

General Motors dexos® Turbocharger Coking Test

Form 2

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**General Motors dexos® Turbocharger Coking Test
Form 3
Summary of Test Method**

The purpose of this engine dynamometer test is to rapidly evaluate engine oil's potential to create hydrocarbon deposits in turbocharger oil passages and bushings under elevated temperature conditions. The test takes approximately 3 weeks to run and consists of a 0.26 hour schedule which is repeated for 2000 cycles. The schedule is defined by 8.5 minutes of engine operation followed by 7.5 minutes of engine off soak period. At the conclusion of the test, the oil is sampled, drained, weighed, and oil consumption is calculated.

Best test repeatability occurs when the engine is operated 24 hours /day until the end of test. The deposit level severity is determined by the calculating the percent temperature increase in the turbo housing, rating the components post-test and the degradation of turbocharger rotor rotation. The deposit rating technique is used in current ASTM methods. If engine fails to attain specified boost pressure due to the reduction turbocharger rotor rotation the test should be terminated.

Turbocharger Coking Procedure

Step	Action	Ramp time, seconds	Engine speed, rpm	Engine MAP, kPa	Engine run time, minutes
1	Start engine and idle	30	Idle	No load	0.5
2	Ramp up and maintain conditions	30	3000	80	6.5
3	Ramp down and maintain conditions	10	2000	80	50/60
4	Shut engine off	-	-	-	-
5	Engine stop and soak	0	0	0	7.5
6	Repeat steps 1 – 5 1999 more times	-	-	-	-

General Motors dexos® Turbocharger Coking Test

Form 4

Test Results Summary

Lab		Oil Code	
Stand		Test Number	
Lab Oil Code			
Formulation/Stand Code			
SAE Viscosity Grade			
Engine Block ID		Total Engine Block Hours	
Cylinder Head ID		Total Cylinder Head Hours	
Turbocharger ID		Fuel Batch Code	

Test Results	
% Change, 100 - 1800 Period Cycle	%
Turbo Coolant Outside Temperature, 3000 rpm	
Banjo Bolt Oil Delta Pressure, 3000 rpm	
Turbo Speed at Idle	
Result	Value
Total Number of Test Cycles	
Additional Results	
Rating Area	Merits
Turbine Shaft Area (A)	
Turbine Shaft Area (B)	
Center Housing Turbine End Hole (C)	
Center Housing Turbine Inlet Hole (D)	
Center Housing Turbine Outlet Hole (E)	
Inlet Pipe (F)	
Total Average Merit Rating	

Result	Value at EOT
Percent Viscosity Increase at 40°C, %	
Oxidation, DIN 51453	
Nitration, DIN 51453	
TAN, D 664	
TBN, D4739	

General Motors dexos® Turbocharger Coking Test
Form 5
Operational Summary – Soak Stage

Lab		Oil Code	
Stand		Test Number	
Lab Oil Code			
Formulation/Stand Code			

Parameter	Average	N	Std. Deviation	Minimum	Maximum
Oil Gallery Temperature, °C					
Oil Sump Temperature, °C					
Coolant In Temperature, °C					
Coolant Out Temperature, °C					
Turbo Coolant Inside, °C					
Turbo Coolant Outside, °C					
Turbo Feed Pipe Temp., °C					

General Motors dexos® Turbocharger Coking Test
Form 6
Operational Summary – Idle Stage

Lab		Oil Code	
Stand		Test Number	
Lab Oil Code			
Formulation/Stand Code			

Parameter	Average	N	Std. Deviation	Minimum	Maximum
Engine Speed, rpm					
Fuel Flow, kg/h					
Man. Abs. Pressure(MAP), kPa					
Torque, Nm					
Fuel Pressure, kPa					
Inlet Air Pressure, kPa					
Crankcase Pressure, kPa					
Exhaust Back Pressure, kPa					
Post Turbo Boost Pressure, kPa					
Oil Gallery Pressure, kPa					
Humidity, g/kg					
Fuel Temperature, °C					
Oil Gallery Temperature, °C					
Oil Sump Temperature, °C					
Coolant In Temperature, °C					
Coolant Out Temperature, °C					
Pre-Turbo Inlet Air Temp., °C					
Pre-Intercooler Boost Temp., °C					
Turbo Coolant Inside, °C					
Turbo Coolant Outside, °C					
Turbo Feed Pipe Temp., °C					
Turbo Speed, rpm					
Turbo Feed Oil Pressure, kPa					
Banjo Bolt Oil Delta Press., kPa					

