



# HONDA F3 AMERICAS ENGINE OPERATING INSTRUCTIONS

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HONDA PERFORMANCE DEVELOPMENT  
COMMERCIAL MOTORSPORTS DEPARTMENT  
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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 filtered 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 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.

<b>No Action</b>	<b><i>RPM ≤ 7100</i></b>
<b>Borescope Engine</b>	<b><i>7100 &lt; RPM ≤ 7500</i></b>
<b>Change Engine</b>	<b><i>RPM &gt; 7500</i></b>

## 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 :

<b>RPM Range</b>	<b>Time Allowed within Range</b>
<b>0-4500</b>	<b>≤ 2.5 seconds</b>
<b>4501-5000</b>	<b>≤ 2.0 seconds</b>
<b>5001-5500</b>	<b>≤ 1.5 seconds</b>
<b>5501-6000</b>	<b>≤ 1.0 seconds</b>
<b>&gt; 6000</b>	<b>0 seconds</b>

## Engine Bleed Procedure

Please read the entire bleeding procedure in details 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.

2 methods are described below. Either of them will yield identical results.

Method 1 : Bleed procedure from an empty system – gravity fed.

1. Attach clear hoses to all bleed ports (LHS Radiator Fig.1, RHS Rad Fig.2 and cylinder head port fig.6)
2. Position all clear lines in a position such that they are above the header tank. The hoses need to be free of obstruction, open to atmosphere. It is recommended to use clear hoses as it will be easier to witness the presence of bubbles.
3. Fill the cooling system with distilled water until no more air bubbles can be seen in the clear bleed lines (~4 Gallons).
4. While filling up make sure that the water level is the same between the clear lines and the water tank. The bleed line open ends will be slightly above the header tank.
5. Remove clear bleed lines. Ensure that the water level in the header tank is ~2in below the bleed ports.  
NOTE: As the clear lines are removed, a small quantity of air can be introduced. Add water to the header tank to maintain the water level.
6. Connect one (1) bleed from the RHS radiator, one (1) from cylinder head port and one (1) from the LHS radiator to the water header tank (do not overtorque).
7. Clean and dry any spilled water.
8. Start the engine and inspect for leaks. It is easier to detect leaks when the bleed ports are dry and free of contaminants. Warm to engine to 60 to 70degC and always check the water level at this temperature.
9. With the header tank cap off, monitor the water level on engine run-up, the water level should be stable and should not have any air bubbles. Always monitor coolant temperature on the dash while doing so. **Do not exceed 90degC.**
10. Run the engine with moderate ramp up and ramp down and monitor the bleed lines for air. The system will be bled when a constant stream of water comes out of the bleed lines into the header tank.
11. Inspect the cap seals for defects. Close the header tank ensuring that the cap is closed tightly. It should have a positive feel. If the cap feels loose, replace immediately. Check for leaks in water system once more. NOTE : the cap pressure rating recommended is 1.6Bar (22PSI). No other rating should be used.
12. The recovery tank must remain empty. **Under no circumstances should it be filled.**

Method 2 : Bleed procedure from an empty system – vacuum fill.

1. Attach the vacuum fill system to the header tank.
2. Connect all bleed lines to the header tank (the oil cooler bleed line will remain capped off)
3. Pinch the line connected from the header tank to the recovery tank in a manner that no air can seep through.
4. Follow the recommended fill method per the instruction of the system you are using.
5. With the system filled, monitor the level in the header tank through the sight glass; it should be approximately 5in from the top.
6. Clean and dry any spilled water.
7. Start the engine and inspect for leaks. It is easier to detect leaks when the bleed ports are dry and free of contaminants. Warm to engine to 60 to 70degC and always check the water level at this temperature.
8. With the header tank cap off, monitor the water level on engine run-up, the water level should be stable and should not have any air bubbles. Always monitor coolant temperature on the dash while doing so. Do not exceed 90degC.
9. Run the engine with moderate ramp ups and ramp downs and monitor the bleed lines for air. The system should have no air and a constant stream of water should come out of the bleed lines into the header tank.
10. Inspect the cap seals for defects. Close the header tank ensuring that the cap is closed tightly. It should have a positive feel. If the cap feels loose, replace immediately. Check for leaks in water system once more. NOTE : the cap pressure rating recommended is 1.6Bar (22PSI). No other rating should be used.
11. The recovery tank must remain empty. Under no circumstances should it be filled.

