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Regulations for Emissions from Marine Vessels



This page provides links to regulations and other information for marine engine emissions.

- [Regulations for emissions from marine spark-ignition engines](#)
- [Domestic regulations for emissions from marine compression-ignition \(diesel\) engines](#)
- [International standards to reduce emissions from marine diesel engines and their fuels](#)

LAST UPDATED ON AUGUST 16, 2017

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International Standards to Reduce Emissions from Marine Diesel Engines and Their Fuels

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Overview

EPA participates on the U.S. delegation to the International Maritime Organization (IMO), which is part of the United Nations. The Marine Environment Protection Committee (MEPC) is a group of member states within IMO that works on maritime safety and security and the prevention of marine pollution. The resulting global standards are embodied in the International Convention on the Prevention of Pollution from Ships, a treaty called "MARPOL." In particular, MARPOL Annex VI defines engine and vessel requirements related to air pollution.

The first round of standards under MARPOL Annex VI, adopted in 1997 and entered into force in 2005, involved maximum allowable sulfur concentrations in marine fuels, and maximum oxides of nitrogen (NO_x) emission rates in engine exhaust. MARPOL Annex VI was amended in 2008, most importantly to set more stringent fuel sulfur limits and more stringent NO_x emission standards, especially for vessel operation in designated Emission Control Areas (ECAs).

Together with Canada and France, the U.S. Government successfully petitioned the International Maritime Organization to designate the North American Emission Control Area for both fuel-sulfur standards and NO_x emission standards. This area includes

most coastal waters up to 200 nautical miles from the coasts of the continental United States and large portions of coastal waters around Alaska and Hawaii, in addition to significant portions of the Canadian coasts and the French Islands of Saint Pierre and Miquelon.

The U.S. Government later successfully petitioned the International Maritime Organization to also designate the U.S. Caribbean Sea Emission Control Area for both fuel-sulfur limits and NO_x emission standards. This area includes waters surrounding Puerto Rico and the U.S. Virgin Islands.

Vessels operating in Emission Control Areas must meet the following requirements:

- Fuel-sulfur concentrations may not exceed 0.10 weight percent, or vessels may use an approved equivalent method (such as SO_x scrubbers, also known as exhaust gas cleaning systems).
- Engines above 130 kW installed on vessels built (or modified) since 2000 must be certified to meet appropriate emission standards corresponding to the vessel's build date (or modification date). As of January 1, 2016, engines installed on new and modified vessels are subject to the Annex VI Tier III NO_x standards while those engines are operating in the ECA.

The international standards apply to both U.S. vessels and to foreign vessels. Engines installed on U.S. vessels are also subject to fuel standards and engine emission standards that EPA has adopted under the Clean Air Act. (For more information, see "Diesel fuel standards" in Related Topics.)

Learn more:

- [Guidance documents related to Annex VI standards for marine vessels](#)
- [Reports related to Emission Control Areas \(ECAs\) for marine vessels](#)
- [Designation of the U.S. Caribbean ECA for marine vessels](#)
- [Designation of the North American ECA for marine vessels](#)

List of Related Regulations and Other Publications

Help

For help on using the table:

- [View Table Instructions](#)

North American and U.S. Caribbean Sea ECA – Understanding Compliance Issues

This document addresses Annex VI compliance issues for a range of circumstances. Please note that this discussion is not meant to address every possible circumstance for the topics covered. Vessel operators are encouraged to contact EPA or U.S. Coast Guard before applying these responses for a particular set of circumstances.

Exhaust Gas Cleaning Systems (EGCS)

Keeping in mind application of the International Maritime Organization's (IMO) Resolution MEPC.259(68) 2015 Guidelines for Exhaust Gas Cleaning Systems (EGCS), what are U.S. EPA requirements for the disposal of sludge from an EGCS?

Sludge or residues generated in treating exhaust gas scrubber washwater discharge must not be discharged in waters subject to the VGP (i.e., including waters of the territorial sea up to a distance of three miles) and should be delivered ashore to adequate reception facilities. VGP 2.2.26. The United States further expects MARPOL Annex VI Regulation 4 equivalency approvals to be conditioned upon compliance with IMO guidelines, including IMO's 2015 Guidelines for Exhaust Gas Cleaning Systems. See Regulation 4.3. The 2015 Guidelines at 10.4 explain that EGCS residues should not be discharged to the sea, and Annex VI prohibits incineration on board.

For open loop EGCS, will EPA consider the effluent pH value based on a calculation (i.e., computational fluid dynamics) as described in IMO Resolution MEPC.259(68) 2015 Guidelines for Exhaust Gas Cleaning Systems?

EPA clarified in the response to comments for the 2013 VGP that a computational calculation is not an approved method for demonstrating compliance with Vessel General Permit (VGP) pH requirements. (RTC, p.981).

