Republic of Rwanda
Ministry of Education

RTB | RWANDA TVET BOARD

DIESEL ENGINE SYSTEMS REPAIRING

AUTER401

Competence: Repair diesel engine systems

RQF Level: 4

Learning Hours: 60

Credits: **6**

Sector: Transport and Logistics

Trade: Automobile Technology

Module Type: Specific

Curriculum: TRLAUT4001- TVET Certificate IV in Automobile Technology

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Purpose statement	This module describes the knowledge, skills, and attitudes required to repair automotive engine systems with minimum supervision. It is intended to be pursued by learner at TVET level IV for TVET Certificate IV in Automotive technology. At the end of this module, learners will be able to maintain Diesel engine fuel supply system, Diesel air supply system; Service engine lubrication system, Maintain engine cooling system and repair Diesel engine exhaust system.					
Leaning assumed to be in place	Safety, Health and environment at workplace, Apply basic electricity and electronics, Repair automotive petrol engine.					
Delivery modality	**Training delivery**		**100%**	**Assessment**		**Total 100%**
	Theoretical content		30%	Formative assessment	30%	50%
	Practical work:		70%		70%	
	• Group project and presentation	20%				
	• Individual project /Work	50%				
				Summative Assessment		50%

Elements of Competency and Performance Criteria	
Elements of competency	**Performance criteria**
1. **Maintain Diesel engine fuel supply System**	1.1. Fuel supply system components are properly identified based on the types of injection system
	1.2. Fuel supply system components are properly described based on the types of injection system
	1.3. Tools, materials and equipment are properly selected according to the type of fuel supply system
	1.4. Fuel supply system components are properly inspected according to diagnosing procedures
	1.5. Fuel supply system components are appropriately dismantled according to the repair manual
	1.6. Fuel supply system components are appropriately disassembled according to the manufacturer's instructions

	1.7. Fuel supply system components are correctly cleaned and inspected according to the manufacturer instructions.
	1.8. Fuel supply system damaged components are properly adjusted according the manufacturer instructions.
	1.9. Fuel supply system damaged components are properly replaced according the manufacturer instructions.
	1.10. Diesel Fuel supply system components are properly re-assembled based on manufacturer instructions
	1.11. Fuel supply system components are properly re-installed according to the repair manual
	1.12. Engine fuel supply system is properly bled according to the manufacturer's instructions
	1.13. Fuel supply system is correctly tested according to the system functionality
2. Diesel air supply system	2.1. Air supply system components are properly described based on their function
	2.2. Tools, materials and equipment are properly selected according to the type of fuel supply system
	2.3. Air supply system is properly inspected according to diagnosing procedures
	2.4. Air supply system is appropriately dismounted according to the repair manual
	2.5. Air supply system components are appropriately disassembled according to the manufacturer's instructions
	2.6. Air supply system components are properly cleaned and inspected according to the manufacturer instructions
	2.7. Air supply system components are correctly replaced according to the manufacturer instructions
	2.8. Air supply system components are appropriately re-assembled according to the manufacturer's instructions
	2.9. Air supply system is appropriately remounted according to the repair manual

	2.10. Air supply system components are correctly tested according to the manufacturer's instructions
3. Service engine lubrication system	3.1. Engine lubricating system components are adequately described according to the specifications
	3.2. Tools, materials and equipment are properly selected based on their function
	3.3. Lubricant is properly drained according to the manufacturer's recommendations
	3.4. Engine lubricating system components are properly inspected according to the diagnosis procedure.
	3.5. Engine lubricating system components are replaced according to the faults detected.
	3.6. Lubricant is properly re-filled according to the manufacturer's recommended level.
	3.7. Engine lubricating system is correctly tested according to the lubrication system functionality
4. Maintain engine cooling system	4.1. Engine cooling system are properly classified according to the types of cooling system
	4.2. Engine Cooling system components are adequately described according to the specifications
	4.3. Tools, materials and equipment are properly selected based on their function
	4.4. Engine cooling system components are properly inspected according to the diagnosis procedures.
	4.5. Coolant is properly drained according to the manufacturer's recommendations
	4.6. Engine cooling system components are properly dismantled according to the repair procedures.
	4.7. Engine cooling damaged components are properly adjusted according to the repair manual
	4.8. Engine cooling damaged components are properly replaced according to the repair manual
	4.9. Engine coolant is properly re-filled according to the manufacturer's recommendations
	4.10. Engine cooling system is correctly tested according to the cooling system functionality.

