

HKS700T

Operations Manual

Please read this manual before using.

Engine S/N: _____



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HKS 700T

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Do not operate this engine over densely populated areas. Do not operate this engine over terrain where a safe, power off landing cannot be performed.

The operating and maintenance instructions supplied with this engine must be followed at all times. Flying any aircraft involves the risk of injury or death, building and maintaining your own aircraft requires great personal responsibility.

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2. HKS700T ENGINE

2.1. Type designation.

HKS-700T

1 2 3

1. Manufacturer: HKS.

2. Piston displacement in c.c.

3. Turbocharged

2.2. Description of the HKS-700T.

Air-cooled, four-stroke.

Cylinder arrangement: 2 cylinders, horizontally opposed.

One central camshaft-pushrods-OHV, hydraulic lifters.

Oil cooled cylinder head.

Dual ECU Dual ignition.

Electric starter.

Alternator.

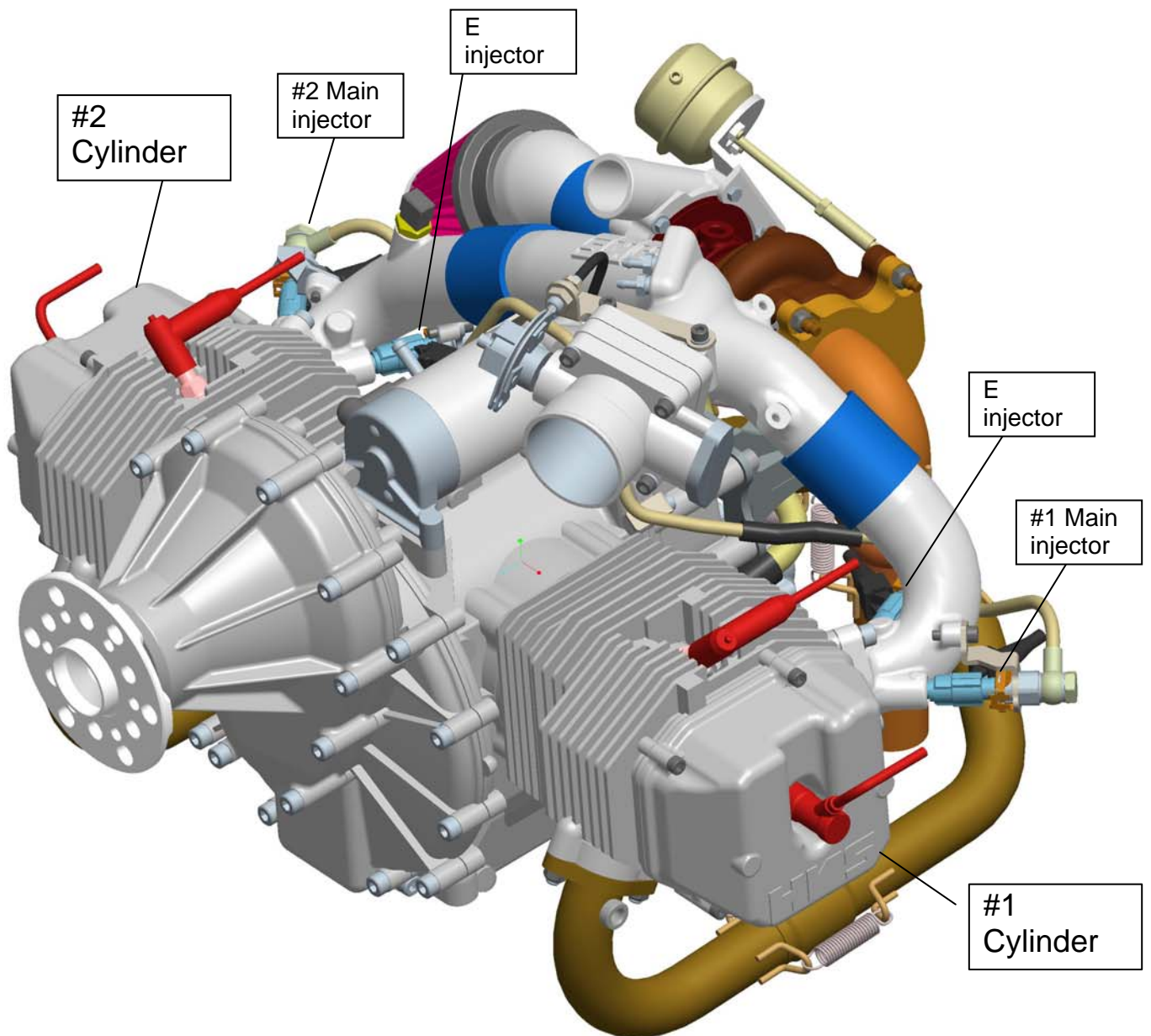
Nickel ceramic composite coated cylinders.

Dry sump forced lubrication.

Turbocharger with intercooler.

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2.3. Views of the engine.



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3. TECHNICAL DATA HKS 700T

3.1. Dimensions and weights.

Bore:	85 mm
Stroke:	62.5 mm
Total piston displacement:	0.709 L (709 CC)
Compression ratio:	8.8:1
Direction of crankshaft rotation:	Clockwise (Looking from pilot seat, tractor configuration.)
Direction of prop shaft rotation:	Counter clockwise
Weight:	Approx. 57kg (127LBS.) dry, with all electrical equipment, electric starter, exhaust, turbocharger and gearbox.
Weight:	Approx. 65kg (143 LBS.) Total system with oil tank, oil cooler and intercooler.

3.2. Equipment

Engine management system:	Dual electronic control fuel injection system. Minimum voltage for the ignition systems operating is 10 volts.
Ignition timing:	
Spark plugs:	DENSO IK24C11
Electrode spacing:	1.1 mm (.043")
Alternator performance:	280W DC at 4000 to 5300 r/min 100W at 2000 r/min and up
Throttle:	HKS 60 mm
Air filter:	K&N tapered.
Fuel pump:	Electrical fuel pump.
Fuel filter:	High pressure type.
Starter:	12V/0.6kW, engagement via gear reduction and overrunning clutch.

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3.3. Performance

Normal power

Take-off power (3 min.) Approx. 59.7kW (80HP) at 5300 r/min

Max continuous power. Approx. 57.4kW (79HP) at 5000 r/min

 **CAUTION!**

- Take-off power by wide open throttle must not be operated continuously more than 3 minutes.
- Once it has been operated at wide open throttle continuously for more than 3 minutes and the engine is damaged, the malfunction will be out of warranty.
- The total time of wide open throttle operation must be within 5 minutes per hour.

3.4. RPM limitations

Max. permissible r/min	5300 r/min
Max. continuous r/min	5000 r/min
Idle r/min	1300 to 1600 r/min

3.5. Fuel consumption (With full throttle (loaded))

Consumption @ max. permissible r/min	35 L/H (9.2 GPH.)
Consumption @ max. continuous r/min	28 L/H (7.4 GPH.)

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3.6. Information about fuels and lubricants

- Fuel: Aviation gasoline 100LL.
Fuel pressure: Pressure of intake manifold + 300kPa(3.1 kgf/cm², 44 psi)
Oil type: No aircraft engine oils.
Only multi-grade brand-name 100% synthetic oils for **AUTOMOBILE** engines, according to API-classification (API min. **SJ**).

Usable grade

5W-40

5W-50

10W-50

- Oil volume: 4 Liters (4.2 quarts)
This will vary based on the oil line layout and oil cooler size used.
Oil level is between 1/2 and 2/3 of oil tank after 3 minutes idling.
Oil consumption: Max. 0.1 L/h (1/10th quart per hour)
Oil pressure: Min.490 kPa (5.0 kgf/cm²,71psi) @5300 r/min
Min.118 kPa (1.2 kgf/cm²,17 psi) @ idle r/min
Oil temperature (readings off of the feed line into engine):
Min. 50 Deg.C (122 Deg. F)
Max.100 Deg.C (212 Deg. F)
Optimum oil temperature range: 80 - 90 Deg.C (170 - 194 F.)

