SPECIFICATION DEVELOPMENT PROCESS

Introduction

The process for developing future engine oil specifications is being debated in industry at this time due to concerns from many about the current process. This process, as used for GF-3, consists of the following responsibilities and flow:

1.) SAE: This organization establishes the need for a new specification and defines the performance areas where improvement is needed.

2.) ASTM: This organization receives the SAE needs request and determines what performance tests and limits are appropriate to satisfy the identified needs and define a new performance category such as “SL”. ASTM will develop new performance tests as required.

3.) API: This organization receives the performance category technically defined by ASTM and develops appropriate user language and licensing.

Other significant organizations involved in the consensus process outlined above are ILSAC and ACC. Both these organizations have influential roles other than just through members that are also ASTM voting members. ILSAC has drafted proposed gasoline performance specifications (e.g. GF-3), which became the initial basis for the ASTM category limit setting consensus process. ACC reviews ASTM test methods to determine if test discrimination and precision are acceptable for inclusion in the ACC Code of Practice. Only those tests included in the code can be scheduled through the Registration Systems, Inc. registration process that assures all candidate test results are reported. All engine tests for API licensing must be conducted in accordance with the ACC Code of Practice.

SPECIFICATION DEVELOPMENT PROCESS

The concerns expressed with the current system are varied and come from many sources. Concerns most commonly voiced are:

- The process is much too long
- Too many redundancies
- ASTM balloting process too cumbersome
- New categories do not always reflect technology capabilities (limit setting process lowers requirements to an acceptable common level).
- Not responsive to consumer needs
- Process too costly and has inequitable distribution of cost / benefits among stakeholders

ILSAC and ACC have both developed proposals for changing the new specification development process to address these concerns. (See Appendix A on page B-5 and Appendix B on page B-8) The general features of each proposal follow:

ILSAC Proposal

- ILSAC Responsibilities / Authority. ILSAC has final say but would solicit input from industry.
  - Establish needs
  - Develop any new tests required
  - Establish pass / fail limits for each test
  - Define industry specification

- ASTM Responsibilities / Authority
  - Surveillance of performance tests
  - Test calibration and LTMS administration

- API Responsibilities / Authority
  - License oils
  - Aftermarket auditing

ACC Proposal

- OEM Responsibilities / Authority (OEMs would have final say for their individual specifications but would be expected to solicit input from industry before finalizing)
  - Establish needs
  - Develop test procedures
  - Establish OEM-specific specifications and pass / fail limits
  - Each OEM establish and maintain own product approvals

- ACC Responsibilities / Authority
  - Determine what tests are included in the Code of Practice
  - Establish minor formulation modification guidelines
  - Establish BOI and VGRA guidelines
  - Maintain candidate registration system

- ASTM Responsibilities / Authority
  - Surveillance of performance tests
  - Test calibration and LTMS administration

- API Responsibilities / Authority
  - Maintain current and currently in development specifications SH, SJ, CF, CF-2, CF-4, G-4, CH-4, GF-3, SL, PC-9 (but no new ones)

Discussion of these proposals is ongoing at this time within ASTM, API, SAE, ILSAC and ACC. Significant updates will be reported as they occur.

The ILSAC and ACC proposals have been debated at several industry forums without reaching a consensus process. More recently API has developed a "Proposed Gasoline and Diesel Engine Oil Licensing and Certification System".

The API proposal incorporates ideas from both the ILSAC and ACC proposals in an attempt to increase industry consensus. The AAM have rejected this proposal as not meeting their needs. (See Appendix C on Page B-45).

API Proposal

- ILSAC/API joint responsibilities/authority
  - Establish need
  - Establish test development needs
  - Develop draft specification
  - Establish specification limits

- ILSAC Responsibilities/Authority
  - Develop tests
  - Issue final specification

- API Responsibilities/Authority
  - Collect data on demonstration oils
  - Approve licensing criteria
  - Administer voluntary certification and licensing program
  - Administer aftermarket audit program

- ASTM/CEC/JASO Responsibilities/Authority
  - Formalize tests

In November 2001, ILSAC met with the API Lubricants committee to present modifications to the API new specification process proposal, which would make it acceptable to ILSAC (see Appendix D on page B-50). The two most significant modifications requested by ILSAC are: ← **12/01**

1.) **ILSAC have at least a 50% vote on the determination of need and timing for any new specification.**
2.) **ILSAC have the "tie breaking" vote on final specification limits if an industry consensus cannot be reached.**

ILSAC has asked for API review and concurrence by January 1, 2002. If API does not accept this modification, ILSAC has indicated they will pursue a specification process outside of the API system.

ILSAC/Oil met in March 2002 and came to an agreement in principal on a new specification process essentially as outlined on page B-50. The specifics of each new process step are being developed as GF-4 progresses. It has been agreed that there will be six voting members in the key steps: need and timing, draft specification, final limits. The voting members at this time follow: ← 4/02

OEMs	Company
Bob Olree (Chair)	General Motors
Charlie Sherwood	Ford Motor Company
John Shipinski* (retired)	Toyota ← **12/03**
Tracy King (alternate)	DaimlerChrysler
Oil	
Cliff Venier	Pennzoil-Quaker State
Thom Smith	Valvoline
Harji Gill (alternate)	Pinnacle Oil
Additive	
Glenn Mazzamaro	Ciba
Rich Lee	Oronite

***Replaced by Hannah Murray**

ILSAC/Oil is currently working to finalize the "GF-4 Needs Statement" and to establish a time schedule for completion of this specification. A copy of ILSACs updated GF-4 Needs Statement draft proposal as of 3/27/02 can be found on page B-51 (Appendix E). ← 4/02 The Needs Statement was updated again at the April 30 ILSAC/Oil meeting as shown on page B-52. ← 6/02 A firm time schedule for the GF-4 development process has not been established, but ILSAC is requesting final GF-4 specification approval by year-end 2002 latest.

ILSAC/Oil have held numerous meetings since the group's formation in March 2002. See Section E for a summary of GF-4 specification development activity by ILSAC/Oil. ← 8/02

December 2003

APPENDIX A

ILSAC NEW SPECIFICATION DEVELOPMENT PROPOSAL
(Presented to Industry October 2000)

Engine Oil Standards Development

- OEM community (Alliance, EMA, JAMA) dissatisfied with current system.
    - Not responsive to consumer needs
    - Process much too long
    - Too many redundancies
    - ASTM balloting process too cumbersome
    - New category limits don't always reflect technology capabilities

- Current system cannot respond to legitimate needs required in a timely manner (<3-4 years).

Conclusion: Current system cannot work for ILSAC GF-4 development, required for 2004.

What Needs To Be Changed?

- Needs should be defined by consensus of OEMs that actually have the need.
    - Input should still be sought from other appropriate parties

- Test procedures should still be developed by OEMs and formalized by technical organizations such as ASTM, CEC and JASO.

- Test limits should be determined by OEMs
    - Based on needs defined
    - After consideration of industry input

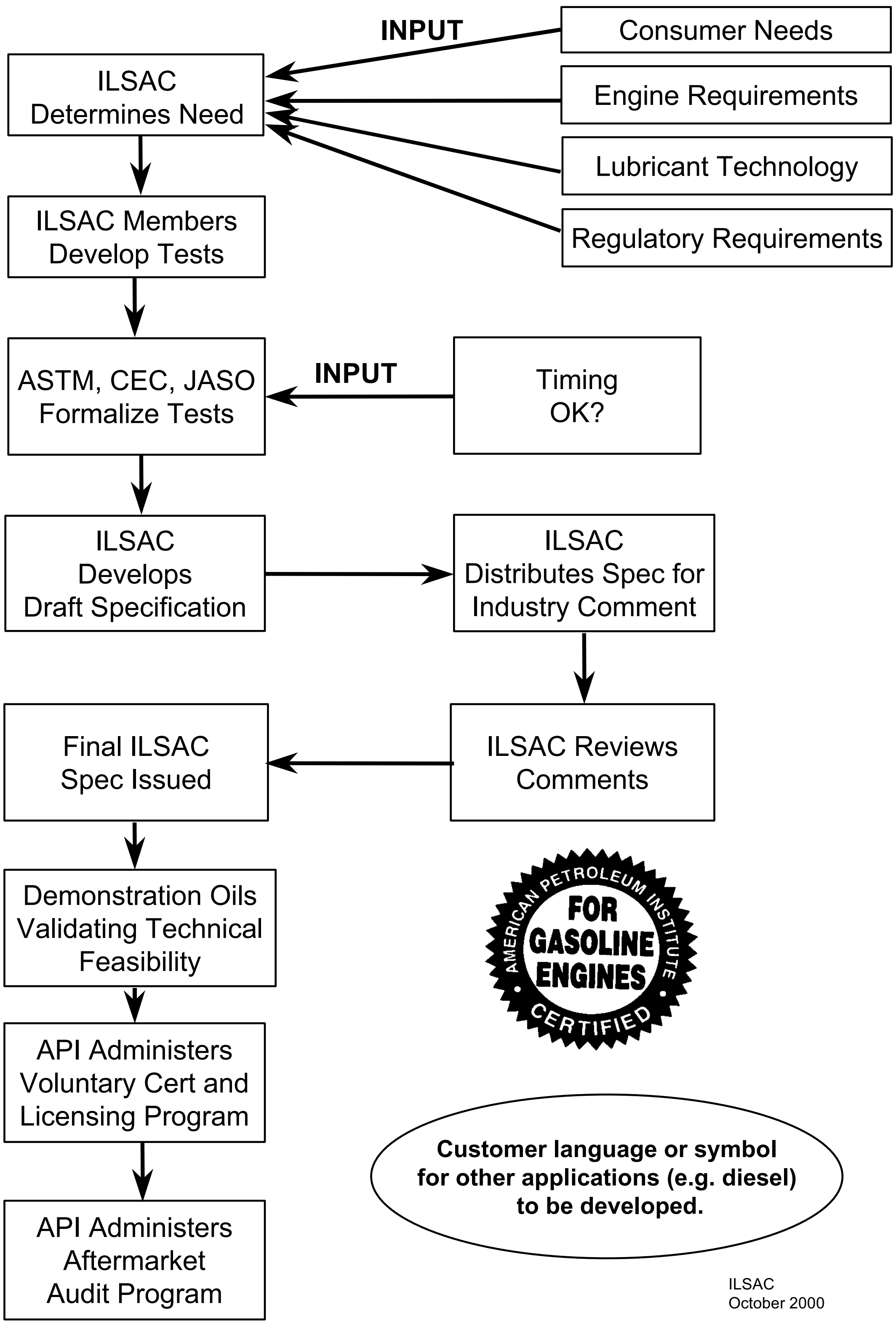
APPENDIX A (Cont.)

PROPOSAL FOR NEW SYSTEM FOR GF-4 DEVELOPMENT

Action Requested

- API endorsement of new Proposed Gasoline and Diesel Engine Oil Licensing and Certification System
- Use of new system in development of ILSAC GF-4 for use beginning in January 2004

PROPOSED GASOLINE AND DIESEL ENGINE OIL LICENSING AND CERTIFICATION SYSTEM



ILSAC
October 2000

APPENDIX B

ACC New Specification Development Proposal

Engine Oil Quality Assurance

A New Direction

March 20, 2001

Foreword

The American Chemistry Council (ACC) member companies have historically been responsible for sponsoring the engine and bench testing. This testing is necessary to show conformance to a customer's desired performance and to bring engine lubricants into the marketplace. Although some lubricant marketers also are actively engaged in this test activity, there has been an evolutionary process that has resulted in formulation development and testing being conducted within a relatively small number of companies. As a result of escalating test costs and foreshortened category life cycles, among other factors, the burden on the additive companies has become very high.

As a result of the above, the ACC believes that a fundamental change, rather than minor adjustments, to the current process is needed.

Accordingly, the ACC has been exploring new directions that can be taken to enable a more equitable distribution of costs and benefits among stakeholder industries, while offering the opportunity for higher value-added products to be available to the end user. This document describes some history that leads to the current system and proposes a new direction designed to better meet the needs of the automakers, oil marketers and additive company members of the ACC.

The American Chemistry Council Petroleum Additives Panel recommends a new direction that would rely on individual OEM specifications, with limits and approvals established and controlled by individual OEMs. This would eliminate the current industry category systems for all future quality levels. This includes both OEM-sponsored industry-wide requirements as well as the API category system for future oil quality levels. API SL and the evolving heavy-duty category – PC-9 – would continue as API licensable categories.