**General Motors dexos® Turbocharger Coking Test
Form 9
100-Cycle Period Averages**

Lab		Oil Code	
Stand		Test Number	
Lab Oil Code			
Formulation/Stand Code			

100-Cycle Period	End of Period Test Time (hh:mm)	Turbo Coolant Outside Temp (°C)		Banjo Bolt Oil Pressure (kPa)		Turbo Speed at Idle (rpm)	
		3,000 rpm ^A	% Change	Delta ^B	% Change	At Idle ^C	% Change
100							
200							
300							
400							
500							
600							
700							
800							
900							
1000							
1100							
1200							
1300							
1400							
1500							
1600							
1700							
1800							
1900							
2000							

^A 60 - 150 seconds

^B 3,000 rpm

^C 18 seconds

**General Motors dexos® Turbocharger Coking Test
Form 10
Rating Summary**

Lab		Oil Code	
Stand		Test Number	
Lab Oil Code			
Formulation/Stand Code			

ASTM Manual 20 Non-Rubbing Carbon Method					
Turbine Shaft Area (A)			Turbine Shaft Area (B)		
Area %	Rating	Merit	Area %	Rating	Merit
Total Merit:			Total Merit:		
Center Housing Turbine End Hole (C)			Center Housing Turbine Inlet Hole (D)		
Area %	Rating	Merit	Area %	Rating	Merit
Total Merit:			Total Merit:		
Center Housing Turbine Outlet Hole (E)			Inlet Pipe (F)		
Area %	Rating	Merit	Area %	Rating	Merit
Total Merit:			Total Merit:		
			Rating Date:		
			Rater:		

Total Average Merit Rating	
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General Motors dexos® Turbocharger Coking Test

Form 11

Oil Analysis Part 1

Lab		Oil Code	
Stand		Test Number	
Lab Oil Code			
Formulation/Stand Code			

Oil Analysis							
Test Hours	Fresh Oil						EOT
Viscosity 40°C, cSt							
Vis. Increase, %							
Oxidation, DIN 51453							
Nitration, DIN 51453							
TAN, D 664							
TBN, D4739							

Oil Consumption Summary	
Oil Charge (g)	
Oil Drain Weight (g)	
Oil Consumption (g)	
Oil Consumption Rate (g/h)	

**General Motors dexos® Turbocharger Coking Test
Form 12 - Oil Analysis Part 2**

Lab		Oil Code	
Stand		Test Number	
Lab Oil Code			
Formulation/Stand Code			

Metal Elements (ppm)	Fresh Oil	100	200	300	400	500	EOT
Aluminum (Al)							
Boron (B)							
Calcium (Ca)							
Chromium (Cr)							
Copper (Cu)							
Iron (Fe)							
Potassium (K)							
Magnesium (Mg)							
Manganese (Mn)							
Molybdenum (Mo)							
Sodium (Na)							
Nickel (Ni)							
Phosphorus (P)							
Lead (Pb)							
Sulfur (S)							
Silicon (Si)							
Tin (Sn)							
Titanium (Ti)							
Zinc (Zn)							