 **CAUTION!**

- Don't use any aircraft engine oils and additives.
- You must install the oil cooler in the return line to the oil tank.
- Unspecified fuel (Low octane value, Alcohol contained etc.) will damage engine internal parts. Engine failure caused by use of unspecified fuel is out of warranty.

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3.7. Cooling system

Free air-cooling.

For the engines with full-cowled engine installation, ducting is required to properly channel cooling air to the cylinders.

3.8. Cylinder head temperature

Max. permissible cylinder head temperature

(Measured on the hottest cylinder): 180 Deg. C (356 Deg. F)

Optimum cylinder head temperature range: 140 - 170 Deg.C (284 - 338 F.)

 CAUTION!

- | |
|--|
| <ul style="list-style-type: none">● Use the HKS CHT probe. (Type K thermocouple)● Continuous operation at over CHT 180 Deg. C (356 Deg. F) will damage internal parts of engine. Engine failure caused by continuous operation at over CHT 180 Deg. C (356 Deg. F) is out of warranty. |
|--|

3.9. Propeller drive-reduction gear

Reduction ratio: crankshaft to prop shaft=2.61:1

Torsional shock absorption is based on progressive cushioning from an axial spring-loaded hub with dogs.

3.9.1. Propeller mass moment of inertia

Max. permissible propeller mass moment of inertia

6000 kg cm²

3.10. Exhaust gas temperature

Max. EGT [Deg. C] (Deg. F) : 780 (1436) at the original PT boss.

 CAUTION!

- | |
|--|
| <ul style="list-style-type: none">● Continuous operation at over EGT 780 Deg. C (1436 Deg. F) will damage internal parts of engine. Engine failure caused by continuous operation at over EGT 780 Deg. C (1436 Deg. F) is out of warranty. |
|--|

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3.11. Manifold pressure

Base boost pressure level

Atmospheric pressure + 80kPa(0.816 kgf/cm²,11.6psi)

Boost up function

At CHT140 - 165 Deg.C (284 - 329 F.)

Atmospheric pressure + 99kPa(1.01 kgf/cm²,14.3psi)

 CAUTION!

- | |
|---|
| <ul style="list-style-type: none">● The pressure in intake manifold will be above mentioned pressure at wide open throttle. When throttle opens less, the pressure will be also less. |
|---|

3.12 Service Ceiling

5000m(16500feet)

3.13. Permissible ambient temperature range

-20 Deg. C to 40 Deg. C.

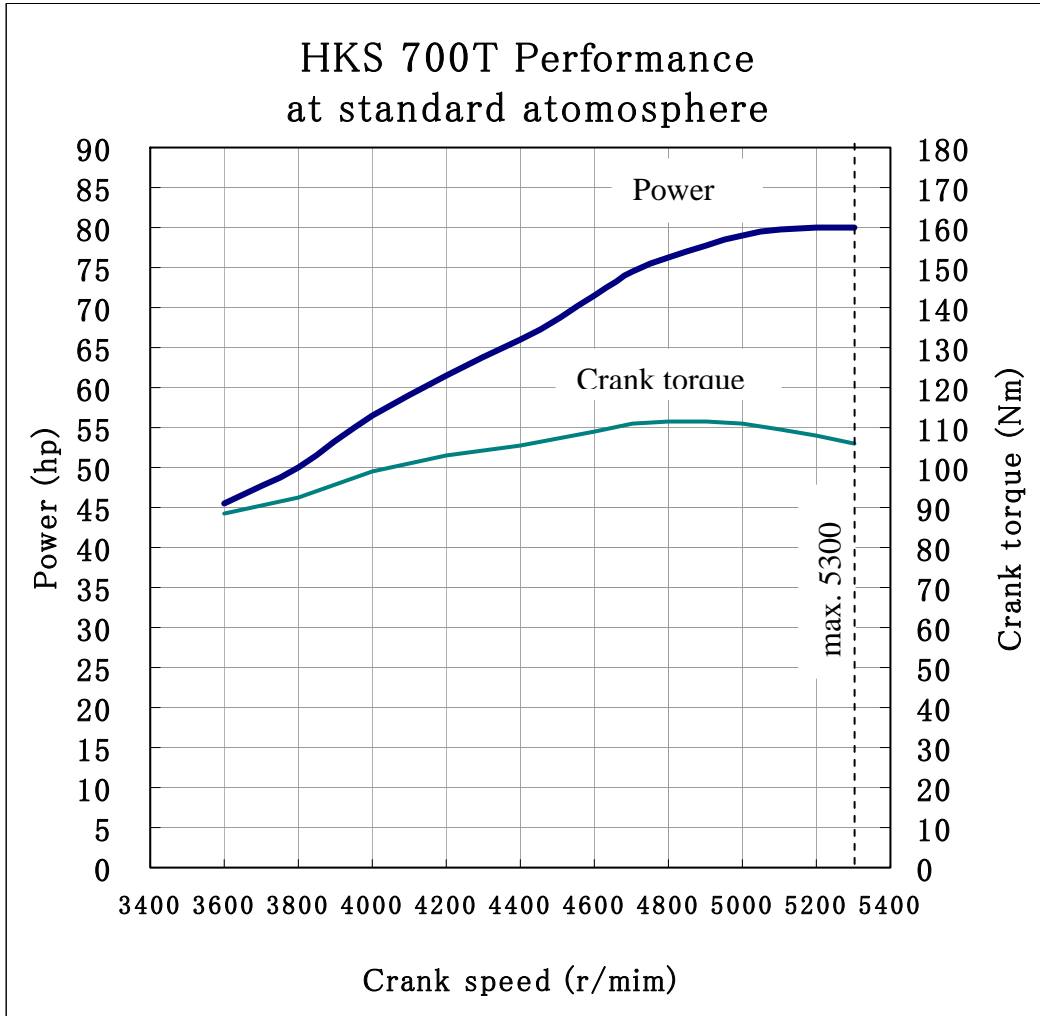
3.14. ECU workable ambient temperature range

ECU must be used at from -20 Deg. C to 75 Deg. C.

Ensure that ECU is not submerged or no condensation.

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4. PERFORMANCE CURVE



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5. OPERATING INSTRUCTIONS FOR THE HKS-700T

These instructions and procedures must be followed in detail for the proper operation of the engine and systems. To deviate from these instructions may lead to increased engine wear and a loss of reliability.

5.1. Before starting the engine

- With the aircraft chocked or tied down.
- Ignition "OFF"
- Has the daily check been done? (See Sec 6.1)
- Check the range and free movement of the throttle lever.
- Turn the propeller by hand; check the engine for unusual noises or hard movement.

5.2. Starting the engine

- Parking brake: Set (or aircraft chocked)
- Fuel shutoff valve: OPEN
- Throttle: Closed
- Master switch: ON
- Ignition: Both ON
(LED turns on for 3 seconds and
Then, it goes off.)
- Starter: Engage
- Let engine run at approx. 2000 r/min
- Oil pressure Check nominal. (See Sec 3.6)

 CAUTION!

