



# SGS - Australian Standard

## Diesel – May 23, 2023



In May and June 2023, the independent and accredited laboratory SGS received a sample of diesel oil supplied by the engine workshop Australian Marine Services, established in the province of Victoria, Australia. The laboratory analyzed the regular fuel, then treated a sample with **XBEE Enzyme Fuel Technology** at the advised ratio of 4,000:1. This additized sample was stored for a few weeks in order to simulate storage, and was finally analyzed according to the Australian standard CAN/ CGSB-3.51-2020.

| Analyses   | Methods     | Without XBEE                     | With XBEE                          | Units                  | Limits    |
|--|-------------|----------------------------------|------------------------------------|------------------------|-----------|
| Ash<br>· Ash content<br>· Sample mass  | ASTM D 482  | <0.01<br>79.86                   | <0.01<br>100.8                     | Mass %<br>g            | 0.01 max  |
| Fatty Acids Methyl Ester content (FAME / Biodiesel)  | NF EN 14078 | < 0.05                           | < 0.05                             | Vol %                  | 5.0 max   |
| Carbon residue – 10 % distillation residue   | ASTM D 4530 | <0.10                            | <0.10                              | Mass %                 | 0.20 max  |
| Cetane Index (Proc. A)   | ASTM D 4737 | 53.9                             | 53.9                               | Vol %                  | 46 min    |
| Electrical conductivity at 20°C  | ASTM D 2624 | 1,160                            | 930                                | pS/m                   | 50 min    |
| Copper corrosion - 3h at 50°C  | ASTM D 130  | 1a                               | 1a                                 | mg/kg                  | n°1       |
| Density at 15°C  | ASTM D 4052 | 834.3                            | 834.4                              | kg/m <sup>3</sup>      | 820 – 850 |
| Derived cetane number  | ASTM D 613  | 56.9                             | 56.3                               | Mass %                 | 51 min    |
| Distillation at 101.3 kPa (T95)  | ASTM D 86   | 356.0                            | 347.0                              | °C                     | 360 max   |
| Flash point  | ASTM D 93   | 71.0                             | 68.0                               | °C                     | 61.5 min  |
| Filter blocking tendency<br>· Volume passed<br>· Initial pressure<br>· Final pressure<br>· Fuel temperature<br>· Procedure | IP 387      | 1.0<br>300<br>0<br>10<br>23<br>B | 1.01<br>300<br>11<br>15<br>21<br>B | MI<br>kPa<br>kPa<br>°C | 2.0 max   |
| ... next page  |             |                                  |                                    |                        |           |

# Analysis of Australian diesel by SGS

| Analyses   | Methods     | Without XBEE                      | With XBEE                         | Units                                | Limits                 |
|--|-------------|-----------------------------------|-----------------------------------|--------------------------------------|------------------------|
| Kinematic viscosity at 40°C  | ASTM D 445  | 2.874                             | 2.872                             | mm <sup>2</sup> /s                   | 2.0 – 4.5              |
| Lubricity by HFRR <ul style="list-style-type: none"> <li>• Minor axis</li> <li>• Major axis</li> <li>• Wear scar diameter</li> <li>• Fuel temperature</li> </ul>   | ASTM D 6079 | 340<br>540<br>440<br>60           | 450<br>370<br>410<br>60           | µm<br>µm<br>µm<br>C°                 | 460 max                |
| Oxidation stability, accelerated method <ul style="list-style-type: none"> <li>• Filterable insolubles</li> <li>• Adherent insolubles</li> </ul>   | ASTM D 2274 | 1<br>1                            | 1<br>0                            | g/m <sup>3</sup><br>g/m <sup>3</sup> | 2.5 mg /<br>100 ml max |
| Polycyclic Aromatic Hydrocarbons (PAH) <ul style="list-style-type: none"> <li>• Mono-aromatics</li> <li>• Di-aromatics</li> <li>• Tri + aromatics</li> <li>• Polyaromatics</li> <li>• Total aromatics</li> </ul> | IP 391      | 24.5<br>1.7<br>0.1<br>1.8<br>26.3 | 24.7<br>1.8<br>0.2<br>2.0<br>26.7 | Mass %                               | 11 max                 |
| Total sulfur content   | ASTM D 5453 | 6.8                               | 5.7                               | mg/kg                                | 10 max                 |
| Water and sediment   | ASTM D 2709 | <0,01                             | <0,01                             | Vol %                                | 0.05 max               |
| Water content  | ASTM D 6304 | 50                                | 50                                | mg/kg                                | 200 max                |