Best Regards,

Dick Kuhlman
Chairman,
Product Approval Protocol Task Group

Steve Kirk
Chairman,
Petroleum Additives Panel

Engine Oil Quality Assurance – A New Direction

Introduction

The current system that establishes performance categories for light-duty and heavy-duty engine oils had its beginnings over 30 years ago. For the last several years, there has been a growing concern within the American Chemistry Council (ACC) member companies that this system has led to an inequitable distribution of the cost/benefits equation among the various industries that make up the list of "stakeholders" in this process. Accordingly, in 1997, studies have been commissioned with an eye toward identification and quantification of these costs and benefits. Those efforts have resulted in a plan for a new process to be considered for adoption by the lubricants industries. This document is intended to describe the plan and identify what we believe to be the benefits of this new direction.

History

The current API system has its roots in 1969-70. Up to then, the API system classified oils as ML, MM and MS (Light, Medium and Severe gasoline engine duty, respectively) and DG, DM and DS (similar ratings for diesel engines). These designations were "evergreen," with any specific oil quality changes being transparent to the consumer. Each of the U.S. OEMs had their own service fill specifications, such as Ford's ESE-M2C-101-B and GM's 6041-M. The oil marketers responded with statements that the oil "Meets or Exceeds Automaker Specifications".

A movement toward "more consumer friendly" API oil identification resulted in the current generic "S" and "C" system. This formalized the Tripartite, with defined roles of API, SAE and ASTM. The first "S" category oils defined in 1970 were SA through SD, with SE established in 1972, SF in 1980 and SG in 1989. The first "C" category oils defined at the same time were CA through CD, with CE designated in 1983.

There was no trademarked API identifier, preventing API from seeking any legal recourse against those marketers suspected of not meeting the Tripartite-developed oil performance requirements. This changed in 1980 when the API symbol was developed. The "S" and/or "C" categories was developed in the upper half of the outer annular ring of the circle, the designation of fuel savings properties in the lower half, and the SAE viscosity in the middle.

During API discussions concerning the above, some lubricant marketers realized, and stated that, the movement toward the symbol would lead to engine oils becoming commodity items.

Thus began the movement toward engine oils being generic, commodity products. This has continued today, inhibiting the oil marketer's ability to promote value added products, including advertising the difference between oil that just meets the API requirements, one that significantly exceeds those requirements, or one that provides enhanced performance by meeting additional requirements – even those of an automaker.

The desire by the OEMs for 'generic' oils was established in the late 1970s by a ruling of the EPA. A major automaker had tried to certify its vehicles with a 5w-20 synthetic for fuel economy benefits. The EPA disallowed the use of such oil and established a number of criteria for oils that may be used when certifying against emission and Corporate Average Fuel Economy (CAFE) standards.

Therefore, oil used for certification must be:

- No higher quality than that used for factory fill;

- No higher quality than that called for in the owner's manual and required for warranty;

- Widely available to the consumer;

- Cost the consumer no more than prevailing costs of engine oils in the market and;

- No higher fuel economy improvement performance than the sales-weighted average of oils in the marketplace.

This movement toward a single quality oil in the marketplace led to the formation of lubricants activities within OEM trade associations to jointly request new oil categories as the basis for their certifications. In 1990, MVMA (Motor Vehicle Manufacturers Association), now AAM (Alliance of Automobile Manufacturers), proposed the establishment of the North American Lubricant ***Standardization*** and Approval System (NALSAS), the very name underscoring their desire for generic oils.

Negotiations between API and the International Lubricant ***Standardization*** and Approval Committee (ILSAC), comprised of the above North American OEM group and the Japanese Automobile Manufacturers Association, concerning NALSAS. These negotiations resulted in the current API Engine Oil Licensing and Certification System (EOLCS). The resulting Memorandum of Understanding (MOU) establishing this joint activity specifies that the OEMs will support the system they helped create. In 1992, the then CMA (Chemical Manufacturers Association) Code of Practice for engine testing was introduced, providing a quality process for testing candidate oils against their intended performance.

API SH was developed in 1992 as a result of the establishment by CMA of the Code of Practice, a quality process for engine testing. The Code of Practice was incorporated into the EOLCS as a requirement for all engine testing. The only difference between API SG and API SH is the increase in oil quality as a result of the implementation of the CMA Code of Practice. ILSAC's GF-1 specification was implemented at the same time as a companion to API SH. Since the introduction of API's EOLCS, all new API categories have been based on the OEMs (light- and heavy-duty) desires for the oils to assist them in meeting mandated emissions reductions and/or CAFE. In each case, additional design changes to the engine or the vehicle could have achieved at least the same end result. However, such engine/vehicle changes – and in the case of CAFE, product slate sales mix – have associated costs or reductions in margins to the OEM that are significantly more than their investment in engine test development for oil evaluations. In the case of the heavy-duty oils, the development of new categories has allowed the OEMs to use increased service intervals as a marketing tool.

Cost-benefit analyses have been conducted by ACC for both the light- and heavy-duty segments of the engine oil markets. Both studies clearly show that the oil and additive companies are significantly disadvantaging themselves by continued participation in the current API system. Meanwhile, the OEMs enjoy significant margin improvements through their ability to use generic oils of a specific quality rather than investing in other alternatives such as improved catalysts, lighter weight materials, and lower friction components.

It is, at least partially, a result of these and other economic analyses that additive companies and others have publicly called for fundamental change in the way in which oils are developed and marketed to the consumers. The outcomes of these two studies are outlined below.

The Light-Duty Study

In 1997, the ACC member companies (CMA at the time) undertook an effort to develop an economic model for new engine oil category development (See Attachment I). That effort culminated in an NPRA paper that was delivered on November 13, 1998[1]. This study was completed using publicly available information, compiled and analyzed by a knowledgeable team and utilized members with widely varying backgrounds. The financial outcomes are expressed in terms of net present value (NPV). A scenario that arose from the model is shown as follows:

[1] NPRA reference LW-98-156, Economic Model for New Engine Oil Category Development -by Carol Stack (CMA) and John Ahern (Lubrizol). November 13, 1998, Omni Hotel, Houston, TX

Net Present Value (NPV)
millions of dollars

Additive Companies	(97)
Independent Testing Labs	2
Oil Companies/Marketers	(166)
OEMs	150
Total	$(111)

This study clearly points out that the additive and oil industries fail to derive real value that is in anyway commensurate with their investments.

Although this study was presented in numerous public forums, published, widely distributed, and quoted in the press, to this date there have been virtually no comments made to the ACC that challenge the assumptions or refute the findings.

The case may be made that the oil and additive companies are more concerned about the long-term – beyond OEM warranty period – consumer benefits of oil than are the OEMs. OEMs are more concerned about having available an oil that reduces their engineering and production costs, while allowing certification. OEMs also want to enhance their marketing efforts – higher CAFE allowing the continued sales of larger, more profitable vehicles while still meeting CAFE, and promoting extended oil drains to support low maintenance claims. It is worth noting that, while 2000 saw a record number of new vehicle sales, the total number of 17.4 million new vehicles is only 8% of the 213 million vehicles in use in the U.S. today.

The Heavy-Duty Study

A work group was organized in 1999 by ACC to investigate the economic model for heavy-duty engine oil category development. As shown in Attachment II, the major findings of this group have been made public at industry forums. Once again, using a set of assumptions and staying within publicly available data, the study shows that the additives and oil industries are significantly disadvantaged by today's process.

Net Present Value (NPV)
millions of dollars

Additive Industry	(91)
Test Labs	17
Lubricant Industry	(11)
OEMs	143
Net Benefit to Industry	$59

Dissatisfaction with Current System

Each of the major stakeholders – OEMs, oil and additive companies and their respective trade associations – has expressed varying degrees of dissatisfaction with the current system. The reasons for the dissatisfaction vary.

OEMs

The OEMs, both on the light- and heavy-duty side, have expressed dissatisfaction with the general lack of responsiveness of the current system. They would like complete control over the process in terms of establishing the need, the necessary tests and the pass/fail criteria for the category.

Oil Marketers

The ACC studies show that the oil marketers do not derive sufficient value at present. The current system creates sameness among branded products and inhibits innovation.

Independent Test Laboratories

While the test laboratories derive benefits from numerous and changing engine tests and specifications, currently there is a significant lag time between when the new tests are identified, by the OEMs, and when they are in demand for commercial purposes. This creates a deferred revenue stream with the expected effects.

Consumer

Through all of this, the consumer is favored with products meeting his or her basic needs, but since the emphasis is on emissions and incremental CAFE, the value of new categories is not evident at the retail level. Thus, there is little incentive for products to be developed that could be of benefit to the individual consumer.

Current Reality Regarding Engine Oil Quality

Although the OEMs participate in the MOU with API and have stated their support for the API system, it's apparent that some of them have moved away from the system by supplementing the API and/or ILSAC specifications with their internal specifications.

- Ford, in the recent past, has had additional requirements revolving around rheological properties. Within Ford's WSS-M2C-153-H – there is included an additional, non-industry-standard engine test, which was not a part of the Ford or ILSAC request.

- DaimlerChrysler's Chrysler Group has informed industry of its new service fill specification – MS 6395 – including the language that will be used in the owner's manuals stating that oils that meet this internal specification are to be sought and used. This internal Chrysler specification not only includes test limits more restrictive than recently agreed to by it and the other OEMs as the basis for ILSAC GF-3 and API SL, but also has additional requirements that were never requested of industry.

- Only General Motors – of the US-based Light-Duty OEMs – continues to “support the API system” through adherence to the consensus-developed specification via telling the consumers, in their owner’s manuals, to use API-Certified oils in all of their vehicles, except the Corvette.

- Mack Truck continues to maintain an oil approval list, with requirements beyond those in the most current “C” category.

- Cummins Engine continues with an internal specification with limits different from those in the most current “C” category.

This leaves the oil and additive industry with four levels of performance for engine oils, beyond those for factory fill.

- API categories that are used internationally for all viscosity grades and are separated into performance properties – the S or C designation – and attributes – the Energy-Conserving designation,

- ILSAC categories, which cover only limited viscosity grades and do not differentiate performance and attributes as above,

- The heavy-duty OEM inspired “Global Diesel Heavy Duty (DHD)-1 specification and,

- Individual, specific OEM service fill specifications.

While the ILSAC specification is largely under the control of the OEMs, the latter two above – DHD-1 and individual OEM specifications – are completely within the control of the OEMs. It is only the API system over which the oil and additive companies have any degree of control.

The New Direction

The ACC Petroleum Additives Panel recommends a new direction that would rely on individual OEM specifications, with limits and approvals established and controlled by individual OEMs. This would eliminate the current industry category systems for all future quality levels. This includes both OEM-sponsored industry-wide requirements as well as the API category system for future oil quality levels. API SL and the evolving heavy-duty category – PC-9 – would continue as API licensable categories.

How Does This Process Create Success

Create “value-added” opportunities including:

- The opportunity for a tiered/niche marketplace where the added value of higher performance oils will be recognized by the consumers;

- Promote the concept of an engine oil marketplace driven by individual OEM specifications, which would be more easily understood by the consumer and;

- Providing enhanced product choice to the individual consumers.

Reduce costs

- Elimination of future API categories (or other industry specification) development, reducing resources devoted to API category development,

- Reduction of redundant approval testing based on OEMs utilizing technology driven BOI/VGRA and minor formulation modification guidelines developed and published by ACC and,

- Reduction in engine test costs accomplished by modifying the current ACC Test Template and the Code of Practice to encourage development of more precise tests.

To aid in the understanding of how this new process will flow, a chart has been included as Attachment III. Referring to this chart, it is noteworthy that ACC proposes to assume the leadership responsibility in the setting of BOI/VGRA guidelines. Further, to assist in comparing how the various plans would agree and contrast, Attachment IV is useful.

<u>Features and Benefits Summary</u>

The ACC view on features and benefits to the affected stakeholders can be summarized as follows:

<u>OEMs</u>

1. Complete control of setting the “needs” for new automotive engine oils (AEO) performance criteria.

    - While soliciting input from ACC & Oil Marketers, the final decision for improved performance parameters would reside with the individual OEM.

    - No need for compromise within the OEM community or with other stakeholders.

2. Complete freedom to develop their own engine tests as deemed appropriate by each individual OEM.

    - Assistance in developing engine tests can still be available from oil marketers, ACC members and dependant/independent testing labs, as is the case today.

- No compromise within the OEM communities

- Concerns could be expressed by individual stakeholders, but the decision would rest with the individual OEM.

6. Technology-based “read across” guidelines (BOI/VGRA) would be developed by ACC. Each individual OEM can embrace these guidelines, as it deems appropriate.

7. Timing for introduction of new performance standards would be at the discretion of the individual OEM.

- No need for industry consensus for timing.

- Once new advanced technology is available it could be specified and introduced immediately.

