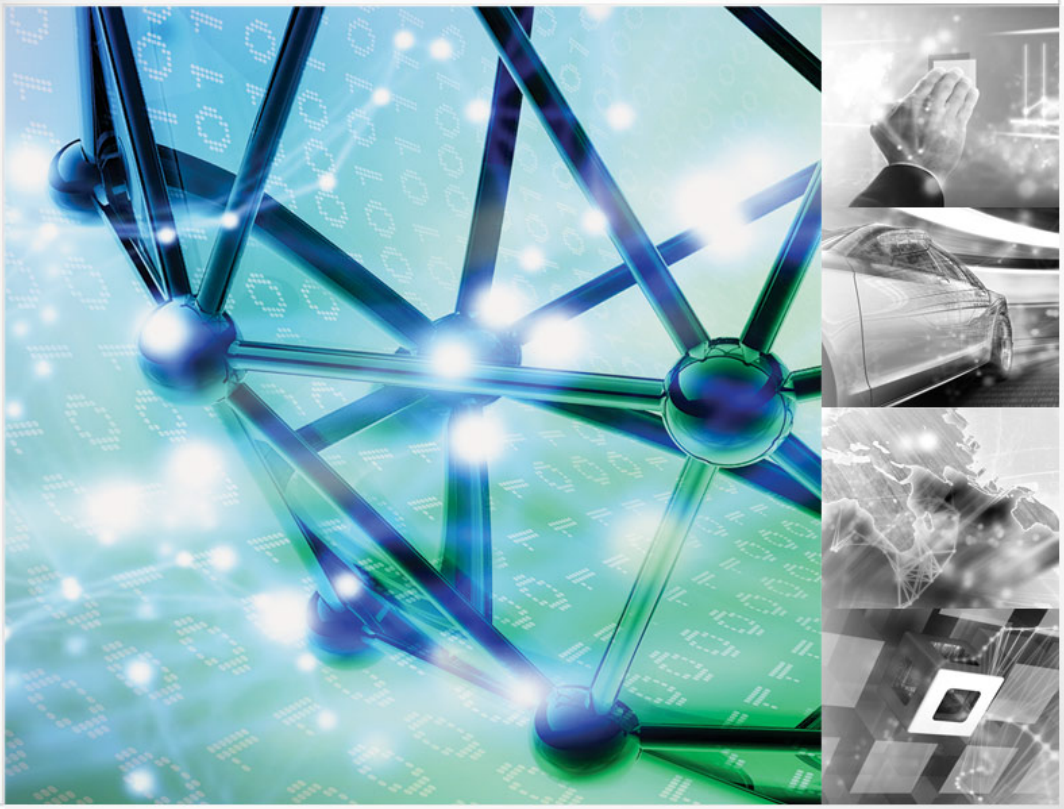

Caterpillar 1N Cooling Cart

Cart Overview & Data Review

11 December 2018

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Summary

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- Cart Overview
- Data Review
- Proposal

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Cart Overview

Cart Overview: General Setup

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Cart Overview: General Setup

