High Efficiency Oil Filters Focus Groups

Final Summary and Report

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Executive Summary

Purpose and Background

In March 2004, the California Department of Toxic Substances Control (DTSC) Office of Pollution Prevention and Technology Development (OPPTD) contracted with the Public Research Institute at San Francisco State University (PRI) to conduct a series of focus groups of California vehicle fleet operators as part of a pilot demonstration of High Efficiency Oil Filter (HEOF) technology. Funding for the demonstration project was provided through a contract with the California Integrated Waste Management Board.

The objective of the DTSC/OPPTD demonstration project is to implement a pilot test of HEOF technology and develop a strategy for promoting HEOF to State fleets. The demonstration will evaluate and quantify the HEOF performance, effects on oil procurement, used oil generation, and cost savings resulting from the use of HEOF. To inform the demonstration project, a survey of public and private fleet managers was administered by the OPPTD in Fall 2003. In May/June 2004, PRI conducted a series of 5 focus groups of public and private fleet managers in Sacramento, the San Francisco Bay Area, and San Diego. The focus groups encompassed the following objectives:

- validate the fleet manager survey results;
- identify barriers to implementing HEOF technology in vehicle fleets;
- solicit suggestions for overcoming the barriers identified, and
- conduct a filter selection exercise to identify information needs of fleet managers.

The information gathered through the surveys and focus groups will be used to address barriers in the design of the demonstration project and to create suggestions for promoting HEOF technology to fleet operators. This report discusses the results of the focus groups.

Key Findings

Survey Validation

The OPPTD administered a survey to public and private fleet managers in Fall 2003, to obtain information about their fleets and identify potential costs and benefits of HEOF technology that are important to fleet managers. To validate the survey results, participants in the focus groups were shown a graph comparing survey respondents' relative importance ranking of various costs and benefits in considering whether to purchase HEOF for their fleets. While survey respondents ranked **performance factors** as higher in importance than **cost factors**, focus group participants felt that survey respondents in administrative positions may have considered cost as more important while those in maintenance/service positions considered performance factors more important.

- Focus group participants considered effects on engine warranty the most important of the performance factors presented.

- Most participants did not consider decreasing engine wear of high importance since engine failure due to lubrication issues is very rare; the exception was a city mass transit fleet manager looking to extend the engine life of his vehicles.

- Participants representing state fleets expressed willingness to let the initial investment pay for itself over 3 to 5 years to half the expected the life of the vehicle, whereas those in local governments typically said that 1 to 3 years was the maximum acceptable time frame.

- Participants in the focus groups considered oil analysis a measure of filter performance, and therefore higher in importance than the survey results indicated.

Oil Analysis

- Approximately half of the participants had conducted an oil analysis. Of these, most had used analysis to diagnose engine problems rather than to extend the engine oil life. Participants were largely unfamiliar with the idea of using oil analysis to track oil viability over time, and expressed preference for using standardized ranges within test parameters to assess the viability of oil.

- Total Base Number (TBN) and viscosity were considered the most important indicators of oil failure; metal detection was considered the most important to measure filter performance.

- Participants expressed concern that using HEOF to remove particles from the oil would decrease the diagnostic value of oil analysis.

Filter Selection

Thirty participants completed a filter selection "report card," scoring each filter model on the following criteria: 1) performance, 2) design and construction materials, 3) initial purchase and on-going service costs, 4) oil sample collection and filter change services, and 5) warranty.

- Of the 11 participants who preferred a specific filter, 5 participants chose the PuraDYN, 4 chose the OilGuard, and 3 chose the Fleetguard model.

- Warranty on the filter and effect on engine warranty were among the top concerns. Participants praised the PuraDYN model for its OEM warranty letters stating that use of the filter would not in itself invalidate engine warranty, but participants thought the PuraDYN's 12-month filter warranty was too short.

- Initial and maintenance costs, including cost of filter elements, were considered among the most important selection criteria.

- Micron size and breadth of substances filtered were of secondary importance; in this regard, participants rated the PuraDYN favorably, based on manufacturer's information listing a wide variety of substances filtered.

- Participants mentioned maintenance, specifically the ease of filter element replacement and the potential mess created during replacement, as notable selection criteria.

- Concerns about installation and routing included whether sufficient space is available in the crankcase for the large filters, whether filters can be installed so that the unit is kept away from the heat generated by the engine, and whether installation equipment is included in the filter price.