5. Repair Diesel engine exhaust system	5.1. Exhaust system is appropriately identified according to the exhaust tail pipes.
	5.2. Exhaust system components are properly described based on the manufacturer's instructions
	5.3. Tools, materials, and equipment are properly selected based on their function
	5.4. Exhaust system components are properly inspected according to the repair manual
	5.5. Exhaust system is properly dismounted from the vehicle according to the repair manual
	5.6. Exhaust system components are methodically disassembled according to the repair manual
	5.7. Exhaust system components are correctly welded according to the faults detected
	5.8. Exhaust system components are correctly replaced according to the faults detected
	5.9. Exhaust system components are methodically re-assembled according to the repair manual
	5.10. Exhaust system is properly re-mounted to the vehicle according to the repair manual
	5.11. Exhaust system is correctly tested according to the exhaust system functionality

Intended Knowledge, Skills, and Attitude

Knowledge	Skills	Attitude
✓ Types of tools, materials, and equipment ✓ Basic mechanical principles ✓ Mechanical attitude ✓ Applied mathematics ✓ Applied physics ✓ Applied chemistry ✓ Safety rules, precautions and security ✓ Use of Personal Protective equipment ✓ Technical drawing ✓ Theory of welding ✓ Technical symbols ✓ Interpretation of specifications ✓ Quality of materials	✓ Computer skills ✓ Communication skills ✓ Troubleshooting skills ✓ Report elaboration skills ✓ Good service delivering skills ✓ Interpersonal skills ✓ Analytical skills ✓ Problem-solving skills ✓ Task management skills ✓ Parts replacement skills ✓ Diagnostic skills ✓ Proper use of measurement instruments. ✓ Basic welding skills ✓ Use of tools, materials, and equipment	✓ Honest ✓ Accountability ✓ Self-motivated ✓ Gender sensitive ✓ Customer care oriented ✓ Decisive ✓ Time management ✓ Humble ✓ Creative ✓ Patient ✓ Responsible ✓ Innovative ✓ Flexible ✓ integrity ✓ Goal oriented ✓ Self-confident

Course content

Learning outcomes	**At the end of the module the learner will be able to:** 1. Maintain Diesel engine fuel supply System 2. Diesel air supply system 3. Service engine lubrication system 4. Maintain engine cooling system 5. Repair Diesel engine exhaust system
Learning outcome 1: Maintain Diesel engine fuel supply System	**Learning hours: 25**
Indicative content	
• **Identification of diesel fuel supply systems** ✓ Rotary pump injection system ✓ Inline pump injection system ✓ Common rail injection system ✓ Unit-injector system ✓ Unit pump system • **Description of diesel fuel supply system**	

- ✓ The Rotary pump injection system
- ✓ Inline pump injection system
- ✓ Common rail injection system
- ✓ Unit-injector system
- ✓ Unit pump system

- **Selection of tools, materials and equipment used for Diesel engine fuel supply system**
  - ✓ Hand tools
  - ✓ Power tools
  - ✓ Materials
  - ✓ Equipment

- **Inspection and dismantling of fuel supply system components**
  - ✓ The Diesel tank
  - ✓ The fuel lines
  - ✓ The fuel transfer pump
  - ✓ The filters
  - ✓ The injection pump
  - ✓ The injection nozzles

- **Disassembling, cleaning and inspection of diesel fuel supply system components**
  - ✓ The injection pump
  - ✓ The injection nozzles

- **Adjustment or replacement of diesel fuel supply system components**
  - ✓ The diesel tank
  - ✓ The fuel lines
  - ✓ The fuel transfer pump
  - ✓ The filters
  - ✓ The injection pump
  - ✓ The injection nozzles

- **Re- assembling and re-installing of diesel fuel supply system components.**
  - ✓ The injection pump
  - ✓ The injection nozzles
- **Bleeding of diesel engine fuel supply**
- **Testing of diesel fuel supply functionality.**
  - ✓ Static
  - ✓ Dynamic

