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SEAFDEC Training Department

SOUTHEAST ASIAN FISHERIES DEVELOPMENT CENTER

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A COLLECTION OF PROBLEMS
CONCERNING FUNDAMENTALS
OF THE DIESEL ENGINE

by
Shinzo YAMAMOTO



Text and Reference Books Series No. 57
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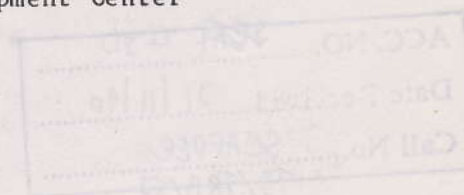
**A COLLECTION OF PROBLEMS
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OF THE DIESEL ENGINE**

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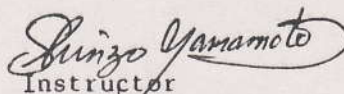
PREFACE

These questions have been prepared for readers of the SEAFDEC text series of Internal Combustion Engines for Fishing Boats (I, II, III, IV, V), Stern Equipment For Small Fishing Boats (TRB/No. 24), and Diesel Engine's Supercharger (TRB/No. 47) in order to assist them to monitor their progress and understanding of the subject.

If any question cannot be answered, reread that section of the text or consult your instructor for further clarification.

Other recommended reading includes the I.C. Engines Fundamentals (I) and I.C. Engines Fundamentals (II) (Applications), compiled by the same author and, for these, try to solve the problems provided in the texts.

November 1990


Instructor
Shinzo Yamamoto
Training Department
SEAFDEC

Questions (Lesson 1)

1. What is the nationality of the person who invented the Diesel engine, his name, and how many years ago?

(1) The nationality? ()
(2) Who? ()
(3) How many years ago? ()

2. Which type engine listed below is the same as the Diesel Engine?
(Circle the number)

(1) Spark ignition engine
(2) Hot bulb engine
(3) Compression-ignition engine
(4) Suction engine
(5) Injection engine

3. What is the approximate thermal efficiency of each of the following engines? (Show with % Sign).

(1) External combustion engine
()
(2) Spark-ignition engine
()
(3) Diesel engine
()

4. Which of the following items are 1) the action method of the workshop's diesel engine; and 2) which piston connecting method is it in accordance with? (Circle the letter)

(1) Acting method
(a) single acting engine
(b) double acting engine
(c) opposite acting engine
(2) Piston connecting method
(a) trunk piston type
(b) cross head type

5. What is the purpose of a crankshaft? Please answer briefly.

Questions (Lesson 2)

1. Which of the following is the correct compression ratio?
(Circle the number)
 - (1) Compression ratio is "the value which the volume exhausts as a piston moves from a bottom dead center to a top dead center, divided by the remaining volume when a piston gets to a top dead center".
 - (2) compression ratio is "the value which the volume exhausts as a piston runs from a bottom dead center to a top dead center, added to the remaining volume when a piston gets to a top dead center, divided by the remaining volume when a piston gets to a top dead center".
 - (3) Compression ratio is "the value of all the volumes when a piston is at a bottom dead center, divided by the volume exhausted while a piston runs from a bottom dead center to a top dead center".
2. Approximately, what is the compression ratio of diesel engine pressure?
()
3. Show the order of motion of 4 cycle diesel engine.
() _ () _ () _ ()
4. Approximately how much is a 4 cycle diesel engine's compression pressure?
()
5. What do you call the power calculated from an indicated diagram?
()

Questions (Lesson 3)

1. Calculate the engine brake horse power under the following conditions:

- (1) internal diameter of cylinder (Bore) 145 (mm)
 - (2) piston stroke 200 (mm)
 - (3) engine's revolutions per minute 850 (rpm)
 - (4) number of cylinders 5
 - (5) indicated mean effective pressure 6.5 (kg/cm²)
 - (6) mechanical efficiency 80 (%)
 - (7) cycle 4 cycle single acting engine
- (Ans. horse power)

2. You are asked to install a fuel tank for the conditions listed below: Calculate the fuel consumption and state the desired volume of the fuel tank.

- (1) rate of fuel consumption (4/4 load per hour) ... 210 (g/ps.h)
 - (2) rate of fuel consumption (1/4 load per hour) ... 250 (g/ps.h)
 - (3) brake house power (4/4 load per hour) 30 (BPS)
 - (4) operating time (4/4 load) 6 hours
- Total 10 hours
- (5) operating time (1/4 load) 4 hours
 - (6) specific gravity of fuel 0.88

fuel consumption
_____ ℓ

Ans.

the volume of fuel tank
_____ ℓ

3. Calculate the torque when the following conditions apply:

- (1) brake horse power 80 (ps)
 - (2) engine's revolution 850 (rpm)
- (Ans. m.kg)

Questions (Lesson 4)

1. Combustion chambers are roughly classified into four types.
A) Describe these types; B) List which of these can be applied to the workshop's diesel engine?