Among the most notable elements, we can notice that the lubricity is improved, going from 440 to 410 µm of wear, i.e. a 6.8% improvement.

# Annexes

Original reports

# CERTIFICATE OF ANALYSIS

**Client** XBEE SA  
**File Nr** H2300330LV

**Operation** XBEE 04/23  
**Product** GASOIL  
**SGS OGC Nr** LV2307172d  
**Nature** Ref Mobile diesel

**Sample Ref** Australian diesel  
**Receipt on** 2023-04-26

| ANALYSIS                                   | METHODS            | UNITS             | RESULTS | MIN | TYPICAL | MAX  |
|--|--------------------|-------------------|---------|-----|---------|------|
| <b>Ash from petroleum products</b>         | <b>ASTM D 482</b>  |                   |         |     |         |      |
| Ash content                                |                    | Mass Pct          | < 0.010 |     |         | 0.01 |
| Mass of the sample taken                   |                    | g                 | 79.8646 |     |         |      |
| <b>Fatty Acids Methyl Ester (Inter. A)</b> | <b>NF EN 14078</b> | Vol Pct           | < 0.05  |     |         | 5.0  |
| <b>Carbon residue (micro method)</b>       | <b>ASTM D 4530</b> | Mass Pct          | < 0.10  |     |         | 0.2  |
| <b>10% bottoms used</b>                    |                    |                   |         |     |         |      |
| <b>Cetan Index (calculated - proc. A)</b>  | <b>ASTM D 4737</b> |                   | 53.9    | 46  |         |      |
| <b>Electrical conductivity at 20.8°C</b>   | <b>ASTM D 2624</b> | pS/m              | 1160    | 50  |         |      |
| <b>Copper Corrosion, 3h at 50°C</b>        | <b>ASTM D 130</b>  |                   | 1a      |     |         | 1    |
| <b>Density at 15°C</b>                     | <b>ASTM D 4052</b> | kg/m <sup>3</sup> | 834.3   | 820 |         | 850  |
| <b>Measured cetane number</b>              | <b>ASTM D 613</b>  |                   |         |     |         |      |
| Cetane Number                              |                    |                   | 56.9    | 51  |         |      |
| <b>Distillation at 101.3 kPa, auto</b>     | <b>ASTM D 86</b>   |                   |         |     |         |      |
| Initial Boiling Point                      |                    | °C                | 172.5   |     |         |      |
| 5 % recovered at                           |                    | °C                | 201.6   |     |         |      |
| 10 % recovered at                          |                    | °C                | 213.1   |     |         |      |
| 20 % recovered at                          |                    | °C                | 232.8   |     |         |      |
| 30 % recovered at                          |                    | °C                | 247.8   |     |         |      |
| 40 % recovered at                          |                    | °C                | 260.5   |     |         |      |
| 50 % recovered at                          |                    | °C                | 272.1   |     |         |      |
| 60 % recovered at                          |                    | °C                | 283.8   |     |         |      |
| 70 % recovered at                          |                    | °C                | 297.0   |     |         |      |
| 80 % recovered at                          |                    | °C                | 313.5   |     |         |      |
| 90 % recovered at                          |                    | °C                | 336.3   |     |         |      |
| 95 % recovered at                          |                    | °C                | 356.0   |     |         | 360  |

**In specification parameters.**

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PORT DE BOUC on, 2023-06-22  
Alexandra Cosquer  
Deputy Laboratory Manager Chemist

