National FFA Agricultural Mechanic
Career Development Event
2014
Team Activity

Scoring Rubric

Metal Fabrication Problem

PTO shaft (100 points)

- Lining up metal for welding
  - Correct stub length - 20 pts
  - Correct hole placement - 20 pts
  - Correct size and number of holes - 5 pts
  - Plate perpendicular with shaft - 20 pts
- Quality of welding
  - Weld on correct side - 10 pts
  - Welded completely around shaft - 5 pts
  - Weld is uniform and free of holes - 10 pts
  - Correct amperage and speed used for weld - 5 pts
  - Plate and shaft free of splatter - 5 pts

Final assembly (25 points)

- Assembled according to plans - 15 pts
- Fits on engine - 10 pts

Engine Systems Problem

Engine Coolant Measurement (100 points)

- Coolant test reading - 15 pts
- Estimation of percent of antifreeze - 20 pts
- Correct answer to coolant problem - 30 pts
- Formula created will work properly - 35 pts

Safety (50 points)

- Safety glasses are worn by all team members at all times - 25 pts
- Safety practices used at all times - 15 pts
- No injuries occurred during the activity - 10 pts

Team work (50 points)

- Work was evenly distributed - 15 pts
- Time was managed well - 10 pts
- All team members were actively employed at all times - 15 pts
- Team appeared to be organized - 10 pts
    - Get started right away
    - No down times during session
    - Not scrambling at end of session

Report (50 points) *points are delineated on the summary report sheet

- Follows outlined format
- Spelling, grammar and technical writing are correct
- Report is organized and concise
- Report is accurate

Questions (25 points)

- Answers are printed and submitted on a separate word document

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Guidelines for writing the summary report

This report is to summarize the work your team did during the team activity. It will include the steps of the project so someone reading your report could duplicate the project. This report will include the following parts:

- An introduction - 5 pts
- Delegation of tasks - 5 pts
- Discussion of success or challenges - 5 pts
- Steps that another group could use to recreate the Kohler engine PTO shaft - 5 pts
- Suggestions for improving the process fabricating numerous PTO shafts - 5 pts
- Discussion of safety practices in fabricating the PTO shaft - 5 pts
- Report of cooling system test - 5 pts
- Discussion of formula to solve coolant problem - 5 pts
- List of safety practices associated with cooling system - 5 pts
- Conclusion - 5 pts

Scores on report will be based on content, grammar, spelling, organization, and conciseness.

Introduction
The introduction should be concise. It should be a brief overview of the team activity. This should be written in narrative form.

Delegations of tasks
In this section the judges want to know how the labor and responsibilities were divided. Explain how the group worked as a team. Identify the division of labor and management. Begin with an introductory sentence. The remainder can be written with bullet points.

Successes or challenges
This section gives you the opportunity to express the successes or challenges your team experienced during the team activity. It can be brief and should be written in narrative form.

Steps to construction
The purpose of this section is to explain to another team how to construct the engine stand. Begin with an introductory sentence. The remainder can be presented in numbered statements.

This part of the report can be an opportunity to make suggestions that would improve the process where you experienced particular challenges.

Suggestions for improving the construction steps

In this section consider the manner in which you can make improvements in the process. Include additional tools, set ups, conditions, or other factors that would improve the process of accurately making the PTO shaft in mass quantities.

Metal Fabrication Safety Practices

Discuss the safety practices to be observed in the fabrication process.

Coolant Test Results

Discuss the results of your test of the strength of the antifreeze in the coolant.

Calculation of Coolant Problem Formula

In this section, create a formula for solving the coolant problem for the data given that can be generalized to other data.

Conclusion

Like the introduction, the conclusion should be brief and to the point. A statement of what was learned from this activity should be included. It should address both parts of this activity, that is, the fabrication of the PTO shaft and the cooling system problem.

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Agricultural Technology and Mechanical Systems

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Team Activity

Directions for Team Activity

Situation:

Kohler manufactures a diesel engine that can be used for multiple purposes. In this problem, the intended use is to mount this engine on a stationary irrigation pump that can be used to irrigate an orchard.

There are two parts to this activity. Part A is to fabricate a power take off (PTO) shaft that can be mounted to the flywheel of the Kohler engine. Part B is a problem set related to the liquid cooling system of this engine.

