

**General Motors Turbocharger Coking Test
For dexos®
Form 1**

Version

Conducted For

| | |
|--|---|
| | V = Valid |
| | I = Invalid |
| | N = Results cannot be interpreted as representative of oil performance (Non-reference oil) and shall not be used for multiple test acceptance |

| | |
|--|------------------------|
| | NR = Non-reference oil |
| | RO = Reference oil |

| Test Number | | | |
|----------------------------|--|----------------|--|
| Stand: | | Stand Run: | |
| Formulation/Stand Code | | | |
| Oil Code | | | |
| Ref. Oil Code ^A | | | |
| Date Started | | Time Started | |
| Date Completed | | Time Completed | |
| Test Length | | Total Downtime | |
| Alternate Codes | | | |

^A Reference Tests Only

| |
|--|
| In my opinion this test _____ been conducted in a valid manner in accordance with test procedure GMTC and appropriate amendments. The remarks included in the report describe the anomalies associated with this test. |
|--|

Submitted By: _____
Testing Laboratory

Signature

Typed Name

Title

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 | |

| % Change, 100 - 1800 Period Cycle | % |
|--|---------------|
| Turbo Coolant Outside, 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 |
|--|--------------|
| Percent Viscosity Increase at 40°C, % | |
| Oxidation, DIN 51453 | |
| Nitration, DIN 51453 | |
| TAN, D 664 | |
| TBN, D4739 | |
| Evaporation Loss by NOACK Method (% Loss) | |
| EOT Kinematic Viscosity @ 100°, mm ² /s | |
| EOT HTHS @ 150° by ASTM D4683, mPa·s | |

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 (hhh: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 | |
|-----------------------------------|--|

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) | | | | | | | |

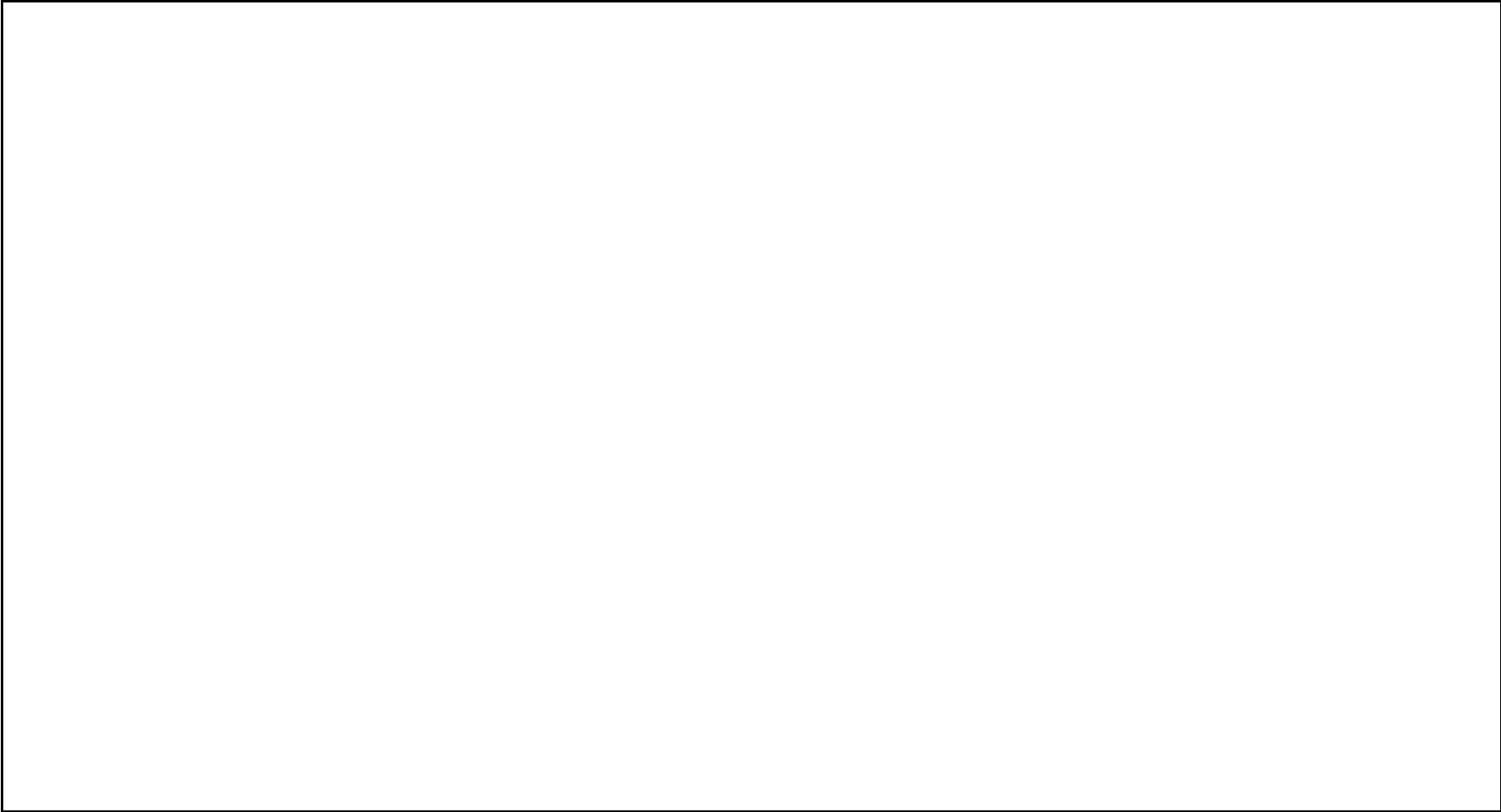
General Motors dexos® Turbocharger Coking Test

