Application Note: Distillation of Diesel according to ASTM D7345 using the STARDist micro

Introduction

Distillation analysis of diesel fuels is an essential quality control step, as the boiling range distribution directly influences engine performance, combustion efficiency, and emissions. Traditionally, laboratories have relied on ASTM D86 for atmospheric distillation of middle distillates such as diesel. While accurate, the D86 procedure is time-consuming, requires larger sample volumes, and involves extensive operator interaction.

STARDist micro from Orbis BV

The STARDist micro is a next-generation automatic atmospheric distillation analyzer, fully conforming to ASTM D7345 and EN 17306. It provides a direct correlation to ASTM D86 and ISO 3405, ensuring regulatory acceptance and consistency with established distillation practices.

Conformity: ASTM D7345, EN 17306, IP 596
Direct Correlation: ASTM D86, ISO 3405, IP 123

Key Features and Benefits:

- **Ultra-fast testing:** Complete distillation of diesel samples in under 10 minutes, compared to 60–90 minutes for ASTM D86.
- **Automation & ease of use:** One-touch operation with automatic heating profile optimization.
- **Accurate and compliant:** Results in excellent correlation with ASTM D86, validated through global interlaboratory studies.
- **Improved safety:** Automated Extinguisher fire suppressing system.

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Theory of Micro-Distillation

Micro-Distillation according to ASTM D7345 uses the principles of vapor–liquid equilibrium and the ideal gas law (PV = nRT) to determine boiling behavior with only 10 mL of sample.

As the sample is heated in a sealed cell, changes in temperature and vapor pressure are precisely measured. Instead of collecting and weighing large volumes of distillate as in ASTM D86, the method calculates distillation points directly from these pressure–temperature relationships. This approach makes the process much faster, safer, and more efficient while still delivering results that correlate closely with ASTM D86.

The figure below illustrates a typical distillation profile generated by the STARDist micro during analysis of a diesel sample according to ASTM D7345.

