Small Engines

Revised 6/2024

Purpose and Standards

The purpose of the contest is to stimulate an appreciation for small engine repair and serve as one method of training Future Farmers in the skills and safety practices needed in diagnosing engine malfunctions. Schools will be required to bring a prescribed list of tools. There will be a critique following the contest.

Foundation Standards: Mathematics Algebra 10 and Geometry 11, Listening and Speaking 1.8, 2.3, Technology 4.1, 4.2, 4.6, Problem Solving and Critical Thinking 5.1, 5.2, 5.3, Health and Safety 6.2, 6.4, 6.5, Ethics and Legal Responsibilities 8.3, Leadership and Teamwork 9.1, 9.2, 9.3.

Ag Mechanics Pathway Standards: Safety B 1.0, Engines and Machinery B 10.0, B11.0.

Contestants

The contest team will be made up of three members. Each member will compete in the Theory and Identification areas. The top ten teams based on the combined scores of Theory and Identification areas, will compete in Problem Solving, Technical Skills, and Troubleshooting. The top five individuals, if they are not part of one of the top ten teams, will compete in the Problem Solving and Technical Skills area as well.

Classes

|  |  |  |
| --- | --- | --- |
| **Class** | **Individual Points** | **Team Points** |
| Identification | 50 | 150 |
| Theory Test | 50 | 150 |
| Problem Solving | 50 | 150 |
| Technical Skills | 50 | 150 |
| Troubleshooting |  | 200 |
| Total | 200 | 800 |

Tiebreaker

1. Individual and team ties will be broken by individual’s/team’s scores on problem solving.
2. If a tie persists it will be broken by score on technical skills test.
3. If a tie persists it will be broken by score on theory test.
4. If a tie persists it will be broken by score on identification test.
5. If a tie persists it will be broken by the flip of a coin.

\*In the qualifying rounds of Theory and Identification, ties will be broken by individual/team scores on theory. If a tie persists, follow 4 then 5 above.

Ties in the individual sub-contests will be broken by the highest individual overall score. Team sub-contests will be broken by the highest overall team score.

Requirements of the Host Institution

The sponsoring institution will indicate the parts catalog and price guide format and the engine model number that will be used in the troubleshooting portion of the contest in the registration materials sent to the competing school. A list of troubleshooting engine specifications for the judges will also be provided.

Rules

The contest is made up of the following areas:

1. IDENTIFICATION (Time: 40 minutes)
   1. Identification of engine parts and tools (50 points)  
      A key with the parts identified will be available at the end of the contest. All names used shall be those used by the manufacturer's engine or parts manual (16 horsepower or less).  
      See Appendix I list.
2. THEORY (Time: 40 minutes) (50 points - Maximum of 50 questions)
   1. A written test on Basic Engine Theory including the following areas:

|  |  |  |
| --- | --- | --- |
| Compression |  | Troubleshooting |
| Carburetion |  | Fuels |
| Ignition |  | Cooling systems |
| Lubrication |  | Safety |
| Maintenance |  | Starters |

* 1. Questions may be submitted by each school planning to compete at State Finals in the Small Engines Contest. They are to include the textbook page number, question and correct answer. They must be submitted by December 1 of each year to the Chairman at the school hosting the State Finals Contest.
  2. Test questions will be derived from the following Reference Materials:
     1. Briggs Stratton Repair Manual – Single Cylinder ‘L’ Head and OHV (Intek)
        1. [Textbook](https://www.amazon.com/Briggs-Stratton-Single-Cylinder-Repair/dp/B00004TKNL)
     2. FOS (Compact Engine by John Deere)
        1. [Textbook](https://www.amazon.com/ENGINES-FUND-OF-SERVICE/dp/0866914234)
     3. Small Gas Engines by Alfred C. Roth
        1. [Textbook](https://www.amazon.com/Small-Gas-Engines-Alfred-Roth-dp-1637760728/dp/1637760728/ref%3Ddp_ob_image_bk)
     4. Small Engines by Bruce Radcliff (American Technical Publications)
        1. [Textbook](https://www.amazon.com/Small-Engines-4th-Bruce-Radcliff-dp-082690033X/dp/082690033X/ref%3Ddp_ob_image_bk)
  3. The questions on this test will be theoretical in nature and will not include any references to exact engine specifications that should be looked up in the engine technical manual.
  4. A copy of that year’s written test will be provided to coaches as a hard copy or electronically.