Information:

The Kohler engine is a model KDW1003. It is the three cylinder diesel engine pictured in Figure 1. An owner's manual and a service manual can be found on the drive provided to you.

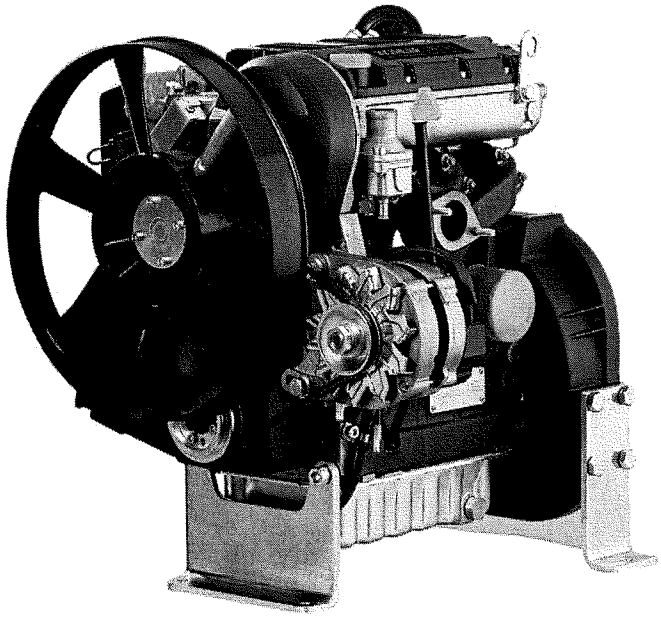

Figure 1. Kohler Diesel Engine

Part A: Fabricating the PTO drive shaft

The engine has a flywheel but does not have a power take off shaft. Figure 2 shows the flywheel. It has eight threaded holes for mounting a circular plate such as a clutch plate.

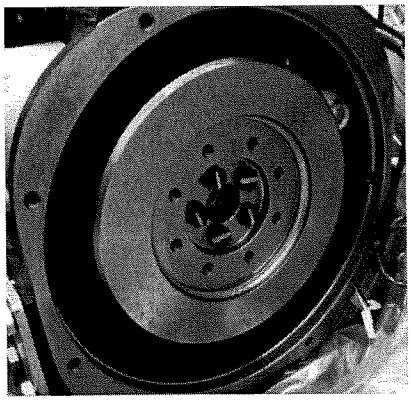

Figure 2. Engine Flywheel

Your task is to fabricate a power take off shaft that could serve to connect the engine to a stationary pump. A circular metal plate is provided. This plate already has the 1¼ inch center hole cut out. You will drill eight mounting holes and weld a shaft to the plate. Figure 3 illustrates the details for fabricating this piece. A drawing can also found in the file entitled "Flywheel Drive Shaft Plan."