- | |
|--|
| <ul style="list-style-type: none">● Crank the starter for a maximum of 10 seconds only. If the engine does not start, a cooling down period of 3 minutes is required.● Check the oil pressure after starting engine, if the indicated oil pressure is too low, stop the engine. Otherwise the engine will be damaged. |
|--|

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5.3. Warm up and run up

- Let the engine run at 2000 r/min for 2 minutes.
- Let the engine run at 2500-3000 r/min for about 5 minutes so that the oil pressure will not exceed the 390kPa (57psi, 4bar) maximum during run up.
- Wait for the oil temperature to reach a minimum of 50 Deg. C (122 Deg.F) before taking off or running up to a high RPM.
- Perform a Mag check of the two ignition circuits at 3000 r/min.
- Engine must not stop during Mag check.

5.4. Take-off and climb

- Advance the throttle smoothly and quickly to full throttle.
- Perform the take-off and initial climb in this position, and then reduce power slightly to the maximum continuous RPM, (See Sec. 3.3).

 **CAUTION!**

- Engine direction: within 20 degrees from vertical of gravitational force direction.
- Observe RPM, oil temperature, cylinder head temperature, exhaust gas temperature and oil pressure. The limits must not be exceeded. If the temperatures are moving towards exceeding the described limitations, reduce engine power (if possible) and increase airspeed to improve engine cooling.

5.5. Engine shutdown

- Let the engine cool sufficiently. Wait for the cylinder head temperature to reach less than 120Deg.C (248 Deg.F).
- Throttle: IDLE
- Ignitions: OFF
- Master switch: OFF

 **CAUTION!**

After taxiing with high power, let the engine cool sufficiently. Wait for the cylinder head temperature to reach less than 120Deg.C (248 Deg.F).
Enough cooling down is required for full cowled aircraft to prevent heat problem.

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5.6. Engine shutdown and restarting in flight

- Let the engine cool sufficiently. Wait for the cylinder head temperature to reach less than 120Deg.C (248 Deg.F).
- Throttle: IDLE
- Ignitions: OFF

The in-flight re-start procedure is the same as on the ground.

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6. MAINTENANCE INSTRUCTIONS

6.1. Daily check

- Take off the engine cowling (if so equipped).
- Check the engine for missing or loose parts as well as for any wear.
- Check the condition of the ignition harness.
- Check the actuating mechanisms for throttle, make certain that the action of the throttle is smooth.
- Check the oil level and fill if necessary. The oil level should be between 1/2 and 2/3rd of the oil tank dipstick or level gauge after 3 minutes idle running.
- Check the breather hoses of oil tank. The breather hoses must not choke.
- Check the oil and fuel system for any leakage.
- Drain the sump(s) to remove water in the fuel tank.
- Reattach the engine cowling if equipped.
- With the ignition off, turn the propeller by hand and check the engine for unusual noises or hard movement and proper compression.
- Before flight engine test run.

Observe the starting behavior. Let the engine warm up, monitoring the temperatures and pressures. Do a run-up observing the throttle response (adequate RPM acceleration) and a full-power run-up. (Maximum RPM depends on the type of propeller and pitch used)

 DANGER!
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- | |
|---|
| <ol style="list-style-type: none">1. Prior to turning the propeller by hand, confirm that.
The ignition and master switches are: OFF
The aircraft is chocked or properly tied down.2. Cockpit operations must be performed by a trained person. |
|---|

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6.2. Periodic inspections

After the first 25 hours of operation the inspections listed in 6.2.1 are to be performed. The next inspection is due to at 50 hours and thereafter every 50 hours. The 100-hour inspection mentioned under 6.2.2 is to be performed every 100 hours but at least **annually**. The 200-hour inspection mentioned under 6.2.3 is to be performed every 200 hours.

6.2.1. First 25-hour-inspection, 50-hour-inspection

- Check condition of the throttle cable.
- Engine mounts. Check for cracks, looseness of mounts, and looseness of engine to mounts.
- Check for looseness of bolts, nuts and pins.
- Check for oil leaks from hoses, the oil tank and fittings.
- Perform an oil change. (See Sec 7.1)
- Check the magnet of oil drain screw for the metal contamination.
- Change the oil filter.
- Fuel lines-check the standoffs, safeties, leaks and wear.
- Fuel filter-check, clean.
- Check 4mm rubber hoses of fuel pressure regulator.
- Check the ignition harness for damage and tight connections at spark plug cap.
- Air filter-check, clean.
- Check rubber hoses of intercooler.
- Check the general condition of the exhaust system; look for cracks, particularly at the welds.
- Check the attaching flanges at the exhaust ports on the cylinders for exhaust leaks.
- Check the ignition coils for wear and security of attachment.
- Check for leaks at the oil pressure and temperature sensors.
- Electrical wiring-check for wear, damage and security of attachment.
- Check the resistance of the electrical equipment (See Sec 7.8).
- Check the crankcase for leaks and cracks.
- Clean engine if dirty or oily.
- Run up the engine. (See Sec. 5.3)
- **Change fuses and rubber hoses every 3 years.**

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6.2.2.100-hour-inspection

- Carry out the 50-hour-check.
- Perform a compression check. (See Sec 7.3)

6.2.3.200-hour-inspection

- Carry out the 100-hour inspection.
- Check the spark plug caps. Change if necessary.
- Change the spark plugs.
- Change the fuel filter.
- Change the air filter.

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6.3. Preservation of the engine for long term storage

For long out of operation periods and at extreme climatic conditions, we recommend the following instructions to protect against corrosion. Extra protection against corrosion beyond these recommendations is not necessary.

1. Warm up the engine, stop the engine, and empty the motor oil.
2. Fill up with new oil.
3. Close all openings, the exhaust tubes, the breather tube and air filters. Protect them against dirt and moisture.
4. Coat all the steel engine parts with engine oil.

Bringing the engine back to operation

1. Remove all the plugs and fasteners.

 CAUTION!

For longer storage periods, the preservation procedures must be performed at least annually.
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6.4. Winter operation

6.4.1. Care of the electrical system

Generally in the beginning of the winter an engine inspection shall be performed.

- Check all the connections of the ignition system and clean if necessary.
- Check the battery voltage.
- The battery poles and terminal connectors should be cleaned.

In countries with extremely low temperatures it is recommended to protect the **ECU and** battery against freezing by keeping it in a warm location for storage between flights. (See Sec 3.6)

**ECU must be stored at from -30 Deg. C to 85 Deg. C.
Ensure that there is no condensation.**

ECU Workable ambient temperature range : -20~+75°C

Storage temperature range : -30~+85°C

Ensure that there is no condensation.

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6.4.2. Fuel system icing

(1) Icing due to water in the fuel

Water in the fuel will accumulate at the lower parts of the fuel system and can lead to freezing of the fuel lines and filters.

Remedies:

- Use a fuel/water separating funnel, if the fuel supply is suspect.
- Drain the water in the fuel tank during the daily check.
- Drain and inspect the fuel system during the 50-hour inspection.
- Prevent fuel tank condensation, by keeping the fuel tank full when in short term storage, drain the fuel tank when not in use for longer periods.
- Avoid temperature differences between aircraft and fuel.

 CAUTION!

Fuels containing alcohol always carry a small amount of water in solution. Temperature changes or an increase of alcohol content may cause water or a mixture of alcohol and water to settle to the bottom of the fuel tank and could cause engine stoppage.
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6.4.3. Induction system icing

To prevent icing that blocks intake system, a shroud against icing should be equipped on the front side.

6.4.4. Venting system icing

Attach I.D. 8mm venting tube to the 8mm nipple on the upper side of oil tank for atmospheric ventilation.

To prevent icing around outlet of venting tube, length of venting tube should be shorter than 1000mm.

To prevent fire of oil mist comes out of venting tube, outlet of venting tube should be at least 300mm far from exhaust system and should not face to the exhaust system.