1. PROBLEM SOLVING: (Time: 40 minutes) (50 points)
   1. Problem solving shall be made up of stations with 'hands-on' skills. A minimum of ten stations are required.
   2. Each station will be equipped with the following:
      1. The specific components needed for the exercise.
      2. All tools needed to perform the task at the station.
      3. All technical manual pages and reference sheets needed that explain the procedure.
      4. A list of all specifications needed to complete the exercise.
   3. Examples of Problem Solving questions are:
      1. On what model engine are you working?
      2. To order a new head gasket for this model engine what is the part number?
      3. What is the valve clearance specification for this model engine?
      4. What high altitude jet would you use in this carburetor?
2. TECHNICAL SKILLS: (Time: 40 minutes) (50 points)
   1. Technical Skills shall be made up of stations with “hands-on” skills. A minimum of ten stations are required.
   2. Each station will be equipped with the following:
      1. The specific components needed for the exercise.
      2. All tools needed to perform the task at the station.
      3. All technical manual pages and reference sheets needed that explain the procedure.
      4. A list of all specifications needed to complete the exercise.
   3. Examples of “hands-on” exercises for Technical Skills are:
      1. Using a micrometer.
      2. Using a hole gauge and micrometer--measure valve guides, connecting rod journals, piston pin journals.
      3. Using a telescoping gauge and micrometer--measure cylinder bore.
      4. Using a dial indicator--measure crankshaft endplay.
      5. Using a feeler gauge--measure valve tappet clearance, point gap, armature air gap.
      6. Using a vibra tach--measure engine r.p.m.
      7. Using plug gauges as available from Briggs and Stratton--measure bearings, valve guides, breaker point plunger guides for "go no go" situations.
      8. Using a leak down tester to test engine compression.
      9. From displays of tools select those items needed for: pulling and installing valve seats; pulling and installing valve guides, etc.
      10. From displays of engine components: identify correctly assembled connecting rods and caps, ignition system, etc.
      11. Use of a billing statement and the calculations involved for parts and labor.
      12. Use of a digital multimeter.
3. TROUBLESHOOTING THE SMALL ENGINE (200 points possible awarded to the team and no individual points to be awarded).
   1. Other than the use of a leak down tester,all tools will be hand powered. All small engines will be of same type starters, carburetors, and ignition systems. Teams are allowed two (2) minutes for tool set up prior to starting trouble shooting. Trouble shooting score sheets will be returned with team results as soon as possible. Each troubleshooting judge should critique each team upon completion of the troubleshooting phase of the contest. Team members may not possess any engine parts except those that might be provided by contest sponsor. Written material will be limited to the appropriate Repair Manual and a list of common specifications for the engine being used in the contest. No score sheets, etc. will be allowed.
   2. (Time: 60 minutes repair time, 10 minutes Pre-Check/Diagnostic Period). Engines will run for one minute.
      1. Time will be stopped for any repairs required that are not a part of the engine scenario and/or bug introduced into engines.
      2. If time is stopped, teams will only be able to correct the issue outside the contest’s intended scope.
      3. Upon completion of these repairs the time will resume.
      4. 10 minute “Pre-Check/Diagnostic Period” will commence during the first 10 minutes of troubleshooting. During the first 10 minutes, teams are to ask and record answers to troubleshooting questions, complete engine prechecks, and verify the customer’s complaint. At the completion of the diagnostic Worksheet, teams will turn in and present their diagnostic findings to the judge. During the “Pre-Check”/Diagnostic Period”, students are not to make any repairs to the engine or order any parts. Teams that have not completed the initial tasks (questions, engine prechecks, or complaint verification) within the first 10 minutes will be allowed to do so during the “Troubleshooting Period”. At the end of the Pre-Check/Diagnostic Period”, 60 minutes will remain to repair the engine.
   3. Common adjustments and repairs will need to be solved by the team in the contest. The team will work together on trouble shooting. Example:
      1. Spark plug out of adjustment
      2. Governor linkage incorrect
      3. Carburetor out of adjustment
      4. Loss of compression
      5. Loose parts
      6. Obstructions
      7. Improper assembly
      8. Missing parts
      9. Worn or damaged parts
      10. Ignition system inoperable.
   4. The contestants will be judged on the following items:
      1. Safety
      2. Proper use of tools
      3. Neatness of work
      4. Starting procedures
      5. Pre-start checks and diagnostics
      6. Troubleshooting and diagnostic methods

7. Completion of work order

Note: Appendix II and III

* 1. If a team’s troubleshooting judge deems the procedures and actions damaging to the engine and its components, the judge will have the team stop with appropriate points deducted on the Small Engines Troubleshooting Score Sheet.