- Participants generally expressed preference for spin-on filter models.

Barriers to Implementation of HEOF Technology

Institutional/service barriers identified in the focus groups included logistic difficulties in tracking analysis for large fleets, overcoming skepticism among technicians, and installation and maintenance difficulties.

- Many participants stated that using HEOF would require them to track analysis over a large number of vehicles and in some cases substantially alter the service schedule for vehicles. Many organizations conduct oil changes as part of an overall regularly scheduled service and participants felt it would be difficult to change existing maintenance routines.

- Participants predicted that there would be general skepticism among vehicle technicians about leaving oil that looks dirty in the vehicle or not following regular oil change intervals. Participants suggested that technician training may overcome this barrier.

- Participants also expressed concern about the difficulty of installation and maintenance. They suggested choosing smaller filter models or making HEOF available as OEM equipment to circumvent installation altogether.

Cost concerns included the large investment in initial equipment purchase and installation, lack of performance and cost-benefit data to inform purchasing decisions, and labor costs associated with conducting regular oil analysis.

- Participants felt that convincing decision-makers to invest in HEOF technology would present a considerable challenge, and expressed desire for credible, detailed cost/benefit data that would allow purchasers to predict the length of time to recover initial investment and the potential performance of the technology.

- Initial and installation costs presented significant barriers, particularly for managers whose organizations are under severe budget constraints. To overcome the initial cost barrier participants suggested providing of HEOF as OEM equipment, negotiating cost breaks for government agencies, and reusing the filters on several vehicles.

- Many participants felt that conducting and tracking oil analysis would be more costly and more labor intensive than conducting regularly scheduled oil/filter changes. Demonstration of cost recuperation and potential performance may help to overcome this barrier.

Warranty concerns presented one of the most significant barriers, but also generated many suggestions for overcoming the barrier.

- Fear of invalidating vehicle warranties was a significant barrier. Most participants felt that it would be too risky to exceed manufacturer recommended oil change intervals while their vehicles were still under warranty. Suggestions for overcoming this barrier included: install the HEOF after the vehicle warranty expires; provide HEOF as OEM equipment; engine manufacturers should specify brands and/or models of filters acceptable for use within warranty, and specify oil change intervals for use with HEOF; alternatively, engine manufacturers could specify of a range of standard oil test results within which the engine oil could still be used without invalidating the warranty.

Perceptual barriers included the following concerns: extending motor oil life would be risky, labor costs of conducting oil analysis would exceed money saved on oil changes, and HEOF technology would not actually produce cost savings. Many participants also expressed the belief that source reduction is not necessary if oil is recycled or rerefined.

- Several participants stated that since oil breaks down because of the engine heat, it is risky to extend engine oil for very large mileage intervals, even if the oil is clean. However, several agreed that if an analysis showed an acceptable viscosity level, that would convince them that the oil was still viable.

- Several participants felt that oil analysis requires the vehicle to come out of service for analysis and possibly again several days after the analysis results are received. Coupled with the perceived labor costs to track the oil analysis and dispose of filter elements, HEOF was not seen as a potential for cost savings.

- Some participants were not clear about the difference between recycling and source reduction in terms of pollution prevention; they viewed using rerefined oil and recycling used oil as equally preferable to source reduction.

Conclusions

The most significant barriers to widespread use of HEOF identified in the focus groups were initial cost and ongoing service/analysis cost, and potential effect on engine warranty.

Detailed cost-benefit information that demonstrates cost savings and allows fleet managers to estimate cost recuperation periods and potential performance by vehicle class is needed to encourage HEOF use.

Most fleet managers have not used oil analysis to track oil viability. Training on how to track oil analysis over time, the labor involved in conducting and tracking analysis, the safety of extending engine oil life, and the range of possible oil life extension by vehicle type may help to encourage HEOF use.

The DTSC should consider pursuing ways to influence vehicle manufacturers to offer HOEF technology as stock equipment. Availability of stock HEOF technology would eliminate many of the most serious barriers to widespread use of HEOF, including engine warranty issues, initial cost justification, and installation costs.

Suggestions for Promoting HEOF Technology to Fleet Managers

In promoting HEOF to fleet managers, DTSC should use testimonials from participants in the demonstration project to exemplify attainable oil change intervals, and performance and cost-savings data for specific vehicle types.

