

Mechanical Sciences

SMALL ENGINES CONTEST GUIDELINES

Member Guide

Pub. No. 4H381



WISCONSIN 4-H PUBLICATION

HEAD • HEART • HANDS • HEALTH

CONTENTS

Purpose	2	Potential Safety and Maintenance Problems	6
Events	2	Potential Tools and Parts for Tools and Part Identification	7
Eligibility	2	Potential Faults for Troubleshooting	7
Contest Planning	2	Practical Troubleshooting Scorecard	8
Responsibilities of the Contest Organizers	2	Part and Tool Identification Scorecard (Junior Division)	9
Equipment Needed	2	Part and Tool Identification Scorecard (Senior Division)	10
Scoring	3	Small Engine Equipment Inspection Scorecard	11
Judging and Protest Handling	3	Problem Solving Scorecard	12
Contest Events	3		
Results	6		



PURPOSE

This contest is designed as a public demonstration of skills and knowledge acquired by 4-H members participating in the small engine program. This event offers young people an opportunity to compete with other 4-Hers and to gain recognition for their accomplishments. It tests knowledge of engine maintenance and skill in safe engine operation while creating enthusiasm and interest among Cooperative Extension workers, 4-H leaders, and parents. As a result, these youth are able to create an improved self-esteem and to develop problem solving and other life skills which will adapt to many phases of their life.

For additional 4-H materials visit the 4-H Cooperative Curriculum System at www.n4hccs.org. The Small Engine materials, *Start Your Engines*, contain four activity guides: *Start It Up* (Grades 3-5), *Warm It Up* (Grades 6-8), *Tune It Up* (Grades 9-12), and *Helpers Guide*.

EVENTS

The contest will include the following events:

1. Written examination
2. Practical troubleshooting
3. Parts and tool identification and use
4. Small engine equipment inspection
5. Problem solving

ELIGIBILITY

Note: The following eligibility requirements are for the state contest only. Each county may use the following rules or develop their own eligibility requirements within the general state 4-H guidelines.

Junior Division

1. Contestants must be enrolled in the 4-H small engine program.
2. The contestants must be in grades 3 through 8 (see Image 1).
3. Each county may select one contestant to participate in the state 4-H small engine contest, junior division.

Senior Division

1. Contestants must be enrolled in the 4-H small engine program.
2. The contestants must be in grades 9 through 13.
3. Each county may select one contestant to participate in the state 4-H small engine contest, senior division.

CONTEST PLANNING

County

- The county contest should be organized by the county small engine leader(s) and/or Youth Extension agent.
- Holding the county contest during the county fair can create a considerable level of spectator interest and public support for the program.

State

- The state contest will be organized by the University of Wisconsin-Extension Department of Youth Development and the state small engine specialist.
- The state 4-H small engine contest will be held at a designated site during the late summer.

RESPONSIBILITIES OF THE CONTEST ORGANIZERS

1. Select the date for the contest.
2. Make arrangements for the contest site.
3. Notify all county youth development staff and participants of the time, date and place for the contest.
4. Acquire the equipment listed below.
5. Obtain the judges. There should be a minimum of three judges. *Note:* For suggestions on selecting judges see the section entitled “Judging and Protest Handling” on page 3.
6. Publicize their contest in the news media (newspaper, radio, etc.). The event should be publicized prior to the contest to encourage youth to participate. In addition, the results of the contest should be publicized immediately following the event.

EQUIPMENT NEEDED

1. Clipboards and pencils. (One clipboard per judge plus a sufficient number of pencils so that the contestants may take the written examination, parts and tool identification, problem solving, and small engine equipment inspection events.)
2. Tables. One table per small engine plus two or three additional tables for parts and tools identification, problem solving, and written examination will be sufficient. *Note:* A sufficient number of tables are needed for the contestants to take the written segments of the contest.
3. Small engines for county events may be obtained from the state Mechanical Science specialist.