1. TOOLS – Each team’s toolbox should include tools commonly used in the repair and maintenance of small gas engines. A current recommended tool list will be available for teachers to download from the CATA Curricular Code website.

APPENDIX I

**IDENTIFICATION LIST**

Toolsused for the identification portion of the contest are to be those commonly used in small gas engine repair. Some examples are listed in the table below. In regards to the engine parts, list the items shown serve only as a point of reference for study. Similar items from other brands of engines may be used.

**TOOLS**

|  |  |
| --- | --- |
| Adjustable open end wrench | Ratchet handle |
| Allen wrench | Regular or slotted screwdriver |
| Ball peen hammer | Ring compressor |
| Battery pliers | Screw pitch gauge |
| Box end wrench | Six point socket |
| Center punch | Socket adapter |
| Cold chisel | Socket extension |
| Combination end wrench | Soft face hammer |
| Combination slip join pliers | Spark plug gauge |
| Deep socket | Spark plug socket |
| Diagonal pliers | Spark tester |
| Drift punch | Speed handle |
| Flat feeler gauge | Strap wrench |
| Flex handle | Tachometer |
| Fuel clamp pliers | Torque wrench |
| Lever jawed wrench | Torx screwdriver |
| Long nose pliers | Torx socket |
| Nut driver | Universal joint |
| Offset screwdriver | Valve spring compressor |
| Open end wrench | Volt ohm milliamp (VOM) meter |
| Phillips screwdriver | Water pump pliers |
| Pin punch |  |

SPECIAL TOOLS

Briggs & Stratton Service Tools Catalog

**ENGINE PARTS**

The engine parts will be selected from the following: Briggs & Stratton Series 60000 to 260000.

Example:

Briggs & Stratton Illustrated Parts Lists specified below:

|  |  |
| --- | --- |
| **MODEL NUMBER** | **TYPE NUMBER** |
|  |  |
| 91200 TO 91299 | 0017 |
| 124700 TO 124799 | 0101 |
| 110400 TO 110499 | N/A |
| 261700 TO 267199 | 0020 |

APPENDIX II

Troubleshooting – General Information

Each team of three contestants will be given a maximum of one hour to diagnose and repair an engine and complete a standardized work order (see example – Appendix III). The judge will act as the customer and the team will act as the service technicians. Each team will be read a scenario by the judge. The scenario should include the type of equipment the engine is used on, where and how it was stored, used, etc. Through a series of standard questions, asked by the team members, they will diagnose and repair the engine based on the responses received from the judge (see example below). Upon starting the engine, the team will then be required to complete a work order including costs for parts, labor, and sales tax. Each judge will be provided with a written scenario and answers to the questions.

**Example**

**Scenario**

This engine is from a rototiller that has been used for one season. It was stored outside, uncovered for six months with no other use.

Standard Questions and Example Responses:

Question: What is wrong with the engine?

Response: The (equipment type) will not run.

Question: How did the engine act when the problem occurred?

Response: It ran fine the last time I used it, but when I went to use it again, it would not start.

Question: Did you do anything to the engine prior to bringing it in?

Response: I removed the carburetor and looked inside. I also removed the float bowl and didn’t see anything wrong, so I put it back together.

Question: What would you like us to do to the engine?

Response: Repair the problem.

Question: When was this engine last serviced?

Response: I had it serviced last year after using it on a job site. It’s been sitting in my garage for the last six months.