Resources required for the learning outcome	
Equipment	Projector, computer, Personal protective equipment (PPE), Multimeter, injection pump test, injection-nozzle test rig , Oxy-acetylene Gas welding equipment, shielded

	metal arc welding machine, Grinding machine, Drilling machine.
Materials	Whiteboard, marker pen, black board, chalk, flipchart, Bolts and nuts, shop rags, Welding electrodes, Wire brushes, fuel lines, injection pumps, injection nozzles, injector adjusting shims, mazout, grease ,clamps,
Tools	Pry bar, chipping hummer, Chisels, Scriber, Ruler, Allen key, Hummers, scan tool, Socket spanner, Phillips screwdriver, Slot screwdriver, Air wrench, Extension bars, Offset box wrenches, Combination wrenches, Torque wrench, T-bar (T-handle), Box wrenches, Rubber mallet, Plastic and rubber hummer, Standard sockets, oil filter spanners
Facilitation techniques	• Group discussion • Trainer guided • Brainstorming • Demonstration • Simulation
Formative assessment methods	• Written assessment • Oral based assessment • Performance based assessment • Product based assessment

Learning outcome 2: **Diesel air supply system**	**Learning hours: 7**
Indicative content	

- **Description of diesel air supply system components**
  - ✓ Throttle body
  - ✓ Air filter
  - ✓ Intake manifold
  - ✓ Air mass flow sensor

- **Selection of tools, materials and equipment used for Diesel engine air supply system**
  - ✓ Power tools
  - ✓ Hand tools
  - ✓ Materials
  - ✓ Equipment

- **Inspection of air supply system components**
  - ✓ Leakage
  - ✓ Broken lines
  - ✓ Looseness
- **Dismantling of air supply system components**
  - ✓ Throttle body
  - ✓ Air filter

- ✓ Intake manifold
- ✓ Air mass flow sensor

- **Disassembling, cleaning and inspection of diesel air supply system components**
  - ✓ Throttle body
  - ✓ Air filter cover
  - ✓ Intake manifold
  - ✓ Air mass flow sensor

- **Adjustment or replacement of diesel air supply system components**
  - ✓ Throttle body
  - ✓ Air filter
  - ✓ Intake manifold
  - ✓ Air mass flow sensor

- **Re- assembling and reinstalling of diesel air supply system components.**
  - ✓ Throttle body
  - ✓ Air filter cover
  - ✓ Intake manifold
  - ✓ Air mass flow sensor

- **Testing of diesel air supply system functionality.**
  - ✓ Static
  - ✓ Dynamic

Resources required for the indicative content	
Equipment	Projector, computer, Personal protective equipment (PPE), Multimeter, lamp tester ,hand scanner.
Materials	Whiteboard, marker pen, black board, chalk, flipchart, , Bolts and nuts, shop rags, air filter, sensors, intake manifold gasket ,intake manifold parts, clamps.
Tools	Pry bar, chipping hummer, Chisels, Scriber, Ruler, Allen key, Hummers, scan tool, Socket spanner, Phillips screwdriver, Slot screwdriver, Air wrench, Extension bars, Offset box wrenches, Combination wrenches, Torque wrench, T-bar (T-handle), Box wrenches, Rubber mallet, Plastic and rubber hummer, Standard sockets,
Facilitation techniques	• Group discussion • Trainer guided • Brainstorming • Demonstration • Simulation
Formative assessment methods	• Written assessment • Oral based assessment

	• Performance based assessment • Product based assessment
Learning outcome 3: Service engine lubrication system	**Learning hours: 8**
Indicative content	

- **Description of lubrication system components**
  - ✓ Oil pressure regulator
  - ✓ Oil sump/Pan
  - ✓ Engine oil filter
  - ✓ Piston cooling nozzles
  - ✓ Oil pump.
  - ✓ Strainer
  - ✓ Magnetic filter
  - ✓ The oil galleries.
  - ✓ Oil cooler
  - ✓ The oil pressure indicator/light
- **Selection of tools, materials and equipment used for engine cooling system**
  - ✓ Tools
  - ✓ Materials
  - ✓ Equipment
- **Draining of diesel engine lubricant**
- **Inspection of lubrication system**
  - ✓ Leakage
  - ✓ Pressure
  - ✓ Oil level
  - ✓ Abnormal noise
- **Cleaning or replacement of lubrication system components**
  - ✓ Oil pressure regulator
  - ✓ Oil sump/Pan
  - ✓ Engine oil filter
  - ✓ Piston cooling nozzles
  - ✓ Oil pump.
  - ✓ The oil galleries.
  - ✓ Oil cooler
  - ✓ The oil pressure indicator/light
- **Re-filling engine lubricant**
- **Testing of lubrication system functionality**
  - ✓ Static

