. | Test input sensors and related circuitry; determined needed repair. | P-1 |
| 5. | Verify output commands from electronic control module (ECM). | P-1 |
| 6. | Test operation of fuel metering device; service or replace as needed. | P-1 |
| 7. | Inspect and test operation of throttle actuator or throttle assembly; determine needed repair. | P-1 |
| 8. | Inspect and test operation of waste-gate; determine needed repair. | P-3 |
| 9. | Test fuel supply pressure to the fuel metering device; determine needed repair. | P-1 |
| 10. | Service system fuel filter(s). | P-1 |
| 11. | Inspect and test catalytic converter; determine needed repair. | P-3 |

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| 12. | Analyze symptoms and perform diagnostic procedures on vehicles with supplemental on-board computer support systems. | P-1 |
| 13. | Diagnose and repair intermittent or complete failure of electric, electronic or mechanical devices (e.g., hour meters, fuel level indicators, fuel selection devices). | P-2 |

IX. GASEOUS FUELS ENGINE PERFORMANCE

B. PREVENTATIVE MAINTENANCE

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| 1. | Perform pre-maintenance safety inspection; report abnormal or unsafe conditions. | P-1 |
| 2. | Identify specific maintenance needs (engine oil, ignition systems, catalyts) for gaseous fueled engines. | P-1 |
| 3. | Identify and inspect all fuel system connections, fittings, hoses and tubing for damage, chaffing, leaks, routing and mounting; perform necessary maintenance. | P-1 |
| 4. | Identify and inspect low pressure regulator for mounting integrity. | P-2 |
| 5. | Perform recommended regulator maintenance. | P-2 |
| 6. | Identify and inspect fuel metering device(s); perform necessary maintenance. | P-1 |
| 7. | Identify and inspect throttle actuating assembly (and linkage) for proper operation. | P-1 |
| 8. | Identify and inspect secondary ignition components; perform necessary maintenance. | P-1 |
| 9. | Remove, inspect, and replace spark plugs according to manufacturer's procedures (procedures differ for alternative fuel vehicles). | P-1 |

CNG ON-BOARD FUEL STORAGE AND DELIVERY SYSTEMS *

For every task in CNG On-Board Fuels Storage and Delivery Systems, the following safety requirement must be strictly enforced:

Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.

X. CNG ON-BOARD FUEL STORAGE AND DELIVERY SYSTEMS

A. DIAGNOSIS AND REPAIR

1. Interpret and verify complaint; establish a strategy for diagnosis and repair. P-1
2. Check non-fuel system components such as drive away protection, fire suppression, and leak detection devices. Verify that they are not interfering with the operation of the fuel delivery system. P-2
3. Check fuel system components to include fuel lock-off, valves, solenoids, manual shut-off, connections, fittings, hoses and tubing for leaks, wear, and appropriate installation; service as needed. P-1
4. Check fuel system components to include fuel lock-off(s), valves, solenoids, manual shut-off, and regulator(s) for proper operation; service as needed. P-1
5. Diagnose the cause of fuel odor or fuel loss by inspecting or testing the fuel supply system components (e.g., valves, fuel supply container, pressure relief device, tubing and hoses); service as needed. P-1
6. Diagnose the cause of inaccurate fuel level indicator reading; service as needed. P-2
7. De-fuel fuel system using industry practices or manufacturer's procedures following all local, state, and federal regulations. (Local procedures may vary and extreme care must be exercised if using actual fuel. Use of inert gas or shop air is recommended for practicing this task in the classroom.) P-1
8. Isolate components of the fuel system and de-pressurize affected section before making repairs. P-1