Figure 1: (Radiator Bleed Ports)

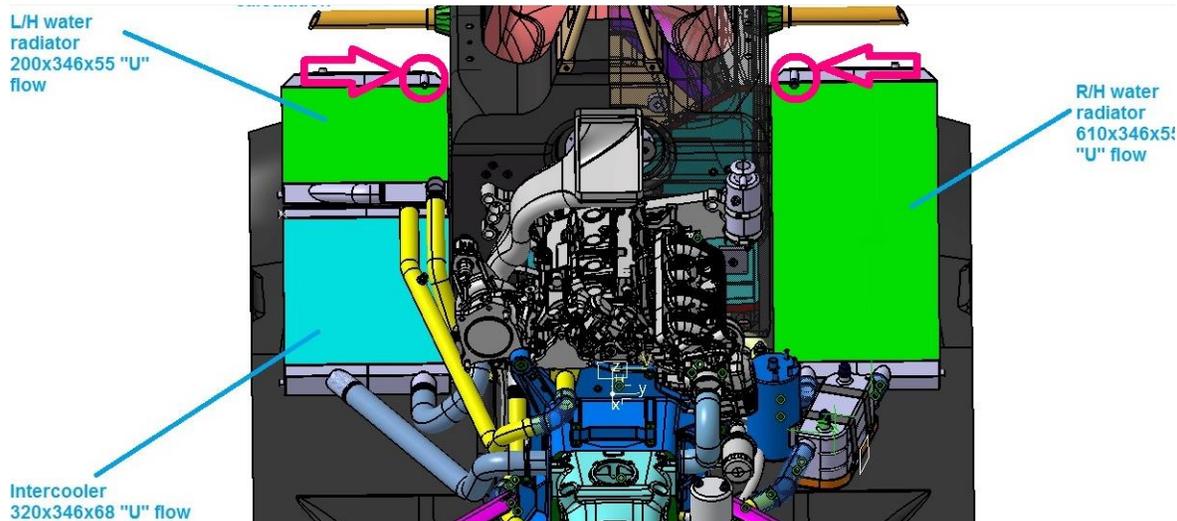


Figure 2: (Radiator Bleed Port – left side - typical)



Figure 3: (oil cooler Bleed Port - typical) – this port to remain capped.



Figure 4: (Radiator Bleed Port – right side - typical)

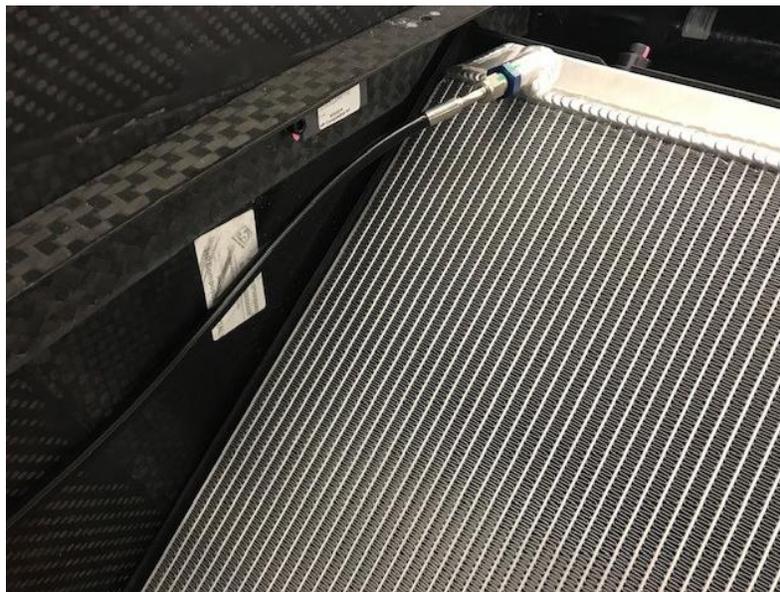


Figure 5.1: (Water header Tank Ports - typical)