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7. MAINTENANCE

7.1. Changing the engine oil

- Warm the engine up to normal operational temperatures.
- Remove the oil drain screws from the engine and oil tank, drain oil, and replace the oil filter.
- Drain the oil from the oil cooler and oil lines.
- Screw in the oil drain screws. Tighten according Chapter 9.
- Fill with new oil in the oil tank (3L).
- Run engine at idle for 3 minutes.
- Recheck oil level of oil tank and fill if necessary, the oil level should be between 1/2 and 2/3rd of the oil tank.

 CAUTION!

- | |
|--|
| (1) Use only multi-grade, brand name oils for automobile engines.
(Oil type See Sec. 3.6) |
| (2) Don't use any aircraft engine oils and/or additives. |

7.2. Air filter

For operation in heavy dust conditions, clean the air filter at shorter intervals or replace.

7.3. Compression test

Measure the engine compression using a compression gauge with a recording dial. The readings are taken with a fully open throttle at an engine oil temperature of between 86 Deg. F. (30 Deg. C) to 160 Deg. F. (70 Deg.C). If the readings are below **116 psi. (8 bar)**, A tear down to inspect the pistons, cylinders, valves and cylinder heads is required.

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7.3.1. Idle speed adjustment

- For the first adjustment, turn back the stop screw so that the throttle valves close completely.

 DANGER!
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The rotating propeller is extremely dangerous! Adjustments must be done with the utmost caution from behind the engine. The aircraft must be tied down or properly chocked. Do not perform this operation without a safety observer.
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7.4. Spark plugs

- Unscrew the plugs only with a cold engine.
- Brush clean with a plastic bristle brush.
- Do not use a brass brush or a steel wire brush for cleaning.
- After 200 hours, replacement of the spark plugs is required.
- Spark plug to use: DENSO IK24C11
- Torque the spark plugs with a cold engine only. (See Chapter 9.)

The shade of the spark plugs can give you the following information:

- Light brown to white:
Spark plugs and EFI system is correct.
- Velvety black:
Electrode gap too wide or the mixture is too rich.
Reduced air intake (air filter dirty) the proper exhaust gas temperature of engine is not reached
- Oily:
The spark plug is not firing or worn cylinder and piston rings.
- Pearly or glazed:
Wrong type of spark plug or the Spark plug not torqued properly, the mixture is a too lean or badly closing valve.

7.5. Exhaust system

- Visually check for any damage and or leaks.
- Check attach-flanges at exhaust parts on cylinder. Tighten the nuts if necessary.

7.6. Misc. bolts and nuts

- Check for tightness, re-torque if necessary (See chapter 9.)

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7.7. Resistance of electrical equipment

Check the resistance of the electrical equipment according to TABLE 1.

TABLE 2.

EQUIPMENT	LOCATION OF MEASUREMENT	RESISTANCE	VARIATION
AC Magnetic stator	White - White of 3 phase connector	0.4ohms	+ - 20%
Pulse detector	White - Red Brown - Green	310 ohms	
High tension coil		4.9 K-ohms	

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8. OVERHAULS

8.1. **Major inspections at TBO** is to be performed by the manufacturer or approved service centers only. For this purpose the engine is to be sent with its logbook to the manufacturer or the nearest approved service center. The recommended time between overhaul (TBO) is at present **500** hours of operation and this overhaul must be performed within 8 years after shipping. An increase of TBO due to field experience will be published in the Service Bulletins of the manufacturer.

8.2. **Major repairs and major modifications** are also only to be performed by the manufacturer or by approved service centers, which are authorized by the manufacturer. In case of prop strikes or sudden stoppage, the engine must be disassembled and the crankshaft must be checked for cracks. This is considered a major repair and must be performed by the manufacturer or an approved service center. If stoppage of the engine is concealed when ordering a repair or major overhaul, the responsibility for the damage and subsequent costs still exists for the owner concealing the damage.

9. TABLE FOR TORQUE VALUES

		ft. Lbs	Kgm
Spark plug	M14	14.5	2
		or 1/4 to 1/2 turn	
Oil drain screw	M14	21	3
Rear cover screw	M6	8.5	1.2
Oil pump screw	M6	8.5	1.2
Crankcase screw	M6	8.5	1.2
	M8	17	2.4
	M10	34.5	4.8
Front cover screw	M6	8.5	1.2
Gear cover screw	M6	8.5	1.2
Cylinder screw	M6	7	1.0
Head screw	M5	4	0.6
Head cover screw	M5	4	0.6
Screw for starter	M6	8.5	1.2
Intake manifold screw	M8	17	2.4
Throttle	M6	8.5	1.2
Turbocharger nut	M8	17	2.4
Turbocharger bracket	M8	21	3.0
Turbocharger oil return pipe	M6	8.5	1.2

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		ft. Lbs	Kgm
Turbocharger oil inert	M10	10.5	1.5
Fuel banjo bolt	M10	21	3.0

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10. INSPECTION AND MAINTENANCE ITEMS

HKS-700T Inspection and maintenance program				
Inspection-maintenance item.	Hourly inspection routine			
	First 25hr.	Every 50hr.	Every 100hr.	Every 200hr.
1. Check condition of throttle cable.	○	○	○	○
2. Engine mounts-check for cracks, looseness of mounts, and looseness of engine to mount.	○	○	○	○
3. Check for looseness of bolts, nuts and pins.	○	○	○	○
4. Check for oil leaks from hose, tank and fittings.	○	○	○	○
5. Exchange oil filter.	○	○	○	○
6. Perform oil change.	○	○	○	○
7. Check the magnet of oil drain screw for the metal contamination.	○	○	○	○
8. Fuel lines-check for leaks, safeties and wear.	○	○	○	○
9. Fuel filter-check, clean or replace.	○	○	○	○
10. Check 4mm rubber hoses of fuel pressure regulator.	○	○	○	○
11. Check ignition harness for damage and tight connections at spark plug cap.	○	○	○	○
12. Air filter-check, clean or replace.	○	○	○	○
13. Check rubber hoses of intercooler.	○	○	○	○
14. General condition of the exhaust system, Check attaching flanges at exhaust port on cylinder for leakage.	○	○	○	○
15. Check ignition coils for wear and security of attachment.	○	○	○	○
16. Check for leaks at oil pressure and temperature sensor.	○	○	○	○
17. Electrical wiring-check for damage, wear and security of attachment.	○	○	○	○
18. Check resistance of electrical equipment.	○	○	○	○
19. Check crankcase for leaks and cracks.	○	○	○	○
20. Clean engine if dirty or oily.	○	○	○	○
21. Compression check (See operation manual).			○	○
22. Check spark plug caps. Change if necessary.			○	○
23. Change spark plugs.				○
24. Change the fuel filter.				○
25. Change the air filter.				○
100-hr-inspections must be performed at least annually. The overhaul must be performed within 8 years after shipping or 500hours operation time.				

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WARRANTEE CONDITIONS

The HKS non-certified aircraft engines limited warrantees

1) Period

HKS as manufacturer, warrants through their authorized HKS distributors from the date of sale to the first consumer, every HKS non-certified engines, sold as NEW and UNUSED, and delivered by an authorized HKS distributor for a period of the earliest of:

- 6 consecutive months for private use owners**
- or 12 consecutive months from date of shipment of the HKS distributors**
- or the first 100 operation hours**

2) What an authorized HKS distributor will do

The authorized HKS distributor will, at its option, repair and/or replace components defective in material and/or workman ship under normal use and service, with a genuine HKS component without charge for parts or labour, during said warrantee period. All parts replaced under warrantee become the property of HKS.

3) Condition to have warrantee work performed

You must present to an authorized HKS service-center, the hard copy of the HKS warrantee registration card and/or proof of purchase delivered to the customer from the selling dealer at time of purchase.