| **Appendix III -- Small Engines Troubleshooting Score Sheet** | | | |
| --- | --- | --- | --- |
| Team Name: | Judge’s Name: | Possible | Earned |
| **Points in these categories are variable** | | | |
| **Safety** – Deduct 1 point for each infraction up to the maximum points in each line item. | | | |
| 1. Wipes up oil and fuel spills as they occur | | 0 to 5 |  |
| 1. Maintains safe work practices | | 0 to 5 |  |
| 1. Each member wears safety glasses at all times | | 0 to 5 |  |
| **Total** | | **15** |  |
| **Tools and Parts – Deduct 1 point for each infraction up to the maximum points in each line item.** | | | |
| a. Uses proper tool for the job | | 5 |  |
| b. Drops tools and parts – (Proper grip, careful not to drop tools and parts, etc.) | | 5 |  |
| c. Parts and Hardware installed correctly (not within the 3 systems below) | | 5 |  |
| d. Uses proper torque specifications and patterns using provided contest approved modified torque specification chart. | | 5 |  |
| **Total** | | **20** |  |
| **Pre Start Checks (Points are all or nothing in this category. NOTE: Steps “a” through “e” can be done in any order.)** | | | |
| a. Check for proper oil level | | 5 |  |
| b. Check Gasoline Quality and Level | | 5 |  |
| c. Starter Operational | | 5 |  |
| d. Air cleaner serviced or replaced | | 5 |  |
| e. Stop Switch Operational | | 5 |  |
| f. Customer Complaint Verified (Tried to start the engine to verify the complaint prior to making repairs. No Points will be deducted for necessary repairs made to verify the complaint or prevent engine damage. No diagnostic repairs)  e. Customer Complaint Verified (Tried to start the engine to verify the complaint prior to making repairs.) | | 5 |  |
| **Total** | | **30** |  |
| **Diagnostic Approach** | | | |
| During the 10 minute “Pre-Check Diagnostic Period” teams will complete a Diagnostic Approach Worksheet.  Teams will use information gained from the scenario, question responses, engine pre-checks, and veriﬁcation of customer complaint to develop a diagnostic approach. Upon conclusion of the Diagnostic Period, teams will present and submit Diagnostic Approach Worksheet to the judge. Once submitted, no changes may be made to the document. For scoring, SEE APPENDIX V “Diagnostic Approach Scoresheet Rubric”. | | **See criteria** |  |
| **Total** | | **35** |  |
| **Procedurals Scoring** – 0 points awarded for improper assembly or incomplete repairs in each area. No points will be given if a team fails to follow proper assembly of all components or if a judge must stop/correct a team for improper procedures that would result in engine dammage. | | | |
| **Fuel System (10pts) Required (circle one) Y N (Select only one Option “a” through “e”.)** | | | |
| a. Repairs Needed, correct procedures used and rational explanation given **(10 pts) or** | | Score in correct box |  |
| b. Repairs Needed, correct procedures used and no or incorrect explanation given  **(5 pts) or** | |  |
| c. Repairs Not needed, but correct procedures used and rational explanation given **(5 pts) or** | |  |
| d. Repairs Not needed, no explanation needed **(10 pts) or** | |  |
| e. Improper or incomplete repairs done and/or Judge stopped team to avoid damage **(0 pts)** | |  |  |
| **Total** | | **10** |  |
| **Ignition System (10pts) Required (circle one) Y N (Select only one Option “a” through “e”.)** | | | |
| |  | | --- | | a. Repairs Needed, correct procedures used and rational explanation given **(10 pts) or** | |  | | c. Repairs Not needed and no procedures used (no explanation necessary) 15pts | | d. Team provides a clear explanation of what procedures were performed and why | | **Procedurals** – 0 Points awarded for improper assembly or incomplete repairs in this area | | | Score in correct box  0 or 5 |  |
| b. Repairs Needed, correct procedures usedand no or incorrect explanation given  **(5 pts) or** | |  |
| c. Repairs Not needed, but correct procedures used and rational explanation given **(5 pts) or** | |  |
| d. Repairs Not needed, no explanation needed. **(10 pts) or** | |  |
| e. Improper of incomplete repairs done and/or Judge stopped team to avoid damage **(0 pts)** | |  |  |
| **Total** | | **10** |  |
| **Compression System (10pts) Required (circle one) Y N (Select only one Option “a” through “e”.)** | | | |
| a. Repairs Needed, correct procedures used and rational explanation given **(10 pts) or** | | Score in correct box  0 or 5 |  |
| b. Repairs Needed, correct procedures usedand no or incorrect explanation given **(5 pts) or** | |  |
| c. Repairs Not needed, correct procedures used and rational explanation given  **(5 pts) or** | |  |
| d. Repairs Not needed, no explanation needed  **(10 pts) or** | |  |
| e. Improper or incomplete repairs done and/or Judge stopped team to avoid damage **(0 pts)** | |  |  |
| **Total** | | **10** |  |
| **RPM Adjustments** – Points are all or nothing in this category – Host will determine ALL RPM settings. All settings must be accurately measured and adjustement procedure is explained if needed. | | | |
| 1. a. Non-governed Idle RPM Spec [ ] – Team Reading: [ ] Adj. Explained: Y N N/A | | 5 |  |
| 1. b. Idle Speed RPM is correct [ ] – Team Reading: [ ] Adj. Explained: Y N N/A | | 5 |  |
| 1. c. Top No Load Speed RPM is correct [ ] – Team Reading: [ ] Adj. Explained: Y N N/A | | 5 |  |
| d. Engine runs for 1 minute within the allotted time after measuring & explaining the above engine RPM adjustments. | | 10 |  |
| **Total** | | **20** |  |
|  | | | |
| Total points awarded for Troubleshooting | | 150 |  |
| Total points awarded for Work Order **(Must be turned in to the judge within the one-hour time limit.)** | | 50 |  |
| **GRAND TOTAL** | | **200** |  |