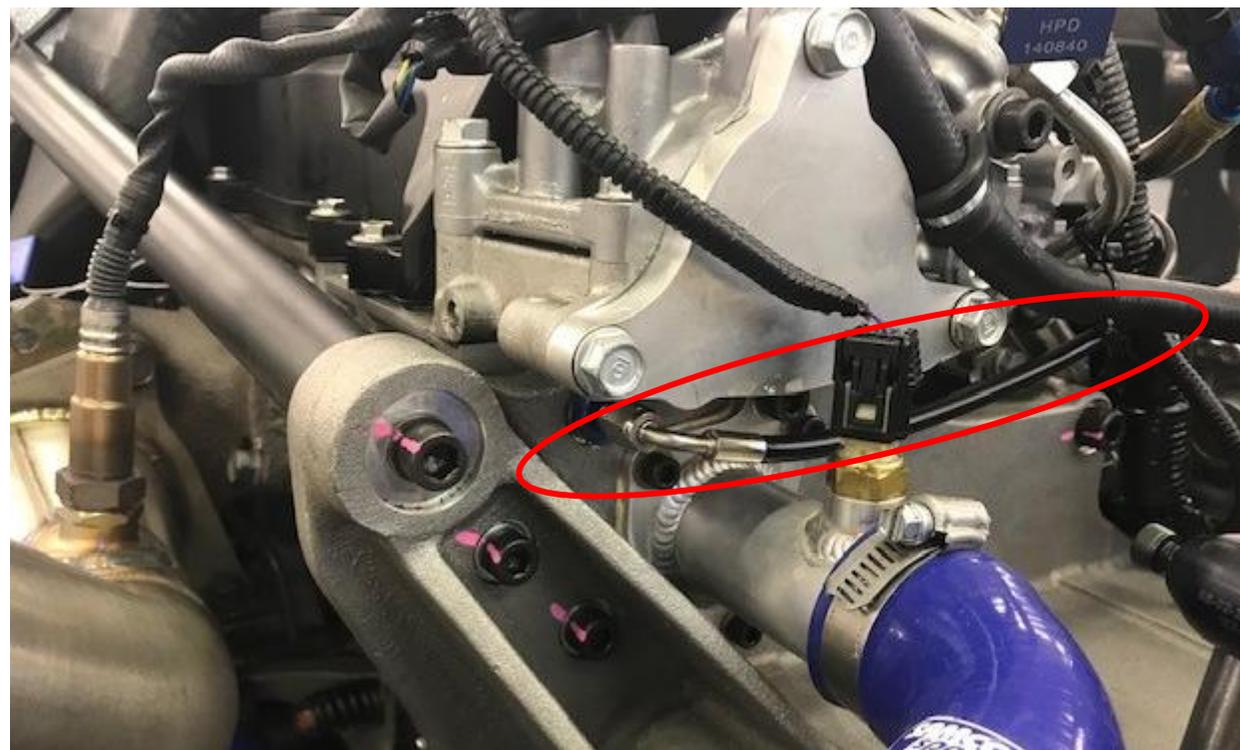
Figure 5.2: (Recovery Tank - typical)



Figure 5.3: (Header Tank and recovery layout- typical)



Figure 6: (Cylinder Head Port – depicted here with a constant bleed line directly behind the water temperature sensor)



## 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
  - Adjust oil pressure according the HPD guideline (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 noticed 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 Grass Root Motorsports team at:

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