# CERTIFICATE OF ANALYSIS

**Client** XBEE SA  
**File Nr** H2300330LV

**Operation** XBEE 04/23  
**Product** GASOIL  
**SGS OGC Nr** LV2307172d  
**Nature** Ref Mobile diesel

**Sample Ref** Australian diesel  
**Receipt on** 2023-04-26

| ANALYSIS                              | METHODS            | UNITS              | RESULTS      | MIN         | TYPICAL | MAX        |
|---------------------------------------|--------------------|--------------------|--------------|-------------|---------|------------|
| Final Boiling Point                   |                    | °C                 | 366.0        |             |         |            |
| Recovered at 250 °C                   |                    | Vol Pct            | 31.7         |             |         |            |
| Recovered at 350 °C                   |                    | Vol Pct            | 93.8         |             |         |            |
| Recovered at 360 °C                   |                    | Vol Pct            | 95.8         |             |         |            |
| Total condensed                       |                    | Vol Pct            | 97.8         |             |         |            |
| Residue                               |                    | Vol Pct            | 1.2          |             |         |            |
| Loss                                  |                    | Vol Pct            | 1.0          |             |         |            |
| <b>Flashpoint P-M Closed (meth A)</b> | <b>ASTM D 93</b>   | °C                 | <b>71.0</b>  | <b>61.5</b> |         |            |
| <b>Filter Blocking Tendency</b>       | <b>IP 387</b>      |                    |              |             |         |            |
| Filter Blocking Tendency              |                    |                    | 1.00         |             |         | 2.0        |
| Volume Passed                         |                    | mL                 | 300          |             |         |            |
| Initial Pressure                      |                    | Kpa                | 0            |             |         |            |
| Final Pressure                        |                    | kPa                | 10           |             |         |            |
| Fuel temperature                      |                    | °C                 | 23           |             |         |            |
| Procedure                             |                    |                    | B            |             |         |            |
| <b>Filter Blocking Tendency</b>       | <b>IP 387</b>      |                    |              |             |         |            |
| RETEST                                |                    |                    |              |             |         |            |
| Filter Blocking Tendency              |                    |                    | 1.00         |             |         |            |
| Volume Passed                         |                    | mL                 | 300          |             |         |            |
| Initial Pressure                      |                    | Kpa                | 1            |             |         |            |
| Final Pressure                        |                    | kPa                | 10           |             |         |            |
| Fuel temperature                      |                    | °C                 | 23           |             |         |            |
| Procedure                             |                    |                    | B            |             |         |            |
| <b>Kinematic Viscosity at 40 °C</b>   | <b>ASTM D 445</b>  | mm <sup>2</sup> /s | <b>2.874</b> | <b>2.0</b>  |         | <b>4.5</b> |
| <b>Lubricity by HFRR</b>              | <b>ASTM D 6079</b> |                    |              |             |         |            |

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**PORT DE BOUC on, 2023-06-22**  
**Alexandra Cosquer**  
 Deputy Laboratory Manager Chemist

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**Client** XBEE SA  
**File Nr** H2300330LV