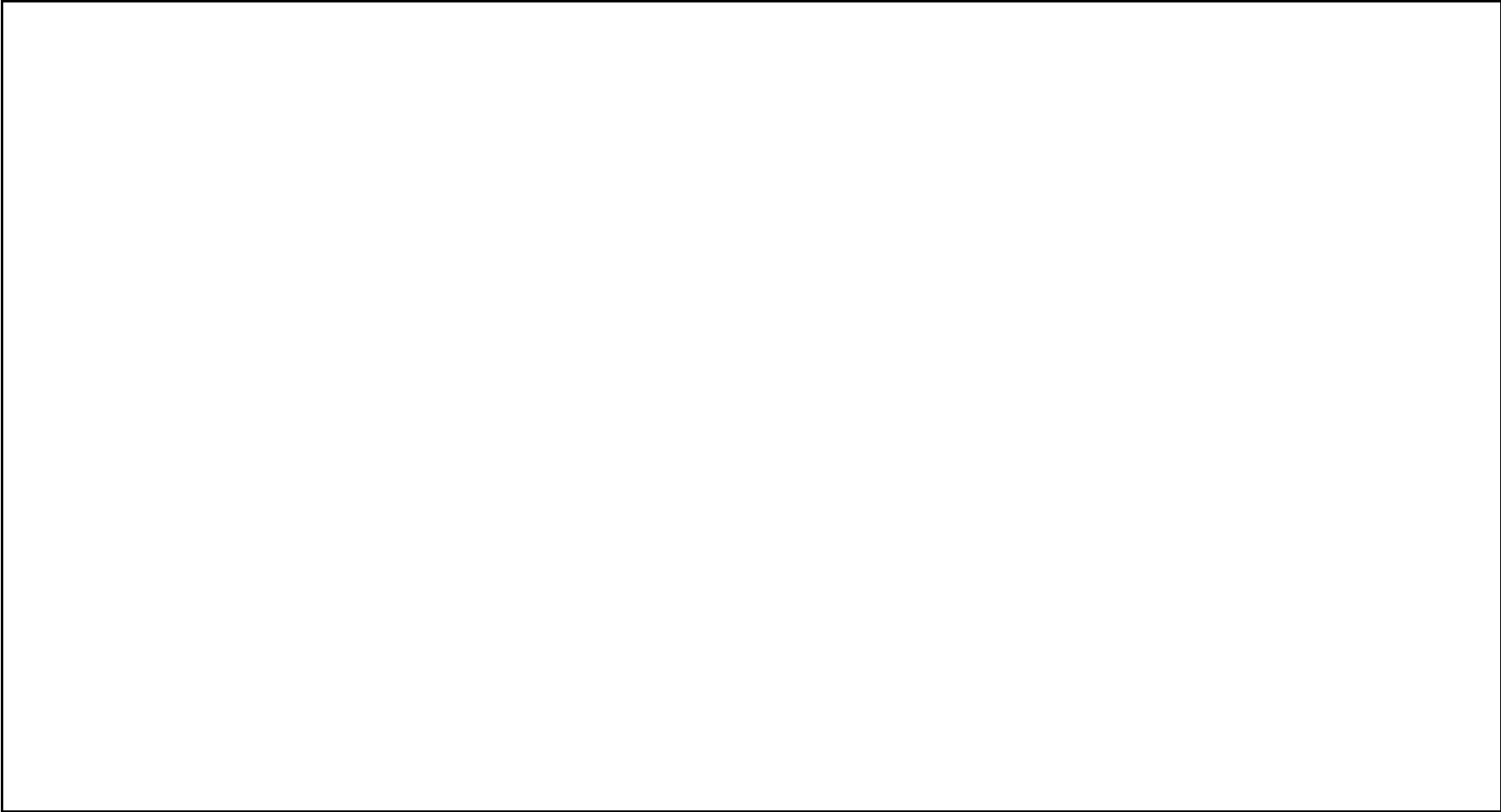
General Motors dexos® Turbocharger Coking Test

Form 13

Turbo Cool Inside Temperature Graph

Lab		Oil Code	
Stand		Test Number	
Lab Oil Code			
Formulation/Stand Code			

Turbo Cool Inside Temperature (°C)