Promoting trust and familiarity in well-known brand names of filter models may help to develop trust in HEOF technology.

The DTSC should consider disseminating a short fact sheet that counters potential misperceptions about oil analysis procedures and cost as well as the effect of HEOF on engine warranties, and also provides basic data on potential performance and cost recuperation.

If acceptable cost recuperation from using HEOF can be demonstrated and if the superiority of source reduction over recycling and using rerefined oil is promoted, managers of government fleets may consider the environmental benefits of HEOF more seriously in purchasing decisions.

If cost recuperation from using HEOF can be demonstrated, private fleet managers may respond to a “green fleet” certification (or similar promotional program) that can be used in advertising as an incentive to use HEOF in their fleets.

Introduction

In March 2004, the California Department of Toxic Substances Control (DTSC) Office of Pollution Prevention and Technology Development (OPPTD) contracted with the Public Research Institute at San Francisco State University (PRI) to conduct a series of focus groups of California vehicle fleet operators as part of a pilot demonstration of High Efficiency Oil Filter (HEOF) technology. Funding for the demonstration project was provided through a contract with the California Integrated Waste Management Board. The total contract amount for the focus groups was $25,000. This report discusses the methodology and results of the focus group sessions.

Background and Purpose of the Research

HEOF technology extends the useful life of engine oil by keeping it cleaner. Such devices range from simple spin-on replacements for automobiles to more complex add on by-pass equipment for large diesel engines. Some systems extend oil life by tens of thousands of miles with only periodic replacement of filter element cartridges.

The objective of the DTSC/OPPTD demonstration study is to implement a pilot test of HEOF technology and develop a strategy for promoting HEOF to state fleets. The demonstration study will include the purchase and installation of HEOF technology in 100 vehicles from the state fleet. The study will evaluate and quantify the HEOF performance, effects on oil procurement, used oil generation, and cost savings resulting from the use of HEOF. To inform the demonstration study, a survey of public and private fleet managers was administered by the OPPTD in Fall 2003. In May/June 2004, PRI conducted a series of 5 focus groups of public and private fleet managers in Sacramento, the San Francisco Bay Area, and San Diego. The focus groups encompassed the following objectives:

- validate the fleet manager survey results;
- identify barriers to implementing the HEOF technology in vehicle fleets;
- solicit suggestions for overcoming the barriers identified, and
- conduct a filter selection exercise to identify information needs of fleet managers.

The information gathered through the surveys and focus groups will be used to address barriers in the design of the pilot demonstration project and to create suggestions for promoting HEOF technology to fleet operators.

A note about qualitative research

Readers of this report are reminded that focus groups are centrally concerned with understanding attitudes rather than measuring them. Qualitative data can help to explain quantitative outcomes, but are not generalizable to a population. However, qualitative results generated in a focus group context are useful as a basis for effective planning and decision making.

Methodology

Fleet Operator Survey

In Fall 2003, the OPPTD administered a 3-page survey to various federal, state and local government as well as private fleet operators throughout California. The survey included of a rating scale to determine the relative importance of selection criteria in purchasing HOEF, information about vehicles in respondents' fleets and their maintenance, and a cost recuperation question. The results of the fleet operator survey provided a basis for focus group discussions. Results of cost, performance and other selection criteria cited as being "very important" in choosing HEOF were compiled to present and validate at the focus group meetings, as were responses to annual mileage and oil change interval items. Data on fleet size and vehicle type were used to assess representativeness at the focus groups.

Focus Groups

Recruitment and Screening

A database of fleet operators, compiled by OPPTD staff, provided the sample used for the survey and the recruitment pool for the focus groups. PRI originally intended to recruit from those who had completed the fleet operator survey, so that their survey responses could be validated in the focus group sessions. However, the wide geographic distribution of those who responded to the survey would not yield enough participants who had completed the survey within a reasonable driving distance to the focus group locations, so the recruitment strategy was adjusted to include all fleet operators in the database whose listed work address was within a 30 mile radius of the selected meeting location, regardless of whether they had completed the survey. The selected meeting locations were Sacramento, Daly City, Berkeley, and San Diego.

