



ICAO ENGINE nvPM EMISSIONS DATA SHEET

SUBSONIC ENGINES

ENGINE IDENTIFICATION: Trent7000-72D
UNIQUE ID NUMBER: 02F23RR143
COMBUSTOR: Phase5 Tiled
ENGINE TYPE: TF

BYPASS RATIO (-): 8.9
PRESSURE RATIO π_{co} (-): 45.8
RATED OUTPUT F_{oo} (kN): 327.9

REGULATORY DATA

| CHARACTERISTIC VALUES: | LTO_{mass}/F_{oo} (mg/kN) | LTO_{num}/F_{oo} (particles/kN) | NVPM MASS CONCENTRATION ($\mu\text{g}/\text{m}^3$) |
|------------------------------------|--------------------------------|--------------------------------------|---|
| LTO/F_{oo} AND MAX $nvPM_{mass}$ | 200.1 | $1.74\text{E}+15$ | 3410 |
| AS % OF CAEP/10 LIMIT | - | - | 87.0 |
| AS % OF CAEP/11 LIMIT (InP) | 57.6 | 41.7 | |
| AS % OF CAEP/11 LIMIT (NT) | 93.5 | 62.5 | |

MEASURED DATA

| MODE | POWER SETTING (% F_{oo}) | TIME minutes | FUEL FLOW kg/s | EMISSIONS INDICES* | | NVPM MASS CONCENTRATION PEAK $nvPM_{mass}$ ($\mu\text{g}/\text{m}^3$) |
|---|-----------------------------------|-----------------|-------------------|------------------------|------------------------------|---|
| | | | | EI_{mass} (mg/kg) | EI_{num} (particles/kg) | |
| TAKE-OFF | 100 | 0.7 | 2.502 | 48.1 | $1.45\text{E}+14$ | |
| CLIMB OUT | 85 | 2.2 | 2.040 | 84.1 | $2.83\text{E}+14$ | |
| APPROACH | 30 | 4.0 | 0.671 | 74.0 | $8.58\text{E}+14$ | |
| IDLE | 7 | 26.0 | 0.259 | 18.8 | $4.47\text{E}+14$ | |
| LTO TOTAL (kg, mg, number of particles) | | | 939 | 47203 | $4.10\text{E}+17$ | - |
| NUMBER OF ENGINES | | | | 1 | 1 | 1 |
| NUMBER OF TESTS | | | | 3 | 3 | 3 |
| AVERAGE LTO/F_{oo} VALUES (mg/kN, particles/kN) | | | | 143.9 | $1.25\text{E}+15$ | - |
| MAX EI VALUES (mg/kg, particles/kg) AND MAX MASS CONC. ($\mu\text{g}/\text{m}^3$) | | | | 152.5 | $9.62\text{E}+14$ | 2649 |

* Emissions Indices are corrected for thermophoretic loss and fuel hydrogen content

DATA FOR EMISSIONS INVENTORIES (ESTIMATIONS FOR ENGINE EXIT PLANE VALUES)

| MODE | POWER SETTING (% F_{oo}) | CORRECTED EMISSIONS INDICES | |
|-----------|-----------------------------------|-----------------------------|----------------------------------|
| | | EI_{mass_SL} (mg/kg) | EI_{num_SL} (particles/kg) |
| TAKE-OFF | 100 | 51.6 | $1.96\text{E}+14$ |
| CLIMB OUT | 85 | 90.9 | $4.12\text{E}+14$ |
| APPROACH | 30 | 85.5 | $1.92\text{E}+15$ |
| IDLE | 7 | 22.7 | $8.92\text{E}+14$ |

AMBIENT CONDITIONS

| | | | FUEL | |
|--------------------------------|--------|--------|-------------------------------|-------|
| | From | To | HEAT OF COMBUSTION (MJ/kg) | 43.34 |
| BAROMETER (kPa) | 100.8 | 101.6 | HYDROGEN CONTENT (%mass) | 13.97 |
| TEMPERATURE (K) | 287.0 | 292.6 | AROMATICS CONTENT (%vol) | 15.9 |
| HUMIDITY (kg water/kg dry air) | 0.0080 | 0.0090 | NAPHTHALENE CONTENT (%vol) | 0.11 |
| | | | SULPHUR CONTENT (ppm by mass) | 300 |

MANUFACTURER: Rolls-Royce plc
TEST ORGANIZATION: Rolls-Royce plc
TEST LOCATION: Derby
TEST DATES: 04/10/2018

REMARKS

1. Certification Report EDNS01000740804
2. Correction of minor error in reported nvPM data
3. The maximum EI_{mass} occurs between 30% and 85% F_{oo}
4. The maximum EI_{num} occurs between 30% and 85% F_{oo}