4. Small engine parts and tools.
5. Compact tractor (lawn and garden tractor). The compact tractor will be used for the small engine equipment inspection segment of the contest.
6. Small engine service manuals. The service manuals will be used for the problem solving and practical troubleshooting segments of the contest.
7. One set of official scorecards for each contestant.
Note: The official scorecards on pages 8 to 11 may be reproduced. The problem solving scorecard on page 12 is *only* an example. A new problem solving worksheet should be developed for each contest.
8. Written examination. One copy per contestant will be required. *Note:* For requirements on the examination see the section entitled “Written Examination” on page 3. Written examinations may be obtained from the state Mechanical Science specialist responsible for the Small Engine project.

SCORING

The penalty system will be used. Therefore, for each incorrect answer, points will be added to the contestant’s score. The winner of the contest and the placings will be determined by the lowest score in an ascending order beginning with the lowest total points charged to any contestant.

All events including the written examination, practical troubleshooting, parts and tool identification and use, small engine equipment inspection, and problem solving will have time limits as indicated in later sections of these rules.

JUDGING AND PROTEST HANDLING

County

The county 4-H small engine coordinator(s) should select three judges who are knowledgeable of small engines. The coordinator(s) and judges should meet prior to the contest to discuss interpretation of the rules and to answer any questions that may arise. The judges need to have an opportunity to thoroughly study these rules before the contest.

State

Judges will be assigned to handle specific events in the contest. The State 4-H Mechanical Science Contest Committee will interpret all problems relating to the rules arising before or during the contest and will make revisions depending on contest conditions. No questions of protest will be

considered if submitted later than 15 minutes after the last contestant finishes all the events. Decisions of the State 4-H Mechanical Science Contest Committee shall be final.

CONTEST EVENTS

Following is a description of the events for the state small engine contest. County organizers may design their contest differently to meet their specific project goals. To ensure the greatest success of the county’s representatives at the state event, it is suggested that these rules be followed within reason.

Written Examination

(30 minute time limit)

The objective of the written examination is to determine contestant’s understanding of small engines operation, maintenance, and parts. The questions will be based on information found in 4-H Small Engine literature and member manuals.

The written examination for both divisions will consist of 25 questions with 10 points per question. For each question answered incorrectly or omitted, 10 points will be added to the contestant’s score. All questions will be multiple choice or true/false.

For the junior division, the source material for the written examination will be primarily the 4-H Small Engine Project literature and small engine service manuals and will deal with the four-stroke cycle engine.

For the senior division, the source material for the written examination will be from the 4-H Small Engine Project literature and small engine service manuals and will deal with

Image 1: Inspecting an Engine



both the two stroke and four-stroke cycle engines. The senior division examination will require more in-depth knowledge of small engines than the junior division examination.

The number of questions missed or not answered
____ x 10 = ____ points added to the contestant's score.

Practical Troubleshooting Event

(30 minute time limit)

The contestants will have an opportunity to demonstrate their skills in diagnosing engine problems where they will have to evaluate symptoms and take the necessary steps to correct the problems (see Image 2). The knowledge gained in reading member manuals and attending project meetings will be applied in this event.

This event will consist of a contestant troubleshooting three malfunctions in a contest engine. Each engine will be faulted so that the three malfunctions, individually, will prevent the engine from starting or running properly. Potential troubleshooting faults to consider are listed on page 7.

For the senior division, the contestants are expected to identify and correct the malfunctions, start the engine, and correctly adjust the slow and fast idle speeds of the engine. In the junior division, the contestants will have the same requirements as the senior division except they will *not* be

required to correctly adjust the idle speeds but the engine should run at slow and fast idle.