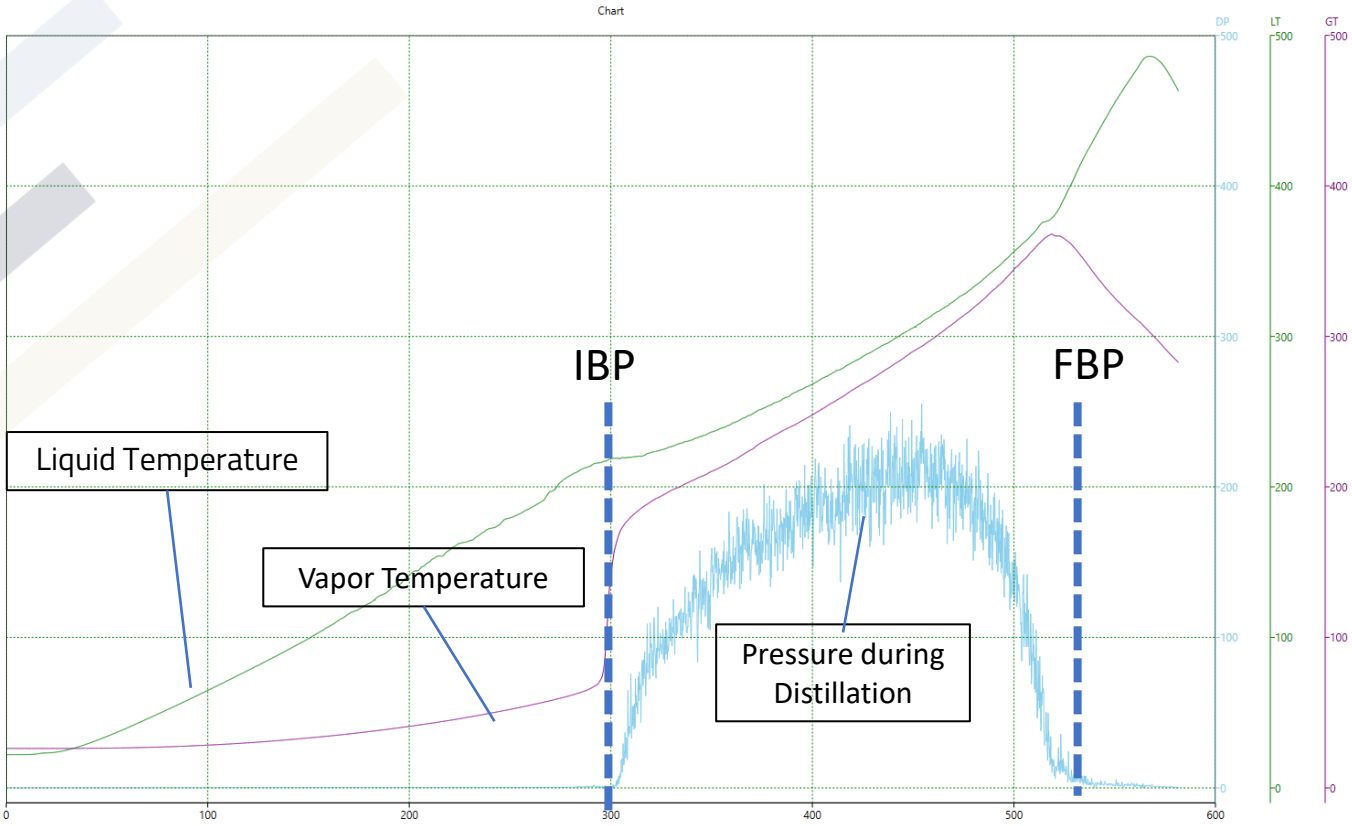

Figure 1: Distillation profile from the STARDist micro on a diesel sample.

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Proficiency Testing Results Diesel Fuel

To validate the robustness of ASTM D7345 for diesel analysis, Orbis BV participated in the ASTM International Proficiency Testing Program (PTP) for No. 2 Diesel Fuel (Sample DF22502, February 2025 cycle) using the STARDist micro.

Key Findings:

- **Excellent correlation with consensus values:**
  Reported results for IBP, distillation recovery points (5%–95%), and Final Boiling Point were all within the reproducibility limits of ASTM D7345.
- **Consistency with global laboratories:**
  More than 30 laboratories worldwide submitted results. The STARDist micro values closely tracked the overall program averages, confirming equivalence to established distillation practices.

These results demonstrate that the STARDist micro produces reliable and reproducible distillation curves fully aligned with international interlaboratory performance.

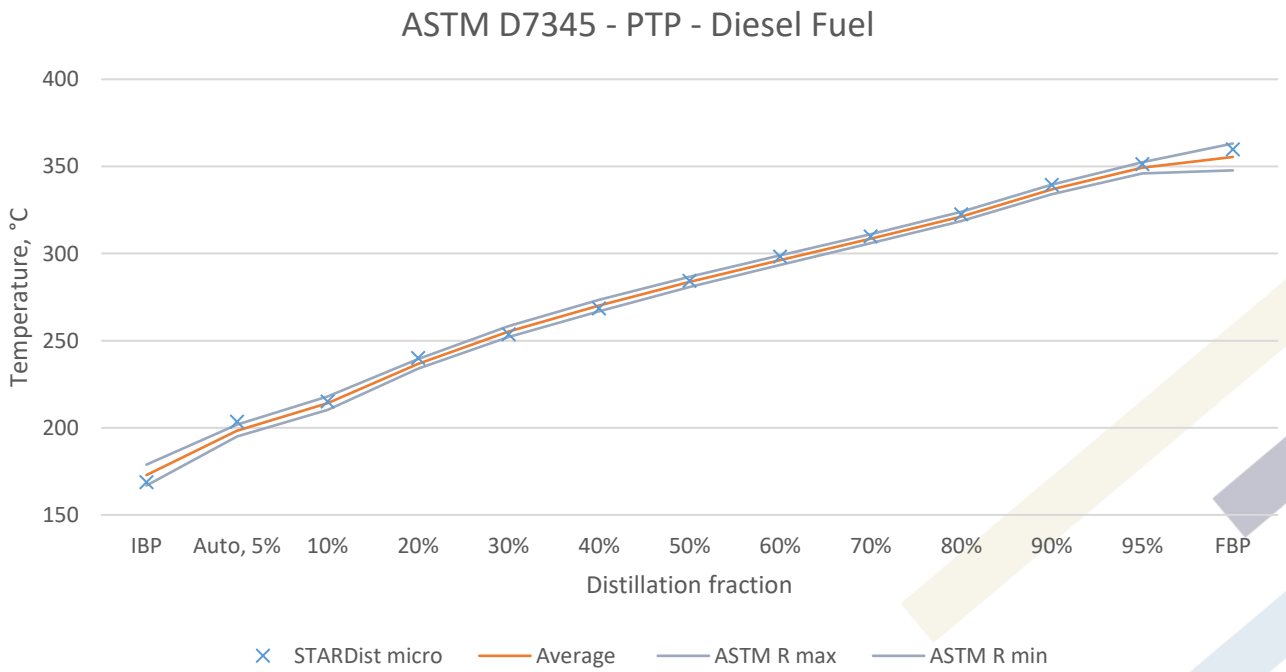

Figure 2: Distillation graph of Diesel from ASTM PTP, n = 34 labs

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Corallation test D7345 vs ASTM D86

To evaluate the correlation between micro-distillation (ASTM D7345) and traditional atmospheric distillation (ASTM D86), datasets of Diesel fuel were analyzed using both the STARDist micro and the STARDist Automated distillation systems from Orbis BV.