4) Exclusion - are not warranted

- Normal wear on all items.
- Replacement parts and/or accessories that are not genuine HKS parts and/or accessories.
- Damage resulting from the installation of parts other than genuine HKS parts.
- Damage caused by failure to provide proper maintenance as detailed in the OPERATIONS MANUAL. The labor, parts and lubricants costs of all maintenance services, including tune-ups and adjustments will be charged to the owner.
- Aircraft engines designed and/or used for racing or commercial purposes.
- All optional accessories installed on the aircraft engine (The normal warrantee policy for parts and accessories, if any, applies).
- Damage resulting from running the aircraft engine without propeller.
- Damage resulting from modification to the aircraft engine not approved in writing by HKS.

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- Damage caused by electrolysis.
- Cold seizure and piston scuffing.
- Use of a gear reduction not designed by HKS.
- Use of propellers, which exceed the inertia and balance limits as specified by HKS.
- If engine instruments recommended by HKS have not been installed.
- Losses incurred by the aircraft engine owner other than the parts and labor, such as, but not limited to, mounting and dismounting of the engine from the aircraft, loss of use, transportation, towing, telephone calls, taxis, or any other incidental or consequential damage.
- Damage resulting from accident, fire or other casualty, misuse, abuse or neglect.
- Damage/rust/corrosion premature wear to the engine caused by water ingestion.
- Damage resulting from sand/stones infiltration.
- Damage resulting from any foreign material ingestion.
- Damage resulting from service by an unqualified mechanic.

5) Expressed or implied warranties

This warranty gives you specific rights, and you may also have other legal rights, which may vary from state to state, or province to province. Where applicable this warranty is expressly in lieu of all other expressed or implied warranties of HKS, its distributors and the selling distributor, including any warranty of merchantability or fitness for any particular purpose; otherwise the implied warranty is limited to the duration of this warranty. However, some states or provinces do not allow limitations on how long an implied warranty lasts, so the above limitation may not apply.

Neither the distributor, nor any other person has been authorized to make any affirmation, representation or warranty other than those contained in this warranty, and if made, such affirmation, representation or warranty shall not be enforceable against HKS or any other person.

HKS reserves the right to modify its warranty policy at any time, being understood that such modification will not alter the warranty conditions applicable to aircraft engines sold while the above warranty is in effect.

HKS 700T

6) Consumer assistance procedure

If a servicing problem or other difficulty occurs, please contact: -authorized HKS service-center or authorized HKS distributor.

7) Warrantee will only be valid if the end user completes this registration card as soon as the aircraft engine goes into service, and returns it to the national authorized HKS distributor of the area in which the aircraft engine is firstly operated.

8) This warrantee will be effective for all non-certified aircraft engines delivered by HKS as of September 1st, 1997.

9) WARNING!

This is a non-certified aircraft engine, the possibility of engine failure exists at all times. Do not operate this engine over densely populated areas. Do not operate this engine over terrain where a safe, power off landing cannot be performed.

The operating and maintenance instructions supplied with this engine must be followed at all times. Flying any aircraft involves the risk of injury or death, building and maintaining your own aircraft requires great personal responsibility.

10) All disputes, controversies or differences which may arise between the parties, shall be settled by arbitration in Japan in accordance with the Commercial Arbitration Rules of the Japan Commercial Arbitration Association.

HKS 700T

WARRANTEE CARD

WARRANTEE / OWNER'S REGISTRATION CARD



1. To be eligible for warrantee, this registration card must be returned completed and signed by the end user to the authorized HKS distribution partner of the area of the permanent residence of the end user and/or in which this non-certified aircraft engine is firstly operated, within 30 days as of date of purchase.
2. No other warrantees and/or guarantees than defined in the actual warrantee conditions are made.
3. All disputes, controversies or differences which may arise between the parties, shall be settled by arbitration in Japan in accordance with the Commercial Arbitration Rules of the Japan Commercial Arbitration Association.

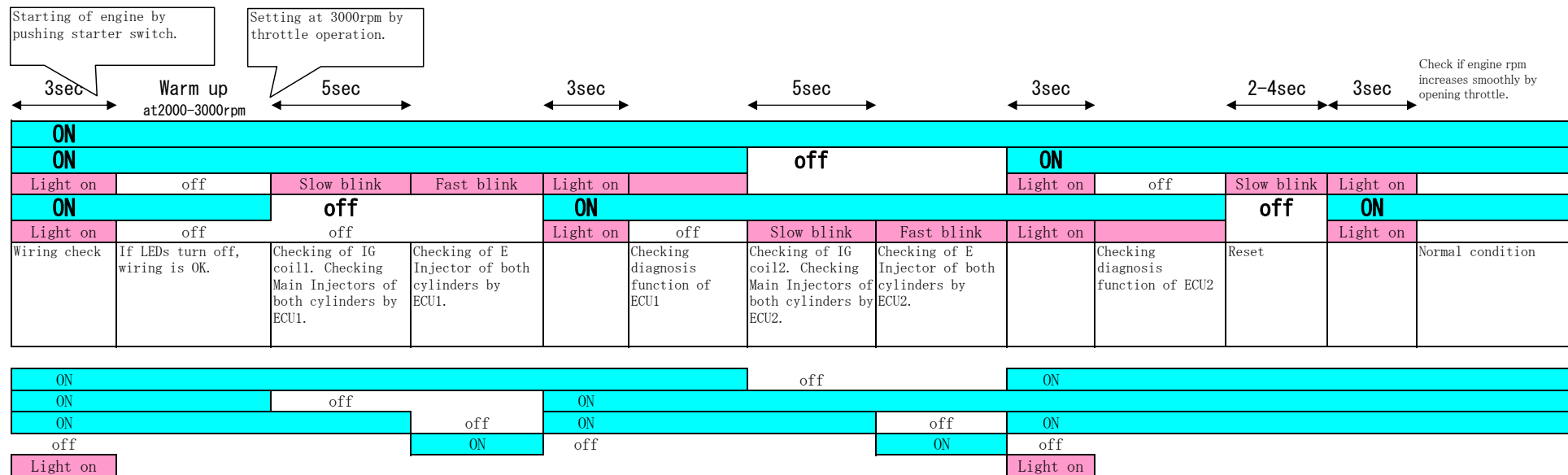
4.

Engine type: HKS700T
.....
Engine S/N.:
.....
Date of purchase:
.....
Buyer:
.....
Address:
.....
Telephone:
.....
Seller:
.....

I have read and understood the operations manual in its entirety.

Date:
.....
Signature:
.....