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Cart Overview: Engine Mods

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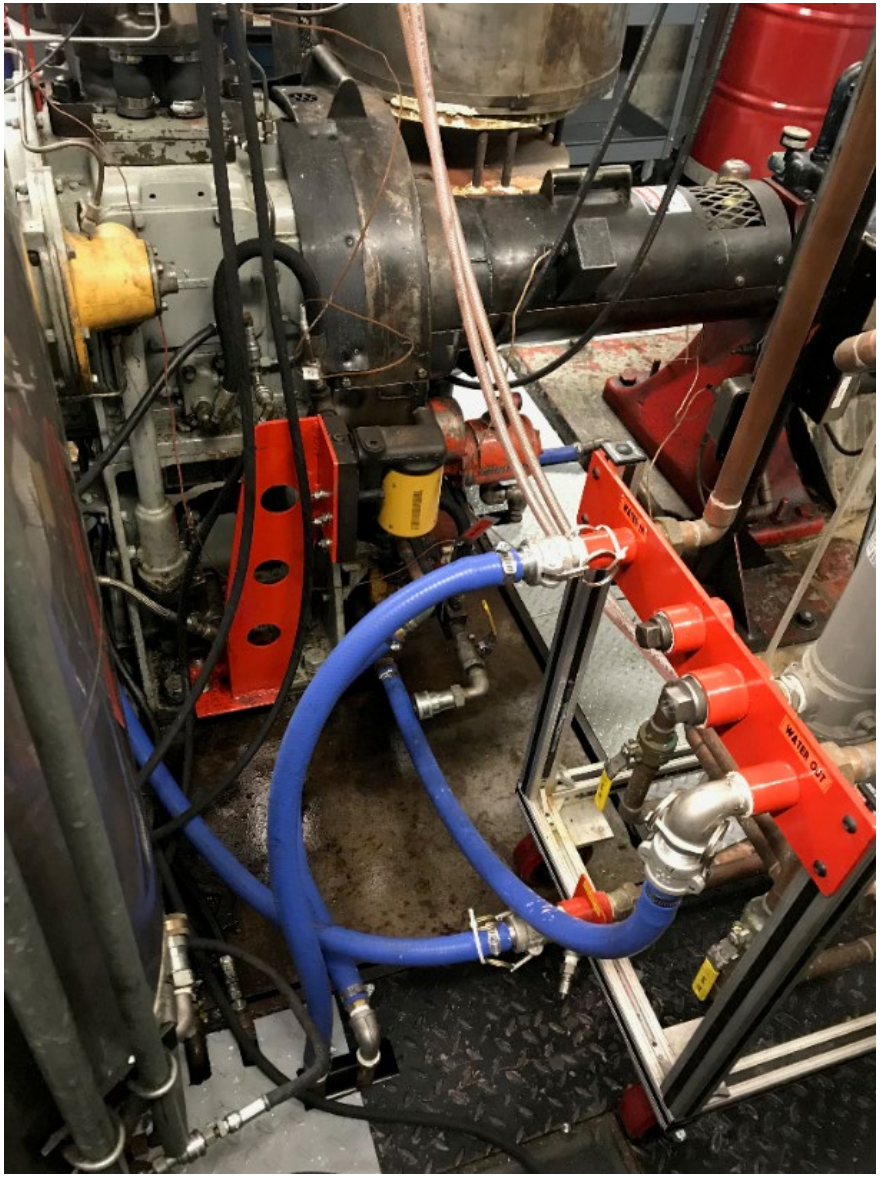