Form 13

Turbo Cool Inside Temperature Graph

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

Turbo Cool Inside Temperature (°C)



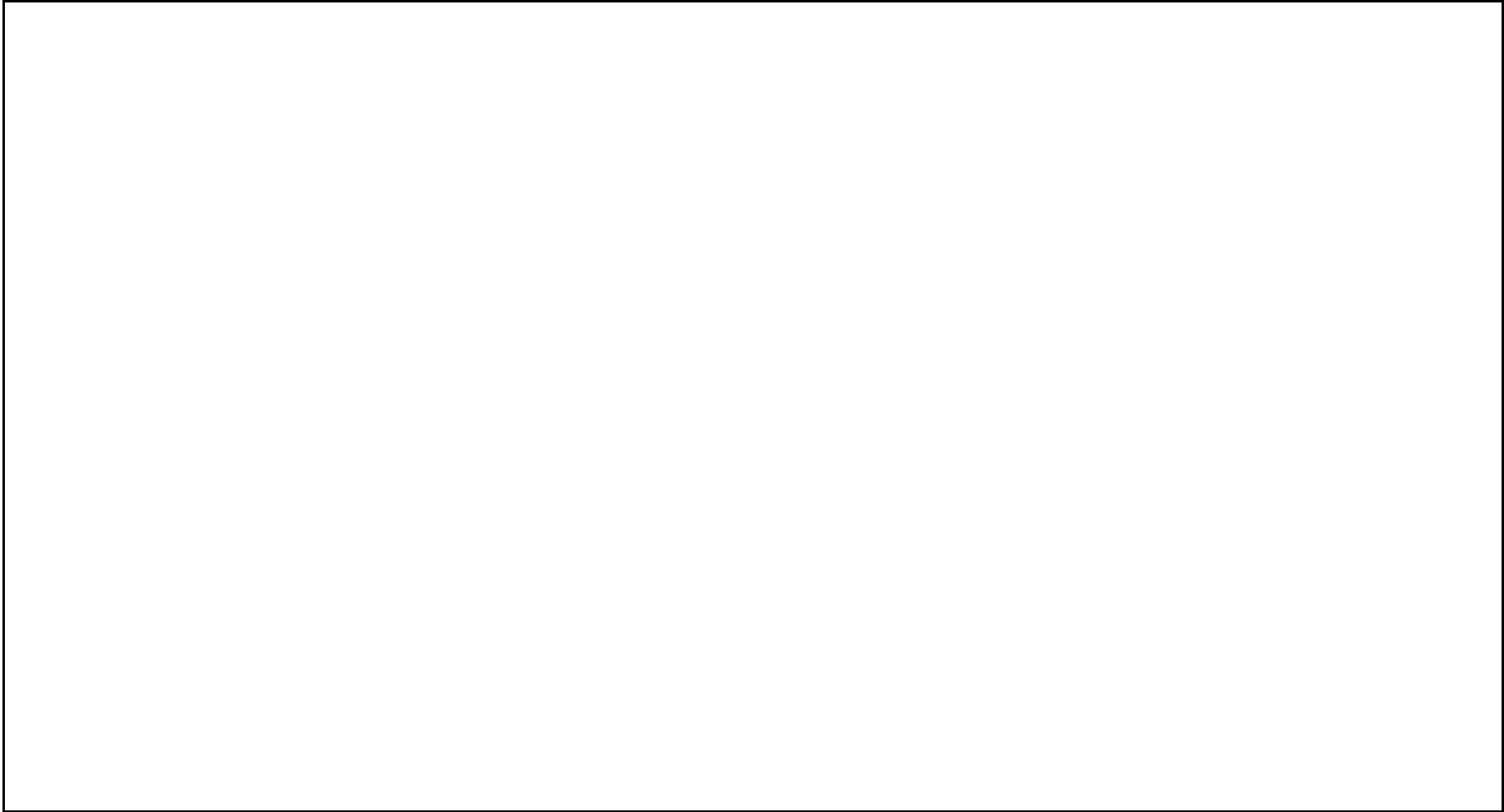
General Motors dexos® Turbocharger Coking Test