**Appendix IV**

**California FFA Small Engines Work Order**

**(Must be turned into the judge within the one-hour time limit.)**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Team Name** | |  | | | |  | | **Date Unit was Inspected** | | | |  | | | | |
| **Engine Number** | |  | | | |  | | **Date Unit was Completed** | | | |  | | | | |
|  | | |  |  | | | | | | |  |  | | | | |
|  | | |  |  | | | | | | |  | **Judges Use Only!** | | | | |
| Judge’s Name | | | Engine Brand | Type of Equipment | | | | | | |  | Possible | | | Awarded | |
| Model / Serial # | | | Type # | Code | | | | | | | 10 pts | | |  | |
| **Customer Comments**: (5 questions at 2 pts ea.) | | | | | | | | | | |  | 10 pts | | |  | |
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|  | | | | | | | | | | |
|  | | | | | | | | | | |
| **Work Performed:** List each task performed on a separate line below and use the Flat Rate Labor Repair Chart description & hours provided to determine Labor Charge. | | | | | | | | | | |  | 10pts | | |  | |
| **Labor Description** | | | | | | | | | **Labor Hours** | **Labor Charge** |
|  | | | | | | | | |  |  |
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|  | | | | | | | | |  |  |
|  | | | | | | | | |  |  |
| **Labor Totals** | | | | | | | | |  |  |
| **Part #** | **Description** | | | | **Qty.** | | **Unit Price** | | | **Total Price** |  | 10 pts | |  | | |
|  |  | | | |  | |  | | |  |
|  |  | | | |  | |  | | |  |
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|  |  | | | |  | |  | | |  |
|  |  | | | |  | |  | | |  |
| Parts Total & Tax calculated from actual Parts Ordered | | | | | | | **Parts Total** | | |  |  | Math Check Only  8 pts | |  | | |
| **Tax (8%)** | | |  |  |
| Labor Charge is $75.00 per hour for work performed. | | | | | | | **Labor Total** | | |  |  |
| Totals 2 points each | | | | | | | **Grand Total** | | |  |  |
| Legibility – 2 points or Zero (0) points – If any portion is not legible, no points will be awarded. | | | | | | | | | | |  | 2 pts | |  | | |
| Judge’s Signature:  **Total Team Points Awarded** | | | | | | | | | | |  | 50 pts | |  | | |
| **Flat Rate Labor Repair Chart** | | | | | | | | | | | | | | | | |
| **Labor Rate is $75.00 per hour** | | | | | | | | | | | | | | **Bill Time** | | |
| Repair/Adjustment Description | | | | | | | | | | | | | | **In hours** | | |
| **Pre-Check & Diagnostics –** Does not include repairs | | | | | | | | | | | | | | 0.2 | | |
| **Fuel System Repairs/Adjustments** | | | | | | | | | | | | | |  | | |
| Carburetor Rebuild / Reassemble \* | | | | | | | | | | | | | | 0.4 | | |
| Carburetor Replacement \* | | | | | | | | | | | | | | 0.2 | | |
| Carburetor Spacer Replacement \* | | | | | | | | | | | | | | 0.2 | | |