For discharges of scrubber wash water effluent from open loop EGCS outside three miles but within an ECA, has EPA developed any additional requirements for scrubber wash water effluent pH outside the area where the VGP applies?

EPA has not established requirements that apply to scrubber washwater effluent beyond the requirements implemented through the VGP. However, as noted above, the United States expects Regulation 4 equivalency approvals to be conditioned upon compliance with IMO guidelines, including IMO's 2015 Guidelines for Exhaust Gas Cleaning Systems. See Regulation 4.3.

What are EPA concerns with the measurement of polycyclic aromatic hydrocarbons (PAH), turbidity and temperature in the effluent from the EGCS?

As part of EPA's development of its 2013 VGP, the Agency evaluated EGCS washwater discharges and prepared a report summarizing our findings. That EPA report, "Exhaust Gas Scrubber Washwater Effluent", EPA-800-R-11-006, November 2011, is available online and provides a discussion of those pollutants and monitoring of those pollutants. EPA expects to continue to assess the monitoring of these pollutants over the life of the permit. See, <http://nepis.epa.gov/Exe/ZyPDF.cgi/P100DCMY.PDF?Dockey=P100DCMY.PDF>.

Does the EPA require the effluent from EGCS to be treated?

The 2013 VGP requires EGCS effluent to meet certain numerical discharge limitations. The permit does not specify how the operator is to meet these limitations, although, EPA expects that in most instances, compliance with the numeric limitations cannot be achieved except through treatment. Also, as specified in Part 2 of the VGP, vessel operators cannot use dilution as a substitute for treatment for the purpose of meeting effluent limitations.

What concerns does the EPA have for the reliability, calibration and maintenance of the continuous emission monitoring equipment?

We do not have concerns about the reliability, calibration, and maintenance of the continuous emission monitoring equipment. Specifications are set out in IMO's scrubber guidelines, and measurement equipment meeting the appropriate specifications is commercially available today. The VGP requires that this equipment be calibrated as recommended by the equipment manufacturers. At a minimum, this means at least annual calibration although EPA acknowledges that it may be much more frequent.

Low Sulfur Fuel Requirements—Dual-fuel engines

The European Union (EU) recently allowed for LNG Carriers to use a mixture of 0.50 % Sulfur Heavy Fuel Oil (HFO) pilot fuel and LNG boil off gas ("BOG") as an equivalent within the EU SECAs. Will EPA consider a similar concept for LNG Carriers to operate within North American and Caribbean ECAs?

This question is about whether the ECA fuel sulfur limits apply for the diesel fuel used for pilot injection with natural gas engines. Regulation 14.4 of Annex VI specifically states that “while ships are operating within an emission control area, the sulfur content of fuel oil used on board ships shall not exceed” the relevant ECA fuel sulfur limits. Thus, ECA sulfur limits apply to all fuel oil used on board a ship, where “fuel oil” means any fuel delivered to and intended for combustion for propulsion or operation on board a ship. The diesel pilot fuel is therefore subject to the sulfur standards and the corresponding documentation requirements. This means that engines may use HFO with sulfur content up to the global cap of 3.50 % (as a pilot fuel or as an alternative fuel) outside of ECA boundaries, as long as the engines have EIAPP certificates showing that they meet applicable NO_x emission standards using that fuel. Within the U.S. portions of the North American and the U.S. Caribbean Sea ECAs, the pilot fuel must meet the 0.10 % fuel-sulfur limit (and of course applicable MAPROL Annex VI ECA NO_x requirements). See MEPC.1/Circ.854 (1 July 2015)¹.

A ship operator may request a Regulation 4 equivalency approval for the use of up to 0.50 % S HFO as a pilot fuel in an ECA. A request for an equivalency approval for a U.S. vessel would need to be submitted to USCG. Similarly, a request for recognizing an equivalency for a foreign vessel would need to be submitted to USCG and approval received by the vessel before such an equivalency can be exercised in our ECA. Any request for a Regulation 4 equivalency approval will be considered on a case-by-case basis. U.S. Government approval for a Regulation 4 equivalency for Regulation 14 fuel requirements may be conditioned on a commitment to continuously monitor sulfur levels in the exhaust to confirm that the fueling rate and the pilot fuel sulfur concentration during any operation within ECA boundaries do not cause an exceedance of the 0.10 % standard.

What are the current compliance requirements for foreign-flag dual-fuel steam turbine vessels built before and after August 2011?