Form 14

Turbo Cool Outside Temperature Graph

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

Turbo Cool Outside Temperature (°C)



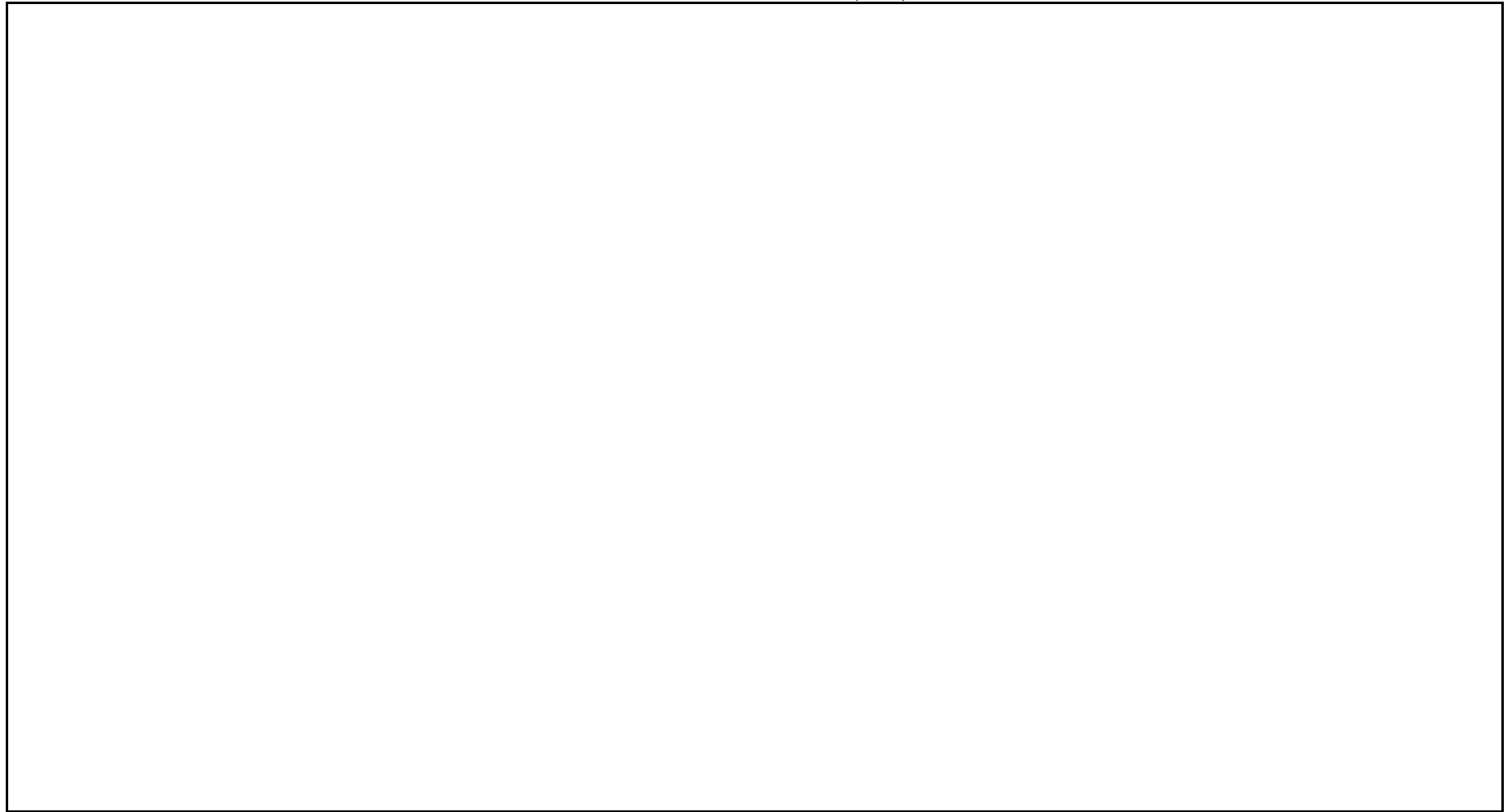
General Motors dexos® Turbocharger Coking Test