PRI staff programmed a recruitment screening instrument into Computer Assisted Telephone Interviewing (CATI) software, WinCati. PRI survey interviewers and coordinating staff conducted the recruitment, contacting fleet operators via telephone. Interviewers verified eligibility based on the following criteria:

1. a potential participant should be the fleet manager of the vehicle fleet, and
2. s/he should be in charge of selecting and procuring oil filters for the fleet.

Once interviewers established eligibility, they described the purpose of the focus groups in detail to potential participants. For the Sacramento meetings, respondents were offered a choice of morning or afternoon time slot, and for the Bay Area meetings, respondents could choose a Daly City or Berkeley location/date. Those who expressed interest but could not commit were scheduled for a callback in 5 business days. Those who refused or were unable to attend on the date(s) and/or time(s) offered were thanked and the recruitment process was terminated. Those who agreed to participate were asked to verify their contact information, and sent a reminder letter with printed directions to and map of the meeting facility. Reminder telephone calls and emails were conducted

2 business days prior to the focus group meetings. Recruitment continued for each session until 12 to 14 participants were scheduled.

- Table 1. Outcomes of Final Recruitment Attempts by Area

	Sacramento		Bay Area		San Diego	
Managers within 30 miles of meeting location	**352**		**371**		**92**	
Disconnected number	39	11.1%	43	11.6%	1	1.1%
Fax/data line			1	0.3%		
No answer	2	0.6%	6	1.6%	5	5.4%
Voicemail	36	10.2%	16	4.3%	42	45.7%
Refusal/Cannot attend on date or time offered	127	36.1%	111	29.9%	4	4.3%
Wrong contact information	45	12.8%	47	12.7%	5	5.4%
Callback	76	21.6%	123	33.2%	23	25.0%
Will participate--Sacramento morning session	14	4.0%				
Will participate--Sacramento afternoon session	13	3.7%				
Will participate--Daly City session			12	3.2%		
Will participate--Berkeley session			12	3.2%		
Will participate--San Diego session					12	13.0%
Total	352	100.0%	371	100.0%	92	100.0%

The average number of attempts to contact and recruit from records deemed eligible in the first contact attempt was 5.9 for Sacramento, 6.4 for the Bay Area, and 7.0 for San Diego records.

Format of the Focus Groups

The focus groups took place in May and June of 2004. Each session was scheduled for 2 hours, with several running for more than 2 hours. Table 2 lists the scheduled times, dates and locations of the focus group sessions.

- Table 2. Dates, Times and Locations of Focus Group Sessions

City	Date	Time
Sacramento	May 25, 2004	10:00 am to 12:00 pm
Sacramento	May 25, 2004	1:30 pm to 3:30 pm
Daly City	June 21, 2004	10:00 am to 12:00 pm
Berkeley	June 23, 2004	10:00 am to 12:00 pm
San Diego	June 28, 2004	10:00 am to 12:00 pm

Participants were asked to arrive several minutes early for the sessions to sign in and read and sign PRI's consent form to participate in the focus group. Participants were informed that their participation was voluntary, that the session would be audiotaped, and that their information would be kept confidential by the researchers and client (DTSC/OPPTD).

The sessions began with introductions of the moderator, PRI staff, and OPPTD/DTSC staff in attendance. Then each participant was asked to introduce himself or herself. After the introductions, the audiotape was turned on. A series of PowerPoint slides were used to present the introduction and objectives of the focus group, fleet manager survey data, and oil test parameters.

The key subtopics addressed in the focus group were as follows:

1. **Validation of survey results**. Results from the fleet manager survey were presented. Participants were asked to clarify questions about, add context to, and validate the results.
2. **Discussion of oil analysis**. The parameters of oil analysis tests were discussed in relation to assessing the performance of HEOF and extending the life of motor oil.
3. **Discussion of implementation barriers**. Participants were asked to identify cost, institutional, and perceptual barriers to using HEOF and generate ideas for overcoming the barriers.
4. **Filter selection exercise**. Participants were asked to complete a "report card" for each filter model displayed, using a) information from a filter selection matrix compiled by OPPTD staff, b) manufacturer provided information, and c) discussion with OPPTD/DTSC staff. See Appendix B for data and comments on the report cards.
5. **Wrap up**. Participants were asked to add any comments or suggestions that were not brought up during the session, and to provide feedback to the facilitator about the focus group format and discussion.

See Appendix A for a complete moderator's guide.

Focus Group Composition

Attendance at the focus groups ranged from 4 to 11 participants. A wide variety of vehicle types were represented in each session. See Table 3.

