



EUROPEAN COMMISSION GUIDELINES: ACTUAL METHANE SLIP FACTORS

The European Commission (EC) has issued Guidelines outlining how Companies can report and verify actual tank-to-wake methane slip (C_{slip}) emission factors for marine diesel engines under the FuelEU Maritime Regulation (FEUM). This approach combines the IMO protocol of Resolution MEPC.402(83) for methane slip measurements with an interim procedure for engine load monitoring until international standards are established and integrated into the EU framework. Operators may also apply the same interim solution under EU MRV/ETS.

WHY VERIFIED METHANE SLIP MATTERS

Methane slip from internal combustion engines increases the vessel's overall CO₂-equivalent (CO_{2eq}) emissions. Given that according to the IPCC Fourth Assessment Report (AR4) methane has 25 times the global warming potential (GWP) of CO₂, methane slip emissions significantly impact a vessel's greenhouse gas (GHG) footprint. Slip levels depend heavily on the engine's load, with lower loads generally resulting in higher slip. High methane slip can erode the GHG advantage of LNG compared to conventional liquid fuels.

Engine designers and manufacturers work on reducing methane slip through advanced combustion technologies and after-treatment solutions. However, default methane slip factors (C_{slip}) used under FEUM are based solely on engine type and may not reflect the improvements achieved through upgrades or optimization. As FEUM thresholds tighten over the next decade, verified actual methane slip factors can significantly lower penalty exposure and generate compliance surplus.

Default methane slip factors under FEUM:

Engine type	Methane slip (% of consumed fuel)
LNG Otto (dual fuel, medium speed)	3.1%
LNG Otto (dual fuel, slow speed)	1.7%
LNG Diesel (dual fuel, slow speed)	0.2%
LBSI (lean-burn spark ignition)	2.6%

KEY NOTES

Applicability:

The European Commission Guidelines apply under FuelEU Maritime and EU MRV/ETS on an interim basis until international standards become available and are accepted under the EU framework.

Significance:

By applying verified methane slip values—especially where technical upgrades have reduced slip—operators can enhance compliance outcomes for the 2025 reporting year and beyond, strengthening the economic case of LNG fueled vessels.

For example, applying actual methane slip emission factors to a 90,000 DWT LNG carrier—with a dual-fuel diesel-electric propulsion system using Otto-cycle medium-speed engines and an emission abatement system achieving a 50% methane slip reduction—could generate over EUR 500,000 annually through pooling arrangements.

MEASUREMENT PROTOCOL: TEST BED AND ONBOARD (IMO MEPC.402(83))

Methane slip measurements and calculations—conducted on a test-bed or onboard—must follow **IMO Resolution MEPC.402(83)** and include the 10% mode point or the lowest mode point at which gas fuel would be used.

- **Onboard measurements following protocol set out in MEPC.402(83):**
 - Acceptable for an **Individual Engine** or for an **Engine Group** represented by the **Parent Engine**.
 - **Not** acceptable for an **Engine Family** without further justification.
- **Test-bed measurements following protocol set out in MEPC.402(83):**
 - May be accepted for an **Engine Family**.

Use of THC as a proxy for methane:

If direct methane measurement is not performed, measurements of total hydrocarbons (THC) performed according to MEPC.402(83) or the NOx Technical Code 2008 (NTC as amended) may be used as a proxy. In that case, the THC measurements should include a 10% mode point or the lowest mode point at which gas fuel would be used.

ENGINE LOAD MONITORING AND CALCULATION OF ACTUAL METHANE SLIP

The EC Guidelines provide an interim procedure for engine load monitoring (ELM) to be used in combination with methane slip measurements verified in accordance with MEPC.402(83). This procedure enables the calculation of a methane slip emission factor that reflects the actual operation of the engine, rather than relying on the predefined weighting factors provided in section 3.2 of the NTC 2008.

Engine load should be continuously monitored and recorded at a frequency of at least 0.0033 Hz and averaged over 30-minute intervals—or shorter, if agreed with the FEUM Verifier.

Load determination may be based on one or a combination of the following signals:

- Direct load measurement signal
- Torque flange and engine speed
- Shaft strain gauge and engine speed
- Calculated from generator output
- Estimated load based on cylinder pressure, injection duration as in 6.4.3.4 of the NTC 2008

The EC Guidelines outline two approaches for calculating actual methane slip:

- **Option A:** Based on gas fuel flow measurement and using C_{slip} (%) data points measured per MEPC.402(83).
- **Option B:** Without gas fuel flow measurement, using emission factor (g/kWh) data points measured per MEPC.402(83).

