eraspec X: Portable FAME in diesel measurement in full compliance with EN 14078

Introduction to using FAME in Diesel and Marine Fuels

Fatty Acid Methyl Esters (FAME) are the predominant biodiesel components blended into petroleum diesel to reduce lifecycle greenhouse-gas emissions and to improve fuel sustainability. Globally, common blend levels include B5 and B7 (5-7% FAME), which are widely used in passenger cars and light-duty vehicles due to compatibility with existing fuel standards and aftertreatment systems. Higher blends such as B20 and B30 are increasingly adopted in heavy-duty trucks, municipal fleets, buses, and agricultural or construction equipment, where modern engines and OEM approvals support enhanced renewable content. B30 is often used in controlled fleet environments to balance emissions reduction with manageable impacts on cold-flow properties, oxidation stability, and material compatibility.

In marine applications, FAME levels generally remain ≤7% to minimize risks related to fuel degradation, microbial growth, and long-term storage on vessels. However, pilot projects with B20 - B30 are emerging in coastal shipping as regulators and operators seek cost-effective decarbonization pathways.

Looking forward, global FAME usage is expected to increase as renewable-fuel mandates expand, especially in heavy-duty and off-road sectors. Nevertheless, its growth will be tempered by feedstock limitations, tightening fuel-quality requirements, and the rising prominence of advanced biofuels and e-fuels. As a result, FAME blends will continue to play a significant role in the long-term diesel and marine-fuel transition.

FTIR standards for FAME measurements

Internationally, the most commonly used standards based on FTIR spectroscopy are EN 14078, ASTM D7806, and ASTM D7371. Although all of them rely on mid-infrared (mid-IR) spectroscopy for the quantification of FAME in petroleum-derived fuels, their underlying measurement principles and operational requirements differ in several important ways.

EN 14078 and ASTM D7806 both employ conventional transmission cells with defined path lengths, whereas ASTM D7371 utilizes an

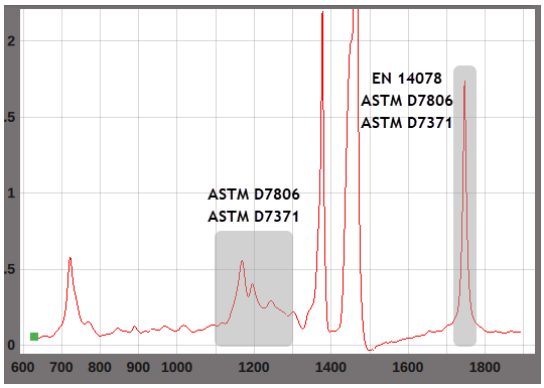

Figure 1: Spectral range FAME measurements

attenuated total reflectance (ATR) cell, resulting in a fundamentally different measurement geometry and interaction depth.

At low FAME concentrations, all three standards exploit the characteristic ester carbonyl absorption band near 1745 cm^{-1} (Figure 1). EN 14078 evaluates the (baseline-corrected) peak height at this wavelength, while ASTM D7806 determines the integrated peak area, enhancing linearity across different fuel matrices.

At higher concentration, ASTM D7806 and ASTM D7371 shift to alternative spectral regions where absorbance remains within an appropriate dynamic range, thereby eliminating the need for dilution. Moreover, ASTM D7806 includes an algorithm for detecting triglyceride (TAG) contamination, offering an additional diagnostic capability.
EN 14078 requires either reducing the optical path length or more commonly used, diluting the sample for the measurement of higher concentrations.

Benefit of EN 14078 over the ASTM methods are a higher precision and its widespread use in fuel specifications and standards. Its scope explicitly covers middle distillates, including automotive diesel and heating oil, and it is also cited by CIMAC for the determination of FAME in marine fuels. Finally, EN 14078 offers a practical advantage in calibration: the same samples can be used across all three measurement ranges when appropriate dilution factors are applied, simplifying calibration and ensuring consistency throughout the measurement process.