Mag check



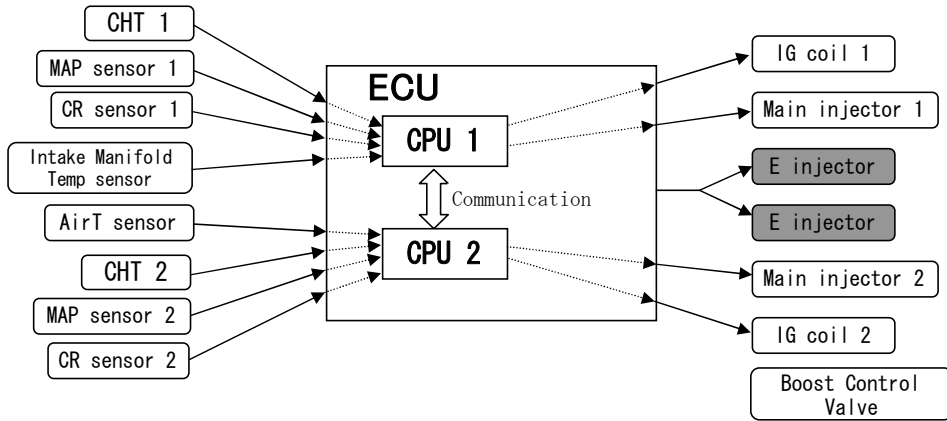
Procedure of Mag check

Close Throttle, turn on all of MainSW, IGSW1, IGSW2. Make sure that all LEDs are ON.
 After 3 seconds, Warning LED1, 2 will be off.
 If LED turns off, there is no problem on the wiring. In case LED remains to be on, wiring is cut or short. Check and repair.
 Press Starter SW and start the engine.
 Adjust throttle to warm at 2000rpm while 2 minutes. Then 2500-3000rpm while increase oil temperature to 50 degrees C (122 degrees F).
 Adjust throttle at 3000rpm. Start Mag check.
 Turn off IGSW2. Warning LED1 blinks slowly. At this time, IG coil1 is checked. Main Injectors of both cylinders are checked by ECU1.
 After 5 seconds, Warning LED1 blinks fast. At this time, E Injectors of both cylinders are checked by ECU1.
 Turn on IGSW2. Warning LED2 turns on.
 After 3 seconds, Warning LED2 turns off. LED1 keeps turning on. At this time, diagnosis function of ECU1 is checked.
 Turn on IGSW1. Warning LED2 blinks slowly. At this time, IG coil2 is checked. Main Injectors of both cylinders are checked by ECU2.
 After 5 seconds, Warning LED2 blinks fast. At this time, E Injectors of both cylinders are checked by ECU2.
 Turn on IGSW1. Warning LED1 turns on.
 After 3 seconds, Warning LED1 turns off. LED2 keeps turning on. At this time, diagnosis function of ECU2 is checked.
 Turn off IGSW2. Warning LED1 blinks slowly. During the slow blinking (about 2-4 seconds), turn on IGSW2 again.
 Both Warning LED1, 2 turn on for 3 seconds. Then, they turn off.
 With the above procedure, all EFI systems can be checked and there is no problem on the system.
 Before take off, open throttle on ground and make sure that engine rpm increases smoothly.
 Keep turning on both IGSW1, IGSW2. It is ready for take off and flying.

Caution

When malfunction (Open or short circuit of crankshaft angle sensor, CHT sensor, MAP sensor, AT sensor, Injector, IG coil) occurs ECU will change to emergency mode automatically and alive factions are connected properly and the engine is kept running. Do not turn off one of IGSW during flight. In case one of IGSW is turned off during flight, EGT and CHT will increase and engine will be damaged.

System at normal condition



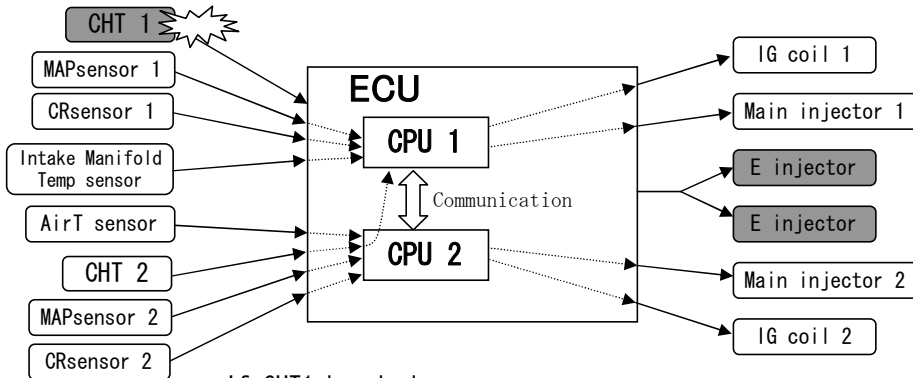
CPU1 provides IMTsensor information to CPU2.
 CPU2 provides ATsensor information to CPU1.
 Both warning LEDs lights out.

System at emergency condition

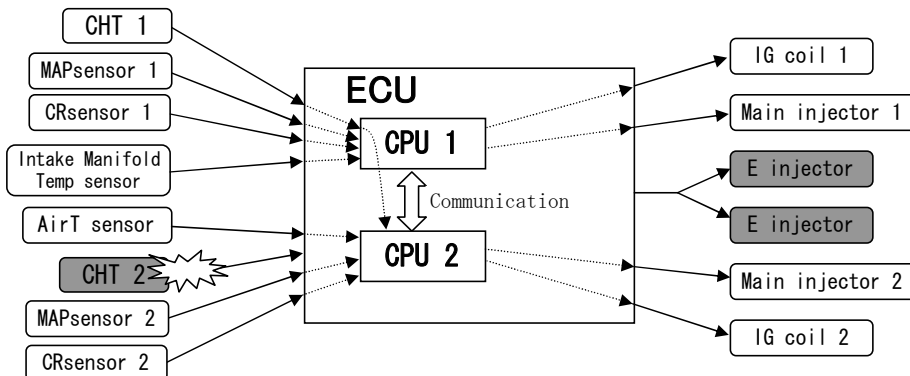
It is following situation if warning LED slow or fast blinking.

Engine is continues running at all following situations.

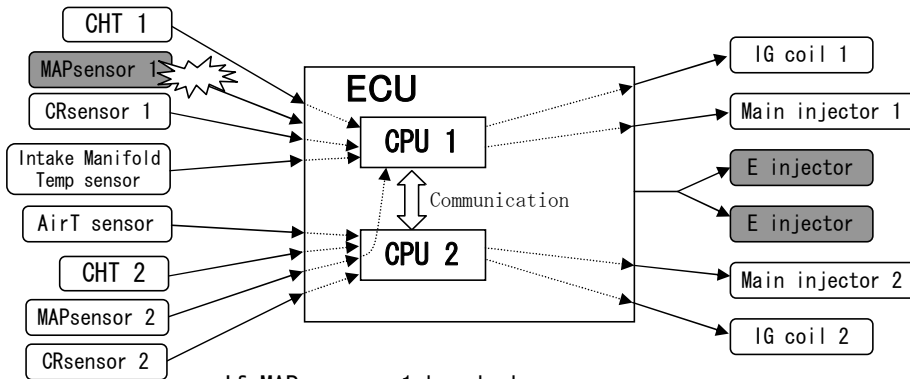
However, please inspect these parts after a landing to safe place immediately.



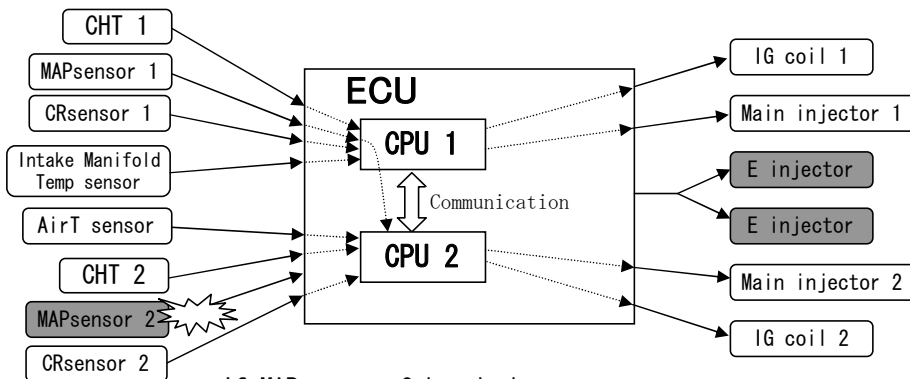
If CHT1 break down,
 CPU2 provides CHT2 information to CPU1.
 Warning LED 1 slow blinking.