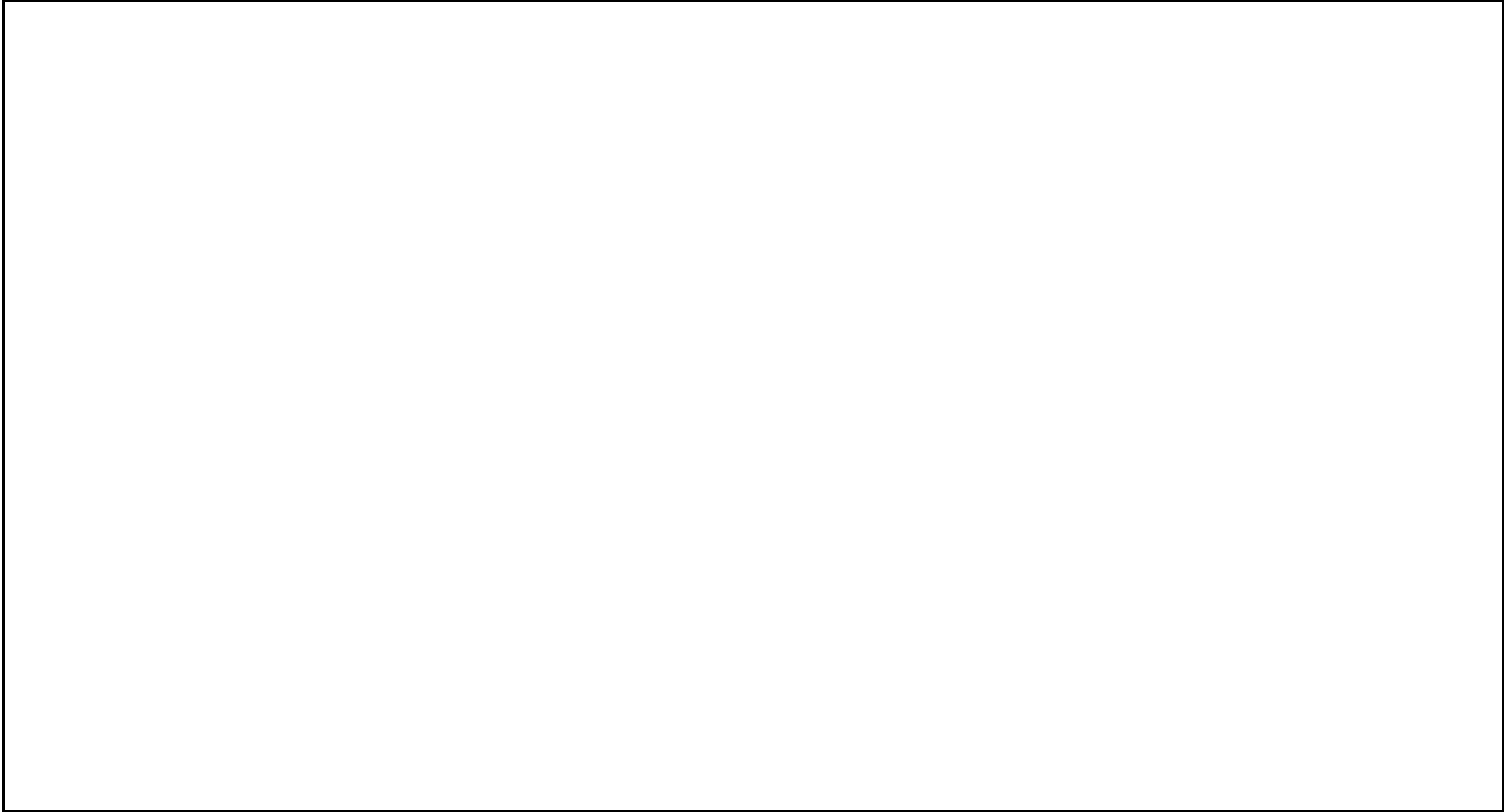
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Form 14

Turbo Cool Outside Temperature Graph

Lab		Oil Code	
Stand		Test Number	
Lab Oil Code			
Formulation/Stand Code			

Turbo Cool Outside Temperature (°C)