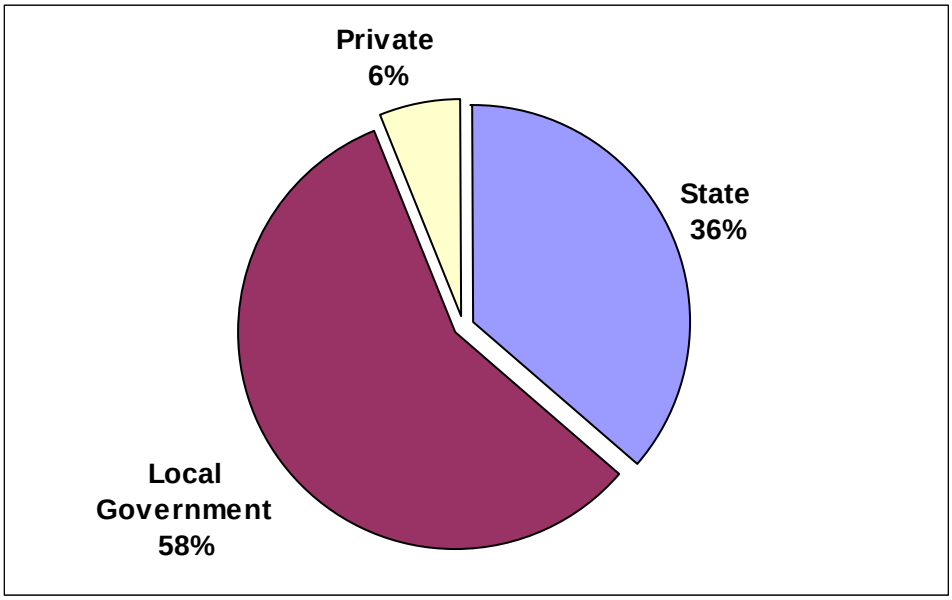
Table 3. Characteristics of Focus Group Attendees and their Fleets

Sessions	Number of Attendees	Fleet Types	Represented Vehicle type(s)							
			Cars	Pick-Ups	Med Trucks	Large Trucks	Semi-Tractors	Buses	Off-Road Vehicles	Stationary Engines
Sacramento-a.m.	5	4 state 1 local gov't.	X	X	X	X	X	X	X	
Sacramento-p.m.	4	2 state 1 local gov't. 1 private	X	X	X	X	X	X	X	X
Daly City	11	5 state 5 local gov't. 1 private	X	X	X	X	X	X	X	X
Berkeley	6	6 local gov't.	X	X	X	X		X	X	
San Diego	7	1 state 6 local gov't	X	X	X	X	X	X	X	X

Fleet Representation

Of all sessions combined, a total of 12 state, 19 local government, and 2 private fleet managers attended. Although every attempt was made to recruit operators of private fleets, and several committed to attend various sessions, few showed up at the sessions for which they were scheduled. See Figure 1.

• Figure 1. Fleet Representation for All Focus Group Sessions Combined (n=33)



Results

Current Knowledge and Use of High Efficiency Oil Filters

Each session began with a discussion of existing knowledge and perceptions about HEOF. The moderator then defined HEOF for the participants. Although most participants had heard of HEOF, few had used the technology in the past, and only 3 worked for organizations currently using the technology. Some thought HEOF included reusable filters.