| Carburetor / Fuel Line Obstruction Removal | | | | | | | | | | | | | | 0.2 | | |
| Main Jet Replacement \* | | | | | | | | | | | | | | 0.2 | | |
| Float Repair/Replacement \* | | | | | | | | | | | | | | 0.3 | | |
| Carburetor Gasket(s) Replacement Only | | | | | | | | | | | | | | 0.2 | | |
| Other Fuel System repair not listed - (must provide summary repair description on work order) | | | | | | | | | | | | | | 0.3 | | |
| \* = Time includes gasket replacement | | | | | | | | | | | | | |  | | |
| **Ignition System Repairs/Adjustments** | | | | | | | | | | | | | |  | | |
| Armature Air Gap Adjustment | | | | | | | | | | | | | | 0.2 | | |
| Armature Replacement | | | | | | | | | | | | | | 0.3 | | |
| Flywheel Key Replacement | | | | | | | | | | | | | | 0.5 | | |
| Kill Switch Repair/Replace | | | | | | | | | | | | | | 0.2 | | |
| Spark Plug Replacement/Adjust Gap | | | | | | | | | | | | | | 0.1 | | |
| Other Ignition System repair not listed - (must provide summary repair description on work order) | | | | | | | | | | | | | | 0.3 | | |
| **Compression System Repairs/Adjustments** | | | | | | | | | | | | | |  | | |
| Valve(s) Replacement | | | | | | | | | | | | | | 0.7 | | |
| Valve(s) Clearance Adjustment | | | | | | | | | | | | | | 0.3 | | |
| Push Rod(s) Replacement | | | | | | | | | | | | | | 0.5 | | |
| Cylinder Head Gasket Replacement | | | | | | | | | | | | | | 0.7 | | |
| Cylinder Head Replacement / Reassembly | | | | | | | | | | | | | | 0.7 | | |
| Other Compression System repair not listed - (must provide summary repair description on work order) | | | | | | | | | | | | | | 0.5 | | |
| **Service** | | | | | | | | | | | | | |  | | |
| 25 Hour - Clean air filter | | | | | | | | | | | | | | 0.1 | | |
| 50 Hour - Clean air filter, Change engine oil, check muffler and spark arrester | | | | | | | | | | | | | | 0.2 | | |
| 100 Hour / Annual - Replace air filter, Replace pre-cleaner, Replace spark plug, Replace fuel filter, Clean air cooling system, Valve adjustment, Change engine oil | | | | | | | | | | | | | | 0.5 | | |
| **Starter Repair/Adjustments** | | | | | | | | | | | | | |  | | |
| Rewind Starter assemble repair | | | | | | | | | | | | | | 0.3 | | |
| Rewind Starter Replacement | | | | | | | | | | | | | | 0.2 | | |
| **Governor Repair/Adjustments** | | | | | | | | | | | | | |  | | |
| Dynamic Adjustment | | | | | | | | | | | | | | 0.2 | | |
| Linkage Repair/Replacement | | | | | | | | | | | | | | 0.3 | | |
| **Exhaust System Repair** | | | | | | | | | | | | | |  | | |
| Obstruction Removal | | | | | | | | | | | | | | 0.2 | | |
| **Engine Repair - Other** | | | | | | | | | | | | | |  | | |
| Other necessary engine repairs not listed above - (must provide summary repair description on work order) | | | | | | | | | | | | | | 0.2 | | |