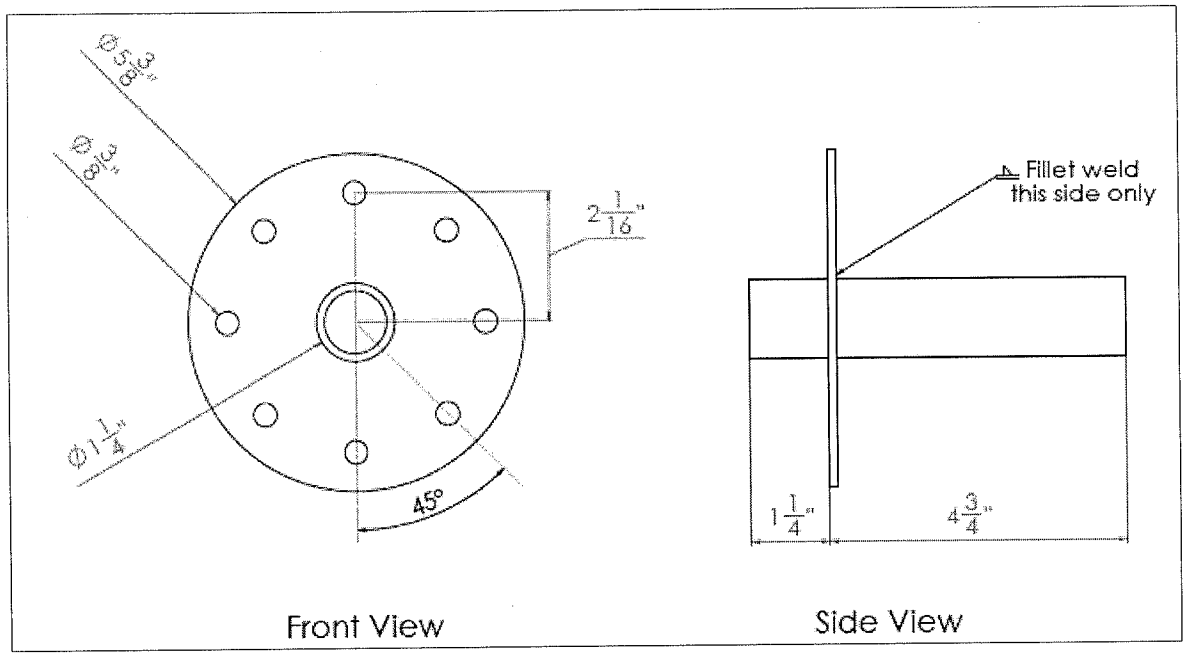

Figure 3. Drive shaft drawings

Given:

To complete this task, you will be given a circular ⅛ inch plate with a 1¼ inch hole cut from the center as illustrated in Figure 4. You will also be given a 1¼ inch outside diameter pipe by six inches to simulate a drive shaft. This is illustrated in Figure 5.

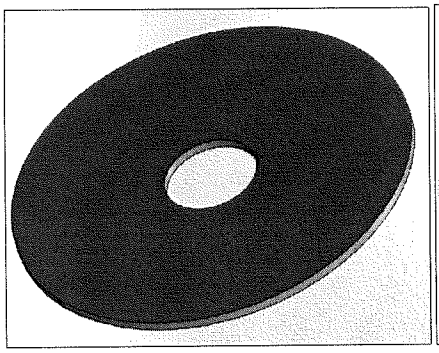

Figure 4. ⅛" plate

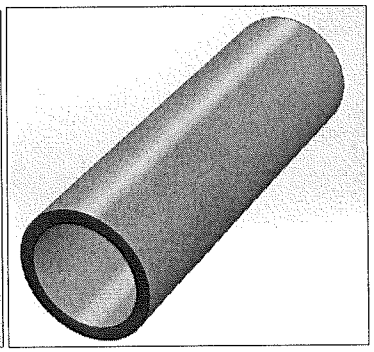

Figure 5. 1¼" O.D. pipe

You will also have at your disposal several tools including the following:

- Tape measure
- Combination square or tri square
- Compass
- Protractor
- ⅜ inch electric power drill
- ⅛ inch metal drill bit
- ⅜ inch metal drill bit
- Center punch
- Hammer
- Welder

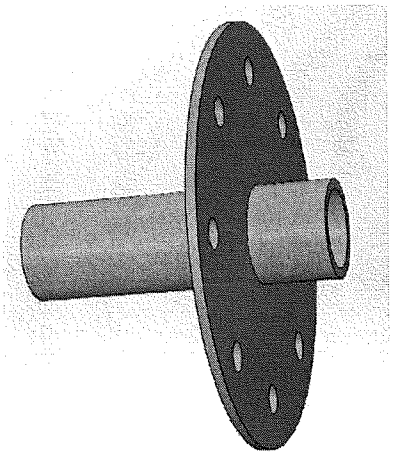

Figure 6. Completed drive shaft

The finished drive shaft plate should look like the illustration in Figure 6. The dimensions should follow the plan in "Flywheel Plate Plan." The plate should be welded to the shaft with fillet welds on the side of the plate with the longer PTO shaft. The plate holes should match the flywheel and be able to be mounted to the flywheel.

In addition to fabricating this item, you will also develop a set of directions to include in your report.

Directions to fabricate the PTO drive shaft:

1. Layout the holes on your plate according to the measurements given in the drawing.
2. Center punch the locations for the holes.
3. Drill a pilot hole at each location with the ⅛ in drill bit.
4. Drill the ⅜ inch holes as illustrated in the plans.
5. Measure and fit the pipe for the drive shaft.
6. Weld the pipe to the plate
    a. Begin by tacking the pipe to the plate
    b. Check for alignment
    c. Complete the weld
7. Write up your directions to fabricating this item.
8. Include a bill of materials for the PTO shaft in your report.
9. Submit the report and the drive shaft at the end of the activity.

