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Air

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# **EPA Regulatory Support Document**

## **Phase 2: Emission Standards for New Nonroad Spark-Ignition Engines At or Below 19 Kilowatts**





# **REGULATORY SUPPORT DOCUMENT**

## **Phase 2: Emission Standards for New Nonroad Spark-Ignition Engines At or Below 19 Kilowatts**

December 1997

U.S. Environmental Protection Agency  
Office of Mobile Sources  
Engine Program and Compliance Division  
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Ann Arbor, MI 48105

## **ACKNOWLEDGEMENTS**

### PHASE II

The Regulatory Negotiation for this rulemaking, held from 1993-1996, was one of the major sources for information in support of this rulemaking. Topics included evaluation of transient and steady state test procedures, investigation of technologies, discussion of compliance programs and emission standards. Interests including the engine and equipment industries, states, environmental groups, the EPA and technology representatives worked together during this process. EPA also acknowledges the support of ICF in analyzing cost data and small businesses impacts. EPA sincerely appreciates the cooperation of all in EPA's technical evaluation of these engines and equipment.

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**CHAPTER 1: INTRODUCTION**

This Regulatory Support Document (RSD) contains the supporting information and analysis for this Phase 2 proposed rulemaking. The information was gathered from sources including the Regulatory Negotiation (1993-1996), industry meetings and EPA contracts. The Regulatory Negotiation task groups provided information on test procedure, technologies and compliance programs. Industry provided data on the in-use deterioration characteristics of these engines from their own test programs. EPA contracts provided information on available technologies, costs of technology changes and regulatory impact for small volume entities. All of this information is utilized in the chapters of this RSD as described below.

Chapter 2 contains a summary of the work done by the Test Procedure Task Group of the Regulatory Negotiation Committee, as relates to this proposal, as well as the test procedure changes for this proposed rulemaking. The work by the Task Group included an investigation into the differences in emission results when small engines<sup>1</sup> are tested on steady state and transient test cycles. The outcome for this proposal is the use of the Phase 1 steady state test procedure with several adjustments including 1) engines equipped with engine speed governors must utilize the governor during the test cycle except for the 100% load mode, 2) the weightings for the handheld test procedure are changed from 90/10 to 85/15 for Mode 1 and Mode 2 respectively, and 3) measures are included for natural gas fueled nonhandheld engines for measuring methane emissions.

Chapter 3 of this RSD presents the supporting rationale for the level of the standards for this proposed rulemaking including a comparison of cost estimates for various technologies. Information on technologies was provided by several sources

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<sup>1</sup> The small engines were tested in Phase 1 and “future technology” configurations.

including the Technology Subgroup of the Regulatory Negotiation and an EPA work assignment with SwRI. The Technology Subgroup of the Regulatory Negotiation investigated a number of engine emission reducing technologies for the exhaust system and fuel system of small SI engines. The results of the testing during these years revealed that some technologies required other engine improvements to be achieved prior to their use, some technologies were currently too expensive compared to the price of the engine and some were in the pre-prototype stages and required additional development before the prototype stage. In 1996, EPA conducted a work assignment with SwRI to investigate Phase 1 engines and identify the features of low and high emitting handheld and nonhandheld engines. The results of this work assignment are the main basis of technologies for this rulemaking.

Cost is a contributing factor due to the price of these engines and is used in this chapter in support of the rationale for the standards. Industry groups and individual companies provided some confidential cost information, however, much of the data did not contain sufficient detail to utilize the cost estimates directly in the cost analysis for this proposed rulemaking. Detailed cost information for this analysis was obtained through a work assignment with ICF, Incorporated and can be found in the docket (docket A-93-29, item II-A-04).

Chapter 4, and Appendix B, contain the data and analysis behind the estimated costs for the technologies for this proposal. The impact of technology changes to the Phase 1 engine families are based on review of the Phase 1 certification database and the proposed regulatory programs for nonhandheld and handheld engine manufacturers. The number of nonhandheld engine families that are likely to be improved are estimated based

on the use of ABT by the engine manufacturers<sup>2</sup> and the comparison of their deteriorated<sup>3</sup> Phase 1 emission rates to the Phase 2 standard with a 10% compliance margin. All handheld engine families must meet the standard and therefore a direct comparison is made of their deteriorated Phase 1 emission rates to the Phase 2 standard with a 10% compliance margin. Technology improvements for nonhandheld engines include improvements in existing SV engines (including oil control rings), conversion of engine families from SV to OHV design and improvements in OHV emission performance. Technology improvements for handheld engines include reduced scavenging and enleanment. Costs assumed for each technology are also presented in this chapter.

Chapter 5 contains the detail of each compliance program and outlines the costs assumed for each program. The programs for this proposed rulemaking include certification, production line testing, field/bench adjustment factor testing and the OHV durability demonstration and handheld in-use program. One major assumption made here for the majority of these programs is the useful lives that would be chosen by engine manufacturers for their engine families. This was done based on the market focus of the engine manufacturers from low cost to high durability to automotive related. Appendix C contains the spreadsheets for this analysis.

Chapter 6 contains a description of the methodology used to calculate anticipated emission reductions and fuel savings as a result of this proposed rulemaking. Appendix F contains related tables used in EPA's Nonroad Small Engine Emission Model. The emission rates for the Phase 1 baseline were based on the Phase 1 certification database and in-use deterioration characteristics were based on information provided by some

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<sup>2</sup> The ABT calculation is performed for each engine manufacturer given the information in the Phase 1 certification database of which some is confidential.

<sup>3</sup> Deterioration rates and functions are obtained from industry supplied data for both nonhandheld and handheld industries.

industry members. Phase 2 emission rates were based on the Phase 2 standards<sup>4</sup> and anticipated in-use emission deterioration were based on the expected technologies. Brake specific fuel consumption rates were based on those used for the Phase 1 rulemaking and limited additional available data.

Chapter 7 contains the aggregate cost analysis for this rulemaking and Appendix E contains the corresponding spreadsheets. The cost estimates presented in Chapters 4 and 5 are used to calculate these costs which include uniform annualized costs for variable and fixed costs per class, average cost per engine per class and overall cost effectiveness. The cost effectiveness with fuel savings is also presented.

Chapter 8 outlines the regulatory flexibility analysis for this proposed rulemaking. The work for this analysis was completed through a work assignment with ICF, Incorporated in 1997. Through this work assignment, EPA analyzed the expected impact on small production volume engine and equipment manufacturers based on the proposed standards and programmatic content of this proposal<sup>5</sup>. Based on the stringency of the standards, phase-in, ABT in the nonhandheld program, and a number of compliance flexibilities, it is anticipated that the impact on small volume manufacturers and small volume models will be minimal.

Chapter 9 contains the background information and analysis on useful lives and regulatory flexibility parameters. The standards in this proposed rulemaking are to be met by engines based on the emissions at the end of the useful life of the engine. Three choices of useful lives for nonhandheld (Class I: 66, 250 and 500 and for Class II: 250, 500, 1000) and two choices of useful lives for handheld (50,300) are included in this proposed rulemaking. These options were based on useful life information PPEMA, CARB and OPEI and EPA's own analysis. The production volume cutoffs for the

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<sup>4</sup> In the case of Class I OHV engines, the Phase 2 standard is the same as the Phase 1 baseline.

<sup>5</sup> This includes certification, production line testing and in-use test programs.

various flexibilities for this rulemaking were based on the information available in the 1996 PSR OELINK database. Chapter 9 contains the rationale behind the decisions for each flexibility cutoff.