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Cart Overview: Engine Mods

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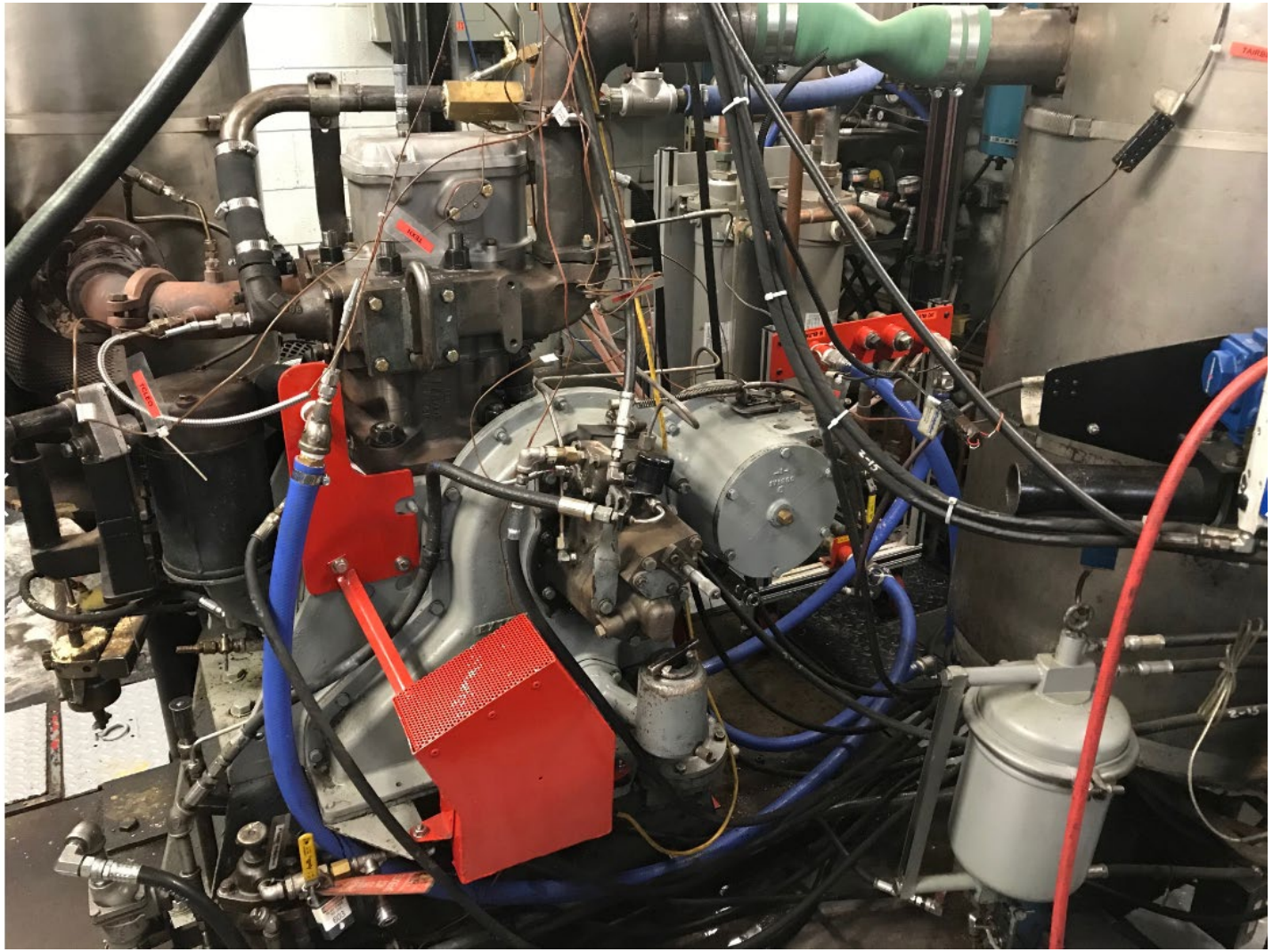

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Data Review

Warmup Coolant Flow Comparisons

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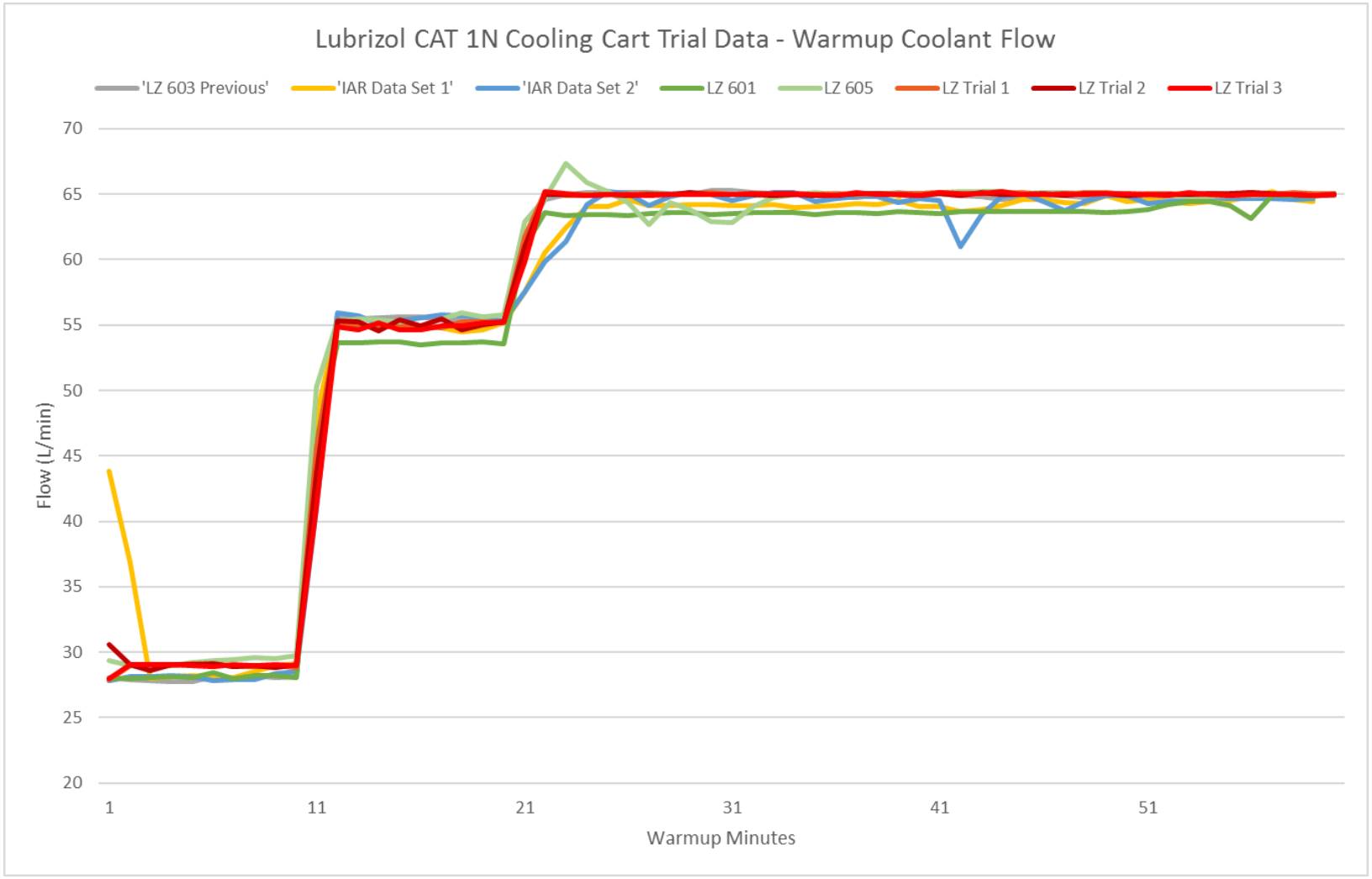

