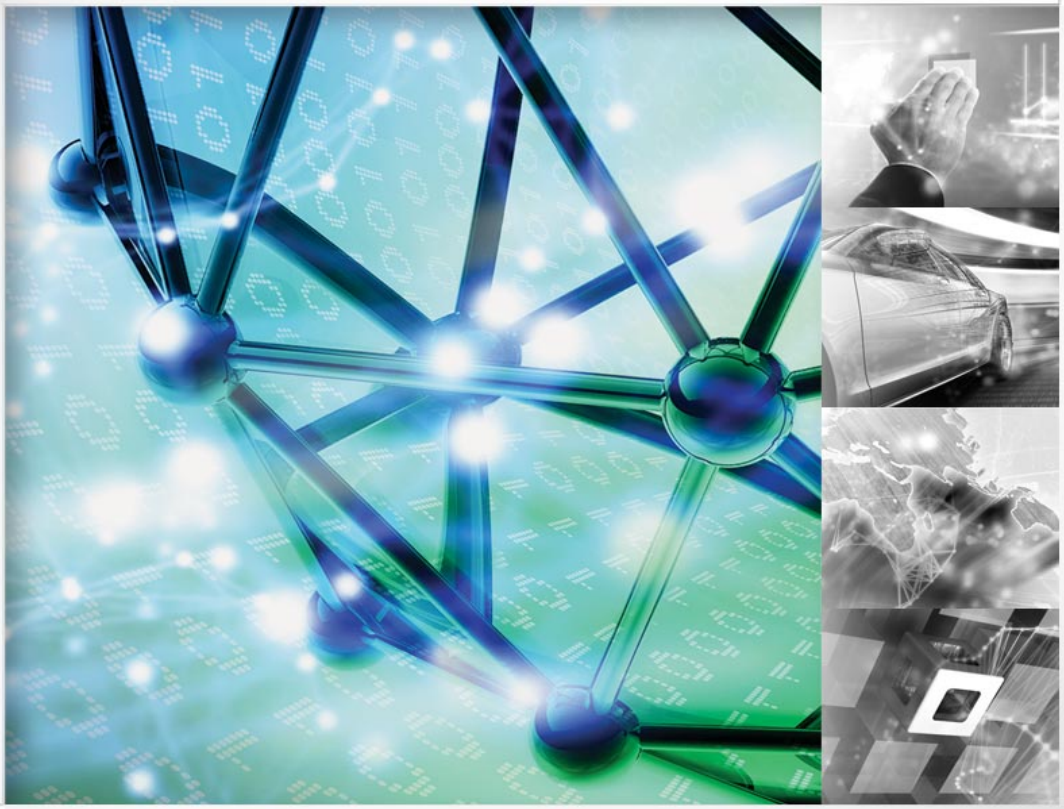

# Limit Count Proposal

**Patrick Joyce**

10 June 2016



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# Limit Count in TMC Report Form

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DD13 Engine Scuffing Test

**Form 5**
**Operational Summary**
**Controlled Parameters**

| | | |
|---|---|---|
| Laboratory: LAB | EOT Date: DTCOMP | EOT Time: EOTTIME |
| Test Number: TESTNUM | | Test Length: TESTLEN |
| Oil Code: OILCODE | | |
| Formulation Stand Code: FORM | | |