Form 15

Turbo Boost Pressure Graph

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

Turbo Boost Pressure (kPa)



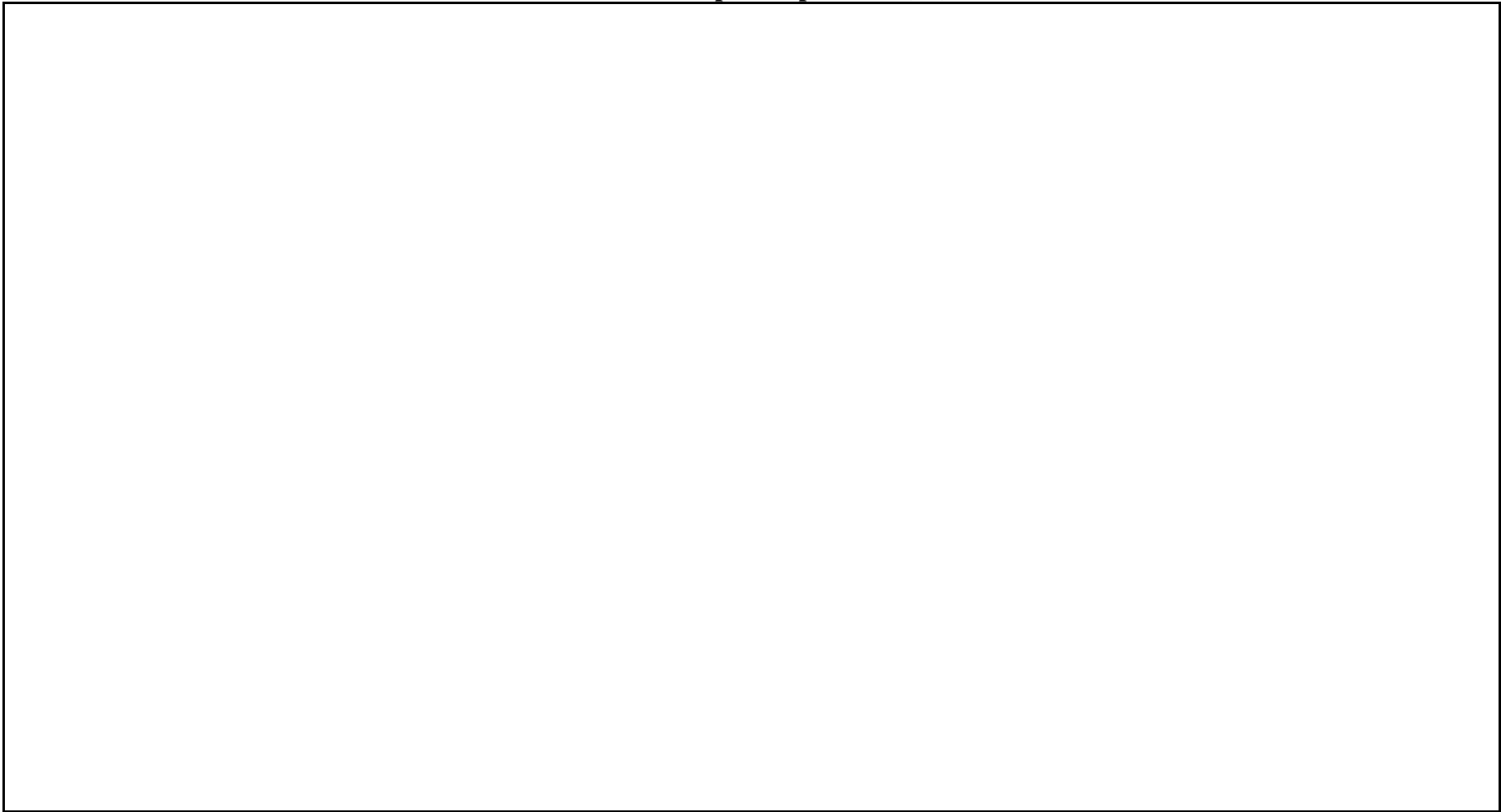
General Motors dexos® Turbocharger Coking Test