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| 9. | Inspect fuel supply container(s) and related hardware (includes brackets, shielding and fasteners) for chaffing or other damage according to manufacturer's procedures; service as needed. | P-1 |
| 10. | Purge and pressurize fuel supply container with inert gas for purpose of repair, shipment or replacement. | P-2 |
| 11. | Check fuel system operating pressures and diagnose cause of abnormal pressures; service as needed. | P-1 |
| 12. | Test on-board methane leak detection system, verify operation; repair or replace as needed (service may require special training and certification). | P-3 |
| 13. | Inspect on-board fire suppression system, verify readiness; repair or replace as needed (service may require special training and certification). | P-3 |
| 14. | Operate/read portable leak detector. | P-1 |
| 15. | Diagnose incorrect heat exchanger operation (including check coolant flow and routing). Check heat exchanger for coolant/fuel cross leaks. | P-1 |

X. CNG ON-BOARD FUEL STORAGE AND DELIVERY SYSTEMS
B. MAINTENANCE

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| 1. | Inspect fuel system, document findings and any abnormal or unsafe conditions identified during maintenance procedures; recommend further service as needed. | P-1 |
| 2. | Inspect fuel supply container(s) and related hardware (includes brackets, shielding and fasteners) for chaffing or other damage according to manufacturer's procedures; service as needed. | P-1 |
| 3. | Visually inspect that data labels and other decals are in accordance with applicable regulation; replace as needed. | P-1 |
| 4. | Identify and inspect fill circuit components; perform necessary maintenance. | P-1 |
| 5. | Identify and inspect fuel pressure gauge; perform necessary maintenance. | P-2 |

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| 6. | Identify and inspect fuel supply container manual shut-off valve, service valve, check-valves, and solenoid valves; perform necessary maintenance. | P-1 |
| 7. | Identify and inspect high pressure regulator(s); perform necessary maintenance (including cooling system service). | P-1 |
| 8. | Identify and inspect secondary pressure regulator(s) (when applicable); perform necessary maintenance. | P-2 |
| 9. | Identify and inspect manual shut-off valve(s) (1/4 turn valve); perform necessary maintenance. | P-1 |
| 10. | Identify and inspect fuel supply container pressure relief device(s) (PRD); perform necessary maintenance. | P-1 |
| 11. | Identify and inspect vent system (when applicable); perform necessary maintenance. | P-3 |
| 12. | Operate/read portable leak detector. | P-1 |
| 13. | Inspect fuel system for leaks. | P-1 |
| 14. | Perform safe fueling procedures. Calculate percent fill based on temperature and pressure. | P-2 |
| 15. | Test on-board methane leak detection system, verify operation; repair or replace as needed (service may require special training and certification). | P-3 |
| 16. | Inspect on-board fire suppression system, verify readiness; repair or replace as needed (service may require special training and certification). | P-3 |
| 17. | Close manual shut-off valve, de-pressurize fuel delivery system, service fuel filter elements and inspect for debris. | P-1 |
| 18. | De-fuel fuel system using industry practices or manufacturer's procedures following all local, state and federal regulations. (Local procedures may vary and extreme care must be exercised if using actual fuel. Use of inert gas or shop air is recommended for practicing this task in the classroom.) | P-1 |
| 19. | Remove or replace fuel supply containers according to manufacturer's specifications. | P-2 |

LNG ON-BOARD FUEL STORAGE AND DELIVERY SYSTEMS *

For every task in LNG On-Board Fuels Storage and Delivery Systems, the following safety requirement must be strictly enforced:

Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.

XI. LNG ON-BOARD FUEL STORAGE AND DELIVERY SYSTEMS

A. DIAGNOSIS AND REPAIR

1. Interpret and verify complaint; establish a strategy for diagnosis and repair. P-1
2. Identify and inspect filler nozzle and receptacle; repair or replace as needed. P-1
3. Identify and inspect fill check valve; repair or replace as needed. P-2
4. Identify and inspect fuel shut-off valve; repair or replace as needed. P-1
5. Identify and inspect excess flow valve; repair or replace as needed. P-1
6. Identify and inspect safety relief valves; replace as needed. P-1
7. Identify and inspect pressure gauge; replace as needed. P-1
8. Identify and inspect economizer/regulator; repair or replace as needed. P-1
9. Identify and inspect manual vent circuit; repair or replace components as needed. P-1
10. Identify, test, and inspect cryogenic pump and components; repair or replace as needed. P-2
11. Identify and inspect vaporizer/heat exchanger; repair or replace as needed. P-1
12. Diagnose incorrect vaporizer operation to include: check coolant flow, coolant routing, and check for vaporizer LNG/coolant leaks. P-1