Part B: Liquid cooling system problem

Ethylene glycol (antifreeze) and water are mixed to provide a coolant for this engine. Note that ethylene glycol is poisonous. Do not consume it. The graph in Figure 8 and the chart in Figure 9 provide information concerning the mixtures of ethylene and water.

Your team is to complete three tasks in this part of the team activity.

1. Use a hydrometer to test the protection level of a sample of coolant.
2. Calculate a problem to increase the amount of protection provided by the coolant.
3. Create a formula that can be used to calculate the amount of coolant that needs to be drained and replaced with antifreeze to achieve the desired protection.

Given:

You are given the following information and equipment to complete part b.

- A graph and a chart of information about ethylene glycol and water mixtures
- A sample of coolant mixture
- A hydrometer similar to the one in Figure 7.
- The engine will be operated in International Falls, Minnesota where winter temperatures can at times get down to minus forty degrees Fahrenheit (-40° F). This is equivalent to minus 40° C.

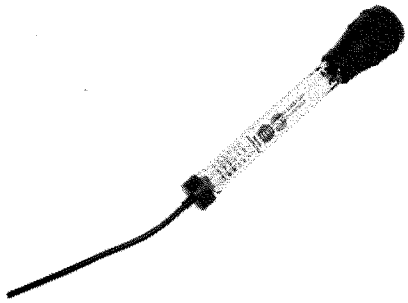

Figure 7. Hydrometer

Directions to solve coolant problems:

1. Use the hydrometer to test the protection level of the coolant sample.
    a. Caution! Ethylene glycol is poisonous. Do not consume!
    b. Return the coolant to the sample container after testing.
    c. Record the safe temperature the engine is protected to with this coolant.
    d. Determine the percent antifreeze and percent water based on your hydrometer reading using the chart in figure 9 on the next page.
    e. Determine the amount of antifreeze and water given that the capacity of the engine cooling system is 2¼ gallons (8.5 liters).
    f. Record your findings in your report.
2. Determine how much coolant needs to be removed from the cooling system and replaced with antifreeze to attain the desired protection, given the following information.
    a. The coolant capacity of the engine is 2¼ gallons (8.5 liters).
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3. Create a formula that will solve the problem described in step 2 above.

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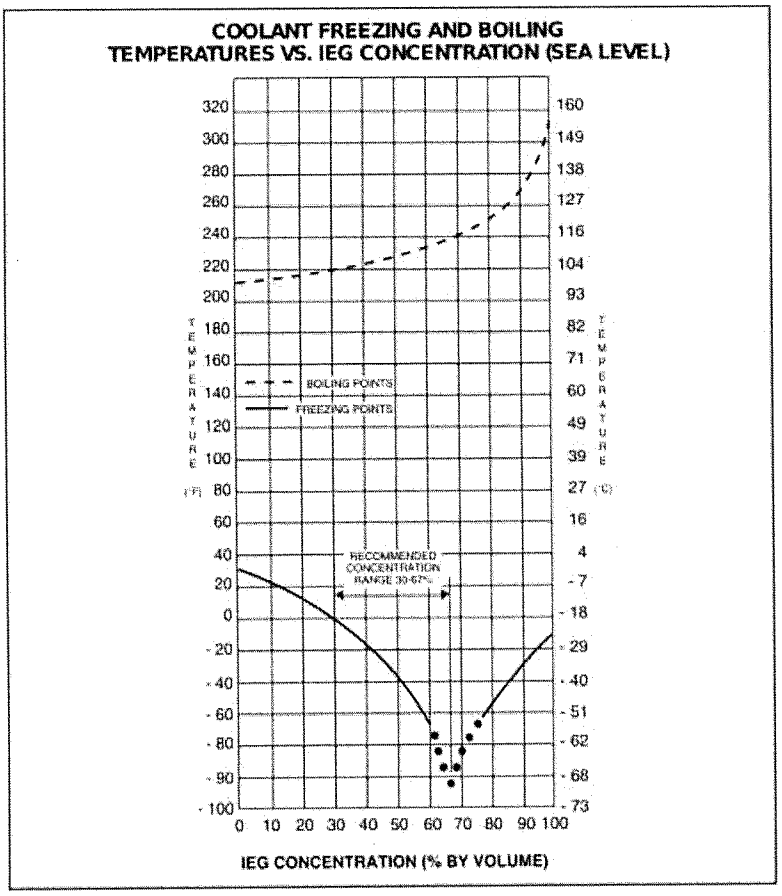

