



HONDA F3 AMERICAS ENGINE OPERATION MANUAL

V04
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HONDA PERFORMANCE DEVELOPMENT
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Introduction

This document provides the instructions for proper start up, break-in, coolant bleeding and operation of the Honda K20C1 engine used in the United States F3 Americas Championship. It also identifies the proper fuel, lubricants, coolants, and normal operating parameters for the engine.

Engine Operating Specifications

Oil type	Red line Pro Series 0W20. No other oils are approved at this time.
Oil capacity	Approximately 11 quarts. Upon fill up, use the Ligier dip stick for accuracy (Fig.1). The minimum mark represents 9 quarts. The maximum mark represents 11 quarts. The middle mark will achieve an oil level which is 4" above baffle surface. Confirm with warm oil and engine running. Note: the oil pressure data trace needs to be reviewed frequently, as it is a good indicator of the health of the oiling system.
Oil change interval	Note: it is recommended to change the oil for each race weekend/track test or 500 miles whichever comes first. Change oil filter for each oil change.
Oil pressure at idle	Greater than 3 Bar (45 PSI)
Oil pressure above 5000 RPM	Greater than 5 Bar (72 PSI) and not to exceed 7.5 Bar (110 PSI)
Oil Temperature Standard Operating Range:	60°C (140°F) - 110°C (230°F)
Oil Maximum Operating Temperature:	115°C (239°F).
Oil Minimum Operating Temperature*:	40°C (104°F).
Coolant Type:	Demineralized water. HPD recommends MoCOOL water additive or an equivalent corrosion inhibitor at a 5% mixture.
Coolant capacity:	Approximately 4 Gallons. After the engine has warmed up and cooled down, the fill should be approximately 2" below the top of the expansion tank while running.

Engine Operating Specifications – continued

Coolant Temperature Standard Operating Range:	70°C (158°F) - 100°C (212°F) Note: the coolant temperature data trace needs to be reviewed frequently, as it is a good indicator of the health of the cooling system. Look for trends and cases where a limit may have been exceeded.
Coolant Maximum Temperature:	105°C (221°F) Important note : >106°C for over 1 minute = engine pull.
Coolant Minimum Temperature:	50°C (122°F). Avoid any high engine load until the engine has reached its ideal operating temperature.
Intake charge temperature	60°C (140°F). Max Avoid any high engine load if the charge temperature is too high.
Spark Plug Gap:	0.7-0.8 mm (.0275"-.0315"). PN(ILZKAR8H8S) (NGK) Note : Gap is set by the manufacturer and must not be adjusted.
Spark Plug inspection and change interval:	Inspect plugs every 1000miles. The plugs should not need to be changed for the life of the engine.
Fuel type	See approved fuel table.
Fuel Supply Pressure:	310kPa-450kPa (45-65 psi) Note : HPP direct Fuel 12-15MPa on start up and idle. Note: it is recommended to empty the fuel system after each race weekend or when the car will be stored for an extended period of time.

Figure 1 – Ligier oil dipstick.



Approved fuels

VP products	WC101 and IMSA100. No additives allowed.
Sunoco products	Sunoco 260 GT. No additives allowed.

Note : for other fuels, please contact HPD before any running as it could damage your engine.

Engine over Rev limits

In the event the engine is operated outside of the guidelines below, the Team is responsible for all costs associated with the repair and rebuild of the engine.

No Action	<i>RPM <= 7100</i>
Borescope Engine	<i>7100 < RPM <= 7500</i>
Change Engine	<i>RPM > 7500</i>

Engine spun backwards limits

In the event of a spin on track, the driver must either lock the brakes completely or immediately depress the clutch pedal to avoid rotating the engine backwards. If the engine rotates backwards it does so without proper oil pressure and damage can occur. HPD will use all data available to decide if these limits have been exceeded. In the event the engine is operated outside of the published guidelines, the Team is responsible for all costs associated with the repair and rebuild of the engine. The following table lists the RPM range and time the engine can be operated backwards:

RPM Range	Time Allowed within Range
0-4500	<= 2.5 seconds
4501-5000	<= 2.0 seconds
5001-5500	<= 1.5 seconds
5501-6000	<= 1.0 seconds
> 6000	0 seconds

Engine Bleed Procedure

Please read the entire bleeding procedure in detail before attempting to bleed a car.