8. Resource requirements for ASTM/API/SAE meetings would be significantly reduced or eliminated.

9. Lubricant technology resources would be more available for fundamental research aimed at advanced lubricants rather than being directed towards the lowest cost formulations meeting the requirements of a commodity market.

10. “Minimum acceptable” performance standards (API SL & PC-9 and earlier categories) will be available for many years to come.

- Can be used for alternate lubricant “service fill” recommendations or by OEMs not wishing to develop their own specifications.

Oil Marketers

1. Per the ACC Economic Models (see attached), today’s system does not provide adequate returns to oil marketers and, therefore, a new approach should be entertained.

2. The opportunity to market “value-added” AEO products would be enhanced.

- Products could be clearly differentiated by claiming individual OEM specifications.

- These products would be more readily understood by the consumer with the direct reference to an OEM specification, rather than the API system.

- Greater opportunity for branding and marketing.

- Added oil attributes, such as extended drain capability or enhanced fuel economy, could be associated with premium, top-tier products.

3. True “minimum acceptable” performance would be defined by API SL/GF-3 or PC-9 performance standards.

- These “minimum acceptable” requirements should be appropriate for many years to come.

4. API Licensing fees could be reduced or eliminated.

5. New product introduction timing would be at the discretion of the individual oil marketer rather than dictated by new category introduction, as is the case today.

- The oil marketers will have control of these “value added” product introductions.

6. Resource requirements for ASTM/API/SAE meetings would be significantly reduced or eliminated.

7. More resources would be available for meeting specific OEM lubrication requirements, leading to “value-added” products.

ACC Member Companies

We believe that this proposal will offer the ACC member companies the following features and benefits:

1. Helps to create an engine oil market place that encourages product performance differentiation by:

   - Enabling market segmentation and specialization;
   Tying oil quality to specific OEM needs and recommendations and;
   Stimulating innovation.

2. Fosters a stronger working relationship with engine manufacturers/ test developers.
   - Increases the OEM understanding of lubricant quality through more frequent contact with ACC member companies.

3. Allows a reduction in downstream test costs, thus enabling ACC member companies to redeploy resources toward new technology.

4. Brings added customer satisfaction to our core constituency – the oil marketers.

5. The proposed process has the potential to lead to a marketplace that appreciates the added value of new improved AEO technology.

- Oil quality is directly tied to specific OEM requirements and recommendations.

- Future development of “industry” specifications that inhibit “step out” technology will be eliminated.

6. BOI/VGRA guidelines would be developed and published by ACC for new tests.

- ACC members have the expertise and data to best develop these guidelines.

7. Approval costs could be reduced, allowing for increased new technology funding.

- Assumes adoption of ACC developed BOI/VGRA guidelines.

- Assumes the individual OEMs would adopt a more flexible approval system (enabling data-based decisions on quality and qualification).

- Unrealistic approval requirements would be moderated by limited availability or extremely expensive approved products in the marketplace.

- Expensive tests

- Redundant tests

- Overly restrictive read across guidelines

8. Individual ACC members can decide which approvals to pursue.

- The elimination of future “industry” specifications will allow our oil marketer customers more flexibility in timing and claims for new product introductions.

9. Tests currently in the Code of Practice and future tests accepted into the Code would be covered by Code.

- This will maintain the important elements of the current system.

10. Resources applied to ASTM would be reduced from today’s level. No need for the time-consuming ASTM D02.B involvement to develop limits etc. for D4485.

Consumer

The current system of engine oil categories has never been fully understood or embraced by the motoring public or the heavy-duty diesel user community despite significant advertising efforts. Neither the Certification Mark nor the API Service Symbol has conveyed the meaning that their proponents had intended. In fact, it can be said that these symbols have frequently led to confusion in the minds of the end user.

Under the ACC new direction process, the consumer will rely on the owner's manual and the oil labeling for the designation of the appropriate product to be used in the equipment. For example, an owner of a Ford would look in his owner's manual for the proper designation to look for on an oil label, or simply see on that label that "This oil meets or exceeds the requirements for Ford vehicles." Also, vehicle durability will be favorably affected through the use of the OEM-recommended lubricant and service interval.

What is the ACC Timeframe?

This new process is intended for future engine oil quality definition beyond ILSAC GF-3 and PC-9. Specifically, it would eliminate the need for industry-wide requirements such as those that have been referred to as GF-4, PC-10, and DHD-2.

Summary

Change is never easy. The current system has taken root over the past 30 years. However, the need for change has never been greater, with each stakeholder industry clearly exhibiting displeasure with the status quo. ACC member companies are hopeful that a new system will enhance equity in the sharing of cost/benefits while maintaining the legitimacy of effort embodied in the old system.

# # #

ATTACHMENT I

ECONOMIC MODEL FOR NEW ENGINE OIL CATEGORY DEVELOPMENT

INTRODUCTION

The Petroleum Additives Panel of the Chemical Manufacturers Association (CMA) sponsored an Economic Analysis Work Group (Work Group) to develop an economic model to analyze the impact of new engine oil standards on the additive, automotive and oil industries. The Work Group was comprised of six representatives having financial, commercial, engineering and planning backgrounds, from companies represented on CMA's Petroleum Additives Panel, and two representatives from CMA. The Work Group met to conduct the analysis over the February to October 1997 timeframe.

ILSAC GF-3 was chosen as a real world standard for developing the model. ASTM matrix testing for ILSAC GF-3 test development is already in progress and this model will not aid in funding discussions relating to GF-3. However, division of funding of test development for future engine oil standards is one potential application for the model.

ASSUMPTIONS

A number of key parameter and cost assumptions have been made for each key stakeholder.

Additive Companies – For additive companies, the largest costs relating to the GF-3 new engine oil category are product development and testing. We assumed product development costs at $30 million and costs of testing and certifying products for customers at $125 million. Product development costs include fundamental studies to develop product platforms to meet the new standard, to understand the correlation between old and new tests, and to understand the relationship with the field.

The product development cost was an estimate by the Work Group. Testing costs involve the programs to qualify products for specific customers, as well as for the general market. The amount is the same as the estimate of monies spent by the additives industry for the ILSAC GF-2 engine oil category in 1995-96. The assumption for GF-3 customer testing costs may be understated, as most of the tests for GF-3 are new, whereas the majority of tests for the GF-2 category had already been in place for the previous (SH) category.

We also assumed shared funding with the OEMs of test development (i.e., design of the specific tests to be used in the standard) costing $4 million, specification development (i.e., input to OEMs, ASTM and technical committees) costing $1 million, and additive industry funding to develop matrices for precision, base oil interchange and viscosity grade read across of $2 million.

We assumed all product development, customer testing and other test development related costs are incurred by the additive companies in the first year of the category upgrade.

We assumed that raw material cost and variable manufacturing costs for additives were approximately $0.50 per pound, and that there was no change in these unit costs as a result of the new ILSAC GF-3 category. The current treat rate was assumed to be 10% additive content in each gallon of blended lubricant, and a 10% increase in this treat rate (to 11% per gallon of blended lubricant) was assumed to be required in order to meet the new standard. The above assumptions were all estimates by the Work Group.

The average market value of additives was assumed to be $0.75 per pound, based on data from a 1994 industry study.

Testing Laboratories – For testing laboratories we assumed a required industry – wide test stand investment of $25 million (from a February 1996 Replacement Tests in ASTM (RETINA) task force report) and assumed that 70% of the tests were run at independent labs (Work Group estimate). We charged only 25% of this investment against GF-3, because the stands would have use beyond the initial conversion of customers, both for continuing testing of GF-3 as well as subsequent specifications. We assumed the new GF-3 specification would require 6,200 tests of all types, at a weighted average cost per test of $20,000. We further assumed that the tests run by the independent labs would be spread out over three years.

The Work Group assumed a direct contribution margin of 6.1% (low) to 11.6% (high) of revenues, based on publicly reported historical financial data for an independent lab as adjusted by the Work Group to eliminate the impact of fixed costs. The Work Group assumed the independent labs would support the development of precision matrices by contributing test services with a value of $1 million in exchange for potential calibration of the test standards if they were approved by the ASTM TMC.

Oil Companies/Marketers – For the oil companies, we made a number of key cost assumptions in addition to key parameters. First, we assumed that a substantial investment to upgrade refinery equipment would be required for moving to GF-3. The investment was estimated at $1.0 billion and was capitalized over a 20-year period. An 8.7 % cost of capital was assumed based on the Bureau of the Census Manufacturers Financial Report (1996). A portion of the cost of the refinery upgrade is assumed to be passed-on to retailers.

We also assumed that yield losses for manufacturing higher quality base stocks would average 5 % and that these costs would fully pass through. In addition, higher costs of base oils and additives (averaging about $0.05 per quart) would be fully passed through to consumers.

Finally, we assumed that the cost of reformulation, product testing and related activities would total $7.5 million and the cost of change in labeling would total $2.0 million. The shared cost of funding precision test development is assumed to be $430,000.

average price to consumers in 1996 was $1.00 per quart of engine oil. Raw materials costs for engine oil were assumed to average $0.50 per quart, of which base oil stocks accounted for $0.25. Packaging and other variable costs were assumed to average $0.09 per quart. For the typical light vehicle, 4.5 quarts of engine oil are assumed with an average oil drain interval of 4,500 miles. We assumed that the new engine oil category development would not result in any change in oil drain interval.

Government data sources (1996) indicate that some 133.9 billion gallons of gasoline, at an average retail price of $1.20 per gallon, are consumed in the U.S. in light vehicles every year. We assumed that implementation of the new engine oil standard wouldn't result in any change in gasoline pricing.

OEMs - For the original equipment manufacturers (OEMs) of light vehicles, a number of key cost assumptions were made in addition to key parameters. Benefits to OEMs are assumed to arise largely as a result of higher margins per vehicle due to either: 1) higher selling prices equal to the value to the consumer of increased fuel efficiency; 2) lower material/component cost due to fuel efficiency (e.g., the ability to avoid switching to lighter vehicle materials, thus retaining lower component costs); 3) lower warranty costs; 4) CAFE penalty avoidance, or 5) some combination of these factors.

The data and assumptions were "normalized" to calendar year 1996. Basic parameters dealing with light vehicles manufactured by OEMs include:

Annual Domestic Light Vehicle Sales (million units)	13.32
Average Vehicle Weight (pounds)	3,241
Average Engine Size (horsepower)	186
Average Vehicle Price	$21,240
Average Vehicle Fuel Efficiency (MPG)	17.2
Average Fuel Efficiency - Automobiles (MPG)	21.9
Average Fuel Efficiency - Other Light-duty Vehicles (MPG)	11.4

The per vehicle penalty for CAFE standard violations is $5 per 0.1 miles per gallon (MPG) difference between the 27.5 MPG CAFE standard for automobiles and the 20.7 MPG standard for other light duty vehicles. Because of carry-forward and carry-back provisions, it is possible that no CAFE penalties could be imposed during the five years time frame of the analysis.

The shared cost of funding test development was assumed to be $5.0 million and the cost of changing owners' manuals was assumed to be $2.0 million. The cost of funding of precision testing was assumed to be $430,000. Basic parameters dealing with light vehicle operation reflect 1996 patterns and include:

Light Vehicles in Use (million units)	191.6
Average Gallons/Year (for All Light Vehicles)	699
Total Miles/Vehicle/Year (for all Light Vehicles)	12,052
Vehicle Miles Traveled by Light Vehicles (million miles)	2,309
Average Annual Fuel Cost/Vehicle	$837
Average Fuel Cost/Mile for All Light Vehicles ($/mile)	$0.069

A key ILSAC assumption for this analysis is that the new engine oil category development from GF-2 to GF-3 would lead to a 0.3 % improvement in fuel efficiency as measured by MPG, but does not lead to any potential savings in warranty costs. This improvement averages 0.1 MPG. It is also assumed that there will be no change in the volume of oil consumed.

DATA SOURCES

The model and the assumptions produced the relative costs and benefits for engine oil ILSAC additive marketers, testing laboratories, oil companies and OEMs from GF-3 new engine oil category development. The analysis was limited to automobiles, light-duty trucks, vans, mini-vans, and sports utility vehicles (SUVs) produced (and in use) in the United States.

The analysis utilized publicly available data and information. Data on the number of light vehicles produced are from the Bureau of Economic Analysis (US Department of Commerce) and number of vehicles in use are from the US Department of Transportation. Data on fuel consumption and efficiency are from the Energy Information Administration (US Department of Energy) and the US Department of Transportation. Other sources included the National Petroleum Refiners Association (NPRA) and various corporate annual and 10-K reports. No company-specific information was shared with other companies unless publicly available.