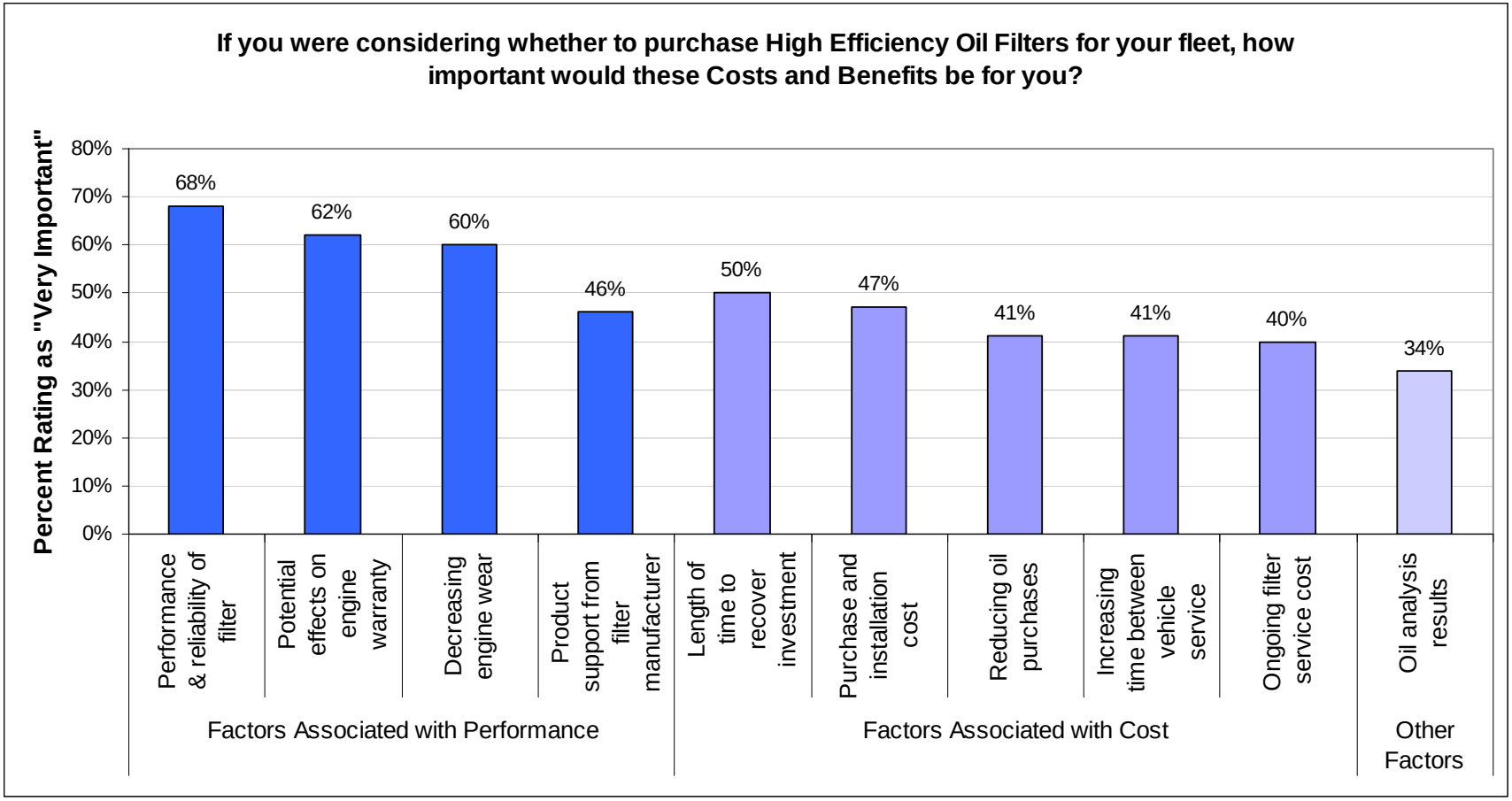
Initial knowledge about HEOF ranged from filtration particle size range to brand name specification. Although participants seemed to be aware that HEOF would keep the oil cleaner by filtering out smaller particles, fewer were aware that the technology is intended to extend the life of the engine oil. Some participants asked whether the filters are add-on filters, and several did not know that the filters are used in conjunction with the regular oil filters.

Of those who had used HEOF technology in the past, some described the reason they no longer use HEOF as "more trouble than it's worth." However, those currently using the technology reported positive performance results.

Survey Validation

To begin survey validation, participants were shown a graph of the percentages of survey respondents who stated that various costs and benefits would be very important in considering whether to purchase HEOF for their fleet. The low percentage of respondents who rated "oil analysis results" as very important, and the high percentage who rated "decrease engine wear" as very important raised questions among OPPTD staff about the respondents' intent, so the focus group participants were asked to suggest why they may have been rated as they were. Figure 2 shows the graph presented to focus group participants.

• Figure 2. Survey Results Presented to Focus Group Participants



As Figure 2 illustrates, survey respondents rated performance factors as higher in importance than cost factors. According to the focus group participants, cost and performance factors would vary in importance depending upon who was answering the survey. Several stated that if the person in charge of the budget had filled out the survey, then cost would have been ranked higher, but if the respondent was more involved in maintenance, then performance factors would be considered more important.