2. Fill in the blanks with two of the features found in direct injection type chambers and pre-combustion chambers, respectively.

Direct injection type	Pre-combustion chamber
1.	1.
2.	2.

3. What is an ignition lag?

4. What is an ignition point?

5. What is a cetane number?

Questions (Lesson 5)

1. Explain briefly different types of wear found on a cylinder liner.
2. Describe points to be taken into consideration to prevent the stripping of a chrome plated liner.
3. How do you judge when the following liners should be changed?
 - (1) Liner (non chrome plated)
 - (2) Chrome plated line
4. Describe items to be taken into consideration when a liner is replaced with a new one.

Questions (Lesson 6)

1. State the reason why Aluminum alloy is used as piston material.
2. Why does the outer diameter of a piston's top differ from its skirt?
3. Roughly classify the shapes of ring cut.
4. Why must the ring cut allow for proper clearance?
5. List the main items required for replacing the rings with new ones:

Questions (Lesson 7)

1. When using a Kelmet metal bearing, the shaft clearance should be wider than that of a white metal bearing. List the reasons.
2. What is the bolt tightening torque of the connecting rod in the workshop's Engine?

(1) 1 E type (	)	(2) 4 CH type ()
(3) 6 M type (	)	(4) 3 DE type ()
3. What is the appropriate clearance between the crankshaft journal and the main bearing?
4. Explain the correct deflection of a crankshaft.
5. What cautions should be exercised when coupling the engine in order to prevent crankshaft breakage?

Questions (Lesson 8)

1. A zinc bar is used for preventing corrosion by sea-water, for what reason?
2. How often does the zinc bar need to be inspected?
3. Explain the cautions for fitting a zinc bar.

Questions (Lesson 9)

1. What is the purpose of welding the stellite on the exhaust valve seat?
2. List the cautions we should observe when replacing the valve seat ring inserted into the cylinder head.
3. List four main reasons which cause cracks to appear between the valve seats in the cylinder head.
4. Briefly describe how? and why? water condensation occurs.
5. List the items which should be taken into consideration when installing an exhaust pipe.

Questions (Lesson 10)

1. Describe the positions at the beginning, or starting, and end of fuel injection of a Bosh type plunger and plunger barrel.

2. Why is the injection quantity adjusted by turning the plunger in a Bosh type?

3. Describe the function of the delivery valve.

Questions (Lesson 11)

1. Describe how the combustion is influenced when injection pressure is excessively low.

2. Explain why we have to be careful when attaching the nozzle to the holder and also the nozzle assembly unit to the cylinder head?

3. List the main properties to be taken into consideration when selecting fuel, in correct order.

Question (Lesson 12)

1. Enumerate the reasons why lubricating oil is used in an internal combustion engine.

2. Lubricating oil is supplied through the by-pass circuit from the by-pass valve when the dust accumulated on the oil filter prevents the oil from passing through the filter. When this occurs, what kind of change can be seen in the pressure gauge?

3. List the properties which are essential when selecting a lubricating oil.

4. How often should the lubricating oil be changed?

Questions (Lesson 13)

1. The actual measured discharge volume of the cooling water pump in a Diesel Engine is sometimes larger than the calculated one. Why does this phenomenon occur?
2. 33.5 litre/min. of cooling water was estimated to be necessary for an engine with output of 60 PS, fuel consumption rate 210 g/PS.h and a heat percentage reduction supplied by the cooling water of 30%. If a fuel with the calorific value of 10,600 Kcal/kg and the sucked water with temperature of 30°C are used, then what is the temperature of the discharged water?

Questions (Lesson 14)

1. What must you do to improve ignition? Itemize below.
2. Give the reasons why it is necessary to change the viscosity of the lubricating oil according to the atmospheric temperature?

Question (Lesson 15)

1. The size of the flywheel is changed depending on whether it is driving a generator or it is used in a ship's main engine. Give the reasons.

2. When installing, removing and resetting the flywheel, what points do you have to consider?

3. What are the causes of governor hunting? List the reasons and explain them.

4. How do you reduce the cyclic irregularity of speed? Give the items.

Questions (Lesson 16)

1. What types of clutches are used in marine diesel engines?
2. What is the purpose of installing reduction gears?
3. Draw a cause and effect diagram of failure of slippage in a hydraulic clutch.

Questions (Stern equipment for small fishing boat)

1. Calculate the gross tonnage of the wooden ship whose specifications are given below. The measurements should be in accordance with the Ship Classification Measurement Regulations.