Analysis of interactions between vehicle price and vehicle weight, horsepower, fuel efficiency and quality were based on a cross-sectional analysis of data supplied by JD Powers and Associates. All other assumptions and data are from analysis of Big Three annual and 10-K reports. Estimates by the working group were necessary in many instances.

HOW THE MODEL WORKS

The model utilizes standard benefit-cost analysis (BCA) methodology for all stakeholders. The methodology is consistent with the latest project evaluation, finance and economics literature as well as OMB guidelines for regulatory impact assessments (RIAs). Parameters and assumptions were based on public information and 1996 as a base year.
Calculations of all stakeholders' costs and benefits are linked with (and interact with) each other. For example, changes in the market value of additives pass through to base oil and then to final engine oil costs and ultimately to the retail market value of engine oil. Net benefits and costs are calculated on an after-tax cash flow basis and are discounted. Net present value (NPV) of net benefits

(and costs) are calculated using each stakeholder's after-tax cost of capital and a five year time period.

In the OEM portion of the model, changes in fuel efficiency and vehicle quality largely drive improvements in per vehicle margins. This is based on a cross-sectional regression analysis of data supplied by JD Powers and Associates. The analysis indicated that per vehicle price is largely a function of such independent variables as average vehicle weight, engine size, fuel efficiency, and quality. The latter is measured by sum of JD Powers indexes. Equation variables were estimated in log form. In the cost-benefit analysis, average vehicle weight, engine size and quality are assumed to remain constant as fuel efficiency improves. The improvement in fuel efficiency, all other things being equal, leads to a higher value being placed on the vehicle by the consumer and results in higher prices or margins per vehicle. The model calculates the NPV of higher margins less development costs over the five-year time frame.

RESULTS

The analysis indicates a range of results among the various stakeholders in the ILSAC GF-3 standard development. These are summarized as follows:

	NPV of Net Benefits (millions of dollars)	
	CASE I	CASE II
Additive Companies	(97)	7
Independent Testing Labs	2	5
Oil Companies/Marketers	(166)	8
Original Equipment Manufacturers (OEMs)	150	1,500
Total	$(111)	$1,520

Additive Companies – For additive companies, costs consist of $162 million of product development and testing related expenses, as well as additional raw material and variable manufacturing costs associated with the higher additive treatment level.

The model calculated the NPV of these incremental costs and revenues over a five-year period. The sensitivity is due to perceived market value. In Case I, pass through of incremental raw material and manufacturing costs results in a negative NPV of $97 million. If the additive companies were to earn the assumed industry average cost of capital of 7.8% (based on public annual reports) on the testing and development investment – the NPV would be zero. Case II assumes the market value of additives increases enough to enable the industry to earn the 1995 average return on capital employed for the two additive companies who publicly report financial results.

Testing Laboratories – For independent laboratories, costs consist of the investment in new test stands and the investment toward development of precision matrices which are recovered through eliminating the need for separate reference oil testing for standard calibration. The benefit consists of earnings from conducting testing programs for additive companies and others.

The model calculates the NPV of test equipment investment, precision matrix contribution and the earnings stream from new GF-3 testing over a three-year period. Sensitivities were evaluated around the number of tests conducted (4,500 on the low side to 6,200 on the high side) and the pre-tax profit contribution assumed (6.1% on the low side to 11.6% on the high side). The testing laboratories earn a NPV benefit ranging from $1.6 million to $4.9 million, depending on the assumption used.

Oil Companies/Marketers – For the base oil companies, costs include a large investment in refinery upgrading and yield losses. Benefits, however, include higher market value for base oils. For the oil marketers, costs include increased base oil costs and higher cost and treatment rates for additives.

The model calculates the NPV of refinery investment, variable cost and revenue changes resulting from the GF-2 to GF-3 transition. A number of sensitivities were evaluated, including the portion of refinery investment allocated to GF-3, as well as price changes to retailers and OEMs (from cost pass through to cost pass through plus 3.0 %). The calculated NPV benefit estimates a range from a negative $166 million (Case I) to a positive $8 million (Case II). Sensitivity is largely a function of how much of the refinery investment is assumed to apply to GF-3, and to perceived market value.

OEMs – For the original equipment manufacturers (OEMs) of light duty vehicles, costs include higher "first-fill" costs of engine oils as well as development costs, costs in changing owner's manuals and other related costs. Benefits include higher per vehicle margins through various ways including either higher vehicle prices, avoidance of CAFE penalties, lower warranty costs, ability to avoid switching to lighter vehicle materials (thus retaining lower component costs), or some combination of these factors.

The model calculates the NPV of cost and revenue changes resulting from the GF-2 to GF-3 transition. A number of sensitivities were evaluated. At the low-end, OEMs are able to avoid CAFE penalties of 0.083 MPG. At the high-end (Case II), OEMs improve margins by $44 per vehicle as fuel efficiency improves (all other factors held constant). Thus, the calculated NPV benefit estimates range from $150 million to $1.5 billion.

Consumers/Society - A wide variety of benefits also accrue to consumers and society at large as a result of the GF-3 new engine oil category development. Included are a longer engine (and vehicle) life, reduced maintenance costs, better gas mileage and potentially reduced emissions.
Reductions in carbon dioxide, carbon monoxide, volatile organic compounds (VOCs), nitrogen oxides, sulfur dioxide and particular matter (PM) can occur. At present, these environmental benefits are not monetized. No attempt is made to estimate the monetary value of longer engine (and vehicle) lives and reduced maintenance costs.

By fostering a better understanding of the impact of new standards on affected stakeholders, the economic model can be of value in discussions of the funding of test development for new engine oil categories.

ATTACHMENT II

Heavy-Duty Diesel Engine Oil Category Development Economic Model

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Introduction, Scope and Objectives

The Heavy-Duty Diesel Economic Work Group was established under the Petroleum Additives (PA) Panel (the Panel) of the American Chemistry Council (the Council) to create a user-friendly economic model of the current American Petroleum Institute (API) heavy-duty diesel engine oil (HDDEO) category development process. The model characterizes the financial impacts of new categories on additive manufacturers, lubricant marketers, engine builders, and independent testing laboratories. A key objective of the Work Group was to design a model that allows users to assess the sensitivity of key category development variables on projected outcomes. The Panel hopes to use the model as a means to create a higher-level awareness of the category implementation affects on industry, and provide background for future discussions of HDDEO category development decisions.

The Work Group was comprised of two Council staff members, the Panel's outside legal counsel, and five PA Panel member company representatives with backgrounds in engineering, marketing, economics, manufacturing, and chemistry.

Background

New heavy-duty diesel engine oil categories as defined by API's Engine Oil Licensing and Certification System (EOLCS) are comprised of many individual performance requirements, including engine, bench, and analytical test methods, which are specifically designed to provide consumers with an overall step-change in engine oil quality. These HDDEO categories historically have been driven by equipment design changes, environmental regulations, and changing performance needs that impact the lubrication requirements of engines. Prior to 1990, new API diesel engine oil categories were infrequent because new categories were driven by engine changes unrelated to regulatory compliance. However, a sharp acceleration in new category development has occurred in the past decade because of more stringent environmental regulations affecting diesel engines. Consequently, while only two HDDEO categories were established in the forty years prior to 1990, the past ten years have witnessed the adoption of five new categories with two more slated for introduction before 2007. This trend of rapid category turnover is compounded by the rising cost of new categories. The cost to develop and implement a single new HDDEO category has risen sharply from less than $10 million in 1990 to well over $100 million today. These economic issues have caused industry to reexamine the processes by which new categories are developed, implemented, and funded. In addition, the costs and benefits of new oil performance categories are being more closely evaluated.

The HDDEO category currently under development, temporarily designated PC-9, is being established to satisfy the lubrication needs of engines equipped with exhaust gas re-circulation. The HDDEO economic model will focus on the PC-9 development process.

Model Assumptions

General

Several key assumptions in the HDDEO industry were necessary in order to show a realistic forecast of the financial outcome for PC-9. However, the model allows the user to modify these assumptions to predict alternative outcomes. The overall assumptions made by the Work Group with respect to the upcoming PC-9 engine oil category are as follows.

The yearly volume of PC-9 diesel engine oil sold in the United States will remain constant with today's demand of 442 million gallons annually. This assumption is based on historical lubricant and vehicle sales data, and the prediction that lubricant service requirements will remain unchanged for PC-9. In addition, the model assumes that manufacturers of all new US diesel engines will recommend PC-9 quality lubricants.

The model assumes PC-9 to have a category life span of four years beginning in 2002. PC-10 is expected to be rolled-out in the 2006 timeframe to coincide with the next round of regulatory changes affecting diesel engine emissions. This parameter is critical in the net benefit/penalty of category development costs of the four industry stakeholders.

The number of industry-wide test programs conducted for PC-9 will be equal to CH-4 (the most current API category). Although mergers and acquisitions have reduced the number of key players in the lubricant industry over the past several years, the number of API-licensed heavy-duty diesel engine oils has actually increased. Moreover, the most consequential industry mergers (those affecting additive package suppliers) occurred prior to the implementation of CH-4, indicating that any testing efficiencies gained through mergers already would be represented in CH-4's testing volume data.

The PC-9 category requirements are estimated based on the most recent outlook of API's PC-9 New Category Development Team (NCDT). This inter-industry team, comprised of representatives from the engine builders, lubricant manufacturers, testing laboratories and additive suppliers, is responsible for managing the PC-9 category development process from conception to implementation. In addition, the costs associated with the industry-sponsored test matrix used to confirm the suitability of the proposed PC-9 engine tests is based on the latest outlook of the API PC-9 Funding Team.

While the costs associated with a new API category are relatively simple to calculate based on historical data, the economic benefits derived from category quality advancements are not so straightforward. The main purpose of API engine oil category upgrades is to better protect consumers' engines and equipment. In so doing, the manufacturers of engines and equipment benefit from category quality upgrades through reduced warranty costs, enhanced engine value, and minimized deferred sales. In addition, higher quality lubricants allow engine designers to mitigate mechanical design changes by providing an added level of engine protection. Based on this principle, the model assumes some financial benefit to the engine manufacturers, and estimates this benefit using the aforementioned factors.

All of the data used to develop and validate the model reflects the market conditions for all industry segments as of the third quarter of 1999. The group understands that these conditions and costs have and will continue to change. The changes in such parameters can be readily made to the model.

The analysis utilized publicly available data and information. Data on the number of vehicles produced are from the Bureau of Economic Analysis (US Department of Commerce) and the US Department of Transportation. Other sources included the National Petroleum Refiners Association (NPRA), Kline and Company Marketing Research Reports, ASTM/TMC, RSI, API PC-9 NCDT, and Funding Groups, and various corporate annual and 10-K reports. No company-specific information was shared with other companies unless publicly available. However, some aggregated data collected confidentially by the Council from individual companies was used. Estimates by the Working Group were necessary in many instances. Furthermore, this group acknowledges that data from other stakeholders would improve the accuracy and predictions derived from the model.

Additive Industry

Parameters:	
Weight of Engine Oil (lbs/gallon)	7.3
On-Highway Engine Oil Market	1,710
Off-Highway Engine Oil Market	1,516
Total Heavy-Duty Engine Oil Market (million pounds)	3,227
Average Treat Rate (or weight of additives as a % of engine oil weight)	16.8%
Diesel Engine Oil Additives Market (million pounds)	542
Change in Volume of Additives Consumed (%)	0.0%
Average Price of Additives ($/pound)	$0.750
Variable Cost (RM+MFG)	$0.488
Variable Cost Percentage of Price	65%
Fixed + Margin	$0.263
Net Additive Treat Price ($/pound)	$0.103
Market for Diesel Engine Oil Additives	$406,551,600
Base Category Life Cycle (in years)	4
Category Life Cycle (in years) **Range: 4-8 yrs**	4
Cost of Capital (%)	8.5%
Cost Assumptions:	
Shared Funding of Matrix Test Development	$850,000
Product Development Costs	$31,000,000
Specification Development Resources	$1,000,000
Benefit Assumptions:	
Treat Rate Change (%)	0.0%
Additive Price Change (%)	0.0%

12/03

By far, the biggest factor impacting the additive industry with respect to the new PC-9 category is the projected product testing, development, and approval costs. The proposed performance requirements for the new category include seven engine tests with a median cost of $55,000 per test. The actual PC-9 test costs were substituted into the historical CH-4 heavy-duty testing volume: candidate tests from Registration System Inc., (RSI) and calibration tests from ASTM Test Monitoring Center (TMC) to estimate the total approval testing costs for PC-9. Test costs were allocated equally whether conducted at independent or dependent test laboratories. On an industry-wide basis this translates to a cost of $135 million in approval testing alone, and this does not include the preliminary product development costs that are estimated to be $31 million. These preliminary costs include fundamental test programs to develop product platforms and studies to understand the correlation between the PC-9 performance tests and real-world field applications. With the yearly total market for heavy-duty additives totaling approximately $406 million, the net PC-9 product testing and approval costs of $166 million translate to over 40% of the annual market size.