13. Inspect fuel storage container for fuel or vacuum leaks, repair or replace as needed. P-1
14. De-fuel fuel system using industry practices or manufacturer's procedures following all local, state and federal regulations. (Local procedures may vary and extreme care must be exercised if using actual fuel. Use of inert gas or shop air is recommended for practicing this task in the classroom.) P-1
15. Prepare fuel storage container for long-term inactivity. P-1
16. Disable fuel delivery and isolate components of the fuel system. P-1
17. Pressure test fuel system, check for leaks. P-1
18. Inspect all connections, fittings, hoses and tubing for damage, chaffing, leaks, routing, and mounting; repair or replace as needed. P-1
19. Inspect and test system sensors (e.g., pressure, temperature, etc.); repair or replace as needed. P-1
20. Check fuel system operating pressures and pressure differential. P-1
21. Diagnose the cause of abnormal fuel delivery. P-1
22. Diagnose the cause of inaccurate fuel level indicator reading. Differentiate between tank sender and fuel gauge problems; service, adjust, repair or replace as needed. P-1
23. Test on-board methane leak detection system, verify operation; repair or replace as needed (service may require special training and certification). P-3
24. Inspect on-board fire suppression system, verify readiness; repair or replace as needed (service may require special training and certification). P-3

XI. LNG ON-BOARD FUEL STORAGE AND DELIVERY SYSTEMS

B. MAINTENANCE

1. Inspect fuel supply container(s) and related hardware for chaffing and damage (includes brackets, fasteners and supply vent system). Visually inspect data plate according to applicable regulations. P-1
2. Identify and inspect fill components; perform necessary maintenance. P-1

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| 3. | Identify and inspect fuel shut-off valve; perform necessary maintenance. | P-1 |
| 4. | Identify and inspect excess flow valve; perform necessary maintenance. | P-1 |
| 5. | Identify and inspect vaporizer/heat exchanger; perform necessary maintenance (coolant & LNG). | P-1 |
| 6. | Identify and inspect safety relief valves; perform necessary maintenance. | P-1 |
| 7. | Identify and inspect pressure gauge; perform necessary maintenance. | P-1 |
| 8. | Identify and inspect economizer/regulator; perform necessary maintenance. | P-1 |
| 9. | Identify and inspect manual vent components; perform necessary maintenance. | P-1 |
| 10. | Identify and inspect cryogenic pump system (when applicable); perform necessary maintenance. | P-2 |
| 11. | Connect relief/vent stack piping to an appropriate outdoor location (or ventilation system). | P-1 |
| 12. | Operate/read portable methane detector. | P-1 |
| 13. | Inspect fuel system for leaks. | P-1 |
| 14. | Visually inspect pressure relief valves; perform necessary maintenance. | P-1 |
| 15. | Inspect and check manual shut-off valves; perform necessary maintenance. | P-1 |
| 16. | Perform safe fueling procedures and determine fuel level. | P-1 |
| 17. | Test on-board methane leak detection system, verify operation; repair or replace as needed (service may require special training and certification). | P-3 |
| 18. | Inspect on-board fire suppression system, verify readiness; repair or replace as needed (service may require special training and certification). | P-3 |
| 19. | Identify and inspect exhaust heat shielding; repair as needed. | P-1 |

LPG ON-BOARD FUEL STORAGE AND DELIVERY SYSTEMS *

For every task in LPG On-Board Fuels Storage and Delivery Systems, the following safety requirement must be strictly enforced:

Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.