(a) Length	14.6 m
(b) Width	3.3 m
(c) Depth	1.3 m

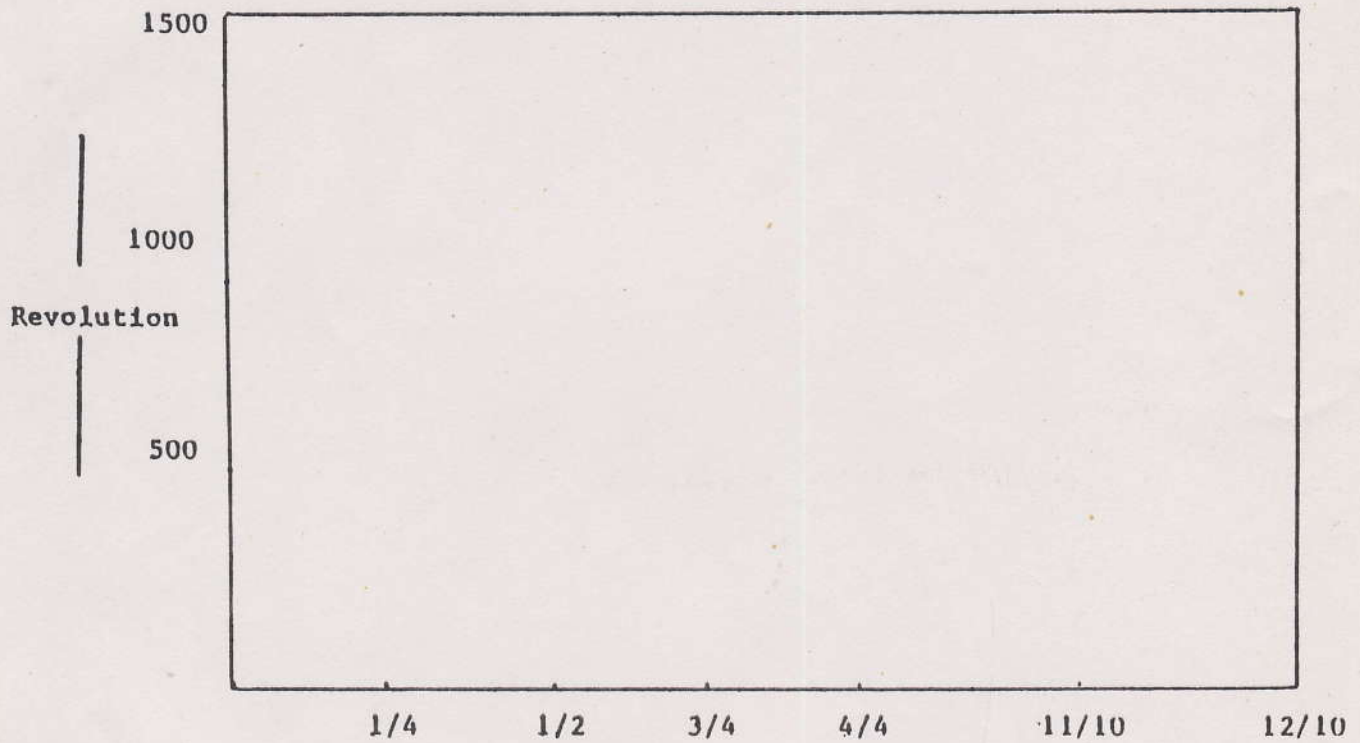
2. Based on a shaft horsepower at full load (4/4), of 30 PS/1200 rpm of the main engine to drive a propeller, calculate the engine revolution at the time of 1/4, 1/2, 3/4, 11/10, 12/10 load and chart their intersecting points. (See box on page 19)

3. Calculate the diameter of a propeller shaft.

4. Calculate the propeller's dimensions:

Maximum output	430 ps
Speed of propeller	390 rpm
Boat speed	9.5 knots

1/4	.....	r pm
1/2	.....	r pm
3/4	.....	r pm
4/4	.....	1200 r pm
11/10	.....	r pm
12/10	.....	r pm



Appendix

(Ans.)

To calculate the diameter of propeller shaft.

Calculation of the diameter of the propeller shaft (according to Japanese government regulations)

$$ds = d^* + \frac{D^{**}}{c}$$

ds = diameter of propeller shaft (mm)
 s = diameter of intermediate shaft (mm)
 D = diameter of propeller
 c = coefficient which varies according to the materials used

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 category II 100

Note 1. d^* is calculated by the formula

$$d = K \sqrt[3]{\frac{T}{R}} \quad (\text{mm})$$

K coefficient varied by number of engine cylinders, eg. 6 cylinders 113

T maximum continuous BHP

R continuous maximum revolution/minutes

(Example)

Engine BHP 90 PS/950 rpm
 reduction ratio 0.405

K 113

$$d = 113 \times \sqrt[3]{\frac{90}{950 \times 0.405}} = 69.63 \text{ (mm)}$$

Questions (Diesel Engines Supercharger)

1. Explain the difference between (a) an axial-flow and (b) an radial-flow or inward-flow turbo-charger.

2. What is meant by the "Surge Limit" of a turbo-charger.

3. Give three of the most important advantages of super charging diesel engine as compared to normal aspiration ration.

4. List causes of turbo-charger failure.

5. Outline how to check the axial (end) play of the turbo-charger shaft.