**Appendix V**

**Diagnostic Approach Worksheet**

Team:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Possible**

**Earned**

**10**

**15**

**10**

**Total**

Judge:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**-Systems in Need of Repair: (Circle all that apply)**

Compression Fuel Ignition

**-Team Diagnostics**

Team Diagnostics should include information from scenario, customer responses, and results of precheck of the engine.

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**-Repair Method**

What diagnostic equipment or repair techniques will be used to isolate and identify repairs needed for the engine.

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**Diagnostic Approach Scoresheet Rubric**

**Systems in Need of Repair**: 10 Points Possible

Score is all or nothing in identifying engine systems in need of repair.

**Team Diagnostics**: 15 Points Possible

15 Points:

The team includes all correct and pertinent information regarding the engine bug from the scenario.

The team's diagnostics incorporate and accurately interpret customer comments.

The results of all engine pre checks relevant to engine bugs are noted.

The presentation to judge is comprehensive, showing a deep understanding of the problem.

10 Points:

The team provides mostly correct information but is missing details specifically related to the engine bug from the scenario.

Customer comments are included and correctly interpreted.

Results of engine pre checks are documented, though there may be minor errors or omissions.

The overall presentation to judge demonstrates a good understanding of the problem but lacks complete detail.

5 Points:

* The team's diagnostics are incorrect or incomplete, missing several key pieces of information.
* Customer comments may be misinterpreted or not included.
* The engine prechecks are either not thoroughly documented or contain significant errors.
* The presentation to judge shows a limited understanding of the problem.

0 Points:

The team makes no attempt to perform diagnostics.

No customer comments are included.

Engine pre checks are not documented.

The presentation to the judge lacks any meaningful content regarding the diagnostics of the engine issue.

**Repair Method:** 10 Points Possible

10 Points:

* The team correctly provides reasons for using diagnostic equipment and repair techniques to isolate and identify the necessary repairs for the engine.
* All repairs are addressed according to their stated Team Diagnostics prompt.
* The team quotes OEM specifications from technical publications and/or provided specification sheets from the host institution and curricular code, demonstrating adherence to manufacturer guidelines.

5 Points:

The team provides some reasoning for using diagnostic equipment and repair techniques, but it may lack clarity or completeness.

Most repairs are addressed from their stated Team Diagnostics prompt, but there may be minor omissions or errors.

The team references OEM specifications, but the application of these specifications may be incomplete or partially incorrect.

0 Points:

The team fails to provide reasoning for using diagnostic equipment and repair techniques, or the reasoning is incorrect.

Repairs are not adequately addressed from their stated Team Diagnostics prompt.

The team does not reference OEM specifications, or the references are incorrect and not used effectively.

**APPENDIX VI-Torque Values**

| **FASTENER** | **TORQUE** | **ADJUSTED TORQUE** |
| --- | --- | --- |
| Air Cleaner Base Screw | 50 lb-in. | 45 lb-in. |
| Air Cleaner Base Nut | 40 lb-in. | 35 lb-in. |
| Armature Screws | 95 lb-in. | 80 lb-in. |
| Blower Housing Screw | 85 lb-in. | 75 lb-in. |
| Connecting Rod Cap Screw | 125 lb-in. | 105 ib-in. |
| Control Panel Trim Screw | 30 lb-in. | 25 lb-in. |
| Crankcase Cover Screws | 210 lb-in. | 175 lb-in. |
| Cylinder Head Screws | 210 lb-in. | 175 lb-in. |
| Cylinder Heat Shield Screws | 50 lb-in. | 45 lb-in. |
| Flywheel Nut | 65 lb-ft. | N/A |
| Fuel Tank Screw | 85 lb-in. | 75 lb-in. |
| Fuel Tank Nut | 100 lb-in. | 85 lb-in. |
| Governor Lever Nut | 30 lb-in. | 25 lb-in. |
| Low Oil Sensor Module Screw | 85 lb-in. | 75 lb-in. |
| Muffler Stud Nut | 95 lb-in. | 80 lb-in. |
| Oil Drain Plug | 150 lb-in. | 130 lb-in. |
| Rocker Arm Stud | 120 lb-in. | 100 lb-in. |
| Rocker Ball Locknut | 70 lb-in. | 60 lb-in. |
| Rocker Cover Screw | 80 lb-in. | 70 lb-in. |
| Spark Plug | 180 lb-in. | 155 lb-in. |
| Speed Control Bracket | 85 lb-in. | 75 lb-in. |

