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ND2 Cooling Test Objectives

Due to concerns from a few cars water temperatures witnessed at the Barber race weekend, Long Road Racing formed a HIT (High Intensity Testing) team to investigate any possible issues with the ND2 cooling system design and function. The purpose of this test summary is to provide you with detailed information of all testing performed, along with the findings of those tests. A separate TSB will be sent out with optional, no cost enhancements based on the findings of this report.

Executive Summary

Extensive systems testing was performed in both a controlled environment and on track to replicate the concerns raised at the Barber race.. The results of the testing suggested that the cooling systems for both oil and water temperature controls are more than sufficient to regulate fluid temperatures, given moderate to low air flows to the nose of the cars. Excessive temperatures can be observed when there is insufficient air flow to the nose of the car, but given short periods of cool air, temperatures are then brought back under control, i.e. management of the operating temperatures are sustainable. Increased cooling management tools will be provided to all ND2 powered cars as an optional, no cost TSB.

Global MX-5 ND2 Cooling System Test Objective, Method & Findings

Our objective was to 1) identify any design issues 2) replicate race conditions that lead to high water temperatures and 3) identify possible enhancements to the ND2 platform.

The first stage of testing was performed on a chassis dyno over roughly two and a half weeks. Timed control runs were performed on the current ND2 and ND1 configurations for a baseline and comparison. Sensors were placed into the cooling system hoses to measure temperature, pressure, and flow rate, etc... Oil temperatures were also monitored. Following the ND1 and ND2 control runs, the LRR ND2 house car was used to test different configurations of oil coolers, radiators, and oil cooler locations. Approximately 47 different runs were performed during the initial testing phase. After collecting data from these runs, the configurations producing the best numbers were chosen for on-track testing.

An open invitation was issued by LRR for ND2 cars to participate in the on-track phase of testing. The teams that responded were then sent different cooling system configurations to be installed on their respective cars. The LRR ND2 house car was left in its ‘stock’ configuration as a control car. LRR coordinated two days of track time at Roebling Road near Savannah, GA for testing. During the test, drivers were instructed to draft continuously and as close as possible. The drivers reported oil and water temperatures back to their teams on a lap-by-lap basis. Drafting order was changed to provide all configurations with the opportunity to be tested in race conditions while either drafting or leading the draft. All configurations saw increased temperatures while drafting at a distance of 1 to 2 feet or less for prolonged periods of time. Drivers were then instructed to attempt to manage temperatures by offsetting the front of their cars to get clean air.

It was discovered during the test that several of the cars were pushing coolant into the overflow tank due to the high temperatures created from tight drafting. If the system was not refilled properly between sessions, the cars would then see spikes in temperature and reduced cooling efficiency. It is important to check the coolant level after every session and refill as necessary. Several other items were tested in an attempt to provide the drivers with aides in managing the temperatures created in a tight draft. These included an exhaust turn to redirect the hot exhaust gas exiting the tailpipe, taping the radiator ducting similar to the ND1, foam around the gaps between the radiator and floor, and a higher PSI cooling system cap. The test was completed on the second day and all data was then collected for review. The teams and drivers were then asked to provide feedback concerning the results of the test. In conclusion, the results of the test are listed below.

- All configurations saw increased oil and water temperatures from prolonged drafting from a distance of 1 – 2 feet. Testing details have been included below for reference.
- The ND2 engine package achieves higher RPM and creates more power than the ND1 package. This in-turn creates more heat. The ND2 package will require more air flow than the ND1 package to properly manage temperatures.
- Drivers will need to monitor and manage oil and water temperatures as needed during drafting on-track. Driver notes have been included below describing the process of managing the temperatures.
- Teams will need to ensure that the cooling system is filled properly and does not contain any air pockets.
- Teams will need to monitor the contents of the coolant overflow catch tank and refill the system as needed after every session on-track.

Global MX-5 ND2 Cooling System Test Engineering Summary

Test Location: Roebling Road
Test Dates: 5-14-19 through 5-15-19
Participants: Long Road Racing ND2 Test Car 19, McCumbee McAleer 72, McCumbee McAlear 48, Possien-Hall Motorsports 76, Michael Carter Racing 08

Weather: 75 deg F to 85 deg F, Sunny Both Days

Purpose: To test various cooling packages for the ND2 Global MX-5 Cup Race Car to improve engine cooling in the draft.