XII. LPG ON-BOARD FUEL STORAGE AND DELIVERY SYSTEMS

A. DIAGNOSIS AND REPAIR

1. Interpret and verify complaint; establish a strategy for diagnosis and repair. P-1
2. Identify and inspect filler valve assembly; verify operation of automatic stop-fill valve(s) (where applicable); service as needed. P-1
3. Identify and inspect fixed liquid level gauge; service as needed. P-1
4. Identify and inspect manual shut-off valve, excess flow valve, and liquid service valve; service as needed. P-1
5. Identify and inspect in-line hydrostatic relief valve(s); service as needed. P-1
6. Identify and inspect internal pressure relief valves; service as needed. P-1
7. Identify and inspect pressure regulator(s); service as needed. P-1
8. Identify, test, and inspect liquid pump, components, and check pressure differential; service as needed. P-2
9. Identify and inspect converter/regulator (heat exchanger); service as needed. P-1
10. Diagnose incorrect converter/regulator (heat exchanger) operation. Check coolant flow, coolant routing, and for evidence of LPG leaks in coolant system; service as needed. P-1
11. Inspect fuel supply container(s) and appurtenances for fuel leaks, service as needed. P-1

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| 12. | De-fuel fuel system using industry practices or manufacturer's procedures following all local, state, and federal regulations. (Local procedures may vary and extreme care must be exercised if using actual fuel. Use of inert gas or shop air is recommended for practicing this task in the classroom.) | P-2 |
| 13. | Remove and replace LPG fuel supply container. | P-3 |
| 14. | Prepare LPG fuel supply container for inactivity and/or shipping. | P-2 |
| 15. | Disable fuel delivery and isolate components of the fuel system. | P-1 |
| 16. | Check pressurized fuel system for leaks; service as needed. | P-1 |
| 17. | Inspect all connections, fittings, hoses and tubing for damage, chaffing, leaks, routing, shielding, and mounting; service as needed. | P-1 |
| 18. | Check fuel system operating pressures. | P-1 |
| 19. | Diagnose the cause of abnormal fuel delivery. | P-1 |
| 20. | Diagnose the cause of inaccurate fuel level indicator reading. Differentiate between fuel supply container sender and fuel gauge malfunctions; service as needed. | P-2 |
| 21. | Test on-board propane leak detection system, verify operation; service as needed (service may require special training and certification). | P-3 |
| 22. | Inspect on-board fire suppression system, verify readiness; repair or replace as needed (service may require special training and certification). | P-3 |
| 23. | Identify and test fuel lock-off and associated components; service as needed. | P-1 |

XII. LPG ON-BOARD FUEL STORAGE AND DELIVERY SYSTEMS

B. MAINTENANCE

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| 1. | Inspect fuel supply container(s) and related hardware for chaffing and damage (includes brackets, shielding, fasteners and supply vent system). Visually inspect data plate and labels according to applicable regulations. | P-1 |
| 2. | Identify and inspect filler valve assembly; verify operation of automatic stop-fill valve(s) (where applicable); service as needed. | P-1 |

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| 3. | Identify and inspect fixed liquid level gauge; perform necessary maintenance. | P-1 |
| 4. | Identify and inspect manual shut-off valve; perform necessary maintenance. | P-1 |
| 5. | Identify and inspect fuel lock-off valve; perform necessary maintenance. | P-1 |
| 6. | Identify and inspect converter/regulator (heat exchanger); perform necessary LPG and coolant system maintenance. | P-1 |
| 7. | Identify and inspect in-line hydrostatic relief valve(s); perform necessary maintenance. | P-1 |
| 8. | Identify and inspect internal pressure relief valve; perform necessary maintenance. | P-1 |
| 9. | Identify and inspect liquid pump system; perform necessary maintenance. | P-2 |
| 10. | Operate/read portable leak detector. | P-1 |
| 11. | Inspect fuel system for leaks. | P-1 |
| 12. | Perform safe fueling procedures and determine fuel level. | P-2 |
| 13. | Test on-board propane leak detection system, verify operation; service as needed (service may require special training and certification). | P-3 |
| 14. | Inspect on-board fire suppression system, verify readiness; repair or replace as needed (service may require special training and certification). | P-3 |
| 15. | Close manual shut-off valve, de-pressurize fuel delivery system, service fuel filter elements and inspect for debris. | P-1 |
| 16. | Document findings and any abnormal or unsafe conditions identified during maintenance procedures. | P-1 |