Score Sheet Judging Criteria

1. **Safety**
   1. Wipes up oil and fuel spills as they occur – within 30 seconds of occurring is acceptable.
   2. Maintains safe work practices – this includes organized worktable, safe tool, and engine handling. Personal injury will incur maximum point deduction.
   3. Each member wears approved safety glasses at all times. – 1 pt deduction for each occurrence. If team member fails to have glasses on for more than 30 seconds, will incur maximum point deduction. No points will be deducted for removing safety glasses to read Technical Manuals or Illustrated Parts Lists.
2. **Tools and Parts**
   1. Uses proper tool for the job – examples of infractions include using the wrong size wrench/socket on a fastener, using a screwdriver to pry, or using a hex wrench in a torx fastener. Should not include: using a socket and extension as a nut driver, using common pliers to remove fuel lines, or using a screwdriver to loosen the oil fill cap.
   2. Drops tools and parts (proper grip, careful not to drop tools and parts, etc.) - examples of infractions for improper grip include not holding a torque wrench at the handle or balance point, touching the torque wrench on other than the handle while torquing, or using a closed fist grip while torquing the flywheel.
   3. Parts and hardware installed correctly (not within the three diagnostic areas) – examples of infractions include sheet metal components not fitted correctly, kill wire or spark plug wire routed incorrectly, or air filter cover incorrect.
   4. Uses proper torque specifications and patterns using provided contest approved modified torque specification chart. Each infraction is 1 point deduction. See Appendix VI
3. **Pre-Start Checks**
   1. Check for proper oil level – team checks that the oil level is within operating range.
   2. Check gasoline quality and level – team checks for sufficient fuel level and takes a fuel sample to check for contaminants.
   3. Starter operational – team checks for proper and safe starter operation. This includes checking starter rope for frays.
   4. Air cleaner serviced or replaced – team checks air filter for debris and replaces as needed.
   5. Stop switch operational – team tests the stop switch operation using an ignition tester as visual confirmation the stop switch is functioning.
      1. All Pre-Start Checks listed above must be done before the team attempts to start and verify customer’s complaint to receive points for each area.
   6. Customer complaint verified – team tried to start the engine and duplicate the customer’s complaint. The team must verify complaint prior to making repairs within the fuel, ignition, and compression systems. Points will not be deducted for necessary repairs made to verify the complaint or prevent engine damage. Acceptable repairs may include: starter rope repair; adding of engine oil; repair of the kill switch; clean out of contaminated fuel; fuel leak repair.
4. **Diagnostic Approach**
   1. Each team will complete a diagnostic approach to determine the cause of engine issue or failure.
   2. During this approach teams will need to isolate the system(s) that are causing the problem with the engine and describe how they will repair the engine using this approach.
   3. Each team will be given 10 minutes to determine what they believe is the issue, the teams will fill out a worksheet with their plan of action and present that information to the judge prior to doing any repairs to the engine.
   4. The Diagnostic Worksheet must be turned into the judge before any repairs are made to the engine.
5. Procedurals
6. Procedurals will not earn points within the Fuel, Ignition, and/or Compression Systems when a team fails to correctly assemble or adjust parts within that system. Examples of a situation that would require a procedural include, but not limited to misadjusted valves, magneto on backwards, improper magneto gap, carburetor spacer on backwards (NOTE: Protrusion must be installed toward the carburetor with a gasket on both sides), governor linkage installed incorrectly, not scraping old gasket material before installing a new gasket, not replacing all required gaskets for the repair.
7. Fuel System, Ignition System, Compression System
   1. Repairs needed, correct procedures used and rational diagnostic explanation given – 10 points will be awarded if the team corrected the problem within the area with no procedurals and explained diagnostic rationale.
   2. Repairs needed, correct procedures used and no or incorrect explanation given – 5 points will be awarded if the team disassembles and assembles system components that were necessary and did so with procedurals but gave no diagnostic explanation.
   3. Repairs not needed, but correct procedures used and rational diagnostic explanation given - 5 points will be awarded if a system is not part of the problem but the team used and explained diagnostic rationale.
   4. Repairs not needed so no diagnostic explanation needed – 10 points will be awarded if a team does nothing with a system because it is not necessary.
   5. When improper or incomplete repairs are done and/or a Judge stops the team to avoid damage to the engine – 0 points will be awarded.
8. RPM Adjustments
   1. Idle Speed & Top No Load Speed RPM will be measured using a tachometer. The judge will verify the team’s measurement is correct and within the desired settings. If necessary, the team will properly explain how each of the governor adjustments would be made according to factory procedures to bring the engine into specification. Zero (0) points will be awarded if the team fails to accurately measure and/or describe approved speed adjustment procedures or fails to identify the engine is out of specification range for each speed adjustment area.
9. Work Order Documentation

The Labor Guide is based on Briggs allowed times where available and designed to bring industry time management practices to the CDE.

* 1. Teams will use the standard repair descriptions and times when documenting the repair on the Work Order.
  2. Teams will need to clearly define when “Other” work is performed that is not listed in the Labor Guide.
  3. Judges will score the Labor and Parts charges on the Work Order portion of the contest as if they were the actual customer. Specifically, Teams should not be docked points if they perform additional work and/or replace parts that make sense and are properly explained as part of the scenario but not listed on the answer key.
  4. The Parts Total, Tax, Labor Total and Grand Total score is a math check only based on the Teams actual work performed & parts replaced.