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## EPA Marine Rules; EPA's Marine Engine Remanufacture Program – What Owners and Rebuilders Need to Know

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### SYNOPSIS

This paper is aimed at exploring different emissions upgrade solutions for vessels to reduce emissions from the existing, or in-use, population of marine engines, with particular focus on meeting the new US Environmental Protection Agency (EPA) Marine Engine Remanufacturing Program requirements. This includes engines that have never fallen under any emissions certifications as well as engines certified up to Tier 2 emissions levels.

The paper focuses specifically on the requirements set forth by the new rules and what is required to comply with the EPA's Marine Engine Remanufacture Program during a normal overhaul. It examines the cost-effective solutions of particular emissions upgrade technologies to meet these new, stricter emissions requirements.

### INTRODUCTION

Emissions from marine diesel engines continue to be highlighted in the public eye, and governmental regulations. Over recent years the EPA has sought to reduce these emissions. Each new Tier level set by the EPA brings about ever-more stringent controls on new marine diesel engines. Because of the relatively long service life of most large marine diesel engines, there is a large population of engines operating around the globe which do not meet current emissions standards, and which will remain in service for years to come. It is this family of engines that the EPA is now focusing on to reduce emissions. The vehicle which the EPA has chosen to use to clean up these unregulated or lesser-regulated engines is the 'Marine Remanufacture Program', the details of which can be found in the CFR Title 40 Sections 1042.801 to 1042.850. This law became effective in March 2008. Further information can be found at [www.epa.gov/OMS/regs/nonroad/marine/ci/420f09003.htm](http://www.epa.gov/OMS/regs/nonroad/marine/ci/420f09003.htm) or <http://ecfr.gpoaccess.gov>.

### EPA MARINE REMANUFACTURE PROGRAM

The following criteria delineate whether a particular engine must comply with the EPA Marine Engine Remanufacture Program:

- Marine diesel engines used in commercial applications. (excluding recreational craft);
- Manufactured between 1973 through the last Tier 2 applicable model year;
- Greater than or equal to 600bKW (804.6bhp);
- Displacement less than 30 litres per cylinder;
- Installed on a vessel flagged or registered in the US.

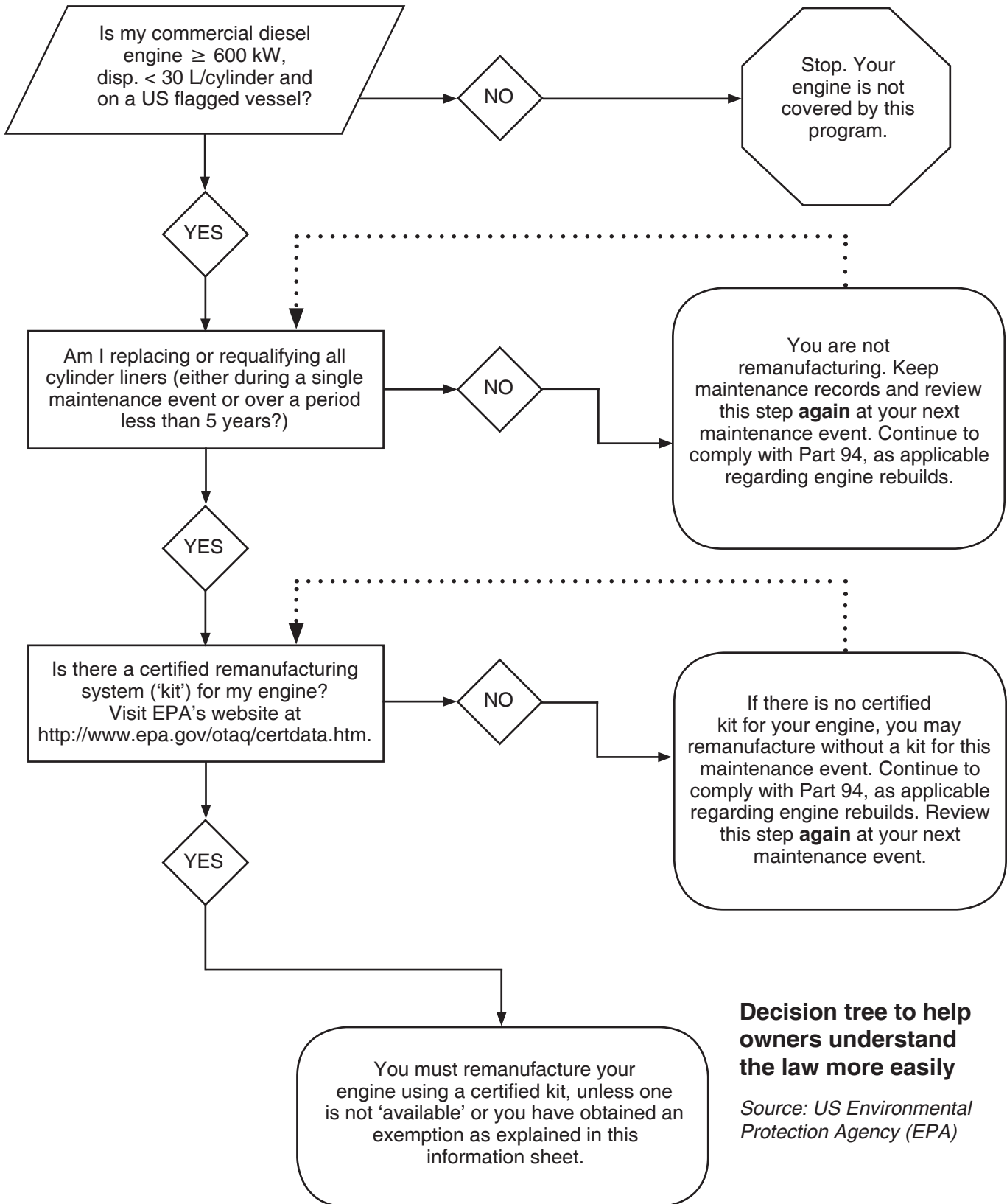
The EPA Marine Engine Remanufacture Program states that if an engine falls under the umbrella of these criteria, and if a 'remanufacture kit' is available that will reduce the engine's particulate matter output by 25 per cent or more without increasing NOx, then such a kit must be used at the next regularly scheduled 'remanufacturing event'. The EPA considers 'remanufacturing' to be the removal and replacement – including the requalifying – of all cylinder liners in a single maintenance event, or over a timeframe of five years or less.