General Motors dexos® Turbocharger Coking Test

Form 15

Turbo Boost Pressure Graph

Lab		Oil Code	
Stand		Test Number	
Lab Oil Code			
Formulation/Stand Code			

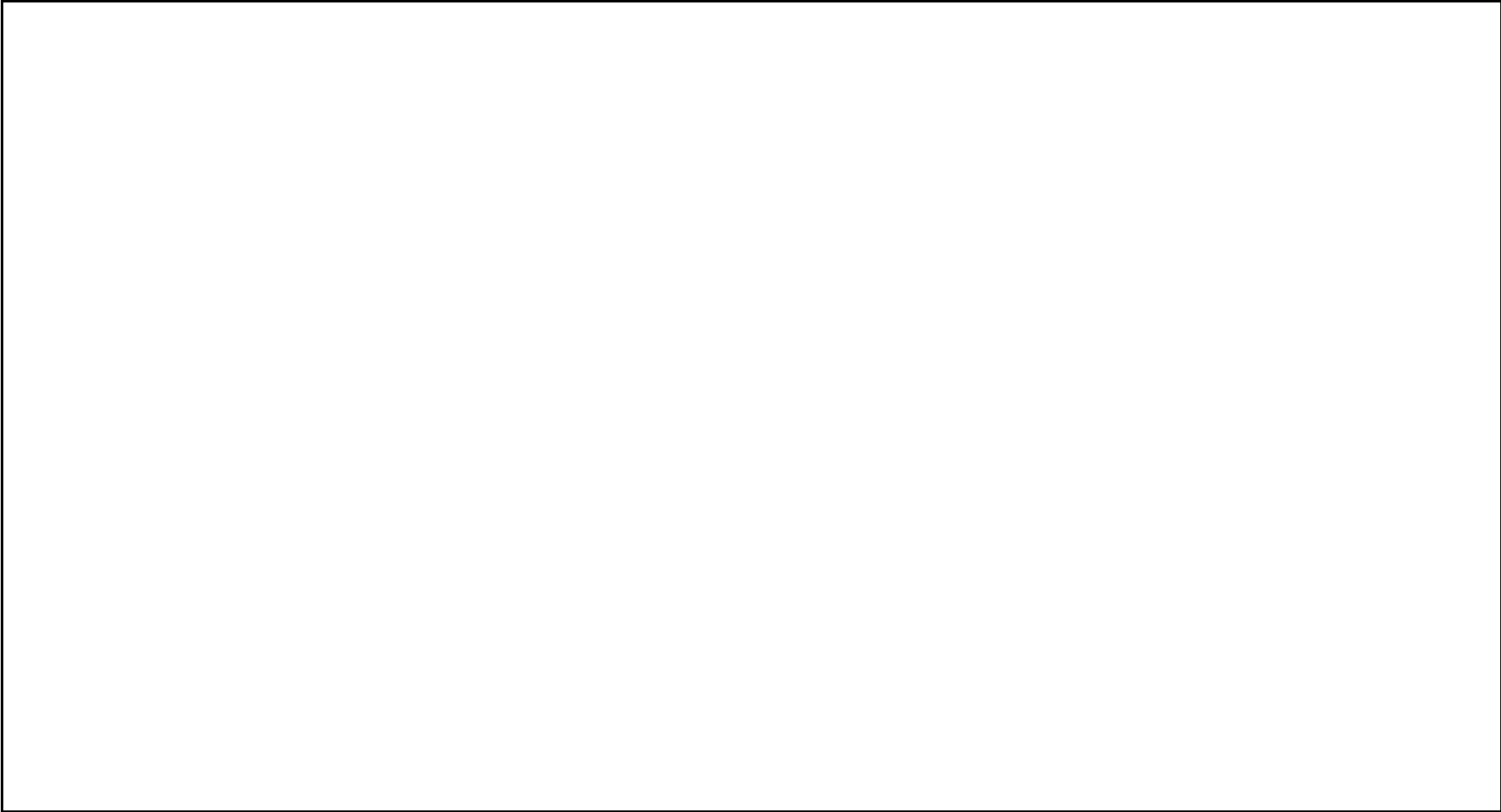
Turbo Boost Pressure (kPa)



General Motors dexos® Turbocharger Coking Test
Form 16
Turbo Feed Pipe Temperature Graph

Lab		Oil Code	
Stand		Test Number	
Lab Oil Code			
Formulation/Stand Code			

Turbo Feed Pipe Temperature (°C)