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Cooldown Coolant Flow Comparisons

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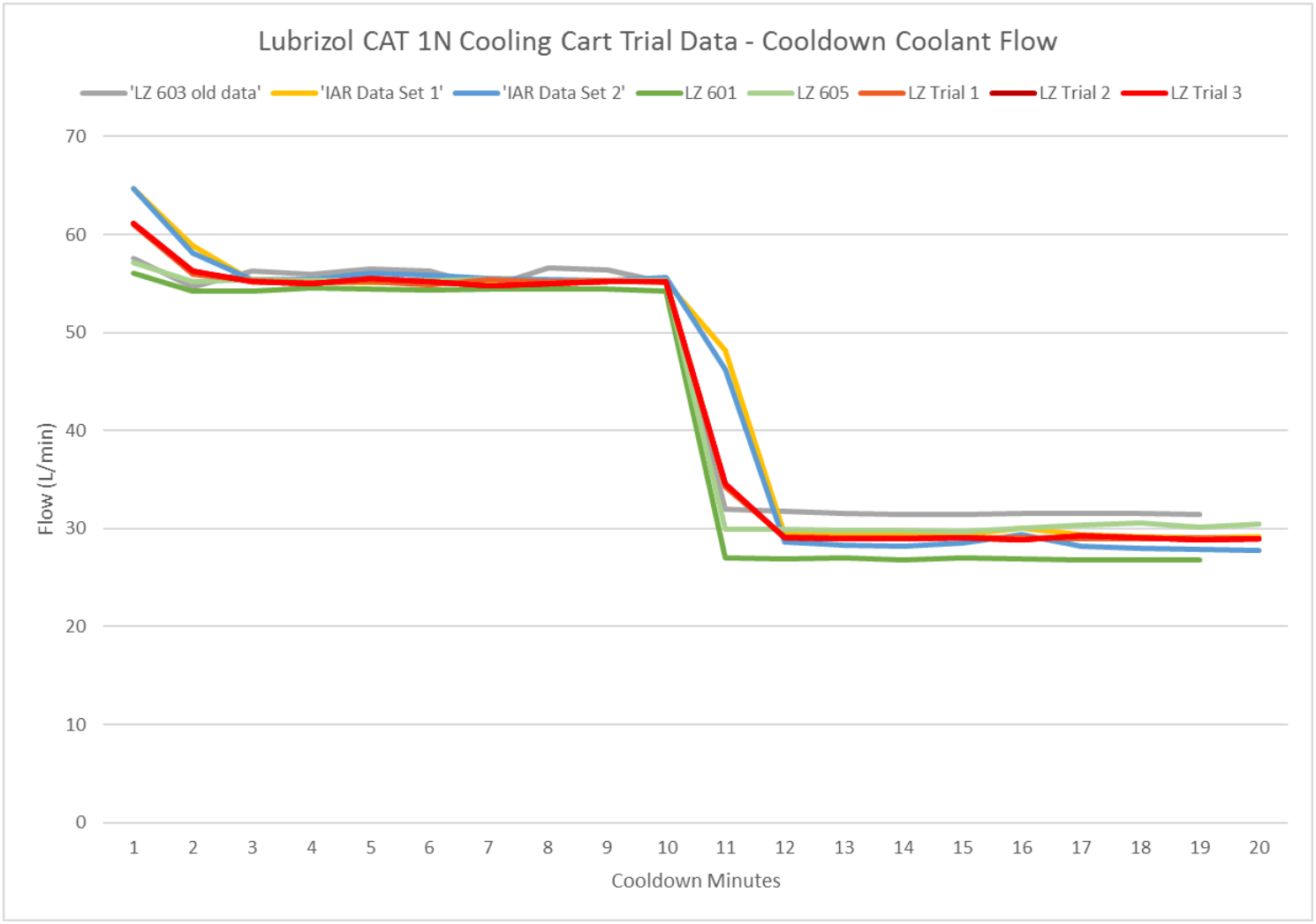