**Operation** XBEE 04/23  
**Product** GASOIL  
**SGS OGC Nr** LV2307172d  
**Nature** Ref Mobile diesel

**Sample Ref** Australian diesel  
**Receipt on** 2023-04-26

| ANALYSIS                                       | METHODS            | UNITS    | RESULTS | MIN | TYPICAL | MAX |
|--|--------------------|----------|---------|-----|---------|-----|
| Minor Axis                                     |                    | µm       | 340     |     |         |     |
| Major Axis                                     |                    | µm       | 540     |     |         |     |
| Wear Scar Diameter                             |                    | µm       | 440     |     |         | 460 |
| Fuel Temperature                               |                    | °C       | 60      |     |         |     |
| <b>Oxidation stability, accelerated method</b> | <b>ASTM D 2274</b> |          |         |     |         |     |
| Filterable insolubles                          |                    | g/m3     | 1       |     |         |     |
| Adherent insolubles                            |                    | g/m3     | 1       |     |         |     |
| Total insolubles                               |                    | g/m3     | 2       |     |         | 25  |
| <b>Polycyclics Hydrocarb. Aromatics IP 391</b> |                    |          |         |     |         |     |
| Mono-aromatics                                 |                    | Mass Pct | 23.4    |     |         |     |
| Di-aromatics                                   |                    | Mass Pct | 1.8     |     |         |     |
| Tri + Aromatics                                |                    | Mass Pct | 0.2     |     |         | 11  |
| Polyaromatics                                  |                    | Mass Pct | 2.0     |     |         |     |
| Total aromatics                                |                    | Mass Pct | 25.4    |     |         |     |
| <b>Polycyclics Hydrocarb. Aromatics IP 391</b> |                    |          |         |     |         |     |
| RETEST   |                    |          |         |     |         |     |
| Mono-aromatics                                 |                    | Mass Pct | 24.5    |     |         |     |
| Di-aromatics                                   |                    | Mass Pct | 1.7     |     |         |     |
| Tri + Aromatics                                |                    | Mass Pct | 0.1     |     |         |     |
| Polyaromatics                                  |                    | Mass Pct | 1.8     |     |         |     |
| Total aromatics                                |                    | Mass Pct | 26.3    |     |         |     |
| <b>Water Content (proc A)</b>                  | <b>ASTM D 6304</b> | mg/kg    | 50      |     |         | 200 |
| <b>Total sulfur</b>                            | <b>ASTM D 5453</b> | mg/kg    | 6.8     |     |         | 10  |

RETEST

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**File Nr** H2300330LV

**Operation** XBEE 04/23  
**Product** GASOIL  
**SGS OGC Nr** LV2307172d  
**Nature** Ref Mobile diesel

**Sample Ref** Australian diesel  
**Receipt on** 2023-04-26

| ANALYSIS               | METHODS     | UNITS   | RESULTS   | MIN | TYPICAL | MAX  |
|------------------------|-------------|---------|-----------|-----|---------|------|
| Water Content (proc A) | ASTM D 6304 | mg/kg   | <b>50</b> |     |         |      |
| Water and Sediment     | ASTM D 2709 | Vol Pct | < 0.01    |     |         | 0.05 |

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**Client** XBEE SA  
**File Nr** H2300330LV