Test Configurations:

1. Current ND2 Configuration – ND2 Radiator with Setrab 925 Oil Cooler
2. ND2 Radiator with Setrab 619 Double Pass Oil Cooler
   Smaller double pass oil cooler to allow more air to the radiator.
3. ND2 Radiator with Setrab 625 Oil Cooler
   Medium sized Oil Cooler to allow more air to the radiator without reducing the oil capacity too much.
4. ND2 Radiator modified to be Single Pass with Setrab 625 Oil Cooler
   Single Pass Radiator to increase water flow through system and even out water pressure before and after radiator to help reduce potential for cavitation.
5. ND2 Radiator modified to be Single Pass with Setrab 925 Oil Cooler
6. ND1 Radiator with Setrab 625 Oil Cooler
   ND1 Radiator is single pass and thinner to see if increased airflow through radiator improved cooling.
7. ND2 Radiator with Setrab 925 Oil Cooler and 5" SPAL Fan on front of Oil Cooler
   Additional fan added to see if pulling more air into the Oil Cooler and Radiator would help when the car is starved for air in a tight draft.
8. Turn down pipe on Exhaust Tip to Redirect Exhaust
   Down Pipe added to lead car to test the exhaust air's effect on cooling.
9. 19 psi Radiator Cap
   Increased cap pressure from 16psi to 19psi to increase the amount of time and temperature before water is lost to overflow.
10. Taping of Aluminum Ducting Panels
    Aluminum ducting was taped similar to ND1 to see if air is escaping at sides of radiator.
11. Filling of Foam Gaps on each side at Bottom of Radiator
    Gaps at the bottom of the radiator were filled to see if air was escaping there.

Parameters:

1. Oil Temp was to be kept under 280 deg F.
2. Water Temperature was considered out of control at 230 deg F when water is definitely being lost to overflow.

1. With all five cars drafting in a normal line with 3 to 4 feet between them, all Test Configurations stayed within workable water and oil temperatures except for configuration 2: ND2 Radiator with the Setrab 619 double pass cooler. This configuration saw a continual climb in Oil Temp.
   a. The Setrab 619 double pass cooler is the smallest of the tested oil coolers, this shows that the higher capacity coolers are needed for this engine package.

2. In a tight draft with 1-1/2 to 2 feet between cars, all Test Configurations would see water temperature increase into uncontrollable temperature ranges as the front of the cars are completely starved of air. Oil Temperature was still maintained with the 625 and 925 coolers.

3. In a tight draft all configurations would cool down and recover if the driver offset the front of the car to get clean air, or if the gap was increased to 3 or 4ft.

4. If water is allowed to get past 225-230 deg F, water may be lost from the system leading to spikes in water temperature reading. Recommended to keep water temp under 225 by adjusting gap or ducking out of line as needed.

5. The down pipe on the exhaust tip redirecting exhaust air flow did not stop cars from overheating if following in a very tight draft. Any gains were marginal at best.

6. The taping of the aluminum ducting and filling of the foam gaps at the bottom of the radiator did not stop cars from overheating if following in a very tight draft.

7. The radiator caps with the higher capacity had no negative effects.

8. It is recommended to install oil temperature gauges to monitor this temperature along with water temperature.

Global MX-5 ND2 Cooling Test Drivers Feedback and Notes

1. With all five cars drafting in a normal line with 3 to 4 feet between them, all Test Configurations stayed within workable water and oil temperatures except for configuration 2: ND2 Radiator with the Setrab 619 double pass cooler. This configuration saw a continual climb in Oil Temp.

2. In a tight draft with 1 to 2 feet between cars, all Test Configurations would see water temperature increase into uncontrollable temperature ranges as the front of the cars are completely starved of air. Oil Temperature was still maintained with the 625 and 925 coolers.

3. In a tight draft all configurations would cool down and recover if the driver offset the front of the car to get clean air, or if the gap was increased to 3 or 4ft.

4. If water is allowed to get past 225-230 deg F, water may be lost from the system leading to spikes in water temperature reading. Recommended to keep water temp under 225 by adjusting gap or ducking out of line as needed.

5. The down pipe on the exhaust tip redirecting exhaust air flow did not stop cars from overheating if following in a very tight draft. Any gains were marginal at best.

Tom Long Driver Notes

- By partially pulling out of line with the trailing car (center line of car over-lap to tail light), the driver can control WT while still having effect of staying in the draft. While cornering, if offsetting with the following car a few feet (while still maintaining a completely reasonable racing line, similar to how an aero car would follow each other allowing partial exposure of the front wing to keep front grip), this too would keep WT in a workable operating range.

- When in an over-temp scenario, continual focus on partial offsetting with inline cars, and gapping at most 1-2 car lengths, would reduce the critical WT in less than 2 miles (approximately 1min), as the cooling system capacity was effective enough to recover at that point.

- If extreme fluctuation in WT is noted by the driver when drafting, coolant needs to be added to the cooling system. This is a direct indicator of air in the system causing spike in WT within a short period of time (i.e. entering straightaway at normal operating temp and by end of straight starting to overheat).