The small engines for the Practical Troubleshooting Event will be provided by contest officials. The small engines used in the event may be either new or used. An engine should be provided for each contestant. The engine used by the contestant in any event will be drawn by lot. The engine provided will be on a table or stand to permit disassembly, reassembly, and starting. Each contestant will be supplied with a kit of hand tools which would normally be used for the maintenance and repair of small engines. This tool kit should include any special tools the contestant might require in the Practical Troubleshooting Event. A service and repair manual with engine specifications will be provided.

All maladjustments, damage, or defective parts will be those that would be found in a small engine performing under normal conditions. Contestants will *not* be allowed to inspect the engine prior to participating in the event. All contestants in each division will be working at the same time.

The contest officials will arrange ahead of time to have any repair parts needed to restore each engine to normal functioning conditions. In addition, a supply of gasoline will be made available in safety cans and the necessary crankcase lubricants and other lubricating materials will be available.

Contestants must signal when they want their engines judged. Their time will then be recorded and no further work allowed. Scoring will be as follows:

- 5 penalty points for each minute (or part of) beyond 15 minutes
- 20 penalty points for failure to find and/or correct each of the three faults
- 20 penalty points for failure to operate engine at slow idle
- 20 penalty points for failure to operate engine at fast idle
- 20 penalty points for each safety infraction
- 40 penalty points for failure to start engine
- 30 penalty points for failure to operate engine at the correct slow idle speed (Senior Division only)
- 30 penalty points for failure to operate engine at the correct fast idle speed (Senior Division only)

Each contestant must demonstrate their engine at the judges' request. During this meeting of the contestant and judges, the judges are encouraged to ask questions in an effort to

Image 2: Troubleshooting an Engine



gain better understanding of the contestant's skill. Questions which may be asked at this time are "What malfunctions did you find?" and "How did you go about correcting the malfunctions?" This meeting should be very informal and the youth should be put at ease.

Note: The practical troubleshooting scorecard can be found on page 8.

Each contestant will be required to wear eye protection during the troubleshooting event (see Image 3). Safety glasses will be provided. Failure to wear eye protection will be a safety infraction.

Part and Tool Identification and Use Event (30 minute time limit)

The contestants will demonstrate their knowledge of:

1. engine parts identification
2. engine parts function and purpose
3. repair tools identification
4. repair tools function and purpose

Before engine problems can be effectively diagnosed and solved, a knowledge of small engine parts and tools is imperative.

This event will consist of identifying and explaining the use of 20 small engine parts and hand or specialty tools used in the maintenance and repair of small engines. Potential parts and tools to be considered for this event of the contest are listed on page 7. For the junior division the contestant will be given a list of parts and tools and will be asked to write the

number of each displayed part or tool adjacent to the name on the list. For the senior division, each item must be identified correctly by its common name and its functional use either as a part of the engine or a tool must be explained. Ten points will be added to the contestant's score for each part or tool incorrectly described or identified, or for each item unanswered.

The number of items in the questionnaire missed or unanswered $____ \times 10 = ____ \text{ points}$ added to the contestant's score.

Note: A score sheet may be found on page 9 (junior division) and page 10 (senior division).

Small Engine Equipment Inspection Event (5 minute time limit)

To minimize the chance for bodily injury when working with small engines, a person must be aware of possible unsafe conditions. The contestant must inspect a small engine machine and identify any unsafe items and any maintenance faults.

For the Small Engine Equipment Inspection, contest officials will provide a riding lawn mower or garden tractor with a spark ignition engine, not to exceed 20 horsepower. The contestants will perform a safety, service, and other functional inspection of the tractor. Potential safety and maintenance faults are listed on page 6.

This event will be conducted in an enclosure away from other contestants and will be given to one contestant at a time. The contestant will inspect for normal service items, such as fuel, lubricants, belt tension, placement of safety shields, and other items. For the junior division there will be four to five items and for the senior division, there will be eight to 10 items. The tractor will *not* be started or operated during the event. The contestant will record items requiring attention based on the routine daily checkup. Prior to the contest, the judges will determine the number of service items which must be checked and 10 points will be added to the score for each missed by the contestant.