During previous running, HPD has witnessed abnormally high water temperatures that have been directly linked to poor bleeding of the cooling system. In an effort to reduce instances of high water temperatures, teams shall follow the bleed procedure outlined below.

Required Tools:

- 1) Lisle 24680 or equivalent spill free funnel modified to accept -3AN bleed lines
- 2) Clear -3 AN Bleed Lines (qty 4)
- 3) -3AN Plug (qty 3)
- 4) -3AN Cap (qty 3)
- 5) Cooling system pressure tester
- 6) Small hand pump

Bleed procedure from an empty system:

Step 1: Raise rear of car so that engine is at minimum 5° angle as measured on the top of the engine (on a level surface this is equivalent to raising the rear wheels until the axle centerline is 19 inches off the ground)



Step 2: Disconnect the tube from the header tank to overflow tank. Cap off the connection on the header tank neck.

Step 3: Install the modified funnel with extension on header tank

Step 4: Disconnect the bleed lines for RHS radiator, LHS radiator, and cylinder head from the header tank and re-connect to the modified funnel. Cap off two of the header tank connections to prevent leaks during filling, on the 3rd header connection attach additional bleed line from header tank to the modified funnel to prevent trapping air pockets in the header tank itself.

AT THIS POINT ALL BLEED LINES SHOULD BE CONNECTED TO THE FUNNEL ON A POSITIVE INCLINE AND WITHOUT ANY DIPS OR FLAT SECTIONS THAT WILL HINDER GRAVITY BLEEDING.

Step 5: Begin filling the header tank with distilled water (and corrosion inhibitor at 5% mixture) and continue until the system is full. The system should hold approximately 4 gallons. Continue to add distilled water until the funnel is half-full.

Step 6: Slowly crack open the bleed caps on oil cooler and LHS radiator out pipe locations until air is released and solid water comes out. Tighten caps. Add coolant to the funnel if the level drops significantly.



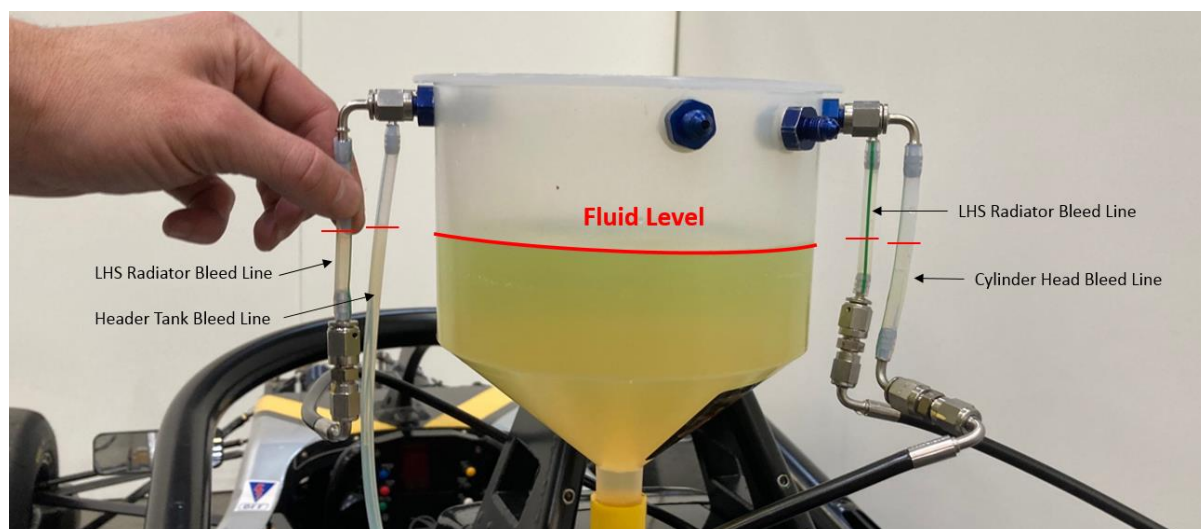
LHS Radiator Out Bleed



Oil Cooler Bleed

Step 7: Burp system several times by squeezing and slowly releasing the oil cooler outlet hose until air bubbles are no longer visible in bleed lines. Note, lines may be disconnected from the funnel one at a time and held vertical to assist in removing trapped air and then reconnected to funnel.