Form 16

Turbo Feed Pipe Temperature Graph

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

Turbo Feed Pipe Temperature (°C)



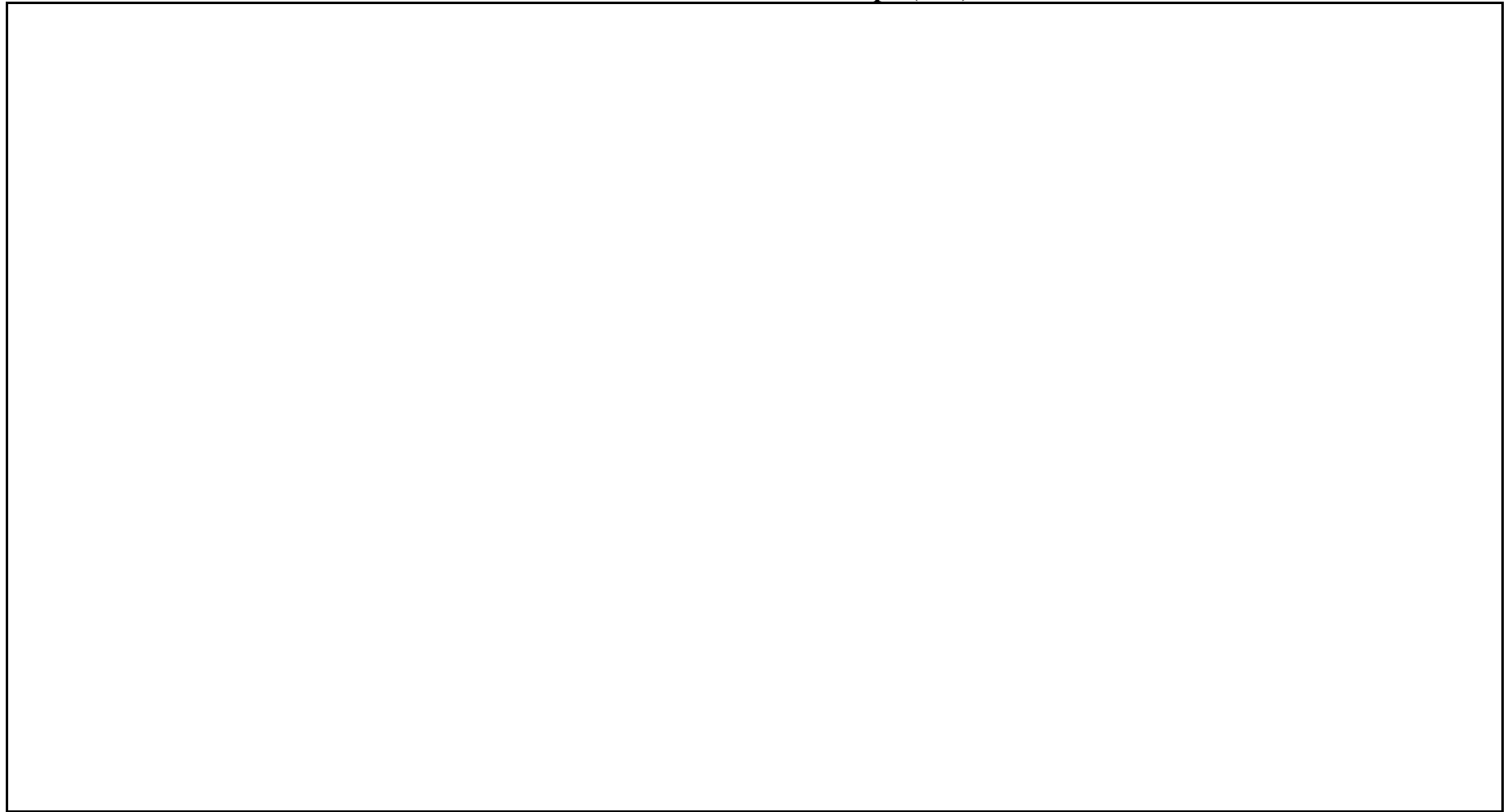
General Motors dexos® Turbocharger Coking Test