'Requalifying' is defined by the EPA as: "Inspecting a cylinder that may have been recently replaced due to a failure, to make sure it qualifies for continued use". If within a maintenance programme, liners are replaced on a rolling basis, such that all of them are replaced within five years, then at the time of the final liner replacement, the company is required to comply with the law. The EPA will levy fines if it is found that the engines are not in full compliance with the law.

The EPA has created a FAQ to help owners understand the law more easily. The decision tree on page 2, excerpted from that FAQ, will help owners to easily determine if their engines are required to meet this law.

### SOLUTIONS

The EPA has recognised that a variety of technologies may be used to affect the requisite reductions in particulate matter. These technologies include engine upgrade to a more current version, aftertreatment installation on board, alternative fuels and/or fuel additives. A quick search of available publications and literature reveals many products that claim to reduce



**Decision tree to help owners understand the law more easily**

*Source: US Environmental Protection Agency (EPA)*

diesel engine emissions. However, these products are not considered to be a 'remanufacturing kit' until certified as such by the EPA.

The EPA has well-defined processes for certifying a remanufacturing kit. This certification includes a variety of in-house tests to be conducted by the kit manufacturer as well as vessel tests. Each of these

tests is intended for a specific engine family. As such, the EPA certifies these kits on a per engine family basis. A remanufacture kit can be developed by anyone who has the capability to do so. They must apply for EPA certification of the kit by submitting test results showing that the kit will reduce particulate matter emissions as required by the rule. Furthermore, the applicant must show whether end users can obtain the kits in

a timely manner, and install them for a cost of less than \$45,000.00 per ton of particulate matter reduced. If the developer of the kit is not the original engine manufacturer, then all correspondence between the owner and the manufacturer must be submitted and all documentation the manufacturer supplied to the owner.

At the time of writing this paper, there is one known engine manufacturer, EMD, that has obtained certification from the EPA for a remanufacturing kit that applies to this marine law. Furthermore there is at least one more manufacturer, Caterpillar, that is preparing to release kits that in some cases far exceed the intent of the law. This is accomplished by converting unregulated engines, and lesser-regulated engines, to configurations that match more current standards. They not only reduce PM greater than 25 per cent as required by the law, but also reduce every other pollutant to regulated levels, all the while reducing fuel consumption.

## Fuels and Additives

The EPA has made an allowance to certify remanufacturing systems that require the use of alternate fuels, which might include bio-diesel and LNG or other additives that would potentially impact a reduction of particulate matter output. However, the EPA further states that such systems will not be considered 'available'. What this means is, they will certify that a certain system using alternate fuels will in fact meet the intent of the law, but they will not make such a system a requirement to use. For example, if an engine has two certified remanufacture kits, one that is fuel-based, and one that is either on engine, or after-treatment based, the owner of the engine will be able to pick which one to use.