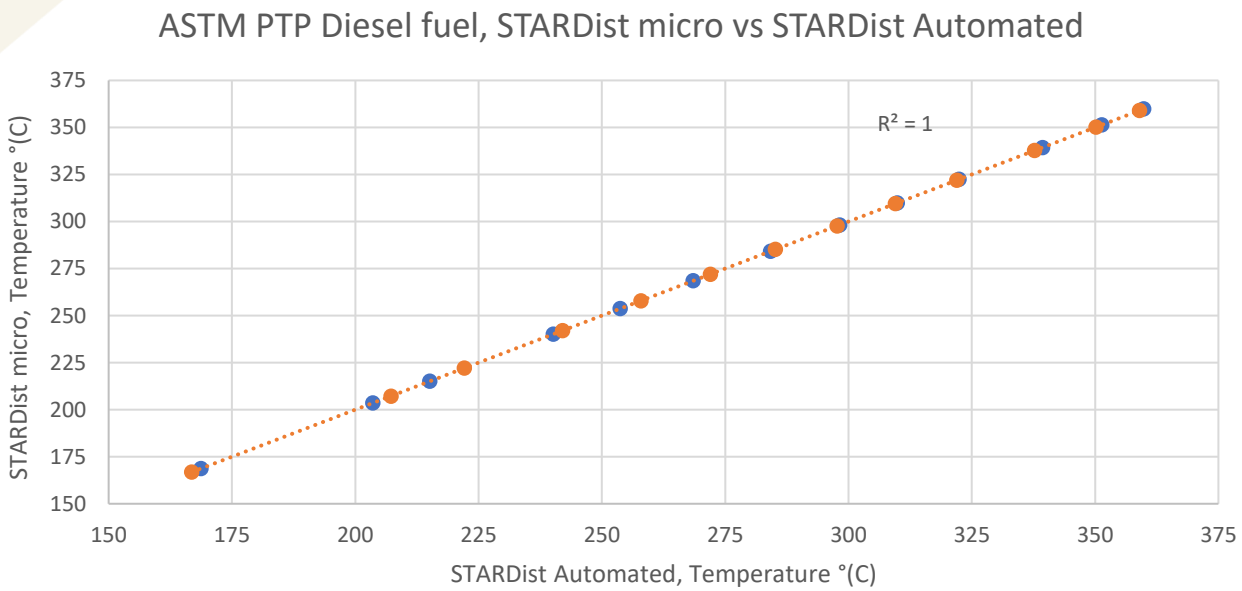

Figure 3: Comparising results from diesel sample distillation by STARDist micro vs STARDist Automated.

Fraction (%)	IBP	5	10	20	30	40	50	60	70	80	90	95	FBP
STARDist micro	168,70	203,50	215,10	240,10	253,70	268,50	284,20	298,20	309,90	322,40	339,30	351,30	359,80
PTP D7345 Average (n=35)	172,87	198,40	214,12	236,79	255,34	270,14	283,75	296,18	308,48	321,27	336,82	349,23	355,46
STARDist Automated	166,82	207,21	222,11	241,98	257,88	271,97	285,18	297,68	309,51	321,93	337,71	350,16	358,96
PTP D86 Average (n=405)	167,31	203,08	219,10	240,19	256,30	270,58	283,68	296,12	308,11	320,63	336,44	348,96	357,40

Distillation temperatures at various recovery points were compared by plotting ASTM D7345 values against ASTM D86 values, with D7345 on the Y-axis and D86 on the X-axis. The data revealed a near-perfect linear relationship ($R^2 = 1$), clearly demonstrating that the STARDist micro delivers distillation results fully equivalent to those obtained by the conventional ASTM D86 method for diesel fuels.

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Conclusion

For diesel fuel analysis, the STARDist micro offers laboratories a powerful alternative to conventional ASTM D86 distillation. It combines speed, safety, and reliability without compromising compliance or accuracy. By adopting ASTM D7345 with the STARDist micro, laboratories can significantly increase productivity, reduce operating costs, and maintain full confidence in their quality control processes.

STARDist micro conforms to the following testing methods:

- ASTM D7345
- EN 17309
- IP 596

STARDist micro is in direct correlation to the following testing methods:

- ASTM D86
- ISO 3405
- IP 123

Key Features

- Only 10ml of sample is required
- Volume measurement of condensate recovered is not required
- One touch operation
- Test process automation
- Intelligent result judgment
- no need to set sample type
- automatic heating profile optimization.
- Sub 10-minute sample analysis
- computer controlled distillation process

STARDist conforms to the following testing methods:

- ASTM D86, D850, D1078
- ISO 3405
- JIS K2254

Key Features

- User-Guided Start – for ensuring method compliant preparation and testing
- Pre-Scan – measurement of actual Charge Volume and Sample Temp. before test start.
- Method Validation – for real-time validation against method-specified limits
- Auto In-Heat – for automatic & dynamic initial heat settings when testing unknown products
- Optimization – for program improvement suggestions that can be implemented automatically
- Easy To Use Software – for extensive customization in a clear interface
- Network Integration – for modern connectivity and data handling solutions