The number of items missed needing service or incorrectly identified $____ \times 10 = ____ \text{ points}$ added to the contestant's score.

The Small Engine Equipment Inspection scorecard may be found on page 11.

Image 3: Youth Examining an Engine



Problem Solving Event

(30 minute limit)

The problem solving event is used to indicate the contestants' ability to use a service manual when determining some engine specifications. The service manual is an important key to servicing and maintaining a small engine.

For the junior division, each contestant will complete five problems which will require service and repair manuals. Ten problems will be used in the senior division. Each incorrect answer is valued at 10 points.

This is an activity involving the gathering and searching of information, studying the data or information, and the use of logical solution process based on commonly accepted standards and available information to solve a specific problem on an engine. An example might be to look up specific data from an operator's manual. Question: When adjusting a two-leg air gap on an 80000 aluminum engine, the proper spacing is a) 0.010, b) 0.016, c) 0.020, d) 0.030 inch. The problem solving score sheet will be provided with the questions. The contestant should have had some familiarization with Service and Repair Instruction Manuals for the various types of small engines. An example of a problem solving worksheet can be found on page 12.

The number of problems missed or not answered
_____ x 10 = _____ points added to the contestant's score.

A Service and Repair Instruction Manual will be provided by contest officials.

RESULTS

After all the contestants have finished the contest, the contest organizer(s) and judges are encouraged to go over the complete contest with the contestants to further the learning process.

At the state contest, the winner in each division will be the contestant with the lowest number of points. Appropriate awards will be made at the end of the contest. For the senior division, the winner will represent Wisconsin in Small Engines at the National Engineering, Science, and Leadership Event. The second place winner will serve as an alternate and will be able to represent Wisconsin if the winner is unable.

For the county contest, the contest organizer(s) should find an appropriate time and place for the awards to be presented to insure that the contestants receive appropriate recognition.

POTENTIAL SAFETY AND MAINTENANCE PROBLEMS

The purpose of this list is to provide the county youth agent and small engine leaders with some ideas for the small engine inspection event of the state small engine contest and may be useful in preparing a county contest. This list is *not* intended to be comprehensive, therefore other problems may be found in the state contest. The safety and maintenance check may also be used as a project activity or skillathon.

1. Fuel cap missing
2. Fuel cap not securely fastened
3. Empty fuel tank
4. Oil cap missing
5. Oil cap not securely fastened
6. Low engine oil level
7. Air filter missing
8. Air cleaner lid not securely fastened
9. Loose spark plug wire
10. Spark plug not securely tightened
11. Spark plug wire missing
12. Kill switch missing
13. Kill switch broken
14. Tires low or flat
15. Loose lug bolts on wheels
16. Missing lug bolts
17. Loose battery connections
18. Dirty, corroded battery post connection
19. Low water level in battery
20. Broken electrical wires including battery cables
21. Broken or cracked belts
22. Deflection shield on mower's deck missing
23. Deflection shield secured in the up position
24. Key left in ignition
25. Missing bolts, screws, etc.
26. Muffler missing
27. Muffler rusted out
28. Missing safety shields
29. Operator's seat no longer adjustable
30. Excessive dirt, oil, etc., on engine
31. Dirty air cleaner
32. Loose ignition wire
33. Loose bolts on operator's seat



POTENTIAL TOOLS AND PARTS FOR TOOL AND PART IDENTIFICATION

The purpose of this list of potential parts and tools is to provide county Extension staff and small engine leaders with some ideas for the county contest. This list is not designed to be comprehensive, therefore other parts and tools may be found in the state contest.