| Controlled Parameters | Parameter | Units | QI Threshold | EOT QI A | Target | | Stage 1 | | | | Stage 2 | | | | No of Samples | BQD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Stage 1 | Stage 2 | Avg | Std Dev | Max | Min | Avg | Std Dev | Max | Min | | |
| | Speed | r/min | 0.000 | QRPM | 1800 | 1800 | ARPM1 | SRPM1 | XRPM1 | IRPM1 | ARPM2 | SRPM2 | XRPM2 | IRPM2 | NRPM | BRPM |
| | Fuel Flow | kg/h | 0.000 | QFFLO | 32 | 71 | AFFLO | SFFLO | XFFLO | IFFLO | AFFLO | SFFLO | XFFLO | IFFLO | NFFLO | BFFLO |
| | Intake Manifold Temperature | °C | 0.000 | QINMA | 75 | 87 | AINM | SINM | XINM | IINMA | AINM | SINM | XINM | IINMA | NINM | BINM |
| | Coolant Jacket Out Temperature | °C | 0.000 | QCOJO | 105 | 105 | ACOJ | SCOJ | XCOJ | ICOJO | ACOJ | SCOJ | XCOJ | ICOJO | NCOJ | BCOJ |
| | Fuel In Temperature | °C | 0.000 | QFUEL | 38 | 38 | AFUE | SFUE | XFUE | IFUEL | AFUE | SFUE | XFUE | IFUEL | NFUE | BFUE |
| | Oil Gallery Temperature | °C | 0.000 | QOILGT | 118 | 118 | AOIL | SOIL | XOIL | IOILG | AOIL | SOIL | XOIL | IOILG | NOIL | BOIL |
| | Intake Air Temperature | °C | 0.000 | QINAIR | 35 | 35 | AINA | SINA | XINA | IINAIR | AINA | SINA | XINA | IINAIR | NINA | BINA |
| | Intake Air Restriction | kPaA | 0.000 | QINAIR | 96.4 | 94.8 | AINA | SINA | XINA | IINAIR | AINA | SINA | XINA | IINAIR | NINA | BINA |
| | Intake Manifold Pressure | kPaA | 0.000 | QINMA | 202.5 | 327.5 | AINM | SINM | XINM | IINMA | AINM | SINM | XINM | IINMA | NINM | BINM |
| | Exhaust Pressure | kPaA | 0.000 | QEXHS | 105.5 | 125.5 | AEXH | SEXH | XEXH | IEXH | AEXH | SEXH | XEXH | IEXH | NEXH | BEXH |
| | Coolant Jacket In Pressure | kPa | 0.000 | QCOLJ | 250 | 250 | ACOL | SCOL | XCOL | ICOL | ACOL | SCOL | XCOL | ICOL | NCOL | BCOL |
| | Coolant Flow | L/min | 0.000 | QCOLF | 350 | 350 | ACOL | SCOL | XCOL | ICOL | ACOL | SCOL | XCOL | ICOL | NCOL | BCOL |

*A - QI values above the threshold are acceptable by then surveillance panel. QI values below the threshold may not be considered acceptable based on engineer review.*

| Counts Above Control Limit | | | | | |
|---|---|---|---|---|---|
| | Transition | Steady State | | Transition | Steady State |
| Fuel Flow | FFLOCNTT | FFLOCNTS | Intake Air Temperature | INATCNTT | INATCNTS |
| Intake Manifold Temperature | IMTCNTT | IMTCNTS | Intake Manifold Pressure | IMPCNTT | IMPCNTS |
| Coolant Jacket Out Temperature | CJOTCNTT | CJOTCNTS | Torque | TRQCNTT | TRQCNTS |




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# Steady State Limit Count Comparison

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| Steady State Limit Counts, ≥ 3 counts | | | |
|---|---|---|---|
| Quantity | Procedure* | Report Forms | Proposed |
| Fuel Flow | No | Yes | No |
| Intake Manifold Temperature | Yes, 70-80 °C, 82-92 °C | Yes | Yes, 70-80 °C, 82-92 °C |
| Coolant Jacket Out Temperature | Yes, 102-108 °C | Yes | Yes, 102-108 °C |
| Intake Air Temperature | Yes, 30-40 °C | Yes | Yes, 30-40 °C |
| Intake Manifold Pressure | Yes, 182.5-217.5 kPaa, 307.5-342.5 kPaa | Yes | Yes, 182.5-217.5 kPaa, 307.5-342.5 kPaa |
| Torque | No | Yes | No |
| Oil Gallery Temperature | Yes, 115-121 °C | No | Yes, 115-121 °C |
| *Limits can be found in section A7 of the procedure | | | |