Figure 8. Graph of ethylene glycol and water mixtures

TEMPERATURE shown on antifreeze tester (F)	ANTIFREEZE CONCENTRATION	WATER CONCENTRATION
32	0%	100%
25	10%	90%
20	16%	84%
15	21%	79%
10	25%	75%
5	29%	71%
0	33%	67%
-10	39%	61%
-20	44%	56%
-30	48%	52%
-34	50%	50%
-40	52%	48%
-50	56%	44%
-60	59%	41%
-70	64%	36%
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	ANTIFREEZE CONCENTRATION SHOULD BE AT LEAST 50%	

Figure 9. Chart of ethylene glycol and water mixtures

Submission of final product:

Your team is to submit three items:

1. The completed PTO drive shaft
2. A copy of the written report
3. The flash drive containing the written report

Clearly mark your drive shaft with the name of your state. Submit the PTO drive shaft to the judges.

Save your written report and bill of materials on the flash drive provided. Affix a label with the name of your state to the flash drive. Print a hard copy of your report and bill of materials. Submit your flash drive and your printed hard copy to the judges.

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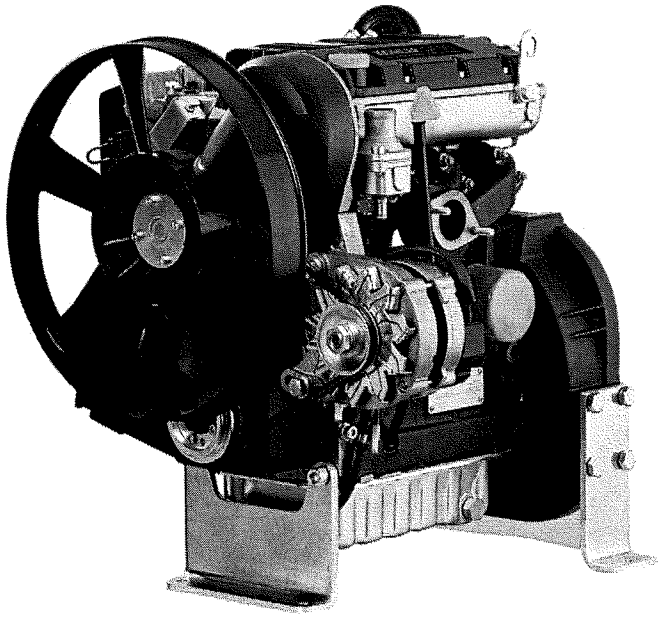

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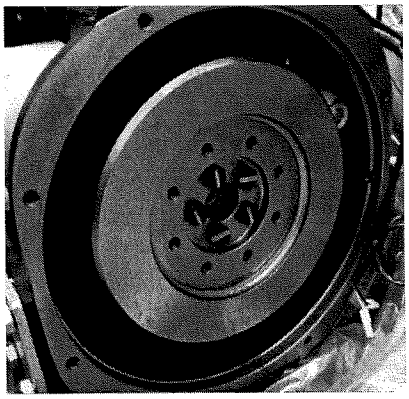