Parts

1. Breaker point plunger
2. Breather, crankcase
3. Camshaft
4. Cam follower
5. Carburetor
6. Choke valve
7. Compression ring
8. Condenser
9. Connecting rod
10. Contact points
11. Crankshaft
12. Cylinder head
13. Dry type air filter
14. Engine block
15. Exhaust valve
16. Exhaust valve spring
17. Float
18. Float needle
19. Flywheel
20. Governor

21. Head gasket
22. Ignition armature
23. Ignition coil
24. Intake valve
25. Intake valve spring
26. Needle valve
27. Nozzle
28. Oil bath air cleaner
29. Oil control ring
30. Oil seal, crankshaft
31. Oil slinger
32. Piston
33. Piston pin
34. Pump diaphragm
35. Push rod
36. Spark plug
37. Starter clutch
38. Throttle valve
39. Valve spring
40. Valve spring retainer
41. Valve tappet

Tools

1. Blade balancer
2. Compression tester
3. Flat feeler gauge
4. Flywheel holder
5. Flywheel puller
6. Micrometer
7. Piston groove cleaner
8. Ring compressor
9. Spark tester
10. Starter clutch wrench
11. Tachometer
12. Tang bender
13. Torque wrench
14. Valve spring compressor
15. Vernier caliper
16. Wire gauge

POTENTIAL FAULTS FOR TROUBLESHOOTING

The purpose of this list of potential faults is to provide the county youth agent and small engine leaders with some ideas for the troubleshooting event of the state small engine contest and may be useful when preparing a county contest. This list is not intended to be comprehensive, therefore other faults may be found in the state contest. A troubleshooting exercise may be used as a project activity or skillathon.

1. Fuel line blocked
2. Fuel supply turned off
3. Fuel tank vent blocked
4. Needle valve maladjusted
5. Needle valve damaged
6. High idle speed
7. Low idle speed
8. Blocked air cleaner
9. Loose cylinder head
10. Fouled spark plug
11. Improper breaker points adjustment
12. Broken ignition wire
13. Broken ground wire



Junior Division _____
Senior Division _____

Contestant Name _____
County _____
Score _____

PRACTICAL TROUBLESHOOTING SCORECARD OF WISCONSIN 4-H SMALL ENGINES CONTEST

Contestants must find and correct three small engine malfunctions. Contestants must signal when they want their small engine judged. Their time will then be recorded and no further work allowed. They must then demonstrate the engine at the judges' request. Penalty points begin after 15 minutes. Time limit is 30 minutes.

Scoring:

Total time (round to the next highest minute) _____
- 15
_____ x 5 points = _____

Faults not corrected 1. _____ x 20 points = _____
2. _____ x 20 points = _____
3. _____ x 20 points = _____

Safety infractions _____ x 20 points = _____

Failure to start 40 points _____

Failure to run at slow idle 20 points _____

Failure to run at fast idle 20 points _____

Failure to operate properly at slow idle 30 points _____
(SENIOR DIVISION ONLY)

Failure to operate properly at fast idle 30 points _____
(SENIOR DIVISION ONLY)

Total points _____



PART AND TOOL IDENTIFICATION SCORECARD
OF WISCONSIN 4-H SMALL ENGINES CONTEST

Place the part or tool number on the line next to the correct name for the part or tool.