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Test Coolant Delta Temp Comparisons

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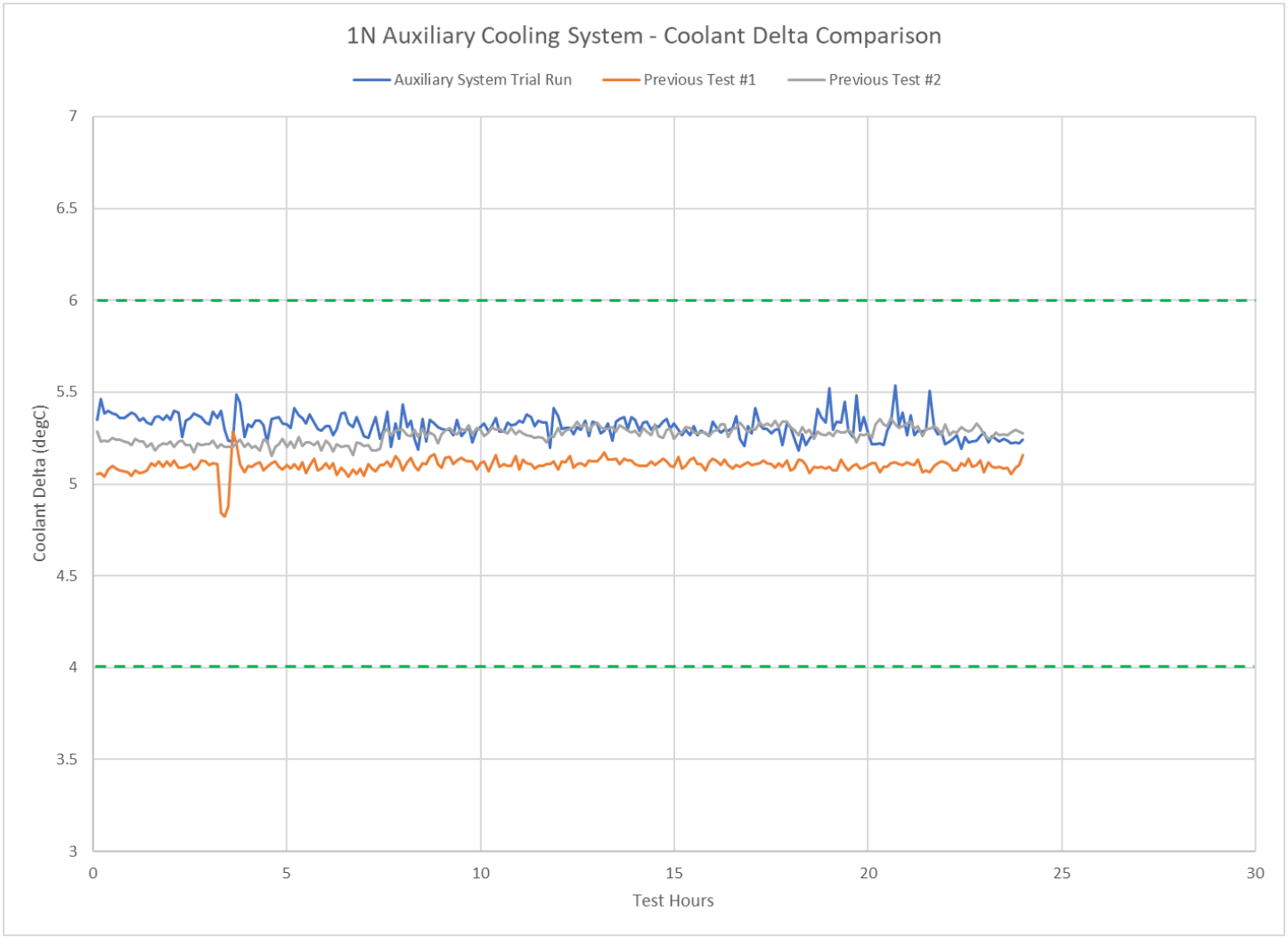