Other costs, although less significant to the additive industry, include an $850,000 funding contribution to PC-9 test matrix and $1 million in specification development resources that includes industry meetings, travel, and additional employee-hours.

The other key factor impacting the additive industry estimates is the projected PC-9 additive treat-cost. Without the specific PC-9 engine tests in place, the PA Panel's Product Approval Protocol Task Group (PAPTG), estimates that the aggregate additive treat rate for PC-9 will remain unchanged from CH-4 at 16.8% by weight. Potentially, PC-9's quality up-grade will be largely attained through a rebalance of additive components, new additive chemistry, and higher quality base oils. The total PC-9 treat-cost is assumed to remain consistent with CH-4.

Independent Testing Laboratories

Parameters:	
Contribution Margin (%)	11.6%
Cost of capital (%)	11.0%
Allowance for Dependent Labs **Range: 10-40%**	17%
Cost Assumptions:	
Calibration/Stand Approval Testing (Indep. Labs Only)	$25,212,080
Calibration/Stand Approval Testing (Indep. And Depend. Labs Combined)	$30,376,000
Capital Expenditures (New Stand Set-up + Engine; Indep. Labs Only)	$7,855,000
Variable Cost (Fuel + Hardware; Indep. Labs Only)	$22,322,717
Variable Cost (Fuel + Hardware; Indep. And Depend. Labs Combined)	$26,894,840
Other Variable Cost for PC-9	$75,887,677
Percent of Fixed + Margin Allocated to Other Variable Cost for PC-9	81%
Fixed + Margin Before Other Variable Cost for PC-9 Removed	$93,114,133
Variable Cost from Contribution Margin	$131,277,474
Contribution Margin (Fixed plus Margin, Majority Margin over Long Term)	$17,226,456

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Test Runs (number; Indep. Labs Only)	1,951
Test Runs (number; Indep. And Depend. Labs Combined)	2,350
Benefit Assumptions:	
Customer Approval Programs (Indep. Labs Only)	$108,373,930
Customer Approval Programs (Indep. And Depend. Labs Combined)	$130,571,000
Customer Development Programs (Indep. Labs Only)	$38,180,000
Customer Development Programs (Indep. And Depend. Labs Combined)	$46,000,000
Matrix Testing Revenue	$1,950,000
Total	$148,503,930

The independent testing laboratories are considered a key stakeholder in the PC-9 category development process as they conduct approximately 83% of the industry tests. As previously stated, the PC-9 testing volume was estimated using RSI and ASTM CH-4 data and the average individual test cost were based on those costs developed for the PC-9 matrix memorandum of agreement between, API, the Council, the independent test laboratories, and the Original Equipment Manufacturers (OEMs). PC-9 testing will generate approximately $148 million revenue for the independent test laboratories. However, the laboratories will realize only a marginal economic benefit from PC-9 due to the cyclical nature of testing demands and high operational costs.

A principal assumption for the test laboratories is that all CH-4 engine test platforms will be replaced by PC-9 engine test platforms. This conversion will cost the test facilities roughly $14 million. Another significant cost for the laboratories is calibration and stand approval costs which are estimated for PC-9 at $21 million using historical ASTM CH-4 calibration data.

The independent test labs have agreed to contribute in-kind testing to the PC-9 industry matrix. Since these tests will qualify their stands for candidate testing, the contribution is captured under the stand approval costs.

Oil Companies / Marketers

Parameters:	
Total Heavy-Duty Engine Oil Market (million gallons)	442
On-Highway	234
Off-Highway	208
Change in Volume Oil Market (%) (+Increase/-Decrease)	0.0%
% of Oils Sold in Commercial Packaging (55 gallons and above)	93%
% of Oils Sold in Consumer Packaging (5 gallons and below)	7%
Average Price - Consumers ($/quart)	$1.330
Average Price - Retailers/OEMs ($/quart)	$1.150

Average Price - Bulk Oil/Consumers ($/quart)	$0.820
Average Price - Bulk Oil/Retailers/OEMs ($/quart)	$0.710
Average Price - Received by Oil Manufacturers ($/quart)	$0.741
Average Raw Material Costs ($/quart)	$0.570
Average Base Oil Costs ($/quart)	$0.250
Additives ($/quart)	$0.230
Average Packaging Costs	$0.090
Variable Costs	$0.660
Fixed + Margin	$0.081
Passthrough of Costs from Base Oil Manufacturer	
to Marketer	100%
Cost of Capital (%)	8.72%
Cost Assumptions:	
Increase in Base Oil Costs (%)	4.0%
Change in Base Oil Costs ($/quart))	$0.010
Funding of Testing	$850,000
Cost of Reformulation, Product Testing, etc.	$15,000,000
Cost of Change in Labeling & MSDS	$3,000,000
Benefit Assumptions:	
Price increase above base oil passthrough ($/quart)	$0.000
Avg. price change received by oil marketer due to base oil cost passthrough ($/quart)	$0.010

Although a large portion of the costs associated with the new PC-9 category is expected to be funded by the additive industry, the oil marketers also will be impacted. The cost of reformulation and new product testing is expected to cost the oil marketing industry $15 million, and an additional $3 million for new labels, changes in MSDS, and other supporting documentation. The oil marketers also spent $850,000 for their share in the funding of the PC-9 test matrix.

Another significant factor impacting the oil marketers is the price of base oil. During the development of GF-3, a substantial investment was made to upgrade refinery equipment, which resulted in the production of higher quality base oils for use in the new passenger car motor oil formulations. These new, less volatile base oils also will be beneficial for use in the new PC-9 products. This increase is expected to be in the range of 4-5% over the previous CH-4 category. Recent increases in the posted price of base oils have caused a shift in the base-line cost estimate, and it is unclear what portion of this cost increase will be passed on to the end user.

Original Equipment Manufacturers (OEMs)

Basic Parameters:	
Base Sales - Total US shipment value of all automotive and nonautomotive ($Million)	$10,031
Fraction of Sales of Class 8 Engines **Range: 0-100%**	40%
Variable Margin (Variable Margin = Sales - Variable Cost) (%)	30%
Total Margin ($Million)	$3,009

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Sales Loss Avoidance - Delay in purchase decision by customer (% Sales $) - Yr 1	5.0%
Price Increase - Durability Related Value (% Sales $)	0.00%
Price Increase - Drain Interval Improvement Value (% Sales $)	0.00%
Current Warranty Claim Rate (% Sales $)	4.0%
Warranty Cost Reduction (% Change in Warranty Claim Rate)	10.0%
% of CGS	85%
Cost of Capital (%)	8.0%
Cost Assumptions:	
OEM Lubricant Evaluation Program ($)	$7,500,000
Shared Funding of Test Development ($)	$250,000
Communication of Specification Change to Customer ($)	$1,000,000
Change in Initial Assembly & Other Costs ($)	$0
Benefit Assumptions:	
Sale of Test Engines & Hardware	$14,742,000
Sales Loss Avoidance (Delay in purchase decision by customer)	$60,186,000
Price Increase (Durability Related)	$0
Price Increase (Drain Interval Improvement)	$0
Warranty Cost Reduction	$40,124,000

The PC-9 engine oil category is being driven by the OEMs response to more stringent emissions regulations. In order to meet these new, more rigorous emissions standards, OEMs are planning to utilize Exhaust Gas Recirculation (EGR). This new technology will help to decrease emissions, however, it also results in more severe engine operating conditions. PC-9 oils will make the impact of these more severe operating environments transparent to consumers.

The model predicts that the PC-9 category will help OEMs avoid sales losses by allowing engine service intervals to remain consistent with previous model years. Without the introduction of PC-9 oils, EGR-equipped engines would require shorter drain intervals, which would make new engine purchases less attractive to potential buyers. In the absence of PC-9 oils, fleet owners may choose to defer the purchase of new engines for a period of time in order to avoid the higher costs of maintaining EGR-equipped engines. These potential deferred purchases could have a significant impact on the OEMs' sales revenue for Class 8 engines.

In addition, PC-9 oils are expected to reduce engine warranty claims, estimated at 5% of the total OEM annual sales of approximately $10 billion. PC-9 oils will be specifically formulated to deal with the harsher demands of EGR-equipped engines, whereas CH-4 oils are not.

PC-9 oils also will enhance the value of new engines by maintaining existing service intervals and engine life, while reducing OEMs cost by avoiding additional durability-related mechanical design changes.

The model predicts that the OEMs will generate about $15 million in revenue from the sale of PC-9 test engines and hardware. The OEMs have agreed to allocate $250,000 to the PC-9 industry test matrix. They will also spend an estimated $1 million on communications of specifications changes when PC-9 is introduced.

How the Model Works

The model is based on an Excel spreadsheet template. This section of the paper outlines the basic structure of the model, the formatting characteristics, and general guidelines for the effective use of this model. The calculation method used to assess the net benefit to each user is Net Present Value (NPV).

The flexibility of the model allows the user to modify significant variables to predict the impact of these changes on NPV for the four major industry players simultaneously. This flexibility is possible as a result of integrating the various related components between the different stakeholders. For example, the change in the category testing requirements impacts the costs to the finished lubricant manufacturers and additive companies, as well as the revenue to the testing laboratories and OEMs. With this flexibility, however, comes increased risk of misunderstanding the results. The user of the model should use discretion in changing too many conditions simultaneously.

Some model variables are not interdependent; for instance, the $31 million in preliminary product development costs for the additive companies was provided by a confidential survey by the Council. If the model user dramatically reduces the number of engine tests in PC-9, this $31 million estimate would no longer be valid. The group recommends that the model user evaluate one change at a time and assess the NPV impact of that change independent of any other changes.

The Excel file has three tabs, "Model," "Testing Reference," and "Sensitivity." The Excel model is found in the "Model" tab. This Model tab is split into four major sections: one section each for the Additives Industry (Rows 1 through 45), Testing Laboratories (Rows 46 through 84), Finished Lubricant Manufacturers (Rows 85 through 128), and Equipment Manufacturers (Rows 129 through 164). Columns A through D entries provide input fields as well as calculations for variables that are considered significant in the PC-9 NPV assessment. Columns F through Z entries are primarily used for advanced calculations of relevant cash flows and PC-9 final conditions relative to CH-4 conditions. Column AB entries provide the source references and notes for independent variables and special calculations in the columns to the left of the notation.

The Testing Reference tab provides the details of the input and output calculations for understanding the testing costs. The results and values from this tab are linked to the Model tab in which calculation of NPV is performed.

The Sensitivity tab provides some predefined sensitivities of the more significant category development variables. In order to simplify the sensitivity analysis, the inputs for the testing data are entered in this tab of the spreadsheet (section G30:J37).

The formatting of the text in the model helps guide the user in the use of the model. All blue text is assumed to be independent, thus allowing the user of the model to modify these values to assess the outcome on the NPV for each of the stakeholders simultaneously. The black text is either considered to be fixed or a calculation from the other independent variables. **Any modification of the black text values will render the model results invalid.**

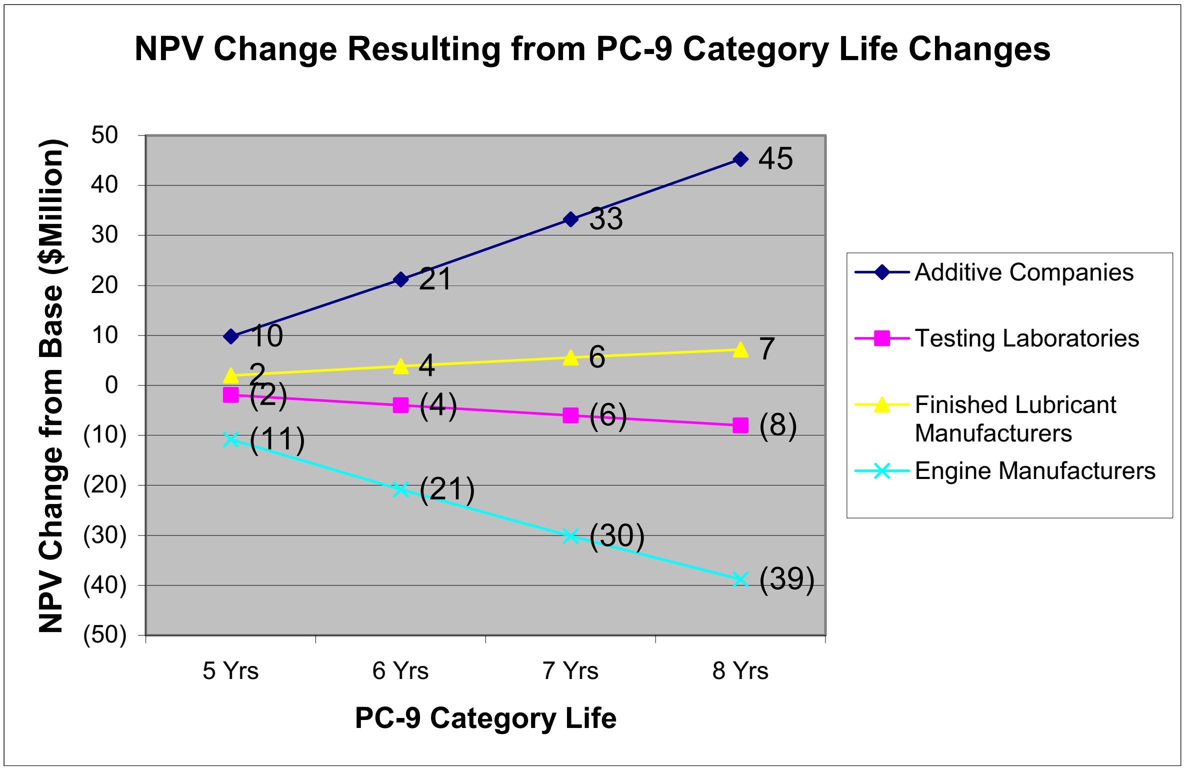
The use of the model requires that the user provide a reasonable range of values for the independent variables. For instance, the model cannot reliably reflect the NPV for a category life that goes much beyond 8 years or less than 4 years. We provide the user with reasonable input guidelines where appropriate in the area just left of the input fields to limit confusion in the use of the model.