- Limits applied to both Stage 1 and Stage 2 Conditions (Excluding 30:00-30:10 during transition)




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# Transition Limit Count Comparison

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| Transition Limit Counts, ≥ 6 counts | | | |
|---|---|---|---|
| Quantity | Procedure | Report Forms | Proposed |
| Fuel Flow | No | Yes | No |
| Intake Manifold Temperature | Yes, +/- 5 °C from 75 to 85 °C ramp | Yes | Yes, +/- 5 °C from 75 to 85 °C ramp, then 82-92 °C SS |
| Coolant Jacket Out Temperature | No | Yes | Yes, 102-108 °C |
| Intake Air Temperature | No | Yes | Yes, 30-40 °C |
| Intake Manifold Pressure | No | Yes | Yes, +15/-20 kPaa from 202.5 to 327.5 kPaa ramp, then 307.5-343.5 kPaa SS |
| Torque | Yes, +/- 50 Nm from 800 to 1800 Nm ramp | Yes | Yes, +/- 50 Nm from 800 to 1800 Nm ramp (5 min ramp only) |
| Oil Gallery Temperature | No | No | Yes, 115-121 °C |

*Limits can be found in section A7.3.2 of the procedure

- Transition includes 2 steps
  - 1: Torque Ramp, 30:00-30:05 hrs
  - 2: Fuel Flow Stabilization, 30:05-30:10 hrs

A7.3.2 During the 30 h stage transition (see Table 2), if any count of 6 or more data points of the torque is greater or less than 50 N•m from the linearly ramped set point or if air temperature in intake manifold is greater or less than 5 °C, conduct an engineering review to determine operational validity for the test.




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# Stage 2 Warm-Up Limit Count Comparison

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| Stage 2 Warm-Up, ≥ 6 counts, document in comments | | | |
|---|---|---|---|
| Quantity | Procedure* | Report Forms | Proposed |
| Intake Manifold Temperature | Yes, +/- 5 °C from 75 to 85 °C ramp (Step 3 Only) | N/A | Yes, +/- 5 °C from 75 to 85 °C setpoint (Step 3 and 4 Only) |
| Coolant Jacket Out Temperature | No | N/A | Yes, Upper Limit Only (whole warm-up) |
| Intake Air Temperature | No | N/A | Yes, Upper Limit Only (Step 3 and 4 Only) |
| Intake Manifold Pressure | No | N/A | Yes, +15/-20 kPaa from setpoint (Step 3 and 4 Only) |
| Torque | Yes, +/- 50 Nm from 800 to 1800 Nm ramp (Step 3 Only) | N/A | Yes, +/- 50 Nm from 800 to 1800 Nm rsetpoint (Step 3 Only) |
| Oil Gallery Temperature | No | N/A | Yes, Upper Limit Only (whole warm-up) |
| *Limits can be found in section A7.3.2 of the procedure | | | |

**Table A6.5 Stage 2 startup sequence**

| Step | Time, h:min | Setpoint Ramp Time, s | Speed, r/min | Torque, N-m | Fuel Flow Rate, kg/h | Coolant Flow Rate, L/min | Air Temperature in Engine Intake, °C | Coolant Temperature at Jacket Outlet, °C | Oil Temperature in Gallery, °C | Fuel Temperature at Engine Inlet, °C | Air Temperature in Intake Manifold, °C | Coolant Pressure at Jacket Inlet, kPa gauge | Exhaust Pressure in Tailpipe, kPa absolute | Air Pressure in Intake Manifold, kPa absolute | Air Pressure at Engine Intake, kPa absolute |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1[A] | | | 600 | Idle | | 340 to 360 | 35 | 105 | 118 | 38 | 75 | 250 | 97.5 | No air to wastegate | 97 |
| 2 | 0:10 | 180[B] | 1800 | 800 | | 340 to 360 | 35 | 105 | 118 | 38 | 75 | 250 | 105.5 | 202.5 | 96.4 |
| 3 | 0:20 | 900[C] | 1800 | 1800 | | 340 to 360 | 35 | 105 | 118 | 38 | 87 | 250 | 125.5 | 327.5 | 94.8 |
| 4 | 0:02 | 120 | 1800 | | 71 | 340 to 360 | 35 | 105 | 118 | 38 | 87 | 250 | 125.5 | 327.5 | 94.8 |