✓ Dynamic

Resources required for the indicative content	
Equipment	Projector, computer, Personal protective equipment (PPE), Multimeter, lamp test, Bottle jack, Car lifter, Scissor jack, Floor (trolley) jack, Jack stands,
Materials	Whiteboard, marker pen, black board, chalk, flipchart, shop rags, engine oil, oil filter
Tools	Pry bar, chipping hummer, Chisels, Scriber, Ruler, Allen key, Hummers, scan tool, Socket spanner, Phillips screwdriver, Slot screwdriver, Air wrench, Extension bars, Offset box wrenches, Combination wrenches, Torque wrench, T-bar (T-handle), Box wrenches, Rubber mallet, Plastic and rubber hummer, Standard sockets, oil filter spanners
Facilitation techniques	• Group discussion • Trainer guided • Brainstorming • Demonstration • Simulation
Formative assessment methods	• Written assessment • Oral based assessment • Performance based assessment • Product based assessment

Learning outcome 4: Maintain engine cooling system	Learning hours: 8
Indicative content	

- **Classification of engine cooling system**
  - ✓ Air cooling system
  - ✓ Liquid cooling system

- **Description of engine cooling system components**
  - ✓ Radiator
  - ✓ Fan
  - ✓ Thermostat
  - ✓ Coolant pump/water pump
  - ✓ Hoses
  - ✓ Water jacket
  - ✓ Radiator Cap/pressure cap

- ✓ Reservoir tanks/expansion tank
- ✓ Fan belt
- ✓ Core plugs

- **Selection of tools, materials and equipment used for engine cooling system**
  - ✓ Power tools
  - ✓ Hand tools
  - ✓ Materials
  - ✓ Equipment

- **Inspection of engine cooling system components**
  - ✓ Radiator
  - ✓ Fan
  - ✓ Thermostat
  - ✓ Coolant pump/water pump
  - ✓ Hoses
  - ✓ Water jacket
  - ✓ Radiator Cap/pressure cap
  - ✓ Reservoir tanks/expansion tank
  - ✓ Fan belt
  - ✓ Core plugs

- **Draining and flashing of engine coolant**

- **Dismantling of engine cooling system components**
  - ✓ Radiator
  - ✓ Fan
  - ✓ Thermostat
  - ✓ Coolant pump/water pump
  - ✓ Hoses
  - ✓ Water jacket
  - ✓ Radiator Cap/pressure cap
  - ✓ Reservoir tanks/expansion tank
  - ✓ Fan belt

- **Adjustment or replacement engine cooling system components**
  - ✓ Radiator
  - ✓ Fan
  - ✓ Thermostat
  - ✓ Coolant pump/water pump
  - ✓ Hoses
  - ✓ Water jacket
  - ✓ Radiator Cap/pressure cap
  - ✓ Reservoir tanks/expansion tank
  - ✓ Fan belt
  - ✓ Core plugs

- **Re-mounting of engine cooling system components.**
  - ✓ Radiator
  - ✓ Fan
  - ✓ Thermostat
  - ✓ Coolant pump/water pump
  - ✓ Hoses
  - ✓ Water jacket
  - ✓ Radiator Cap/pressure cap
  - ✓ Reservoir tanks/expansion tank
  - ✓ Fan belt
  - ✓ Core plugs

- **Re-filling engine coolant**
- **Testing of engine cooling functionality.**
  - ✓ Static
  - ✓ Dynamic

Resources required for the indicative content	
Equipment	Projector, computer, Personal protective equipment (PPE), Multimeter, Bottle jack, , Lamp tester, Car lifter, Scissor jack, Floor (trolley) jack, Jack stands,
Materials	Whiteboard, marker pen, black board, chalk, flipchart, water, cooling system parts, coolant
Tools	Pry bar, chipping hummer, Chisels, Scriber, Ruler, Allen key, Hummers, scan tool, Socket spanner, Phillips screwdriver, Slot screwdriver, Air wrench, Extension bars, Offset box wrenches, Combination wrenches, Torque wrench, T-bar (T-handle), Box wrenches, Rubber mallet, Plastic and rubber hummer, Standard sockets,
Facilitation techniques	• Group discussion • Trainer guided • Brainstorming • Demonstration • Simulation
Formative assessment methods	• Written assessment • Oral based assessment • Performance based assessment • Product based assessment