Results and Discussion

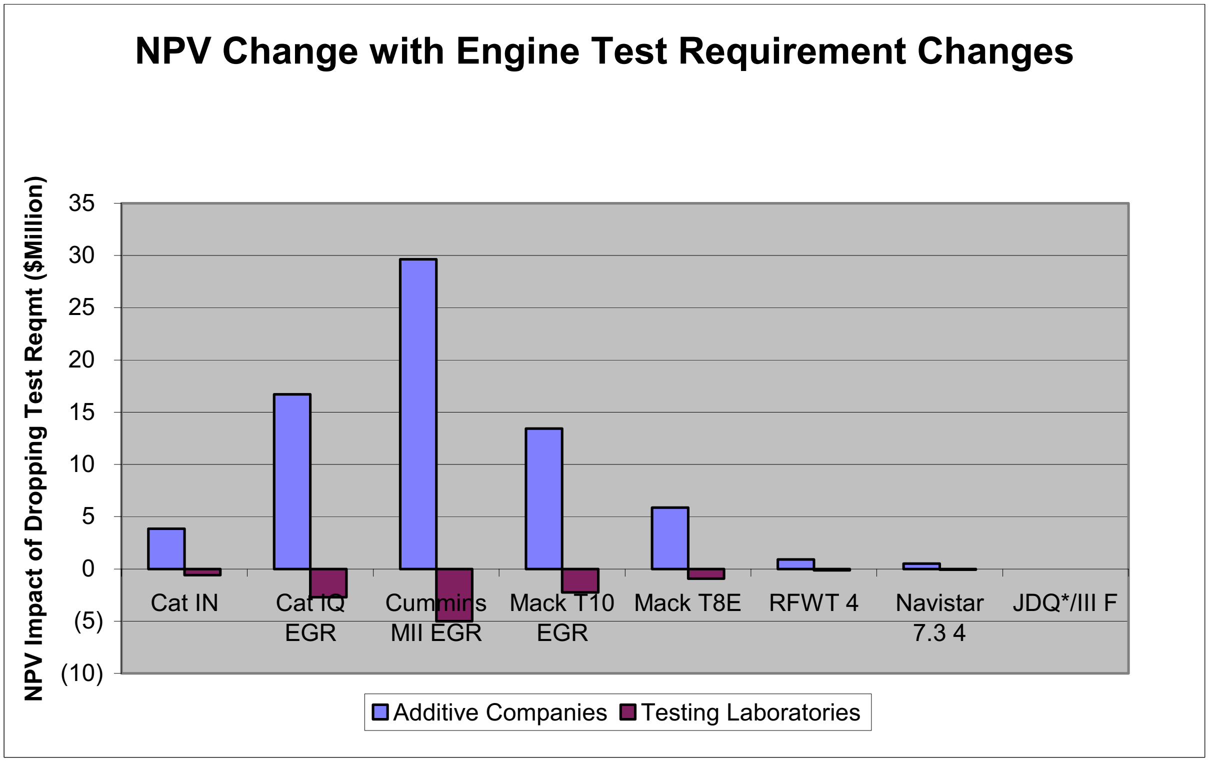
Stakeholders	**Base NPV ($Million)**
Additive Companies	**($91)**
Testing Laboratories	$17
Finished Lubricant Manufacturers	**($11)**
Engine Manufacturers	$143
Total	$59

← **12/03**

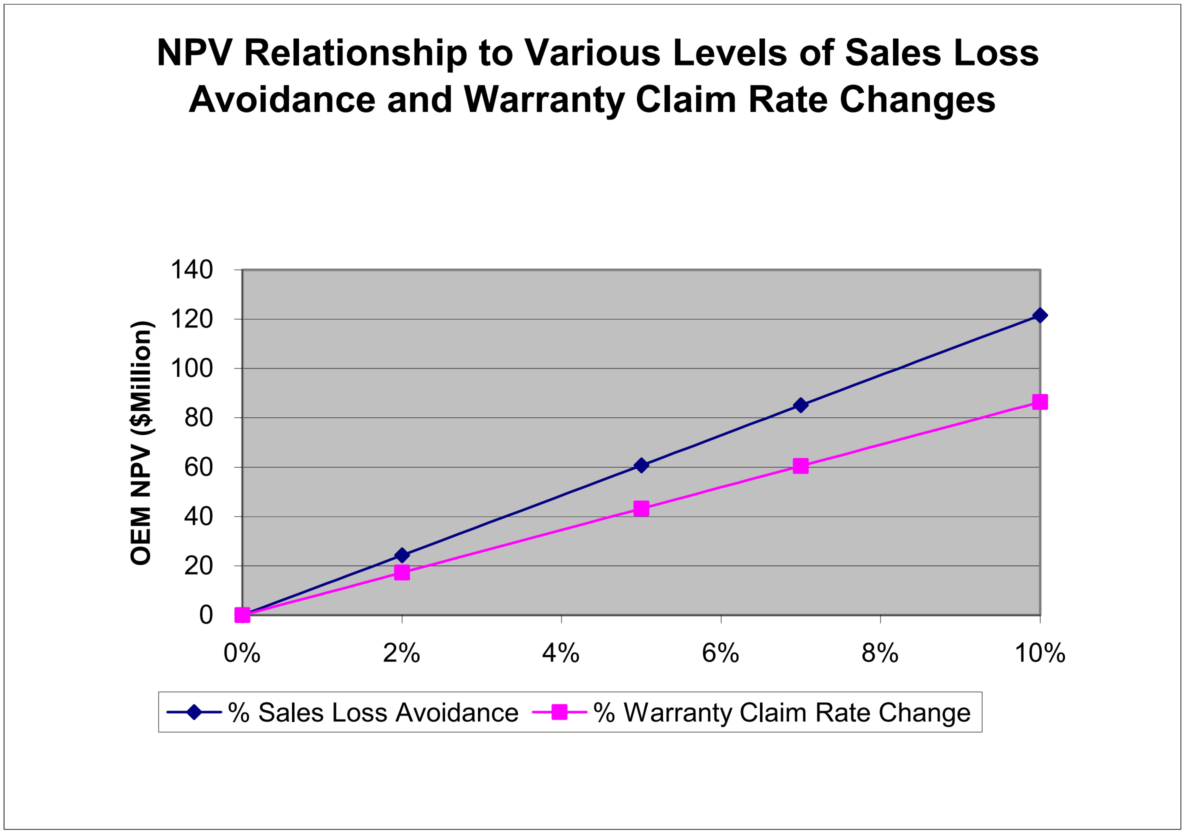
The most significant variables affecting the benefits and penalties to the stakeholders appear to be the years of category life, testing requirements, sales loss avoidance implications, and treat rate changes.



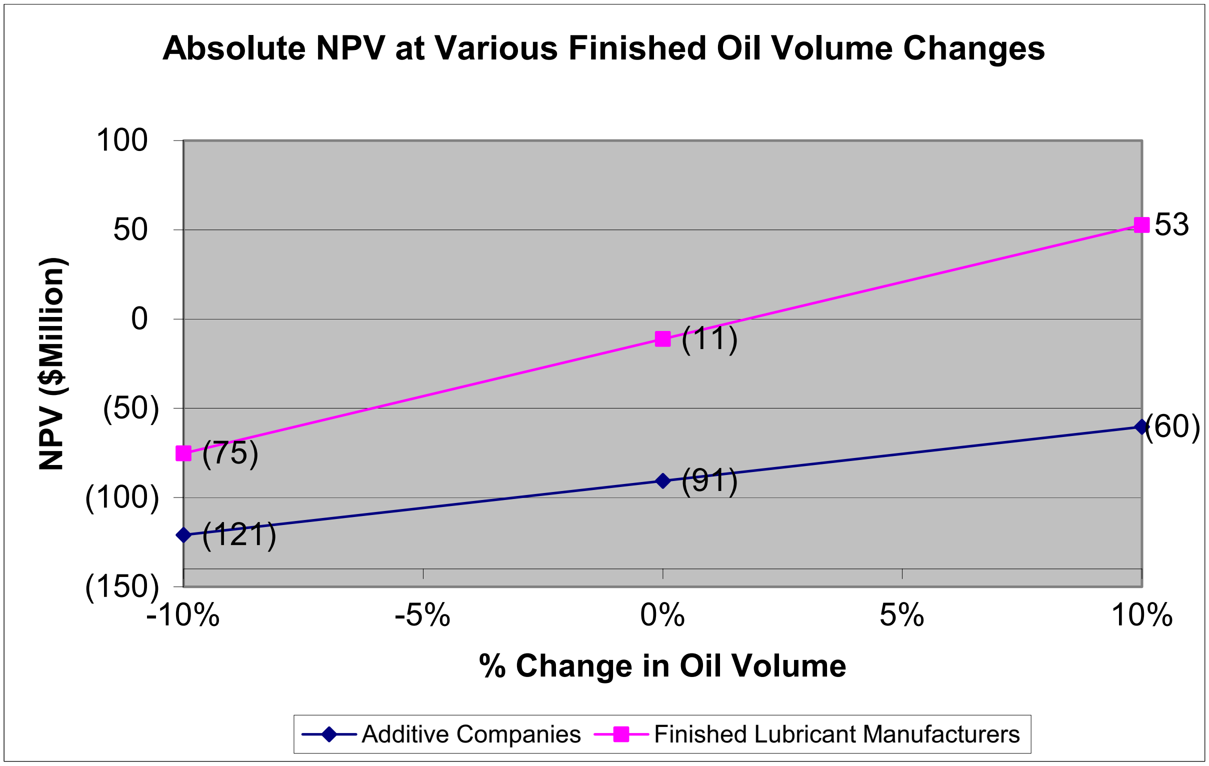
The sensitivity analysis on category life span clearly shows that a longer category life provides an NPV benefit to the additive and oil companies. The testing laboratories have an expected net NPV penalty as category life is extended. The OEMs suffer the most significant penalty as category life is extended if the same factors of sales loss avoidance, warranty claims, etc. are present with PC-10 as are present with PC-9.



The effect of eliminating any single engine test in the PC-9 specification has a positive NPV impact on the additives companies and a negative NPV impact on the test laboratories. The magnitude of the impact is more significant for the additive companies because the entire cost of the engine test is not realized as profit to the test labs.



The magnitude of the OEM sales loss avoidance is estimated in the model base case at 5%. However, since this estimation was intuitive, and made without the benefit of actual data, it is appropriate to show a range of potential outcomes. The same holds true for the warranty claim rate impact.



A number of variables can affect the finished oil volume, including vehicle population, vehicle miles driven, and oil drain intervals. An increase in oil volume has a positive NPV impact upon the additive companies and finished lubricant manufacturers.