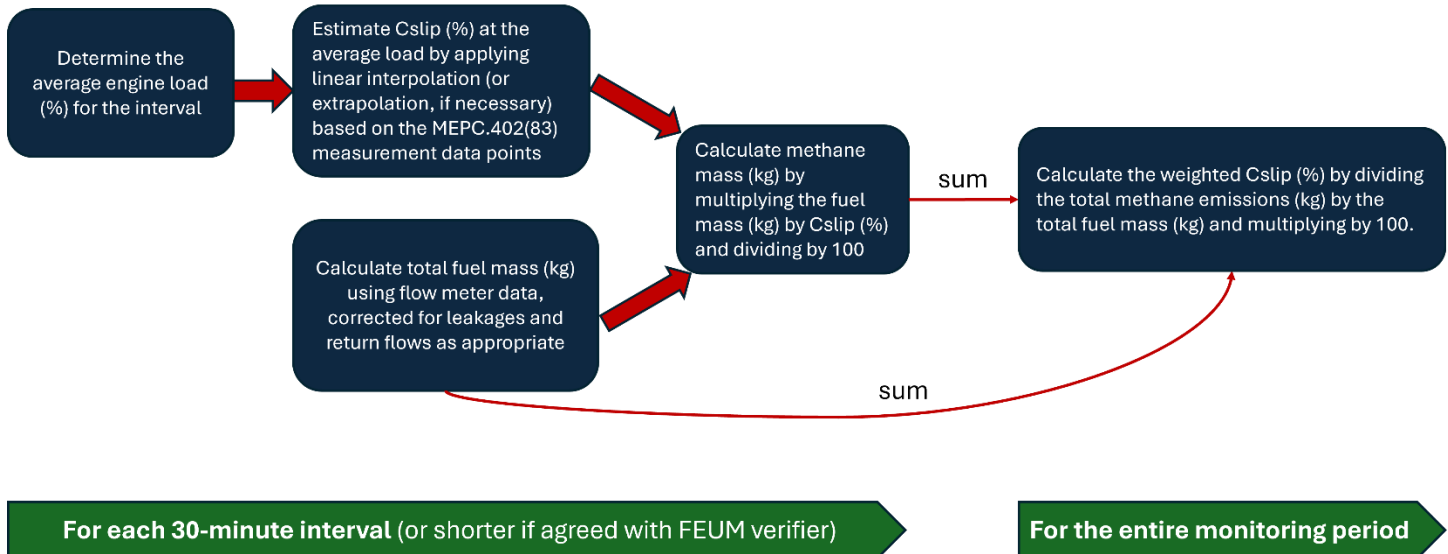


Figure 1: Option A for calculating actual methane slip.

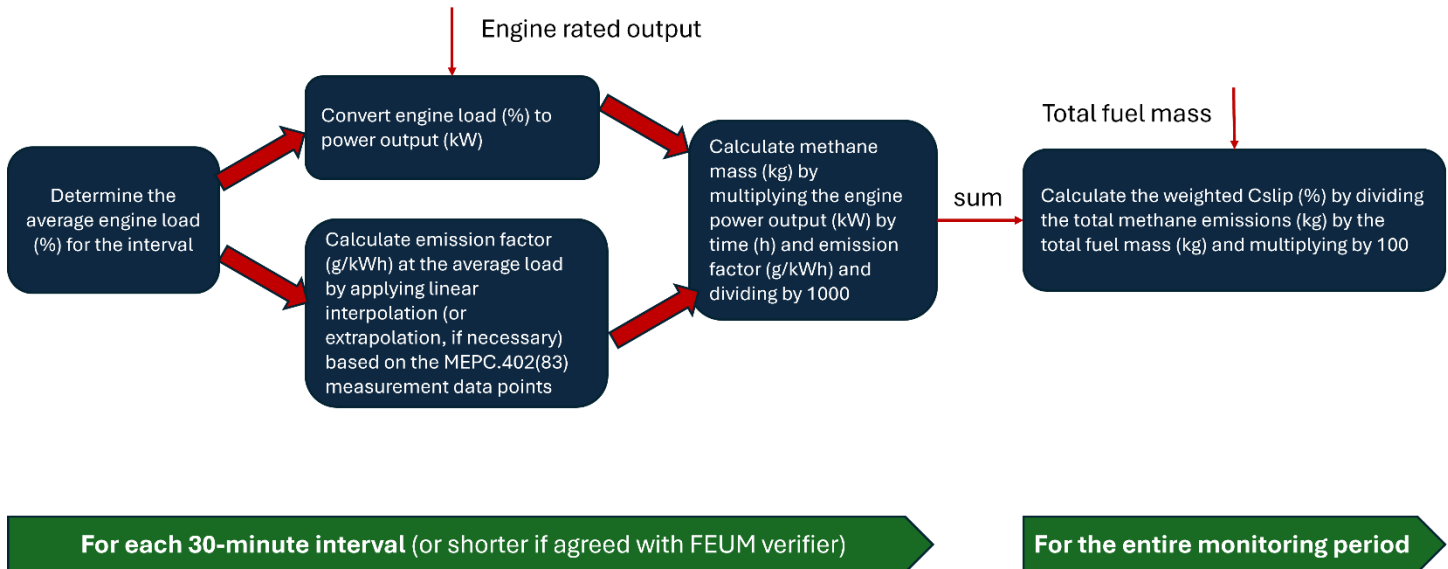


Figure 2: Option B for calculating actual methane slip.