ALTERNATIVE FUELS SUPPLEMENTAL TOOL LIST

GASEOUS FUELS

Combustible Gas Detector, Portable
Digital Storage Oscilloscope
Felt Markers
Fitting Go/No-go gauge (may not be required of all fitting manufacturers)
Grounding Straps/Cables
Heat Gun
High Energy Spark Tester
Leak Detection Fluids
Magnetic Spark Plug Socket
Manometer - 0-10"H₂O
 0-25"H₂O
PC Computer with Interface/Diagnostic Software and Adapters (notebook preferred)
Pressure Gauges - 0-10psi
 0-30psi
 0-500psi
 0-5,000psi
Terminal Repair Kit (with proper repair and removal tools)
Thread Sealant - LNG (cryogenic)
 CNG
 LPG
Tubing Benders (1/4", 3/8", & 1/2"; hand operated - CNG/LPG programs only)
Tubing Cutter (for stainless steel)
Tubing Deburring Tools
Vacuum Leak Detection Devices (e.g., ultrasonic, propane)

CNG/LNG/LPG GLOSSARY ADDITIONS

NOTE: The definition of terms given in this glossary, in as much as practical, are given in the context of how they are typically used in the AFV community.

ABSOLUTE PRESSURE: A pressure measurement that includes atmospheric pressure.

AIR/FUEL RATIO: The proportion, by weight, of air to fuel supplied for combustion.

ALTERNATE FUEL: As defined pursuant to the EPACT, methanol, denatured ethanol and other alcohol's, separately or in mixtures of 85% by volume or more (but not less than 70% as determined by DOE rule) with gasoline or other fuels, compressed natural gas (CNG), liquefied natural gas (LNG), liquefied petroleum gas (LPG), hydrogen, "coal-derived liquid fuels," fuels "other than alcohol" derived from "biological materials," electricity or any other fuel determined to be "substantially not petroleum" and yielding "substantial energy security benefits and substantial environmental benefits."

ALTERNATIVE FUEL VEHICLE (AFV): A vehicle that runs on an alternative fuel.

APPURTENANCES: Attachments/fixtures of a fuel container assembly (e.g. PRD on or in a container).

AUTO IGNITION: Also known as knock and detonation.

AUTO STOP VALVE: A valve used on an LPG vehicle to prevent the overfill of the fuel supply container.

BACKFLOW CHECK VALVE: Directional (one-way) pressure induced check valve used in the fuel supply and refueling circuits.

BOILING POINT: The temperature at which a fuel changes from a liquid to a vapor.

BI - FUEL: A vehicle with two separate fuel systems designed to run on either an alternative fuel or conventional gasoline, using only one fuel at a time. These vehicles are referred to as "dual-fuel" in the CAAA and EPACT.

CALIFORNIA AIR RESOURCES BOARD (CARB): A State agency that regulates the air quality in California.

CETANE NUMBER: An indicator of the ignition quality of diesel fuels.

CLEAN AIR ACT AMENDMENT OF 1990 (CAAA): The original Clean Air Act was signed into law in 1963 and was amended several times, most recently in 1990 (P.L. 101-549). For transportation, the Act sets motor vehicle emission standards and includes provisions for the use of reformulated and oxygenated gasoline. The regulation also requires certain fleet operators to use clean fuel vehicles in 22 cities.

CLOCKING: Positioning of an installed component (e.g. position of LPG fuel supply container).