Consumers and Society

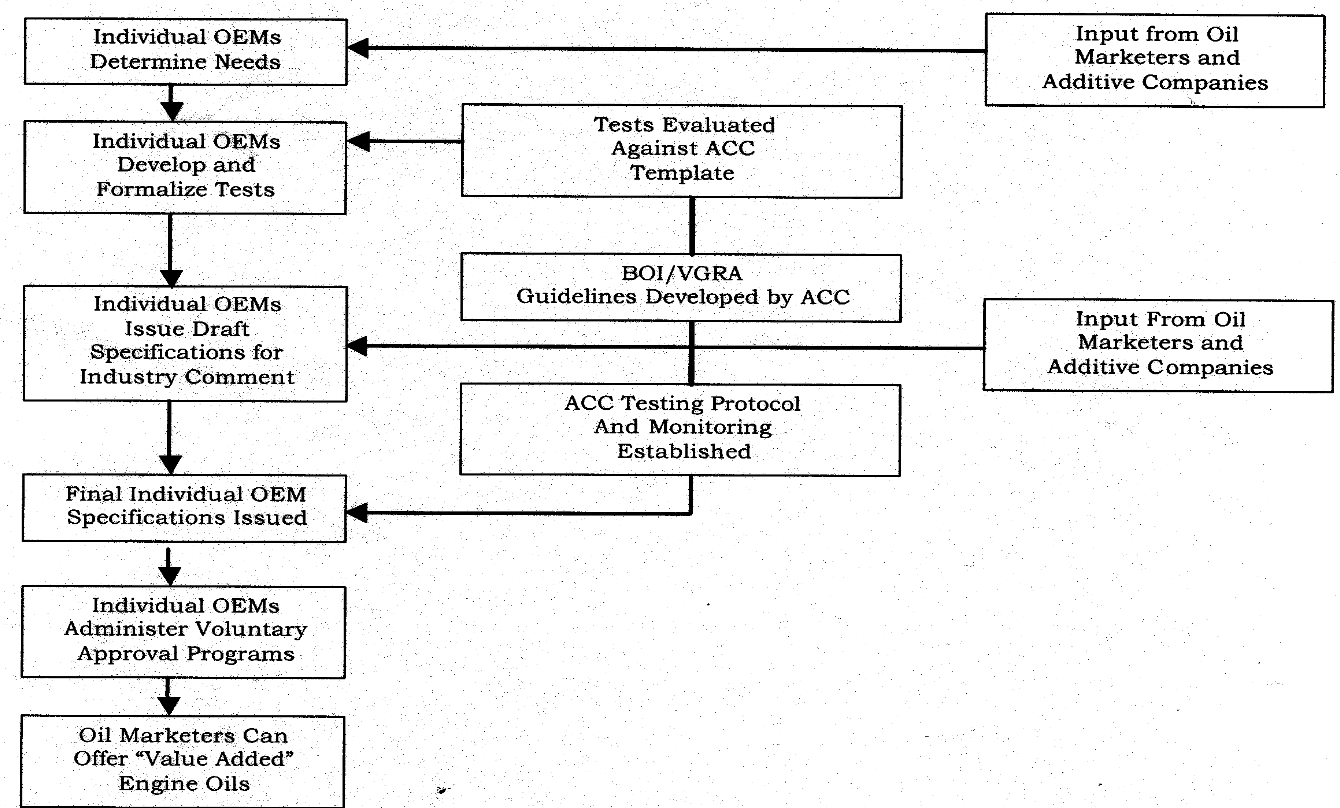
Benefits include longer engine (and vehicle) life and reduced maintenance costs. No attempt is made to estimate the monetary value of longer engine (and vehicle) lives and reduced maintenance costs. There are other potential benefits in reduced transportation costs of delivered goods and services. The changes being made by the OEMs to the engine designs have a positive impact on the environment by reducing carbon dioxide, carbon monoxide, volatile organic compounds (VOCs), nitrogen oxides, sulfur dioxide, and particular matter (PM). PC-9 oils make these changes in engine design transparent to the end user of these redesigned engines.

Conclusion

By fostering a better understanding of the impact of new standards on affected stakeholders, the economic model can be of value in discussions of the funding of test development for new engine oil categories.

According to the model, the additives industry is the most adversely impacted by the current engine oil category development process. The Work Group suggests that the industry stakeholders review the current process, and consider an appropriate action plan that more equitably distributes the impact of new category development on the four key industry stakeholders. This model provides a vehicle to initiate discussions and a tool to make this process efficient.

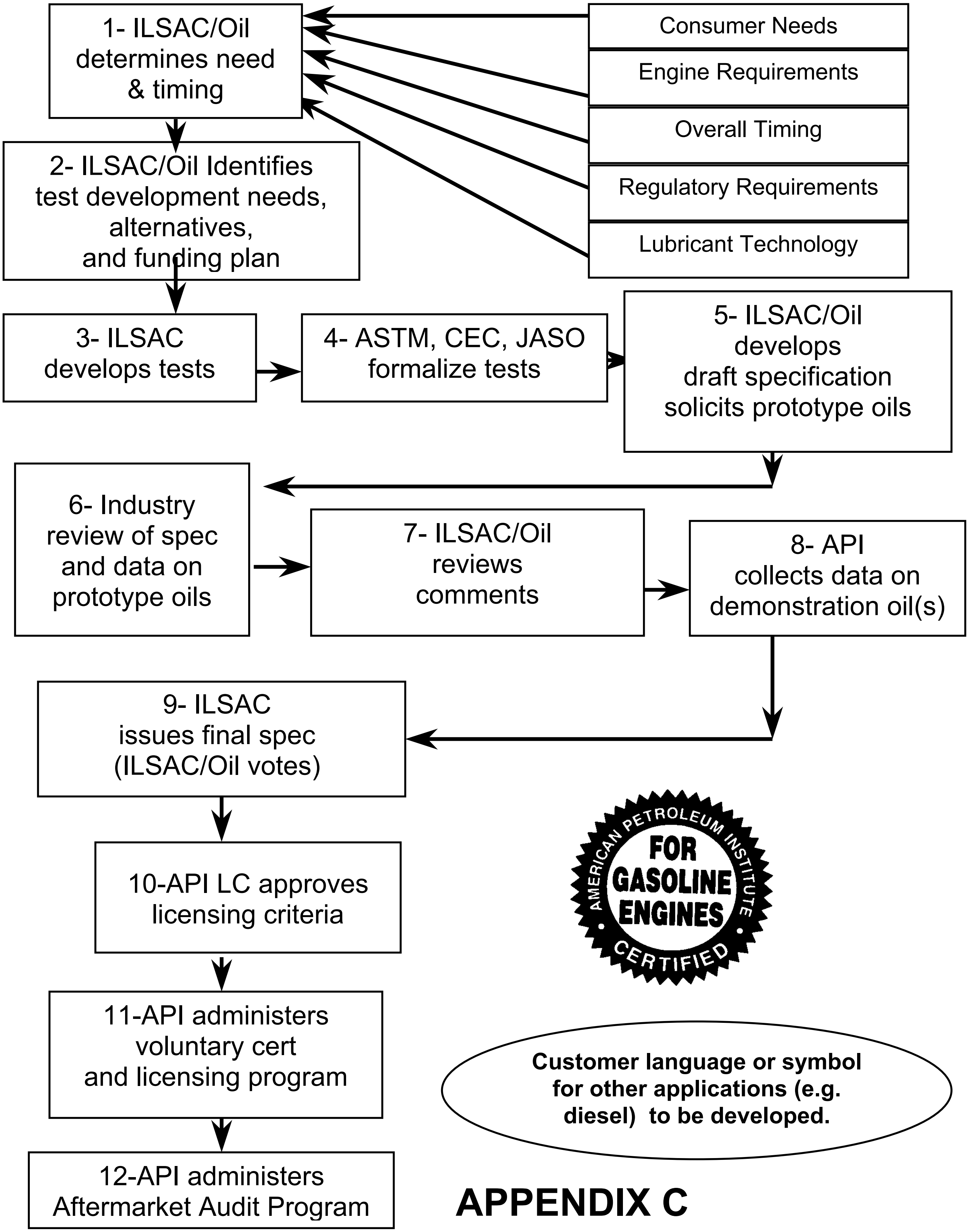
ATTACHMENT III



ATTACHMENT IV

Process/ Sub-process	North America Current Process		ACC Proposal
Specification Development			
Establish need	SAE	OEMs	Individual OEMs
Tests	OEMs	OEMs	Individual OEMs
Test Development			
Hardware selection	OEMs	OEMs	Individual OEMs
Initial procedure	OEMs	OEMs	Individual OEMs
Final procedure	ASTM	various	Individual OEMs
Precision data	ASTM	various	Individual OEMs
Discrimination data	OEMs	OEMs	Individual OEMs
Research Report	ASTM	various	???
Template Evaluation	ACC	ACC	ACC
Monitoring	ASTM	various	ASTM/RSI/OEMs
Reference oils	OEMs	OEMs	Individual OEMs
Testing protocol	ACC	ACC	ACC
Product Approval			
Testing required	ASTM	OEMs	Individual OEMs
Limits	ASTM	OEMs	Individual OEMs
BOI & VGRA	API	OEMs	ACC
Formulation modifications	ACC	OEMs	ACC
Licensing	API	None	None / Individual OEMs

PROPOSED GASOLINE AND DIESEL ENGINE OIL LICENSING AND CERTIFICATION SYSTEM LC



APPENDIX C

EOLCS Process Review

Lubricants Committee Revision 8/22/01

Process Deliverables

- ✓ Development process is more efficient and results in a faster time to market.
- ✓ Because there is better agreement on needs and proof of performance, the product is more robust and will have a longer life cycle.

Discussion of the Proposed Process

The process is a time-based one, not a test available-based one. ILSAC/Oil establishes mile markers and end dates at the beginning of the process. This is a significant change in the process.

The API Lubricants committee endorses this proposal with the understanding that it is subject to further change based on continuing discussions with ILSAC. The objective is to have a process that is acceptable to both ILSAC and API. The process will be incorporated into API 1509.

Block 1

API and ILSAC review and agree on the need and timing for a new category. The development of the needs includes the elements noted as inputs. API and ILSAC may have different requirements, and these may be seen as conflicting. These perceived conflicts are discussed and resolved. A unanimous vote of the ILSAC/Oil group is required on all needs and timing issues.

Block 2

In Block 1, ILSAC/Oil agrees to the needs and timing. In this step, ILSAC/Oil establishes the ways to measure the parameters and their alternates. If a test or a performance measurement is not ready by the agreed time, an appropriate group will recommend a replacement or drop the requirement. There are safeguards in place to prevent the alternate test from becoming the primary test without sufficient data.

A funding plan is in place for the category. (API proposes a 50/50 split between ILSAC and Oil for precision testing, and API recommends that ILSAC also share in BOI/VGRA testing).

A unanimous vote of the ISAC/Oil group is required.

Block 3

ILSAC/Oil established category needs and timing requirements in Block 1. In this step, the OEMs develop the performance tests needed to define the product within the agreed upon time.

Block 4

The appropriate technical groups formalize the tests, establish criteria to demonstrate that the tests are accurate, are reproducible, and discriminate, and agree that the tests measure the category parameters identified in Block 2. The test precision and discrimination criteria, parts availability and test support commitments must be equivalent to or better than that currently established by ASTM D.02.B.

Block 5

Based on the needs, the timing, and the performance tests, ILSAC/Oil members draft a specification for the product. The group would solicit prototype oils to encourage buy-in to the proposed specification. The formulation may not be optimum but it would help determine feasibility. A unanimous vote of ILSAC/Oil is required to issue the draft specification.

Block 6/7

ILSAC/Oil circulates the draft specification to interested parties for comment. Negative comments are submitted with viable alternatives. Added participation by the involved parties in the process could shorten the time between Draft and Final. It might be desirable to have an industry-based group assume the responsibility for gathering and reviewing comments and developing a recommendation for ILSAC/Oil to consider.

ILSAC/Oil will review, in confidence if needed, data on prototype oils. This could be based on the work done during the comment period. In this period, tests and demonstration oil formulations could also be fine-tuned.

Block 8

API will review, in confidence if needed, data on category demonstration oils.
A demonstration oil is intended to show the technical and commercial viability (as determined by the API Lubricants Committee) of the proposed new engine oil category. This is an oil that has been tested in all engine, chemical, physical and bench tests required in the specified category according to the ACC Code of Practice (for engine tests), as candidate oils are tested. Since it is not likely that the tests would have been incorporated into the Code as these tests were

conducted, registration is not needed, but all other practices of the Code would be required. It is necessary that at least one demonstration oil be proven—and the resulting Candidate Data Package available, in confidence if needed—prior to the finalization of the specification as shown in Block 9.
If a demonstration oil is not available, the proposed specification will be re-evaluated by all parties for technical and commercial viability.