DOCUMENTATION REQUIREMENTS

To use actual tank-to-wake methane slip emission factors, the Company should prepare the following documentation:

- **Methane File (MEPC 402(83)):** Compile a Methane File per MEPC 402(83), including additional information detailed in section 2.2 of the EC Guidelines.
- **Record Book of Changes Affecting Methane Slip:** Document changes to components, settings and operational values that may increase methane slip emissions, safeguarding the validity of the measurements.
- **Record Book for the Methane Abatement Aftertreatment Device:** Provide information of operational periods and maintenance activities for methane abatement devices, where fitted.

- **Additional FEUM Reporting:** Submit annually to the FEUM Verifier together with the FEUM Report:
 - Data and calculations related to engine load monitoring for the reporting period.
 - Calibration certificates of instruments used in load monitoring (use NTC requirements as guidance).
 - If applying the parameter check method, include records of changes to engine parameters and settings that may increase methane emissions during the reporting period.

VERIFICATION OF THE METHANE EMISSION VALUES

Initial Verification

- **Approval of Methane File:** Submit the Methane File (per MEPC.402(83) with additions according to section 2.2 of the EC Guidelines) to the flag Administration or a Recognized Organization (RO) for approval.
- **FuelEU Monitoring Plan Update:** Amend Table B9 (*“Procedures for monitoring and reporting the well-to-tank and tank-to-wake emission factors of energy to be used on-board”*) with a brief description of the procedure and a reference to the approved Methane File and submit the modified FuelEU Monitoring Plan to the FEUM Verifier for assessment.

Using actual methane slip factors for the reporting period **requires all of the following conditions to be fulfilled:**

1. Methane measurements completed before the end of the reporting period for which the Company intends to use the actual slip emission factors.
2. No changes to components, settings, or operating values that could increase methane slip across the reporting period.
3. Engine load monitoring procedures were in place from the beginning of the reporting period.

If any condition is not met, the actual emission factor can only be considered from the date when all conditions are satisfied.

Yearly Verification

The following should be reported annually by Companies in the FEUM Report and verified by FEUM verifier:

- Load monitoring data and emission factor calculations according to Annex I of the EC Guidelines.
- Results of the verification procedure, establishing the validity of methane test cycles—via parameter check or onboard measurement.
- For engines with methane abatement systems, an updated maintenance record book as close as practical to the end of the reporting period.

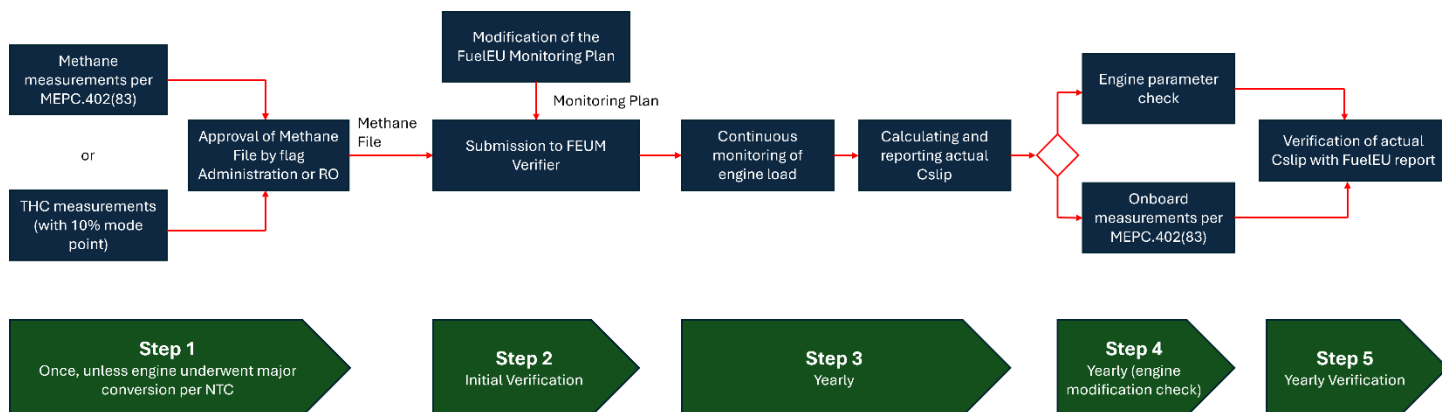


Figure 3: Main steps according to the EC Guidelines.

PRACTICAL RECOMMENDATIONS

- **Assess methane slip reduction solutions:** Perform a techno-economic analysis of applicable abatement technologies to identify the most cost-effective options.
- **Target high CH₄ slip engines first:** Conduct methane measurements on engines with higher default slip factors (e.g., LNG Otto). These engines present the strongest potential for improvement.
- **Ensure instrument readiness:** Ensure load monitoring instrumentation is calibrated and operational, with traceable certificates.
- **Implement change control:** Maintain a robust parameter change log and maintenance record system to defend the validity of measured factors.

REFERENCES

Document	Title
European Commission Guidelines	Guidelines for reporting and verification of actual methane slip tank-to-wake emission factors from marine diesel engines under the scope of FuelEU Maritime Regulation
IMO Resolution MEPC.402(83)	Guidelines for test-bed and onboard measurements of methane (CH ₄) and/or nitrous oxide (N ₂ O) emissions from marine diesel engines

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