**Operation** XBEE 04/23  
**Product** GASOIL  
**SGS OGC Nr** LV2307174d  
**Nature** Ref

**Sample Ref** D+15:GO with fuel additive at 1:4000  
**Receipt on** 2023-04-26

| ANALYSIS  | METHODS            | UNITS             | RESULTS      | MIN        | TYPICAL | MAX        |
|---|--------------------|-------------------|--------------|------------|---------|------------|
| <b>Ash from petroleum products</b>                        | <b>ASTM D 482</b>  |                   |              |            |         |            |
| Ash content   |                    | Mass Pct          | < 0.010      |            |         | 0.01       |
| Mass of the sample taken                                  |                    | g                 | 100.8        |            |         |            |
| <b>Fatty Acids Methyl Ester (Inter. B)</b>                | <b>NF EN 14078</b> | Vol Pct           |              |            |         | <b>5.0</b> |
| <b>Fatty Acids Methyl Ester (Inter. A)</b>                | <b>NF EN 14078</b> | Vol Pct           | < 0.05       |            |         | <b>5.0</b> |
| <b>Carbon residue (micro method)<br/>10% bottoms used</b> | <b>ASTM D 4530</b> | Mass Pct          | < 0.10       |            |         | <b>0.2</b> |
| <b>Cetan Index (calculated - proc. A)</b>                 | <b>ASTM D 4737</b> |                   | <b>53.9</b>  | <b>46</b>  |         |            |
| <b>Electrical conductivity at 20 °C</b>                   | <b>ASTM D 2624</b> | pS/m              | <b>930</b>   | <b>50</b>  |         |            |
| <b>Copper Corrosion, 3h at 50 °C</b>                      | <b>ASTM D 130</b>  |                   | <b>1a</b>    |            |         | <b>1</b>   |
| <b>Density at 15 °C</b>                                   | <b>ASTM D 4052</b> | kg/m <sup>3</sup> | <b>834.4</b> | <b>820</b> |         | <b>850</b> |
| <b>Measured cetane number</b>                             | <b>ASTM D 613</b>  |                   |              |            |         |            |
| Cetane Number   |                    |                   | <b>56.3</b>  | <b>51</b>  |         |            |
| <b>Distillation at 101.3 kPa, auto</b>                    | <b>ASTM D 86</b>   |                   |              |            |         |            |
| Initial Boiling Point                                     |                    | °C                | <b>175.4</b> |            |         |            |
| 5 % recovered at  |                    | °C                | <b>203.6</b> |            |         |            |
| 10 % recovered at   |                    | °C                | <b>216.4</b> |            |         |            |
| 20 % recovered at   |                    | °C                | <b>233.4</b> |            |         |            |
| 30 % recovered at   |                    | °C                | <b>247.7</b> |            |         |            |
| 40 % recovered at   |                    | °C                | <b>258.9</b> |            |         |            |
| 50 % recovered at   |                    | °C                | <b>270.7</b> |            |         |            |
| 60 % recovered at   |                    | °C                | <b>282.4</b> |            |         |            |
| 70 % recovered at   |                    | °C                | <b>295.4</b> |            |         |            |
| 80 % recovered at   |                    | °C                | <b>310.5</b> |            |         |            |
| 90 % recovered at   |                    | °C                | <b>331.3</b> |            |         |            |

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**PORT DE BOUC on, 2023-06-22**  
**Alexandra Cosquer**  
 Deputy Laboratory Manager Chemist



# CERTIFICATE OF ANALYSIS

**Client** XBEE SA  
**File Nr** H2300330LV

**Operation** XBEE 04/23  
**Product** GASOIL  
**SGS OGC Nr** LV2307174d  
**Nature** Ref

**Sample Ref** D+15:GO with fuel additive at 1:4000  
**Receipt on** 2023-04-26

| ANALYSIS                              | METHODS            | UNITS              | RESULTS      | MIN         | TYPICAL | MAX        |
|---------------------------------------|--------------------|--------------------|--------------|-------------|---------|------------|
| 95 % recovered at                     |                    | °C                 | 347.0        |             |         | 360        |
| Final Boiling Point                   |                    | °C                 | 358.1        |             |         |            |
| Recovered at 250 °C                   |                    | Vol Pct            | 31.8         |             |         |            |
| Recovered at 350 °C                   |                    | Vol Pct            | 95.7         |             |         |            |
| Recovered at 360 °C                   |                    | Vol Pct            | irréalisable |             |         |            |
| Recovered at 370 °C                   |                    | Vol Pct            | irréalisable |             |         |            |
| Total condensed                       |                    | Vol Pct            | 98.7         |             |         |            |
| Residue                               |                    | Vol Pct            | 1.2          |             |         |            |
| Loss                                  |                    | Vol Pct            | 0.1          |             |         |            |
| <b>Flashpoint P-M Closed (meth A)</b> | <b>ASTM D 93</b>   | °C                 | <b>68.0</b>  | <b>61.5</b> |         |            |
| <b>Filter Blocking Tendency</b>       | <b>IP 387</b>      |                    |              |             |         |            |
| Filter Blocking Tendency              |                    |                    | 1.01         |             |         | 2.0        |
| Volume Passed                         |                    | mL                 | 300          |             |         |            |
| Initial Pressure                      |                    | Kpa                | 11           |             |         |            |
| Final Pressure                        |                    | kPa                | 15           |             |         |            |
| Fuel temperature                      |                    | °C                 | 21           |             |         |            |
| Procedure                             |                    |                    | B            |             |         |            |
| <b>Kinematic Viscosity at 40 °C</b>   | <b>ASTM D 445</b>  | mm <sup>2</sup> /s | <b>2.872</b> | <b>2.0</b>  |         | <b>4.5</b> |
| <b>Lubricity by HFRR</b>              | <b>ASTM D 6079</b> |                    |              |             |         |            |
| Minor Axis                            |                    | µm                 | 450          |             |         |            |
| Major Axis                            |                    | µm                 | 370          |             |         |            |
| Wear Scar Diameter                    |                    | µm                 | 410          |             |         | 460        |
| Fuel Temperature                      |                    | °C                 | 60           |             |         |            |
| Description of wear scar area         |                    |                    |              |             |         |            |