Regulation 14.4.4 of Annex VI contains a provision that postpones the application of the ECA fuel sulfur limits with respect to certain steamships that operate in the North American and U.S. Caribbean Sea ECA. This flexibility is available to steamships, regardless of flag, “built on or before 1 August 2011 that are powered by propulsion boilers that were not originally designed for continued operation on marine distillate fuel or natural gas.” As explained in our paper to IMO requesting this amendment to Annex VI (MEPC 61/7/6), this provision was adopted to provide relief for older steamships that were designed for dedicated operation with heavy fuel oil. LNG tankers that burn boil-off gases and other dual-fuel steamships are designed for continued operation with natural gas and/or marine distillate fuel, so these vessels are not eligible for relief under Regulation 14.4.4. See also 40 CFR 1043.97. Steamships that burn natural gas with a diesel pilot fuel might be able to use a pilot fuel up to 0.50 % sulfur as described for the preceding question.

NO_x Tier III – Dual-fuel engines

Dual-fueled (gas and liquid) foreign vessels¹ contracted on or after 1 January 2016 will generally be operated in gas mode within an ECA. Certain engines can achieve Tier III compliance with-

out extra NO_x control equipment. On such engines, some exceptions to gas mode operation will occur that require using liquid fuel. What is the acceptability of the following short-term and infrequent situations involving operation in liquid fuel mode at a Tier II NO_x level with foreign vessels? (i.e., the normally Tier III gas fueled vessel would not need to fit additional NO_x control equipment for liquid fuel mode):

i. Starting and stopping a four-stroke dual-fuel engine in liquid fuel mode.

Any operation of an engine, where that engine deviates from its emission control strategy, is considered an Auxiliary Control Device (ACD) and must be disclosed when applying for engine certification (See Annex VI Regulations 2.4, 2.13, and 13.9). This includes the operation of a dual fuel or gas-fueled engine on liquid fuel during starting, stopping low load operation, and maneuvering and reversing operations (see MPEC.1/Circ.854, 1 July 2015). Consideration of ACDs for approval will be handled on a case-by-case basis during the certificate approval process.

ii. Stern propulsion, i.e., reversing the engine, in the liquid mode. Reversing is done for short periods during braking and maneuvering of direct drive ships.

See above response.

iii. Maneuvering in low load operations (i.e., below 10 % engine load).

See above response.

iv. Vessels transiting to/from shipbuilding or ship repair facilities which do not have access to LNG.

In situations immediately following building, before or after dry docking, or when repairs or maintenance are done on board the ship, when a ship is required to be in a “gas free” condition due to safety requirements, we may allow the ship to proceed to or from the shipyard, dry dock, or other maintenance location using liquid fuel, without associated Tier III NO_x controls. See MEPC.1/Circ.854 (1 July 2015), para. 8. Permission must be granted before the vessel operates in a NO_x ECA; requests will be considered on a case-by-case basis.

v. Delays to vessels that may lead to all gas fuel being consumed (for example, port is closed by authorities due to an emergency / bad weather and the vessel cannot bunker more LNG until alongside a terminal).

In general, a ship operator is expected to have enough LNG and other compliant fuel onboard to comply with the Tier III NO_x standard as well as the ECA fuel sulfur limits during the anticipated voyage through the ECA. Depending on the sulfur content of the fuel used and how the engine was certified (whether they were certified to meet Tier III only on gas fuel), use of liquid fuel could result in noncompliance with both SO_x and NO_x standards. The USG would address these potential violations on a case-by-case basis.

- vi. **Operating a vessel in the event of temporary gas mode failure (i.e., fuel gas compressor trip, LNG fuel pump trip or low Methane Number of the fuel gas due to a long voyage and the vessel coming to the end of the fuel supply).**

With regard to the first two situations (fuel gas compressor trip and LNG fuel pump trip), these circumstances may be considered to be emergency situations; see below. In the third case, in which the ship does not bunker the appropriate amount of LNG fuel onboard for the planned voyage (taking into account methane number reduction) and must switch operation over to liquid fuel, then the engine would be out of compliance for NO_x, and possibly for SO_x depending on the sulfur content of the fuel used.

- vii. **Operating the vessel in case of non-availability of gas for any other reason out of the control of the vessel operator.**

In general, it is up to the operator of an LNG vessel to ensure that the vessel has enough LNG on board to comply with the Tier III NO_x standards as well as the ECA fuel sulfur limits during the anticipated voyage through the ECA.

What would the reporting requirements be for short duration, transient trips to Tier II liquid fuel mode from Tier III gas mode?

The process of switching from Tier II liquid fuel to Tier III gas mode (and vice versa) are required to take place outside the boundaries of the ECA. Reporting requirements were approved at MEPC 68 and adopted at MEPC 69. MEPC Circular Letter No. 3551 (8 June 2015). These reporting requirements take effect September 2017. Prior to that date, operators must still demonstrate a compliant switchover prior to entering the ECA; demonstration may be accomplished in accordance with MEPC Circular Letter No. 3551 before the effective date of those amendments.

Is there value to include engine gas fuel mode restrictions outside of the NO_x testing cycle in the engine NO_x Technical File for auditing purposes?