Learning outcome 5: Repair diesel engine exhaust system	Learning hours: 12

Indicative content

- **Description of diesel exhaust system components**
  - ✓ Exhaust manifold
  - ✓ Exhaust pipe
  - ✓ Exhaust gasket
  - ✓ Catalytic converter
  - ✓ Muffler
  - ✓ Resonator
  - ✓ Tailpipe
  - ✓ Heat shields
  - ✓ Clamps,
  - ✓ Brackets
  - ✓ Hangers
  - ✓ Exhaust gas oxygen sensors

- **Selection of tools, materials and equipment used for engine cooling system**
  - ✓ Power tools
  - ✓ Hand tools
  - ✓ Materials
  - ✓ Equipment

- **Dismantling of exhaust system**
  - ✓ Dismount procedures

- **Disassembling, cleaning and inspection of diesel exhaust system components**
  - ✓ Exhaust manifold
  - ✓ Exhaust pipe
  - ✓ Exhaust gasket
  - ✓ Catalytic converter
  - ✓ Muffler
  - ✓ Resonator
  - ✓ Tailpipe
  - ✓ Heat shields
  - ✓ Clamps,
  - ✓ Brackets
  - ✓ Hangers
  - ✓ Exhaust gas oxygen sensors
- **Welding and replacement of diesel exhaust system components**
  - ✓ Exhaust manifold
  - ✓ Exhaust pipe
  - ✓ Exhaust gasket
  - ✓ Catalytic converter
  - ✓ Muffler
  - ✓ Resonator

- ✓ Tailpipe
- ✓ Heat shields
- ✓ Clamps,
- ✓ Brackets
- ✓ Hangers
- ✓ Exhaust gas oxygen sensors

- **Re- assembling diesel exhaust system components.**
  - ✓ Exhaust manifold
  - ✓ Exhaust pipe
  - ✓ Exhaust gasket
  - ✓ Catalytic converter
  - ✓ Muffler
  - ✓ Resonator
  - ✓ Tailpipe
  - ✓ Heat shields
  - ✓ Clamps,
  - ✓ Brackets
  - ✓ Hangers
  - ✓ Exhaust gas oxygen sensors

- **Re-installation of exhaust system on the vehicle**

- **Testing of diesel exhaust system functionality.**

  - ✓ Static
  - ✓ Dynamic

Resources required for the indicative content	
Equipment	Projector, computer, Personal protective equipment (PPE), Multimeter, lamp tester Exhaust gas analyzer, Oxy-acetylene Gas welding equipment, shielded metal arc welding machine, Grinding machine, Drilling machine.
Materials	Whiteboard, marker pen, black board, chalk, flipchart, Exhaust manifold gaskets, Bolts and nuts, shop rags, Welding electrodes, Wire brushes, exhaust system parts, grinding disc, Cutting disc, lambda sensor
Tools	Pry bar, chipping hummer, Chisels, Scriber, Ruler, Allen key, Hummers, scan tool, Socket spanner, Phillips screwdriver, Slot screwdriver, Air wrench, Extension bars, Offset box wrenches, Combination wrenches, Torque wrench, T-bar (T-handle), Box wrenches, Rubber mallet, Plastic and rubber hummer, Standard sockets, key, Hummers, scan tool, Tail pipe expander.

Facilitation techniques	• Group discussion • Trainer guided • Brainstorming • Demonstration • Simulation
Formative assessment methods	• Written assessment • Oral based assessment • Performance based assessment • Product based assessment

Integrated/Summative assessment

Integrated situation

KARASIRA brought the car Toyota Hilux (VIGO) with diesel engine at GEAR MOTOR Garage located in GASABO District KIMIRONKO sector for intervention. He told a receptionist that his engine car is exhausting more black smoke; engine oil consumption and the engine power get down at all. After being diagnosed by the head of the GEAR MOTOR Garage, the results show that his engine car needs the overhauling. The head of the Garage requested you as an engine Mechanic to remove and maintain engine systems even re-mount them after the engine has been overhauled within 8hours.