EN 14078 measurements using eraspec X

era**spec X** is a portable FTIR spectrometer fully compliant with the EN 14078 standard. The intuitive user interface enables the user to enter the actual dilution, and the software supports different calibration curves for different dilution ranges.

To ensure a stable background, era**spec X** prompts the user to perform a solvent based background measurement at least once a day as required by EN 14078. The solvent selected for this step should be identical to the solvent used for the dilution of high concentration samples. Jet fuel or kerosene D140 are recommended, as they don't exhibit any significant absorbances near the ester carbonyl band at approximately 1745 cm^{-1}.

If the anticipated FAME concentration lies within the instrument's linear range, no additional preparation is required. The operator simply injects the sample, initiates the measurement, and era**spec X** automatically evaluates the spectrum and displays the result on the touch screen. era**spec X** exhibits excellent linearity across, and even beyond, the full concentration span defined in EN 14078 (see Figure 2 & 3).

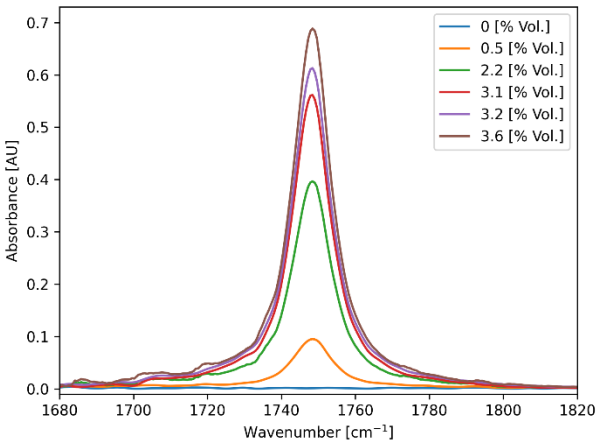

Figure 2: FAME Carbonyl PEAK EN 14078

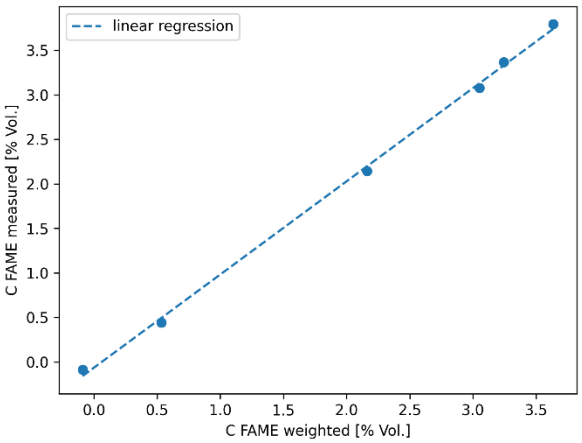

Figure 3: Linear response EN 14078

When the expected FAME content exceeds the linear range, dilution is necessary to bring the sample into the valid measurement window. For range B (up to 20% FAME), a 1:5 dilution (1 part sample plus 4 parts solvent) is recommended. For range C (up to 50% FAME), the dilution ratio increases to 1:10. These steps ensure that absorbance values remain within the optimal dynamic range of the detector and that calibration accuracy is maintained.

Diesel fuels and heating oils can typically be analyzed using the default factory calibration supplied with era**spec** X. In markets where short chain FAME (e.g. PALM FAME), or in marine fuels with non-zero background due to matrix effects, the user can easily introduce custom calibrations directly on the instrument using an intuitive calibration wizard.

Conclusion

The use of FAME as a blending component in fuels is expected to grow in importance, driven by regulatory requirements, decarbonization strategies, and the increasing diversity of renewable fuel formulations. As concentration ranges broaden and fuel matrices become more complex, accurate and reliable on-site measurement becomes essential. era**spec X** offers an optimal solution for FAME determination in full compliance with EN 14078. Its combination of portability, analytical precision, and simple operation makes it equally well suited for the use in centralized laboratories as well as in mobile field-testing environments. In this way, era**spec X** supports effective quality assurance throughout the fuel supply chain, from production and blending to distribution and end-use verification.