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Proposal

Proposed Procedure Changes

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6.3.3 Cooling System—Provide a closed circulating cooling system. ~~with an engine-driven centrifugal water pump.~~ An engine-driven centrifugal water pump, original coolant heat exchanger, original cooling tower, and coolant pump bypass valve may be used. When using these components, follow the specifications outlined in 6.3.3.1 and 6.3.3.2. An equivalent replacement system that could include an electrically-driven pump, replacement heat exchanger, replacement coolant tower, and automated flow control may be used. A suitable electric-motor-driven water pump from MP Pumps is recommended by Caterpillar. Pump details are as follows: MP Part number: 30885, CF1PMP SS 3-3 56C 6.0 T-2100, stainless steel pump, 3hp e phase; 230/460 VAC motor. An equivalent replacement system must meet all steady-state test temperature and pressure specifications (coolant outlet temperature: 93°C ±2.5°C; coolant delta temperature: 5°C ± 1°C; coolant inlet temperature: 88°C; coolant flow: 65 L/min ± 2 L/min; pressure drop across heat exchanger: 1.5 kPa maximum; coolant at jug pressure: 50 kPa). The equivalent replacement system must match engine-driven pump performance; to include engine startup, warmup, on-test conditions, cooldown, hot shutdowns, and programmed shutdowns. System details given in Fig. A8.1 show cooling system modifications; Fig. A8.2 shows coolant temperature, flow, and pressure measurement locations; ~~and~~ Fig. A8.3 shows a water pump bypass arrangement; and Fig. A8.4 shows the pressurized coolant system. See 6.3.3.5 regarding system cleaning.

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Proposed Procedure Changes, cont.

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6.3.3.2 Coolant Flow, Control and Measurement—Modify the engine coolant lines from the cylinder head to the standpipe in accordance with Fig. A8.1. As shown, the coolant line contains (*1*) a calibrated Barco flowmeter, P/N BR 12705-16-31[11,12], 25.4 mm in diameter to measure the coolant flow and (*2*) a P/N 1Y496 orifice, 15.797 mm in diameter before the flowmeter to develop cooling system pressure and thereby to eliminate coolant cavitation. A system using original components must control coolant flow at 65 L/min ± 2.0 L/min at Step 5 (see Table A14.1) by a bypass valve downstream of the water pump, 19 mm in diameter. Replace the production hose and the restrictive 90° elbows that connect the bypass valve to the cylinder block by a Gates 20777 hose[13,12] or equivalent (see Fig. A8.3). An equivalent replacement system may omit the use of a bypass valve to control coolant flow. Measure the coolant pressure at the block to ensure that proper cooling system operation has been attained (see Fig. A8.2).

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Proposed Procedure Changes, cont.