Tools	Pry bar, chipping hummer, Chisels, Scriber, Ruler, Allen key, Hummers, scan tool, Socket spanner, Phillips screwdriver, Slot screwdriver, Air wrench, Extension bars, Offset box wrenches, Combination wrenches, Torque wrench, T-bar (T-handle), Box wrenches, Rubber mallet, Plastic and rubber hummer, Standard sockets, key, Hummers, scan tool, Tail pipe expander.
Equipment	Personal protective equipment (PPE), Multimeter, lamp tester, Exhaust gas analyzer, Oxy-acetylene Gas welding equipment, shielded metal arc welding machine, Grinding machine, Drilling machine, Bottle jack, Lamp tester, Car lifter, Scissor jack, Floor (trolley) jack, Jack stands, aspirator, recharging machine, leakage tester, Projector, computer, Multimeter, lamp test, Bottle jack, Car lifter, Scissor jack, Floor (trolley) jack, Jack stands, Lamp tester, hand scanner, Injection pump test, injection-nozzle test rig, Oxy-acetylene Gas welding equipment, shielded metal arc welding machine, Grinding machine, Drilling machine.
Materials/ Consumables	Whiteboard, marker pen, black board, chalk, flipchart, Exhaust manifold gaskets, Bolts and nuts, shop rags, Welding electrodes, Wire brushes, exhaust system parts, grinding disc, Cutting disc, lambda sensor, engine oil, oil filter, Bolts and nuts, shop rags, air filter, sensors, intake manifold gasket, Welding electrodes, Wire brushes, fuel lines, injection pumps, injection nozzles, injector adjusting shims, mazout, grease ,clamps,

Assessable outcomes	Assessment criteria (Based on performance criteria)	Indicator	Observation		Marks allocation
			Yes	No	
Learning outcome 1: **Select tools, materials and equipment (15%)**	**1.1.** Tools ,materials and equipment are properly selected based on their use	Tools are properly selected			5
		Materials are correctly selected			5
		Equipment are properly selected			5
Learning outcome 2: **Maintain Diesel engine systems (70%)**	1.2. Diesel engine systems are properly inspected according to diagnosing procedures	Fuel supply system is appropriately inspected			2
		Air supply system is appropriately inspected			2
		Lubrication system is properly inspected			3
		Cooling system is properly inspected			3
		Exhaust system is correctly inspected			3
	1.3. Diesel engine systems are properly dismantled according to diagnosing procedures	Fuel supply system is appropriately dismantled			3
		Air supply system is appropriately dismantled			2
		Lubrication system is properly dismantled			3
		Cooling system is properly dismantled			3
		Exhaust system is correctly dismantled			3
	1.4. Diesel engine system components are properly disassembled according to the manufacturer instructions.	Fuel supply system is appropriately disassembled			3
		Air supply system is appropriately disassembled			2
		Lubrication system is properly disassembled			3
		Cooling system is properly disassembled			3

		Exhaust system is correctly disassembled			3
	1.5. Diesel engine system components are properly adjusted/replaced or repaired according to the manufacturer instructions	Fuel supply system is appropriately adjusted/replaced or repaired			3
		Air supply system is appropriately adjusted/replaced or repaired			3
		Lubrication system is properly adjusted/replaced or repaired			3
		Cooling system is properly adjusted/replaced or repaired			3
		Exhaust system is correctly adjusted/replaced or repaired			3
	1.6. Diesel engine system components are properly or re-mounted according to the according to the repair manual	Fuel supply system is appropriately re-mounted			3
		Air supply system is appropriately re-mounted			2
		Lubrication system is properly re-mounted			3
		Cooling system is properly re-mounted			3
		Exhaust system is correctly re-mounted			3
Learning outcome 3: **Test Diesel engine systems** **(15%)**					
	2.1. Diesel engine system are properly tested according to the according to the according to the manufacturer's instructions	Fuel supply system is appropriately tested			3
		Air supply system is appropriately tested			3
		Lubrication system is properly tested			3
		Cooling system is properly tested			3

		Exhaust system is correctly tested			3
Total marks					**100**
Percentage Weightage					**100%**
Minimum Passing line % (Aggregate): 70%					

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