Gas fuel mode restrictions are considered auxiliary control devices (ACDs) whether they are inside or outside of the NO_x testing cycle. These ACDs must be disclosed in the application for certification and must be listed in the NO_x Technical File (see Annex VI Regulation 2.4, 2.13, and 13.9)

What is the EPA/USCG interpretation of Annex VI Regulation 13.9 with respect to “ancillary systems” and the fuel gas supply system chain – is it covered?

This provision allows engine manufacturers to design their engines with auxiliary control devices that are used to protect equipment for delivering fuel to the engine (see Regulation 2.4). These systems and their auxiliary control devices (if any) must be described in the application for certification.

NOx Tier III – Other issues

Will USCG and EPA accept a NOx emission averaging scheme?

No. NOx averaging schemes are not allowed; all engines on-board a ship must comply with the Regulation 13 NOx standards.

For vessels operating in an ECA and constructed after 1 January 2016, it is understood that operation of marine diesel engines not meeting NOx Tier III compliance is prohibited. Is it acceptable to install non-Tier III compliant engines provided the same are not operational while in an emission control area?

MARPOL Annex VI Regulation 13.5 specifies that engines installed on vessels built after 1 January 2016, that are operating within a NOx ECA must comply with Tier III NOx standards at all times.

- U.S. vessels: All engines installed on board must meet the engine standards contained in 40 CFR 1042 and 1043.
- Foreign vessels: The U.S. Government takes the position that engines installed on a vessel built on or after 1 January 2016 that are required to be onboard the vessel under the International Convention for the Safety of Life at Sea (SOLAS) must be Tier III compliant. This is appropriate because SOLAS compliance is required while the vessel is operating in the ECA; thus all such SOLAS engines must be certified to comply with Tier III NOx requirements. In addition, if a vessel built on or after 1 January 2016 has one or more engines that are not certified to Tier III NOx standards, the owner/operator of the vessel has the burden of demonstrating that those Tier II engines have not been and will not be used while the vessel is operating within the North American ECA and the U.S. Caribbean Sea ECA. See MEPC Circular 3551 (8 June 2015); and see Guidance on the Application of Regulation 13 of MARPOL Annex VI Tier III Requirements to Dual Fuel and Gas-Fuelled Engines, MEPC.1/Circ.854 (1 July 2015).

What is the expected level of emission compliance redundancy required for foreign vessels with multiple Gensets when not all are used within the NOx ECA?

As noted above, all engines required by SOLAS must be Tier III compliant, including auxiliary engines and generators. Operators have the burden of demonstrating that only Tier III NOx compliant engines will operate within a NOx ECA. Installing only certified engines is one obvious way to make this demonstration. Another option is to keep records consistent with MEPC Circular 3551. If an installed engine fails to comply with the Tier III NOx engine standards while operating within a NOx ECA, such failure may be subject to enforcement proceedings.

General Question

Are there additional emission requirements for a vessel owner that wants to change from being a foreign-flagged vessel to being US-flagged?

A vessel owner who wants to re-flag to the United States should ask USCG to clarify what must be done to bring that ship into compliance with U.S. laws and requirements. To obtain the required IAPP, all engines above 130 kW installed on the ship must have an EPA-issued EIAPP; EPA may issue this based on the original certification test data for the engine showing that it is in its certified configuration. In addition, if a vessel is converted to be U.S.-flagged, all marine engines installed on the vessel are subject to all the provisions of 40 CFR part 1042, which may require that all those engines also be certified to EPA engine emission standards.

For More Information

You can find additional information about EPA and Annex VI requirements on EPA's Office of Transportation and Air Quality (OTAQ) Web site at:

www.epa.gov/regulations-emissions-vehicles-and-engines/regulations-emissions-marine-vessels

www.epa.gov/regulations-emissions-vehicles-and-engines/epa-collaboration-international-air-pollution-standards

www.epa.gov/regulations-emissions-vehicles-and-engines/guidance-documents-related-emissions-control-areas-marine

You may also contact U.S. Coast Guard and EPA directly as follows:

U.S. Coast Guard Headquarters
Office of Commercial Vessel Compliance
Domestic Compliance Division
2703 Martin Luther King Jr. Ave. SE, Mail Stop 7501
Washington, DC 20593-7501
Phone: (202) 372-1224
Fax: (202) 372-1917
E-mail: HQS-PF-FLDR-CG-CVC@uscg.mil

U.S. Environmental Protection Agency
Office of Transportation & Air Quality
Compliance Division
E-mail: complianceinfo@epa.gov

¹ Engines installed on U.S. vessels must comply with 40 CFR part 1042, which allows for operating at a reduced level of emission control outside of ECA boundaries. This provision also requires manufacturers to design their engines in a way that makes it impossible to operate at the reduced level of emission control within ECA boundaries. All questions about exceptions for dual-fuel engines described in this Question 1 therefore do not apply for U.S. vessels.