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TABLE A14.1 Engine Run-in, Warm-up, Cool-down, and Test Conditions

Step No.	Range	Unit	1	2	3	4	5
Test Time		min	5	5	10	20	20
Engine speed	± 10	r/min	1000	1000	1800	2100	2100
Engine power		kW	idle	12	26	38	52
BMEP		kPa		586	690	855	1240
Fuel Rate	± 53	kJ/min		2160	4250	6250	8430
Fuel flow		g/min		48	94	137	185
B.S.F.C.		kg/kWh				0.222	0.213
Humidity	± 1.7	g/kg				17.8	17.8
		Temperatures					
Coolant out	± 2.5	°C			84	90	93
Coolant in		°C				86	88
Coolant ΔT	± 1	°C				4	5
Oil to bearing	± 2.5	°C			76	93	107
Oil cooler in		°C				96	110
Inlet air	± 2.5	°C			93	93	127
Exhaust	± 30	°C				405	550
Fuel injector housing	± 3	°C				57	57
		Pressures					
Oil to bearing[A]		Max. kPa				440	482
Oil to jet[A]	± 13	kPa			410	370	360
Inlet air (ABS)	± 1	kPa	120	120	160	220	240
Exhaust (ABS)	±1	kPa		104	140	180	216
Fuel filter housing	± 20	kPa				210	210
Crankcase vacuum	± 0.1	kPa					0.7
Coolant jug		kPa					50
		Flows					
Blowby		L/min					23
Coolant flow	± 2.0	L/min	29[B]	29[B]	55[B]	65[B]	65
Air/Fuel ratio							29

[A] Oil pressure operating specifications apply only to 15W-40 oils. Attempt to maintain these limits for all oils. When oils other that 15W-40 oils fall outside these limits, explain these deviations from the limits in the comments section of the test report.

[B] This limit only applies when utilizing an equivalent alternative cooling system as detailed in 6.3.3

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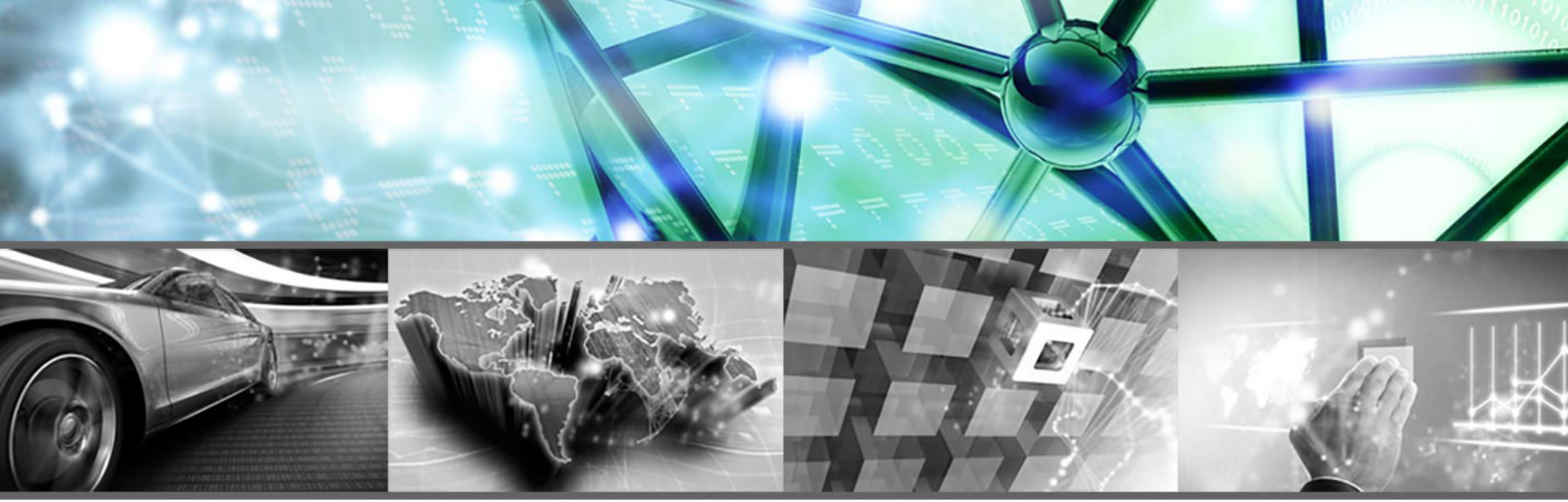

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