[A] Consider setpoints as maximums for idle conditions.
[B] Setpoint ramp time is 180 s for all parameters in step 2 except temperature.
[C] Setpoint ramp time is 900 s for all parameters in step 2 except temperature which will take longer but shall not exceed 30 min.

A7.3.2 During the 30 h stage transition (see Table 2), if any count of 6 or more data points of the torque is greater or less than 50 N•m from the linearly ramped set point or if air temperature in intake manifold is greater or less than 5 °C, conduct an engineering review to determine operational validity for the test.




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# When Limit Counts Applied

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- Proposed: Do not subject any data to limit count criteria after scuff
  - Similar rule as QI's
  - Taskforce agreed to not apply limit count

A7.1.7 If a test has scuffed, any data taken after the hours to scuff, as calculated in 10.7, shall not be used in QI calculations.




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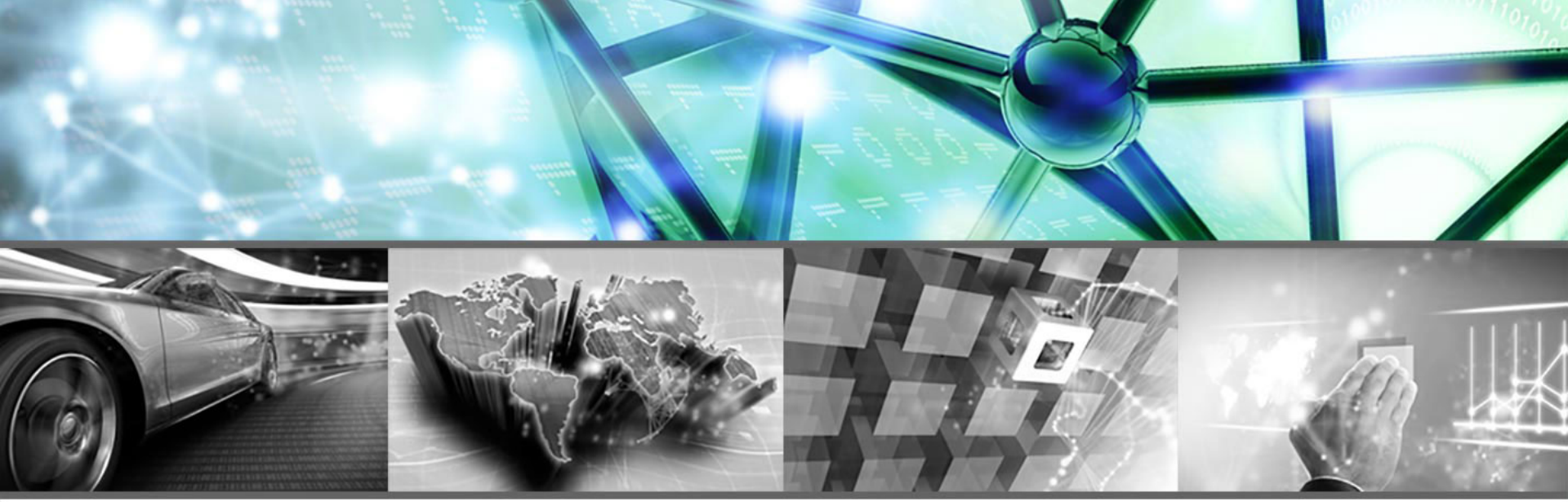

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## Working together, achieving great things

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