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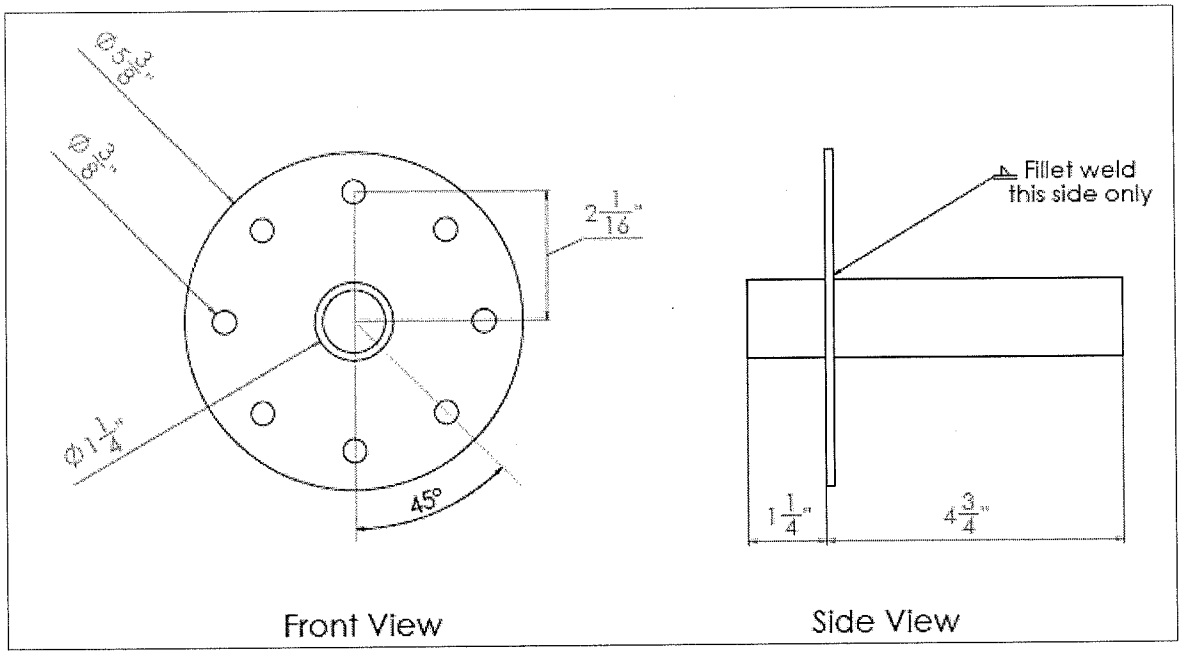

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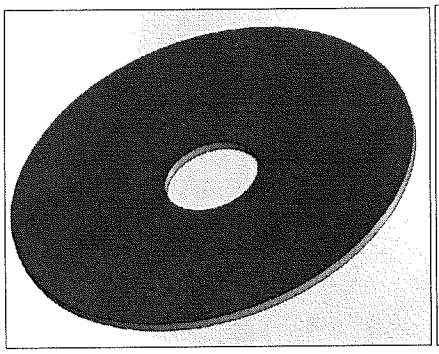

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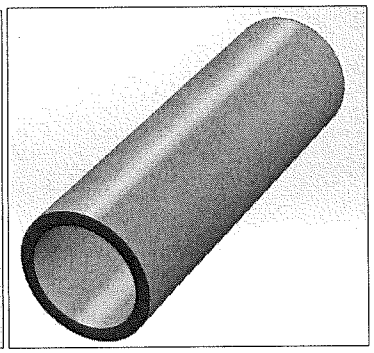

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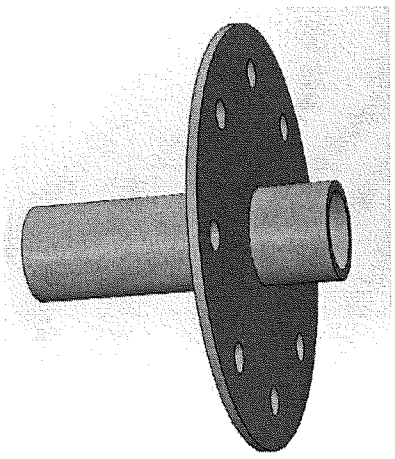

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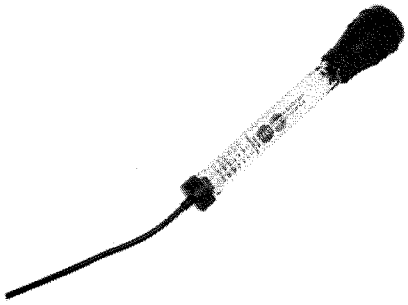