Form 17

Turbo Oil Delta Pressure Graph

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

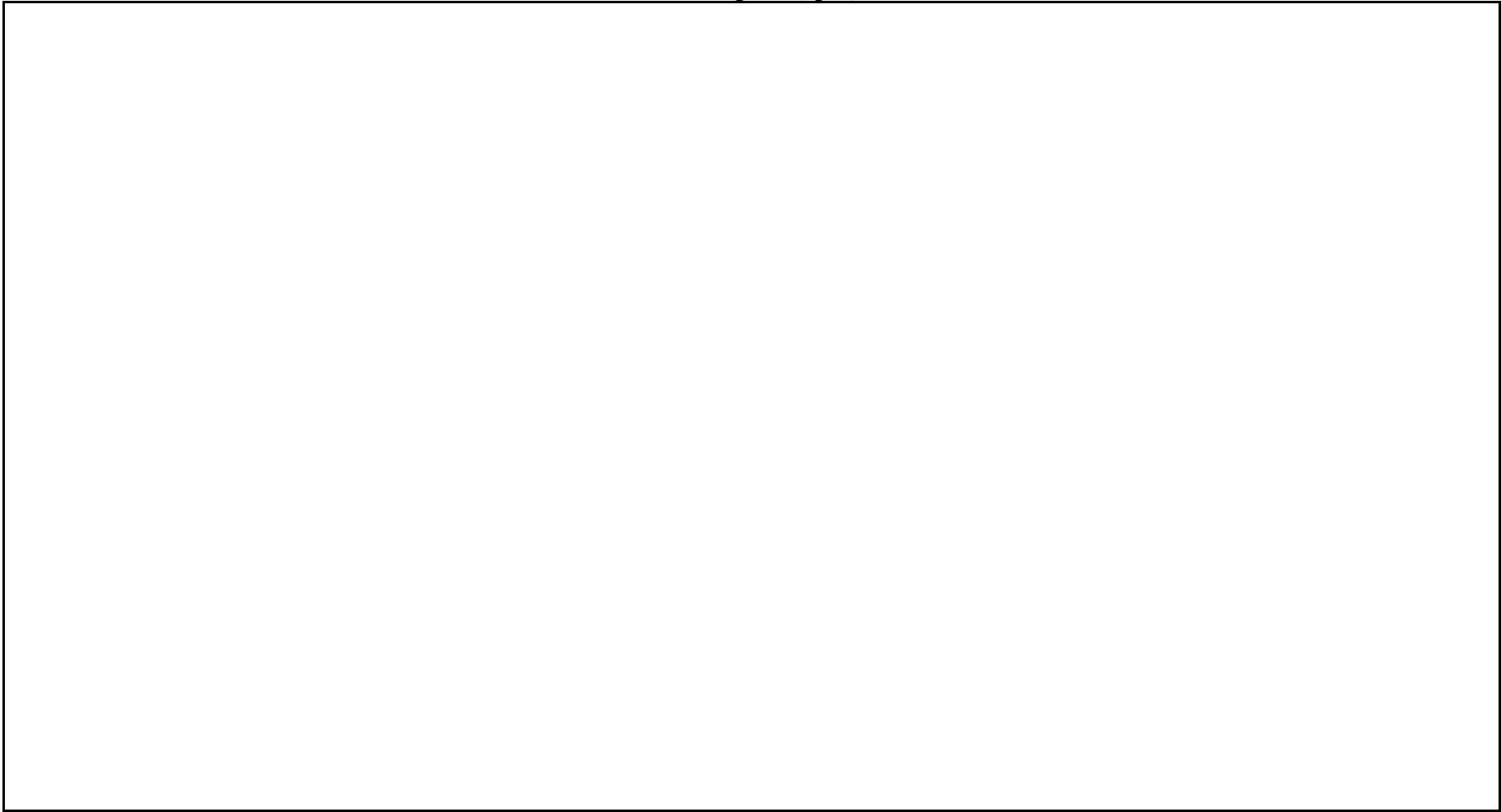
Turbo Oil Delta Pressure Graph (kPa)



**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)



**General Motors dexos® Turbocharger Coking Test
Form 19
Downtime Record**

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

| Number of Downtime Occurrences | | | |
|--------------------------------|------|----------|------------------------------------|
| Test Hours | Date | Downtime | Reason |
| | | | |
| | | | |
| | | | |
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| | | | |
| | | | |
| | | | Total Unscheduled Down Time |

**General Motors dexos® Turbocharger Coking Test
Form 20
Comment Record**

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

| Other Comments | |
|------------------------|--|
| | |
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| | |
| Total Comments: | |