Keep in mind that if the fuel-based kit is chosen, there are stringent tank-labelling and record-keeping requirements to ensure proof of conformity. Also fuel supply considerations will need serious thought. However, if the only option available is a fuel-based kit, then it will not be required to use it at the time of the remanufacturing event.

## Aftertreatment Systems

Aftertreatment systems come in a variety of forms. Each performs its functions using various filters and catalysts. Many require a reagent or other medium to assist in the removal of pollutants. Aftertreatment systems are, as their name implies, another system that must be added to the vessel. Space for the reagent tanks, pumps, filters and catalysts, and in some cases tanks for collecting removed pollutants, must be found within the confines of a vessel that was not originally designed for these extra systems.

There are currently several aftertreatment systems noted on the EPA emerging technologies list. These are likely to be effective at removing the emissions of concern, but at the time of writing this paper, none are certified and further testing is required for them to become certified by the EPA under the Marine

Engine Remanufacturing Program. If, in the future, an aftertreatment-based kit becomes certified for an engine and no other kits are available on the market, it will be required to be installed on the vessel at the time of the next remanufacturing event. There are provisions in the law to petition the EPA for an exemption based on costs, and feasibility.

## Engine Retrofit

Engine manufacturers introduce new engine models, or major changes and upgrades to current engine models, frequently, to keep up with global regulations or to meet ever-changing customer demands. Naturally these engines meet the most current emissions law and in many cases exceed the minimum requirements of the law through implementation of new technologies. (Currently, even if a manufacturer's engine meets the emissions level of the next proposed Tier level, the EPA only allows them to label the engine with the current Tier that is in effect). Owing to the fact that many engine families build on one another from generation to generation, it is not a stretch of the imagination to understand the possibility of retrofitting an older engine with the technology of a newer engine model.

The action of retrofitting an older engine with technology from a new engine model has many benefits beyond reducing particulate matter by 25 per cent. In many cases the engine's emissions levels can be brought into compliance with a more current Tier level. Mechanical engines that are upgraded can benefit significantly from the advantages of electronic engine control. Smoother operation, easier diagnostics, and improved fuel economy are all benefits above and beyond reducing emissions.

Retrofitting an engine has other inherent benefits when compared to aftertreatment solutions, the ease of installation being the most notable. The engine footprint remains the same. No extra tanks are required and readily available fuels can continue to be used without any additional additives or reagents. Considering that this programme is meant to be performed during an overhaul, the act of replacing parts was already on the table; in this case old parts are removed and new updated parts are replaced. All of this is accomplished in hull without major modification of the design or structure of the vessel.

The retrofit option is unique in the fact that it is likely that only the original engine manufacturer has the detailed knowledge of the engine necessary to design such a package. As such, confidence levels in the upgrade should be high. There will be no question as to the compatibility of the upgrade. The EPA requires rigorous testing of an upgrade solution. This includes the testing of a previously in-use engine in a test cell, as well as 1,000-hour field follow tests in an operating vessel. In all cases, in order for these upgrades to be certified by the EPA, not only must they meet the particulate matter reductions, they must also prove durable, and maintain those reductions over time.

The solutions presented in this paper will all meet the intent of the law: the reduction of particulate matter by 25 per cent. Each solution has varying levels of emissions reductions, ease of installation, cost, and further benefits. The decision to use a specific kit may be limited because of the fact that only EPA certified kits are allowed to be used to meet the law.

As with most laws it is important to read the rules very carefully. Currently if no EPA certified kit exists for an engine, then there is no requirement to comply with the Marine Engine Remanufacture Program, until such time as a kit becomes available.

## **CONCLUSION**

The EPA Marine Remanufacture Program is intended to reduce the emissions of engines already in operation. An engine will meet the requirements to comply with it if it is a commercial marine diesel manufactured between 1973 and the last Tier 2 model year, is greater than or equal to 600kW (804.6hp) and has a displacement less than 30 litres per cylinder, and if the vessel is flagged or registered in the United States.

If this is the case, and if the EPA has deemed there is a certified kit 'available' for the engine, then it must be used at the next regularly scheduled remanufacturing event. This event is defined as removing and replacing or requalifying all cylinder liners in a single maintenance event or over a period of five years. There are exemptions to this requirement, which must be requested directly from the EPA. While the law does not state that a kit shall upgrade an engine to a new Tier level, if the engine being upgraded is old enough, it is very likely that upgrading to a Tier level will by definition meet the requirement of the EPA Remanufacture Program.

There are several solution concepts that can be utilised to meet the intent of the law. It is important to remember that a solution must be certified and considered available by the EPA before it is a requirement to use it. When multiple kits are available, the owner will want to carefully choose the best solution for their requirements, keeping in mind installation costs, vessel modifications, and possible other benefits associated with that kit. The EPA has a webpage with a list of certified solutions.