COMPRESSED NATURAL GAS (CNG): Natural gas that has been compressed to high pressures, typically between 2000 and 3600 psi, held in a container (also see natural gas).

CONVERTED VEHICLE: A vehicle originally designed to operate on gasoline or diesel that has been modified or altered to run on an alternative fuel.

CONVERTER/REGULATOR: A device used in the fuel system to regulate the pressure of the fuel. In some systems, it may also control the rate of conversion of the fuel from a liquid to a vapor.

CONVERTER/VAPORIZER: A device which vaporizes liquid fuel which enters it (heat exchanger), and regulates the release of the fuel at a controlled pressure or rate.

DEDICATED FUEL VEHICLE: A vehicle that is capable of operating on only one type of fuel.

DE-FUEL: The action to remove/extract fuel from an on-board fuel supply container in a safe and managed procedure.

DENSITY: The weight of a specific hydrocarbon fuel for a volumetric measurement, e.g., Lb./gallon.

DETERMINE LOCATION: “Determine the proper location” assumes that the most appropriate resource (s) will be used. Manufacturers’ specific instructions on component location (when available) will generally be considered the primary resource. Industry practices/guidelines will be used when the manufacturer does not provide specific instruction for a particular application.

DIESEL CYCLE: An engine operating cycle in which air is heated by compression thus igniting the fuel air mixture.

DUAL-FUEL VEHICLE:

EPACT Definition - Vehicle designed to operate on a combination of an alternative fuel and a conventional fuel. This includes: a) vehicles using a mixture of gasoline or diesel and an alternative fuel in one tank, commonly called flexible-fueled vehicles; and b) vehicles capable of operating on either an alternative fuel, a conventional fuel or both, using two fuel systems.

CAAA Definition - Vehicle with two separate fuel systems designed to run on either an alternative fuel or conventional gasoline, using only one fuel at a time.

ECONOMIZER/REGULATOR: A fuel pressure regulator, which allows coolant circulation (through a heat exchanger) and therefore vaporizes the liquid fuel which enters it, regulating the release of gaseous fuel in an economical manner.

EIGHTY PERCENT (80%) FIXED LIQUID LEVEL GAUGE: A fixed fitting at the 80% (of fill) level on an LPG container, used as an indicator when filling an LPG container.

ENERGY DENSITY: The energy content of a specific hydrocarbon fuel for a volumetric measurement. e.g., BTU/Lb.

ENERGY POLICY ACT OF 1992 (EPACT): (P.L. 102-486) A broad-ranging act signed into law on Oct. 24, 1992. Titles III, IV, XV and XIX of EPACT deal with alternative transportation fuels.

EXCESS FLOW VALVE: Pressure differential sensing, limiting flow valve.

FILL CIRCUITS: Piping/tubing and valves in series, for fueling a vehicle, beginning at the fill receptacle (fill valve), and ending at the on-board fuel supply container.

FLAMMABILITY LIMITS: The minimum or maximum air to fuel ratio that will support combustion.

FLASH POINT: The lowest temperature at which a fuel will give off ignitable vapors.

FLEXIBLE-FUEL VEHICLES: Vehicles designed to run on blends of unleaded gasoline with either ethanol or methanol.

FUEL LOCK-OFF (POSITIVE FUEL SHUT-OFF DEVICE): A positively closed (shut-down) fuel valve designed to shut off fuel and 'lock-off' the supply from delivery to an engine.

FUEL SUPPLY CONTAINER: Device used to store fuel on-board the vehicle. Includes all high/low pressure, and cryogenic fuel containers

GAS LAWS: The relationship among pressure, volume, and temperature of a gas -- as described by Boyles, Charles, and Ideal gas laws.

GAUGE PRESSURE: A pressure measurement that excludes atmospheric pressure.

HEATING VALUE: The amount of heat released during combustion of fuel as quantified by weight (BTU/Lb.).

HIGH HEAT VALUE: The gross (upper) heating value of a fuel before energy losses from combustion.