Block 9
ILSAC/Oil votes on the limits for specific tests and on the complete Specification. Two thirds of the vote of each group (ILSAC and Oil) is needed to confirm the limit or approve the final specification. ILSAC issues Final GF Specifications. It is critical that both ILSAC and Oil agree on this specification so that both parties are willing to accept it and proceed to development. The two parties have a responsibility to work very diligently in Block 9 to bring to the LC, in block 10, an agreed upon set of specifications. Less than unanimous support could lead to uncertainty in the Lubricants Committee about what is wanted, and the voting in Block 10 could become an up or down vote on the system itself and could, in effect, be the end point in the process. Similarly, if ILSAC/Oil deadlocks in this step ILSAC can issue their own specifications and pass it along to Block 10.

Block 10
API LC votes on adoption of ILSAC specification including compliance with due process requirements. LC would also make changes in API 1509 for issues not covered in a GF specification and document the specifications for any products not covered by the ILSAC specification in API 1509.

Block 11 and 12
These steps are the same as currently used and documented in API 1509.

EOLCS Process Review

Proposed Revision 7/25/01

Based on AGP Meeting

TIMELINE

The process is a time-based one, not a test available-based one. ILSAC/Oil establishes mile markers and end dates at the beginning of the process. This is a significant change in the process.

The dates shown are **Completed By**:
To the maximum extent possible, conduct activities in parallel. This would allow for more time for some activities than shown in this time line.

Agree On New Process **10/1/01**

Block 1 Needs Determination
Block 2 Test Development Needs and Alternatives

Completed by: 11/01/01

Block 3 Develop Tests

Completed by: 05/01/02

Block 4 Matrix and Precision Testing

Completed by: 10/01/02

Block 5 Draft Specification
Block 6/7 Comments
Block 8 Demonstration Oil
Block 9 Final Spec
Block 10 API Accepts

Completed by: 4/1/03

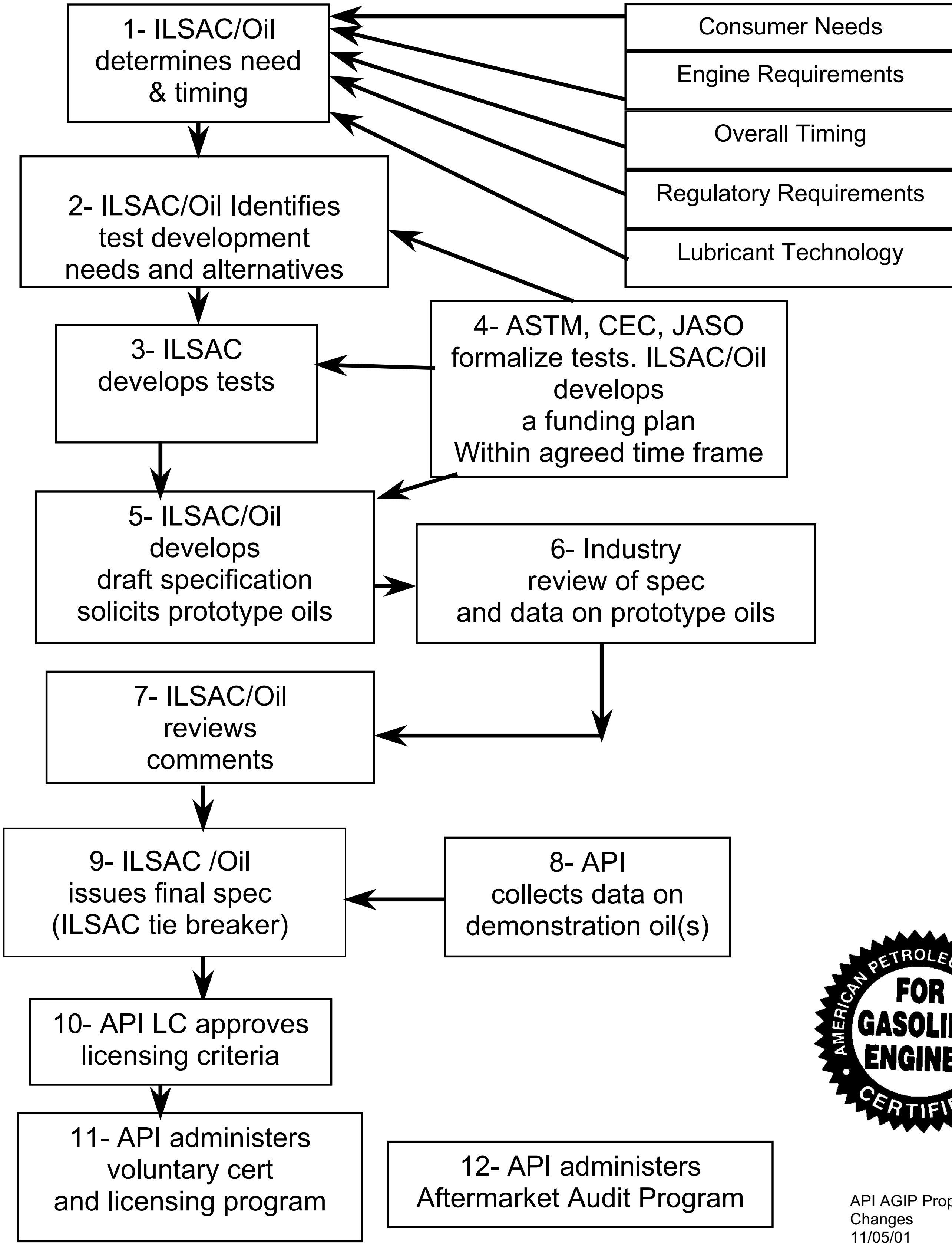
Block 11/12 Licensing and Auditing

First License Date **01/01/04**

Probable Test Changes based on Draft GF-4 Spec circulated by ILSAC.
Replace IIIF with IIIG adds tighter Oxidation and Wear
Add to VG: 3 wear parameters
Tighten Limits on VIB better FEI1and FEI2 and longer time to FEI2

Tighter control of Phos or VII Test OPEST **New test** would need Matrix testing
Limit on Sulfur
Tighter Limit on TEOST
New: Foam measurement on used oil. Two tests

PROPOSED GASOLINE AND DIESEL ENGINE OIL LICENSING AND CERTIFICATION SYSTEM *11-5 AGP*



AMERICAN PETROLEUM INSTITUTE FOR GASOLINE ENGINES CERTIFIED

API AGIP Proposed Changes 11/05/01

ILSAC GF-4 Needs Statement
Revised 3-27-02

New category GF-4 is needed as a minimum performance standard providing

(1) protection of emission systems that meet the 2004 MY Tier 2, Bin 5 emissions limits[1],
(2) improvement in fuel economy,
(3) improved robustness of engine oil to protect the durability and fuel economy of new and future engines, and
(4) protection of the in-use fleet during real world customer usage, i.e. provides backward compatibility to service older engine designs.

GF-4 category oils must provide the same performance as GF-3 category oils plus the following improvements:

1. A reduction of the effects of poisoning of catalyst and emission system components. This is needed to meet Federal Regulation for the 2004 MY Tier 2, Bin 5 vehicles. One of the most demanding requirements of this regulation is a limit of 0.07 gm/mile NOx at 120,000 miles. The levels of phosphorous and sulfur commonly used in current GF-3 oils have been shown to damage catalysts[2].

2. Improved performance in a high temperature, high load engine test as compared to GF-3. This performance improvement is required to safely maintain the current recommended drain intervals for modern engines.

3. Improved low temperature rheological properties at end of high temperature, high load engine testing to reduce the possibility of field failures due to excessive low temperature viscosity.

4. An increase in fuel economy and an increase in FEI retention at longer test length, relative to GF-3. This is needed to provide reduction in CO_2 emissions while allowing a vehicle sales mix desired by the customer.

5. Improved robustness during high temperature operation to improve piston ring belt cleanliness. This is needed because the higher power density and higher speeds in modern engines put higher stress on the oil. Failure to control piston ring belt deposits causes high oil consumption and increases exhaust emissions.

6. Demonstration that high temperature foaming of used oil is well controlled. Used oil foaming tendency is an important factor in actual vehicle operation.

An initial proposal to meet all of these needs is shown in the attached Draft of GF-4 provided by ILSAC.

Footnotes:

1. Federal Register 86.1811-4 Vol.65, No. 28 Feb 10,2000

2. SAE 2002-01-1093 "The Effects of Oil-Derived Poisons on Three-Way Catalyst Performance" includes 14 references 1984 to 2001.

Needs27Mar02.DOC

APPENDIX E

Working Draft GF-4 Needs Statement
As Modified by ILSAC/Oil 4/10/02

Category GF-4 is needed as a minimum performance standard providing for the protection of emission systems to meet the 2004 MY Tier 2, Bin 5 emissions limits[1], and also providing improved:

(1) fuel economy, and fuel economy retention
(2) robustness of engine oil to protect the durability of future engines
(3) (ILSAC – protection of the in-use fleet during real world customer usage, i.e., provides backward compatibility to service older engine designs.
(3) (Oil – no (3))
(3) Group will continue to discuss the issue

More specifically, GF-4 oils must include the following improvements:

1. A reduction of the effects of poisoning of catalyst and emission system components to meet the Federal Regulation for the 2004 MY Tier 2, Bin 5 vehicles. One of the most demanding requirements of this regulation is a limit of 0.07 gm/mile NOx at 120,000 miles. The levels of phosphorus and sulfur commonly used in current GF-3 oils have been shown to damage catalysts[2].

2. ~~Low temperature rheological properties (Oil - of used oils) (ILSAC - at the end of performance engine testing) must also be specified to reduce the possibility of field failures due to excessive low temperature viscosities[3].~~ Low temperature rheological properties of used engine oils which have been stressed in high temperature, high load operation must be controlled to reduce the possibility of field failures due to excessive low temperature pumpability[3].

3. An increase in fuel economy and an increase in both FEI retention and durability, relative to GF-3[4]. This is needed to provide reduction in CO_2 emissions while allowing a vehicle sales mix desired by the customer.

4. Improved robustness during high temperature, high load operation to improve piston ring belt cleanliness and control of nitration and oxidation. This is needed because the higher power density and higher speeds in modern engines put higher stress on the oil. Failure to control piston ring belt deposits causes high oil consumption and increases exhaust emissions. Failure to control nitration and oxidation could lead to unacceptable viscosity increase leading to engine failure[5].

5. ~~Demonstration that high temperature foaming of used oil is well controlled. Used oil aeration tendency is an important factor in actual vehicle operation[6].~~

An initial proposal to meet all of these needs is shown in the attached Draft of GF-4 provided by ILSAC.

Draft GF-4 Needs Statement
01-13-03

Category GF-4 is needed as a minimum performance standard providing for the protection of emission systems to meet the 2004 MY Tier 2, Bin 5 emissions limits[1], and also providing:

(1) Improved fuel economy, and fuel economy retention
(2) Improved robustness of engine oil to protect the durability of future engines
(3) Enhanced protection of the in-use fleet during real world customer usage, i.e., provides backward compatibility to service older engine designs.

More specifically, GF-4 oils must include the following improvements:

1. A reduction of the effects of poisoning of catalyst and emission system components to meet the Federal Regulation for the 2004 MY Tier 2, Bin 5 vehicles. One of the most demanding requirements of this regulation is a limit of 0.07 gm/mile NOx at 120,000 miles. The levels of phosphorus and sulfur commonly used in current GF-3 oils have been shown to damage catalysts[2].

2. Low temperature rheological properties of used engine oils that have been stressed in high temperature, high load operation must be controlled to reduce the possibility of field failures due to excessive low temperature pumpability[3].

3. An increase in fuel economy and an increase in both FEI retention and durability, relative to GF-3[4]. This is needed to provide reduction in CO_2 emissions while allowing a vehicle sales mix desired by the customer.

4. Improved robustness during high temperature, high load operation to improve piston ring belt cleanliness and control of nitration and oxidation. This is needed because the higher power density and higher speeds in modern engines put higher stress on the oil. Failure to control piston ring belt deposits causes high oil consumption and increases exhaust emissions. Failure to control nitration and oxidation could lead to unacceptable viscosity increase leading to engine failure[5].

An initial proposal to meet all of these needs is shown in the attached draft of GF-4 provided by ILSAC.

1 – Federal register 86.1811-04 Volume 65, Number 28, Feb 10, 2000.
2 – Phosphorus: SAE 2002-2-2880, 2002-01-1093 & 2000-01-1881
Sulfur: Effects of sulfur (in gasoline) include SAE 1999-01-1543, 1544, 3675, 3676 and 2000-01-0857 & 2929.
3 - SAE 2001-01-1899
4 - SAE 2001-01-1903
5 - SAE 2001 -01-1899

Note: Document retyped as facsimile copy of original not legible.