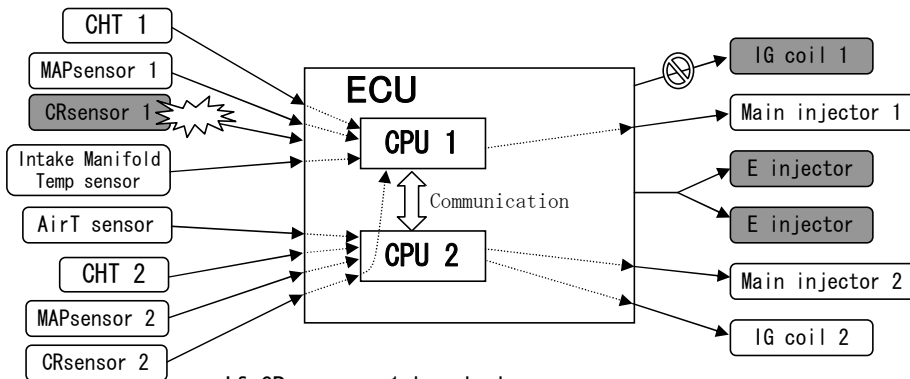
If CHT2 break down,
 CPU1 provides CHT1 information to CPU2.
 Warning LED 2 slow blinking.



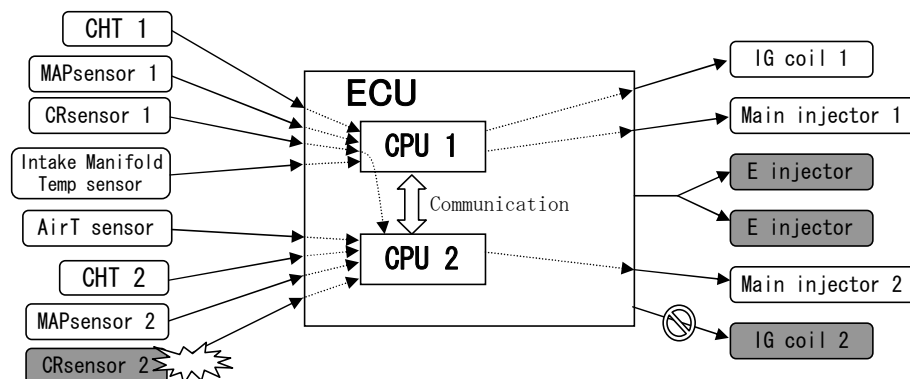
If MAP sensor 1 break down,
CPU2 provides Map sensor2 information to CPU1.
Warning LED 1 slow blinking.



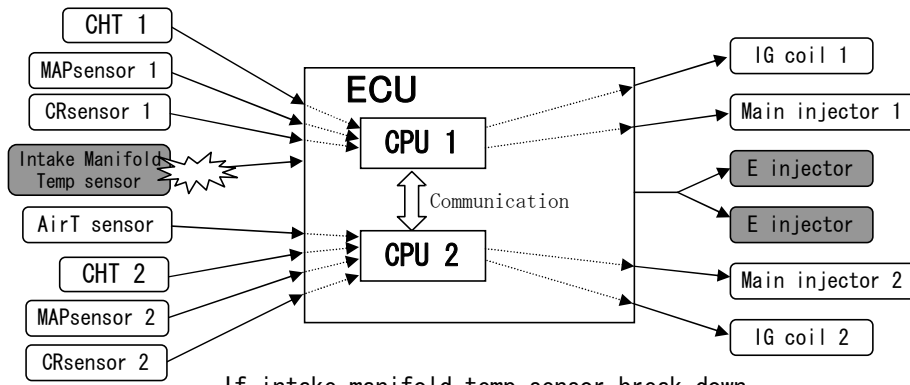
If MAP sensor 2 break down,
CPU1 provides Map sensor1 information to CPU2.
Warning LED 2 slow blinking.



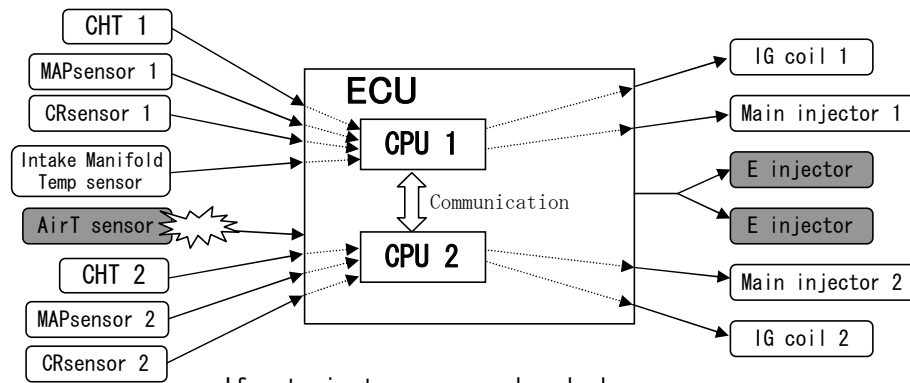
If CR sensor 1 break down,
CPU2 provides CR sensor2 information to CPU1.
Warning LED 1 slow blinking.



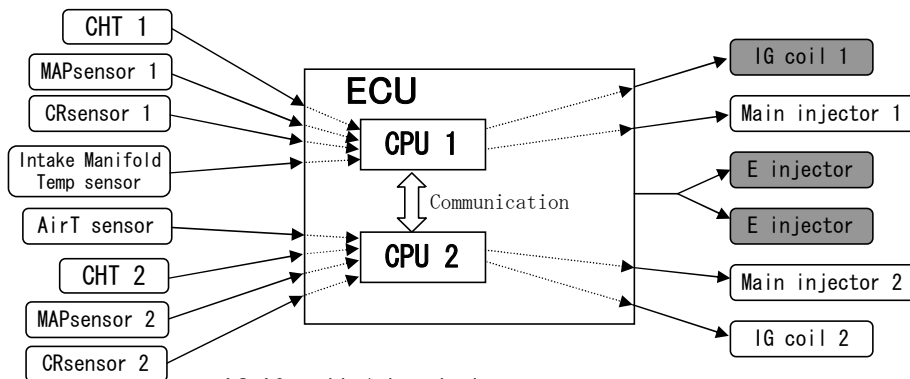
If CR sensor 2 break down,
CPU1 provides CR sensor1 information to CPU2.
Warning LED 2 slow blinking.



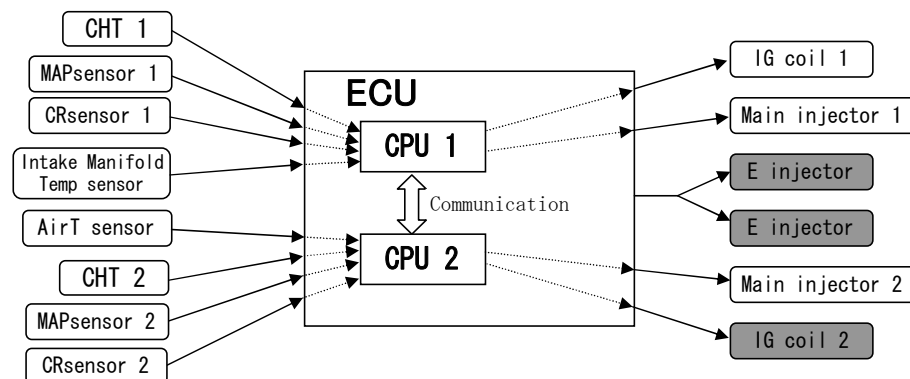
If intake manifold temp sensor break down,
Both CPUs work by standard temperature data.
Warning LED 1 slow blinking.