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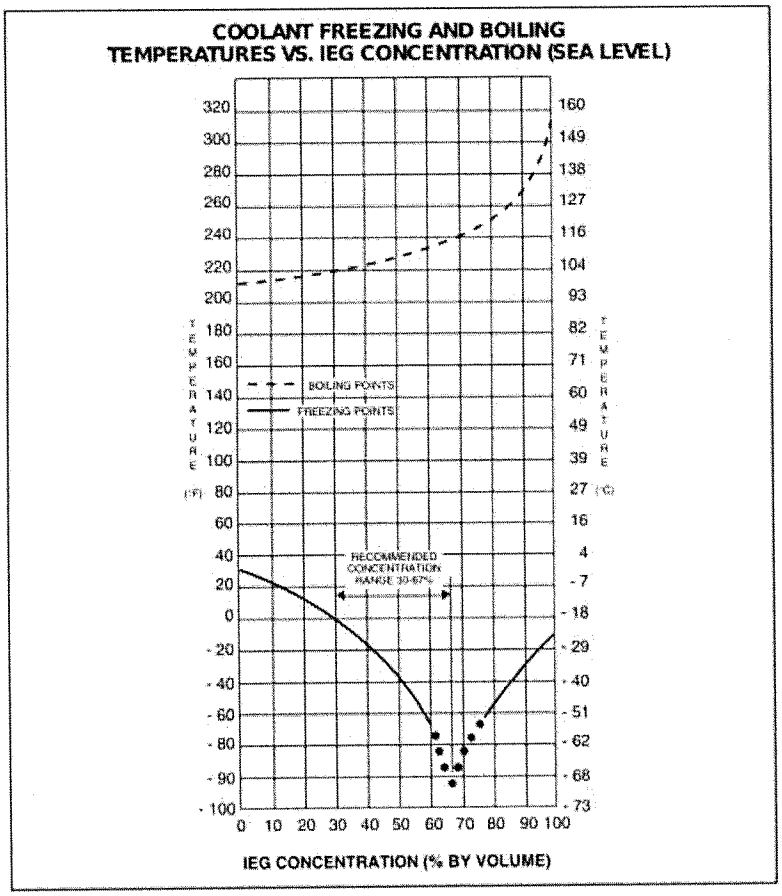

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QUESTIONS:

Name of State _____

1. Why shouldn't diesel fuel be stored in galvanized containers? (3 points)

2. In countries where diesel has a high sulfur content, what is recommended you do to eliminate excessive engine wear? (3 points)

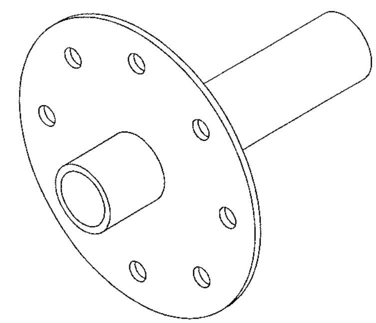
3. After the first 50 hours of operation, what maintenance should be done to this engine? (4 points)

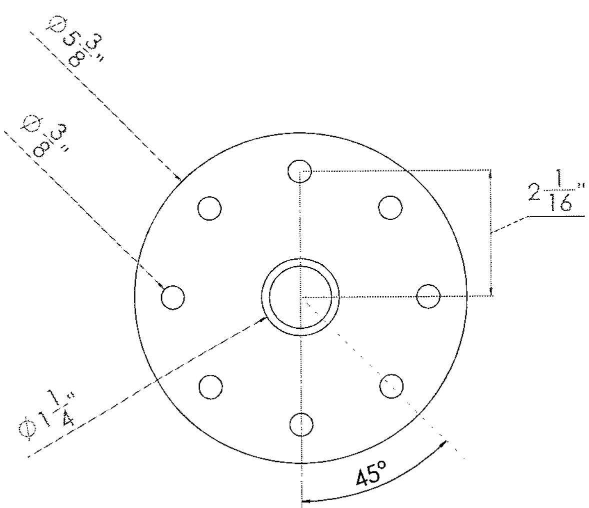
4. What three pieces of information are needed for obtaining replacement parts and where can they be found? (3 points)

5. How should the coolant level be checked and refilled? Include precautions. (4 points)

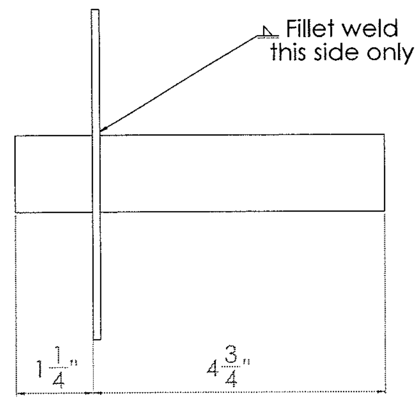
6. This engine does not have oil in it. This is a standard engine. How much oil should you purchase? Which SAE classification should be purchased? What temperature range will this oil operate in? (4 points)

7. Find the bore, stroke and compression rate to calculate the clearance volume for each cylinder. (4 points)





Front View



Side View

Flywheel Drive Plate