HYDROSTATIC RELIEF VALVE: An in-line, pre-set, liquid-to-gas pressure relief valve.

INERT GAS: Any gas that exhibits great stability and extremely low reaction rates (e.g., argon, nitrogen) - also called a noble gas.

INJECTOR: A device for delivering metered pressurized fuel to the intake system or the cylinder.

INTERNAL PRESSURE RELIEF VALVE: Internally mounted (in tank/container) PRD (pressure relief device)

KNOCK: The violent combustion of fuel in an engine caused by multiple ignition points in the combustion chamber.

LEAN BURN: An Otto cycle engine that has 30% - 50% excess air after combustion.

LIGHT-DUTY VEHICLE: Vehicle weighing up to 8,500 pounds.

LIQUEFIED PETROLEUM GAS (LPG): A hydrocarbon and colorless gas, primarily propane, found in natural gas and produced from crude oil.

LIQUEFIED NATURAL GAS (LNG): Natural Gas that has been condensed to a liquid - typically by cryogenically cooling the gas.

LOW HEAT VALUE: The net / lower heating value of a fuel after energy losses from water vapor in the exhaust. The net heat value the engine responds to.

MANIFOLD SKIN TEMPERATURE SENSOR (MST): Device used to determine the surface (skin) temperature of the intake manifold.

MANUAL VENT CIRCUIT: On-board system (valve and piping) for the manual release of pressure from the fuel storage system.

MASS AIR FLOW: A computer controlled fuel management system using information from an air flow meter (e.g., hot wire sensor) to determine engine air intake.

MEDIUM-DUTY VEHICLE: Vehicle weighing between 8,500 and 14,000 pounds.

MOLECULAR STRUCTURE: The composition of hydrocarbon fuels with regards to its atomic make-up, e.g., number (or ratio) of hydrogen and carbon atoms per molecule.

NATURAL GAS: A mixture of gaseous hydrocarbons, primarily methane, occurring naturally in the earth.

NATURAL GAS TANK TEMPERATURE (NGTT): A device used to measure the temperature of the natural gas fuel supply container.

NPT: National Pipe Thread.

OCTANE: A performance measurement of a fuel's anti-knock characteristics.

OTTO CYCLE: The cycle of events in a four-stroke spark ignited engine. Named for the German inventor, Dr. Nicholas Otto.

PRE-IGNITION: The ignition of the air-fuel mixture in a combustion chamber caused by surface ignition or auto ignition before the spark occurs at the spark plug.

RELIEF/VENT STACK: Tubing/piping for channeling vented vapors up and away from vehicle ignition sources.

SPEED DENSITY: A computer controlled fuel management system using engine speed and manifold absolute pressure for engine air intake calculations.

STOICHIOMETRIC AIR/FUEL RATIO: The exact air to fuel ratio required to completely combust fuel to water and carbon dioxide with no excess air or fuel remaining.

SUPPLEMENTAL COMPUTER SUPPORT: A device used to assist or modify input or output signals to/from the original equipment computer (e.g., timing and O2 fixes).

SUPPLEMENTAL ON-BOARD DIAGNOSTICS: On-board diagnostics of a supplemental computer - non Original Equipment computers.

SURFACE IGNITION: The ignition of the air-fuel mixture in a combustion chamber by a hot surface rather than by the spark of the spark plug.

TEMPERATURE SATURATION: The conditioning of a contained cryogenic liquid (LNG) to control its pressure by regulating its temperature.

VALVES: General description - any device in a passageway that regulates the flow of whatever is in the conduit, by means of a flap, lid, plug, etc. acting to open or block passages.

VAPOR DENSITY: Weight of a gaseous fuel in relation to air.

VAPORIZER/HEAT EXCHANGER: See economizer/regulator and converter/vaporizer

WEATHERING: The phenomena where contained LNG undergoes compositional changes over time due to the boil-off of constituents within the fuel having different boiling points.