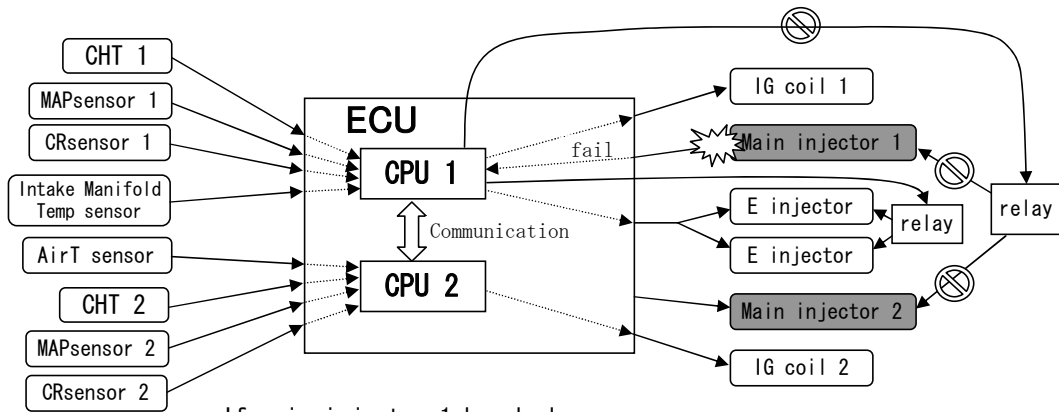
If out air temp sensor break down,
Both CPUs work by standard temperature data.
Warning LED 2 slow blinking.



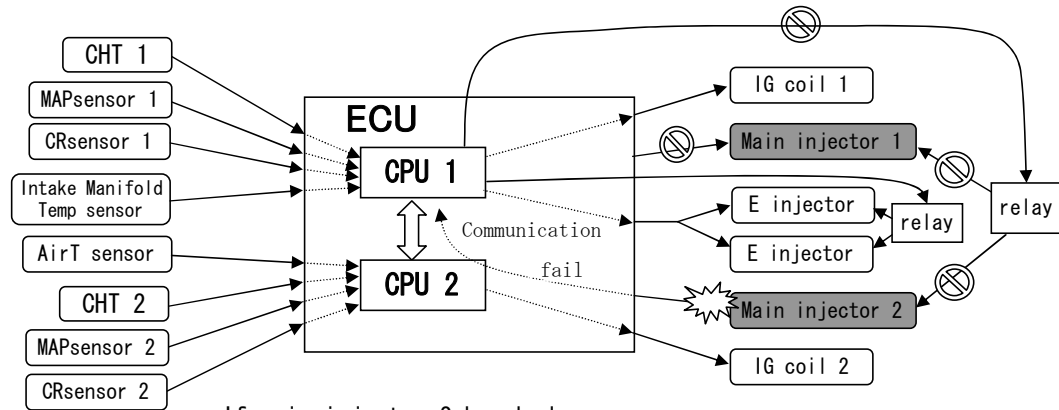
If IG coil 1 break down,
Both CPUs work continue and engine running by only IG coil 2.
Warning LED 1 slow blinking.



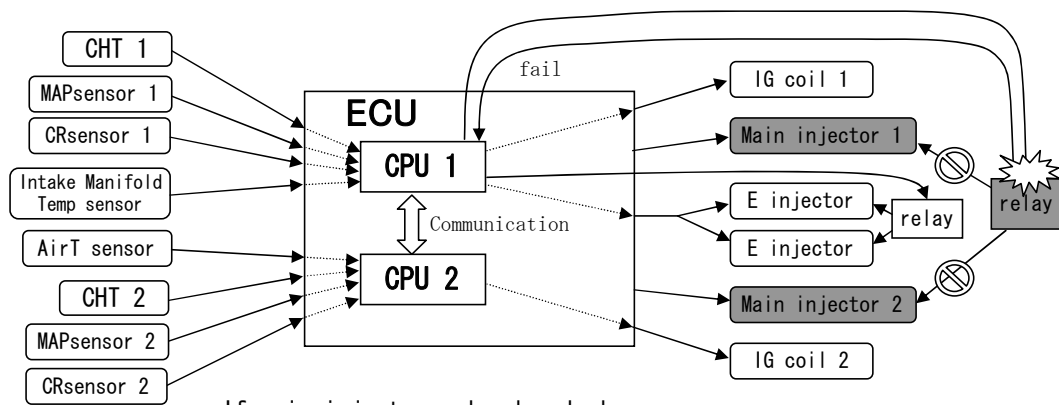
If IG coil 2 break down,
Both CPUs work continue and engine running by only IG coil 1.
Warning LED 2 slow blinking.



If main injector 1 break down,
 CPU1 stops power supply for relay of main injectors.
 CPU1 controls E relay for E injectors.
 Warning LED 1 fast blinking.



If main injector 2 break down,
 CPU2 provides information of failure of main injector2 to CPU1.
 CPU1 stops power supply for relay of main injectors.
 CPU1 controls E relay for E injectors.
 Warning LED 2 fast blinking.



If main injector relay break down,
 CPU1 receives information of failure of main relay.
 CPU1 controls E relay for E injectors.

Emergency function

System operation at normal condition

Each cylinder is controlled independently by ECU

When CHT is increased abnormally, only fuel injection amount of the cylinder that had a trouble will be compensated.

If one of the functions is lost, by communication between ECU1 and ECU2, the lost function will be compensated and the engine does not stop.

If plural different functions are lost, by communication between ECU1 and ECU2, the lost functions will be covered each other and the engine does not stop.

In case one of ECU has an error, engine will be operated with information supplied from the other ECU. The ECU that had an error just stops control but power supply to ECU unit is not cut.

System operation during malfunction

Function	During malfunction		Emergency function
	LED1	LED2	
CHT1	ON		Temperature information of CHT2 is supplied to CHT1.
CHT2		ON	Temperature information of CHT1 is supplied to CHT2.
MAP sensor1	ON		Pressure information of MAP sensor2 is supplied to MAP sensor1.
MAP sensor2		ON	Pressure information of MAP sensor1 is supplied to MAP sensor2.
CR sensor1	ON		Information of CR sensor2 is supplied to ECU1 and Injector1 keeps working. IG coil1 is stopped.
CR sensor2		ON	Information from CR sensor1 is supplied to ECU2 and Injector2 keeps working. IG coil2 is stopped.
InManiT sensor		ON	Controlled with the standard temperature.
AT sensor	ON		As it is not used for engine management, there is no affection.
IG coil 1	ON		Controlled with IG coil 2 only.
IG coil 2		ON	Controlled with IG coil 1 only.
Injector1	ON	ON	Injectors of both cylinders are changed to E Injector.
Injector2	ON	ON	Injectors of both cylinders are changed to E Injector.
BCV	ON		The maximum manifold pressure will be 78kpa (Gauge pressure).
Relay 1			The Main Injector will be off and it is operated by E Injector.
Relay 2			E Injector will be off. As E Injector is not used for normal operation, there is no affection.
fuse 61	ON		IGSW will be off and it is operated by E Injector and IG coil 2.
fuse 62		ON	IGSW2 will be off and it is operated by E Injector and IG coil 1.
fuse 65	ON	ON	Injector1 will be off and Injectors of both cylinders are changed to E Injector.
fuse 66	ON	ON	Injector2 will be off and Injectors of both cylinders are changed to E Injector.
fuse 67			E Injector will be off. As E Injector is not used for normal operation, there is no affection.
fuse 26	Fast blink		Constant power supply from battery to ECU1 will be off. Although ECU cannot memorize error information, engine can be operated.
fuse 60		Fast blink	Constant power supply from battery to ECU2 will be off. Although ECU cannot memorize error information, engine can be operated.
fuse 63	ON	ON	It is power supply for Relay 1. Main Injector will be off. It is operated by E Injector.
fuse 64			It is power supply for Relay 2. Main Injector will be off. It is operated by E Injector.
fuse 70			Although starter motor does not work, engine can be operated.