**In specification parameters.**

Compliance established excluding results uncertainty.

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PORT DE BOUC on, 2023-06-22  
Alexandra Cosquer  
Deputy Laboratory Manager Chemist

# CERTIFICATE OF ANALYSIS

**Client** XBEE SA  
**File Nr** H2300330LV

**Operation** XBEE 04/23  
**Product** GASOIL  
**SGS OGC Nr** LV2307174d  
**Nature** Ref

**Sample Ref** D+15:GO with fuel additive at 1:4000  
**Receipt on** 2023-04-26

| ANALYSIS                                       | METHODS            | UNITS    | RESULTS | MIN | TYPICAL | MAX  |
|--|--------------------|----------|---------|-----|---------|------|
| <b>Oxidation stability, accelerated method</b> | <b>ASTM D 2274</b> |          |         |     |         |      |
| Filterable insolubles                          |                    | g/m3     | 1       |     |         |      |
| Adherent insolubles                            |                    | g/m3     | 0       |     |         |      |
| Total insolubles                               |                    | g/m3     | 1       |     |         | 25   |
| <b>Polycyclics Hydrocarb. Aromatics IP 391</b> |                    |          |         |     |         |      |
| (s) Mono-aromatics                             |                    | Mass Pct | 32.5    |     |         |      |
| (s) Di-aromatics                               |                    | Mass Pct | 2.4     |     |         |      |
| (s) Tri + Aromatics                            |                    | Mass Pct | 0.2     |     |         | 11   |
| (s) Polyaromatics                              |                    | Mass Pct | 2.6     |     |         |      |
| (s) Total aromatics                            |                    | Mass Pct | 35.1    |     |         |      |
| <b>Polycyclics Hydrocarb. Aromatics IP 391</b> |                    |          |         |     |         |      |
| RETEST   |                    |          |         |     |         |      |
| (s) Mono-aromatics                             |                    | Mass Pct | 24.7    |     |         |      |
| (s) Di-aromatics                               |                    | Mass Pct | 1.8     |     |         |      |
| (s) Tri + Aromatics                            |                    | Mass Pct | 0.2     |     |         |      |
| (s) Polyaromatics                              |                    | Mass Pct | 2.0     |     |         |      |
| (s) Total aromatics                            |                    | Mass Pct | 26.7    |     |         |      |
| <b>Total sulfur</b>                            | <b>ASTM D 5453</b> | mg/kg    | 5.7     |     |         | 10   |
| <b>Water and Sediment</b>                      | <b>ASTM D 2709</b> | Vol Pct  | < 0.01  |     |         | 0.05 |
| <b>Water Content (proc A)</b>                  | <b>ASTM D 6304</b> | mg/kg    | 50      |     |         | 200  |
| RETEST   |                    |          |         |     |         |      |
| <b>Water Content (proc A)</b>                  | <b>ASTM D 6304</b> | mg/kg    | 50      |     |         |      |

**Australien diesel D+15:GO with fuel additive at 1:4000**

(s) Test performed by other laboratory.

**In specification parameters.**

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**PORT DE BOUC on, 2023-06-22**  
**Alexandra Cosquer**  
 Deputy Laboratory Manager Chemist