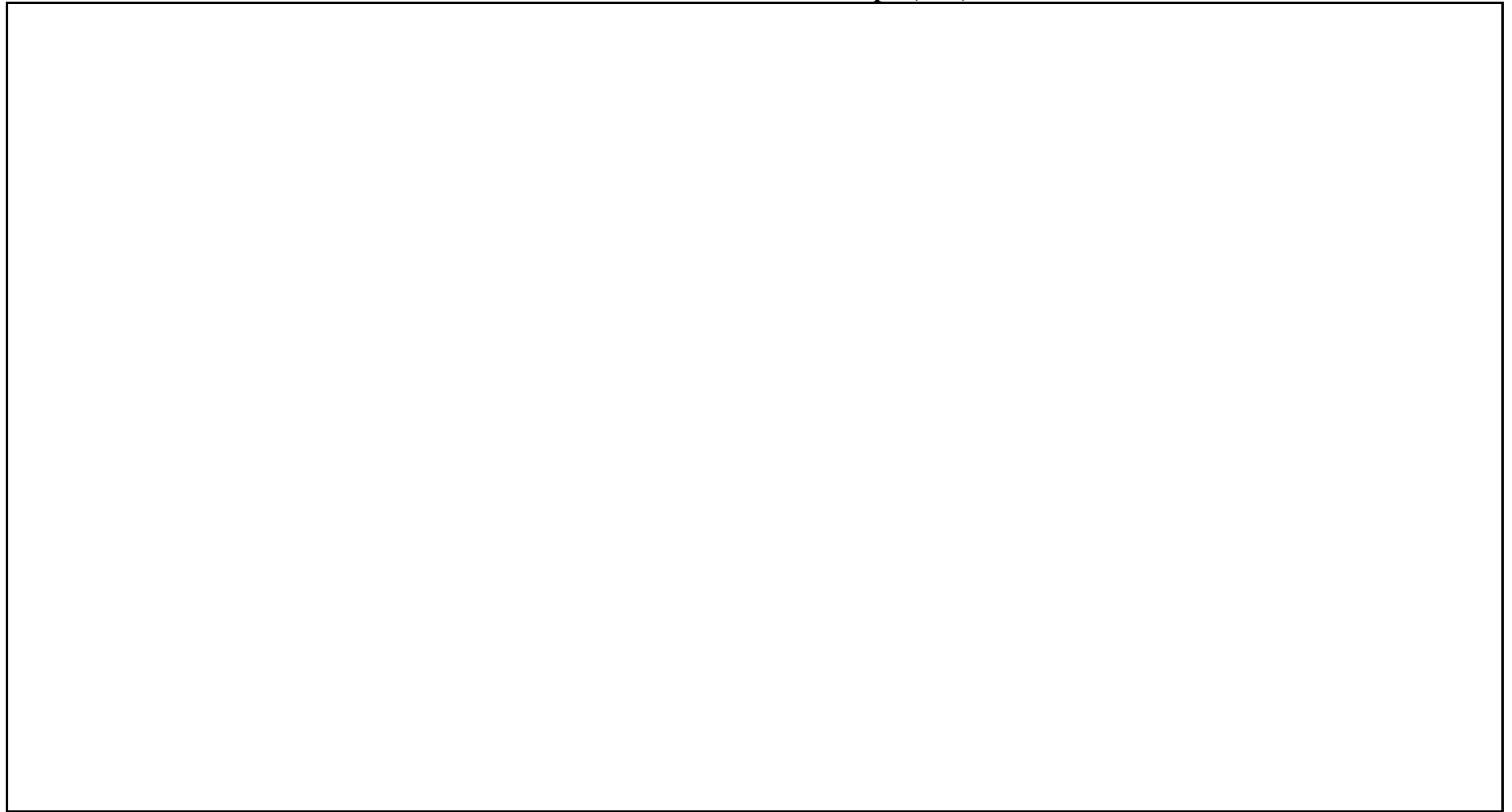
General Motors dexos® Turbocharger Coking Test

Form 17

Turbo Oil Delta Pressure Graph

Lab		Oil Code	
Stand		Test Number	
Lab Oil Code			
Formulation/Stand Code			

Turbo Oil Delta Pressure Graph (kPa)



General Motors dexos® Turbocharger Coking Test

Form 18

Turbo Speed Graph

Lab		Oil Code	
Stand		Test Number	
Lab Oil Code			
Formulation/Stand Code			

Turbo Speed (rpm)