Step 8: Return the car to level and confirm that the coolant level in all bleed lines is near equal to coolant level in funnel. This indicates system is nearly completely bled. (Any small remaining air pockets will be addressed during constant bleed idling.)



Step 9: Remove excess fluid from funnel by disconnecting header tank bleed line from funnel and drain it into a bucket.

Step 10: Disconnect each of the three remaining bleed lines from funnel and install -3an plugs one at a time to prevent spilling.

Step 11: Remove the funnel and reconnect all three bleed lines to the header tank.

Step 12: Set the header tank level to 2" below top of the sight tube. Use a small hand pump to remove excess fluid.

Step 13: Reconnect the overflow hose.

Step 14: Start the engine (after oil pressure priming) with the header tank cap off. The coolant level will likely drop initially as additional air is bled out. Add coolant until the level remains stable at 2" below sight tube. Keep engine running for approximately 15 min to allow constant bleed lines to purge air. Combination of idle RPM and some revs works best for this. Take care not to overheat the engine during this time.

Step 15: Shut down the engine, disconnect the three bleed lines from header tank, and seal off connections on both header tank and bleed lines using -3 AN caps and plugs. Pressurize header tank to 0.5 bar using a cooling system pressure tester. Remove plug from RHS radiator bleed line to burp additional air. Repeat for LHS radiator and cylinder head bleed lines.

Step 16: Allow the engine to cool and then fill the coolant to the bottom of the header tank cap neck. **Install a 1.4-1.7 bar (21-25psi) radiator cap.**

Step 17: Start the engine and allow coolant temperature to reach 90° C. Shut off engine and confirm the coolant level in the overflow tank is at max height. At this point sight tube on both header tank and overflow tank should be full. Top off at the overflow tank if needed. If the level is already at max height, check the catch tank for excess coolant and drain.

IMPORTANT COOLING SYSTEM MAINTENANCE REQUIREMENTS:

- Coolant should be topped off in the header tank between each running session, ideally when at the lowest temperature. This should be done in a safe manner as to prevent injury.
- The engine oil and coolant catch tank should be checked every session and emptied regularly to reduce the risk of oil/coolant mixture ingestion into the engine or gearbox.
- Coolant temperature data should be monitored closely to address any potential issues before they occur. Excessive fluctuation in temperature may be a sign of an air pocket in the system.



Header Tank Full @ 90° Coolant Temp



Overflow Tank Full @ 90° Coolant Temp

Start-up Procedures

Dry Engine Start-Up Procedure

NOTE: Before performing dry engine start-up procedure, ensure that the proper type and amount of coolant has been added, and monitor coolant level as the engine temperature increases.

To start an engine that has no lubricants:

1. Add about 3/4 capacity of oil to the dry sump tank and add a quart to the engine itself to prime the scavenge pump.
2. Open the oil supply line to the bottom rear fitting on the dry sump pump and allow oil flow out, then close and retighten.
3. Crank the engine **without ignition** for 5 seconds. Inspect the oil pressure reading on display. If the oil pressure reading did not change, the pump is still priming, repeat this procedure until you see oil pressure.
4. Turn the ignition back on and start the engine. Let engine idle to normal operating temperature.
5. While the engine is running, inspect for leaks.
6. Shut down the engine and immediately check the oil tank level. The sump and oil tank level will gradually equalize as the engine sits. If the oil level is inspected after the engine has not been running for some time, the reading will be inaccurate, and too much oil might be added to the system.
7. Top up the tank with oil to the proper operating level, if necessary.

Wet Engine Start-Up Procedure

To start an engine that contains oil:

1. Confirm that there is oil in the dry sump tank.
2. Crank the engine **without ignition** for five seconds. Inspect the oil pressure reading on display. If the oil pressure reading did not change, the pump is still priming, repeat this step until you see a change in oil pressure.
3. Turn the ignition back on and start the engine. Let engine idle to normal operating temperature.
4. While the engine is running, inspect for leaks.
5. Shut down the engine and immediately check the oil tank level. The sump and oil tank level will gradually equalize as the engine sits. If the oil level is inspected after the engine has not been running for some time, the reading will be inaccurate, and too much oil might be added to the system.
6. Top up the tank with oil to the proper operating level, if necessary.