- | | |
|-----------------------------|-------------------------------|
| _____ Blade balancer | _____ Needle valve |
| _____ Breaker point plunger | _____ Nozzle |
| _____ Breather, crankcase | _____ Oil bath air cleaner |
| _____ Camshaft | _____ Oil control ring |
| _____ Cam follower | _____ Oil seal, crankshaft |
| _____ Carburetor | _____ Oil slinger |
| _____ Choke valve | _____ Piston |
| _____ Compression ring | _____ Piston pin |
| _____ Compression tester | _____ Piston groove cleaner |
| _____ Condenser | _____ Pump diaphragm |
| _____ Connecting rod | _____ Push rod |
| _____ Contact points | _____ Ring compressor |
| _____ Crankshaft | _____ Spark plug |
| _____ Cylinder head | _____ Spark tester |
| _____ Dry type air cleaner | _____ Starter clutch |
| _____ Engine block | _____ Starter clutch wrench |
| _____ Exhaust valve | _____ Tachometer |
| _____ Flat feeler gauge | _____ Tang bender |
| _____ Float | _____ Throttle valve |
| _____ Float needle | _____ Torque wrench |
| _____ Flywheel | _____ Valve spring |
| _____ Flywheel holder | _____ Valve spring compressor |
| _____ Flywheel puller | _____ Valve spring, exhaust |
| _____ Governor | _____ Valve spring, intake |
| _____ Head gasket | _____ Valve spring retainer |
| _____ Ignition armature | _____ Valve tappet |
| _____ Ignition coil | _____ Vernier calipers |
| _____ Intake valve | _____ Wire gauge |
| _____ Micrometer | |



SENIOR DIVISION ONLY

Contestant Name _____

County _____

Score _____

PART AND TOOL IDENTIFICATION SCORECARD
OF WISCONSIN 4-H SMALL ENGINE CONTEST

Each item must be identified correctly by its common name and its functional use must be explained. BE SPECIFIC

Ten points each. Partial credit may be given. Time limit is 30 minutes.

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____
13. _____
14. _____
15. _____
16. _____
17. _____
18. _____
19. _____
20. _____



Junior Division _____
Senior Division _____

Contestant Name _____
County _____
Score _____

SMALL ENGINE EQUIPMENT INSPECTION SCORECARD OF WISCONSIN 4-H SMALL ENGINE CONTEST

In the space below, identify the maintenance and/or safety hazards found on the compact tractor (lawn or garden tractor). Ten points each. Time limit is 5 minutes. *Note:* Junior division contestants should use only the first five blanks.

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____
13. _____
14. _____
15. _____
16. _____
17. _____
18. _____
19. _____
20. _____

Score (number wrong x 10) _____



PROBLEM SOLVING SCORECARD OF WISCONSIN
4-H SMALL ENGINES CONTEST

Instructions: Each participant will complete the following 10 questions. The questions involve searching for data from the Briggs and Stratton Service and Repair Manual provided. Fill in the blanks with information that you find in the manual.

Please indicate the section and page number where you find the answer. Each problem is worth 10 points. The time limit for this problem solving activity is 30 minutes.

1. If the margin on a valve is less than _____ inches, it should be discarded. Section _____, Page _____.
2. A recommended SAE viscosity grade engine oil for a Briggs and Stratton engine used for a snowmobile is _____. Section _____, Page _____.
3. The recommended maximum governed speed for a 24-inch lawnmower blade is _____ RPM.
Section _____, Page _____.
4. The part having a number of 19167 is a _____. Section _____, Page _____.
5. The crankshaft reject size for the crankpin journal on a 170,000 series Briggs and Stratton engine is inches. _____ Section _____, Page _____.
6. The connecting rod reject size for the piston pin bearing for a 190000 series Briggs and Stratton engine with a cast iron cylinder is _____ inches. Section _____, Page _____.
7. A Briggs and Stratton engine with model number of 136398 has a _____ type of carburetor.
Section _____, Page _____.
8. The air gap for a three-leg armature for a 190,000 series Briggs and Stratton engine with a cast iron cylinder is _____ inches. Section _____, Page _____.
9. The recommended maximum valve tappet clearance on the intake valve for a 240,000 series Briggs and Stratton engine is _____ inches. Section _____, Page _____.
10. On a one-piece flo-jet Briggs and Stratton engine, the initial setting for the needle valve is _____ turns.
Section _____, Page _____.

Score (number wrong x 10) _____





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The 4-H name and emblem are federally protected under Title 18 US Code 707. Created by Ron Schuler, Wisconsin 4-H Mechanical Science Specialist. Layout and design revised by Jenny Streiff, 4-H Youth Development Graphic Artist, June 2005.

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