Engine Break-In Procedure

After adding lubricants and coolant to proper specifications, follow the steps below to properly break-in the engine. Following these procedures will ensure the proper break-in of the engine, if these are not followed, the limited mileage engine warranty will be void.

1. Bring engine to temperature (minimum 60°C coolant temperature)
2. On the first outing, keep RPM below 4000 RPM and throttle at 50%. Bring the engine to stable temperature. Cover a distance of 20 miles. Vary load and engine speed as much as possible and avoid steady states for prolonged periods. Do not exceed 4000 RPM under engine load. Only exceed 4000 RPM for a momentary period under no load conditions (downshifting).
3. Stop and inspect oil level and for leaks.
4. On the second outing, keep RPM below 6000 RPM and throttle at 75%. Bring the engine to stable temperature. Cover a distance of 20 miles. Vary load and engine speed as much as possible and avoid steady states for prolonged length of time.
5. Stop and inspect oil level and check for leaks.
6. Your engine is now ready for an outing at race pace. Although the engine is now broken-in, it is advisable to monitor dash warning lights, including oil pressure, oil temperature and water temperature indicators.

Engine Operation

1. Cold start :

Per the guidelines above, it is preferred to let the engine warm up idle or a low load until it has reached a minimum 50°C coolant and oil temperature.

When the engine is above 60°C, it is acceptable to operate the engine at race pace. Never go full throttle on a cold engine as this may damage bearings and/or turbo.

2. Hot shut down :

As the F3 is equipped with a turbo, whenever possible, it is preferred, prior to a shut down, to lower the temperature of the engine on a cool down lap at low throttle (to avoid spooling the turbo) in order for the turbo temperature to equalize.

Following hot laps at race pace, allow the engine to idle for 60 seconds prior to shutting down. If a cool down lap is performed, idle for 20 seconds prior to shutdown. Following this procedure will ensure the turbocharger is cooled down adequately. While doing so, monitor the coolant temperature on the dash, it should not exceed 95°C to 100°C.

Avoid stopping the engine abruptly right after a hot lap whenever possible.

Failure to follow this procedure may result in damage to the turbocharger.

Dash Warning Indicator Parameters

The sensor indicators will illuminate if any of the following conditions occur:

- Water temperature has reached or exceeds 105°C
 - Stop immediately or pull to the pit at low load and allow to cool down.
- Oil Temperature has reached or exceeds 115°C
 - Stop immediately or pull to the pit at low load and allow to cool down.
- Oil Pressure is below 240kPa and RPM exceeds 1000
 - Shut down engine immediately and troubleshoot (see Oil pressure above 5000 RPM)
- Battery voltage is below 11.5 V and RPM exceeds 1000
 - Pull to the pit and inspect charging system.
- Shift pressure is below 5.5Bar and RPM exceeds 1000RPM
 - Pull to the pit and inspect shift pressure system.
- Fuel supply pressure is below 40PSI and engine RPM exceeds 1000RPM

In general, should you notice an alarm, it is our recommendation to either shut the engine off immediately or make your way to pit lane under minimal load.

Failure to take action will result in irremediable engine damage.

TECHNICAL BULLETINS

Throughout the season, HPD may have technical and operational information that may be relayed to the teams. To facilitate this communication, a technical operations bulletin will be issued. These bulletins will be communicated to you directly or through SCCA Pro, but in rare instances, they may also be distributed in a paper form at a test or race event.

All information bulletins will be prepared in a similar format. We recommend keeping all information bulletins for easy reference.

As with all HPD information, all bulletins are CONFIDENTIAL and need to be stored properly for quick reference and safe keeping. These bulletins must not be copied in any form or distributed to anyone other than the intended recipient without permission of HPD.

If you have any questions regarding the technical content of this Operating Instructions, please contact your appointed HPD representative or the GRMS team at:

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