> "…survey responses may be from the maintenance guys and they're not as concerned with cost.."
>
> "If you're asking uptown, then it's costs, but around the shop…[it's performance]."

Performance Factors

Participants generally agreed that effect on engine warranty was the most important of the performance factors presented.

Interestingly, most participants saw **decreasing engine wear as a cost factor, not a performance factor.** Decreasing engine wear was not considered a problem, since most managers could not even remember the last time they had lost engines due to lubrication failure. The one exception was a fleet manager of a large city transit fleet with extremely high annual mileage, who stated that extending the life of the vehicle would have a significantly positive impact on his budget. In contrast, several mentioned that they sell the vehicles before the life of the vehicle has been spent and so don't worry about extending engine life. In the latter case, extending the life of the engine is not a great concern, but for the former extending engine life is critical, and they may be more open to trying the technology.

> "We've got 12-year-old garbage trucks whose bearings are fine. Lubrication isn't a problem with today's oil."
>
> "We must do overhauls on engines at 350,000 miles, some vehicles are at 150,000 miles. The high efficiency filter tends to extend life of engine, [and] extending the life of the vehicle has a big impact on our budget."—mass transit fleet manager

Cost Factors

Participants thought the **initial purchase and installation cost** was more important relative to other cost factors, acting as a sort of "gatekeeper" to considering other cost and performance information. If initial and installation costs are not in themselves prohibitive, then cost recuperation and maintenance costs can be considered.

> "That's the first thing you ask, is 'How much does it cost?'."

Length of time to recover investment varied according to fleet type and budget circumstances. Participants representing state fleets expressed willingness to let the initial investment pay for itself over 3 to 5 years to half the expected the life of the vehicle, whereas those in local governments typically said that one to 3 years was the maximum acceptable time frame. The private fleet managers allowed for 1 to 2 years. Some with high mileage vehicles would require faster return on investment. Several participants felt they would not have enough information to speak about HEOF specifically, and stated that more knowledge of the costs involved and expected performance of the filters would be needed to answer the question.

> "For [my city], it would be now, with budget situation, it wouldn't be 5 years down the road, but 12 months down the road."
>
> "One fiscal year. If you don't get results, you have to put it on your next budget, if you don't save anything on it, why do it?"
>
> "It would go up to 2 years; we aren't doing bad, so 2-3 years."

Oil Analysis Results

The general consensus was that oil analysis is an indicator of filter performance and reliability and should be ranked higher than the survey results suggest. Participants suggested that those filling out the survey were not maintenance personnel and may not be aware of the importance of oil analysis. In support of the survey result, however, one participant stated that oil analysis shouldn't be a concern if the filter is doing its job.

> "… oil analysis is the Bible of your oil."
>
> "The bosses uptown don't know about oil analysis."

Annual Mileage and Oil Change Intervals

Participants were shown a slide of average annual mileage and oil change intervals obtained by the survey. Because the numbers presented were averages and fleet types varied, most participants did not find any major discrepancies with the oil change intervals and mileage. However, several stated that the mileage between oil changes on passenger vehicles seemed a bit low, and that 6,000 miles seemed more appropriate. Several suggested that time and not meter reads would be a more appropriate measure to use, since it's more accurate for vehicles that idle for long periods of time, such as police vehicles. Some said that school busses get mileage in the low 20,000 range; city mass transit vehicles can go up to 45,000 miles.

Oil Analysis

Knowledge and Use

About half of the participants had ever conducted oil analysis, and most who had, had done so to diagnose engine problems rather than tracking results over a period of time to decide when to change the oil. However, a few with large or high mileage vehicles did use analysis to avoid unnecessary oil changes and save money on oil and disposal.

Use for Assessing Oil Filter Performance

Participants considered the oil test parameters compiled by OPPTD complete and satisfactory to assess filter performance and when oil changes are needed. No other test parameters were mentioned as being necessary or desirable to assess filter performance in the demonstration study.

Parameters mentioned as being the two most important indicators of oil failure were Total Base Number (TBN) and viscosity. To assess filter performance, metal detection was the most cited parameter.

Several participants suggested that creating standard or target ranges for the test parameter values would be helpful in interpreting the results.

In all sessions, participants expressed concern that HEOF technology would filter out substances that may indicate engine problems, reducing the diagnostic value of oil analysis.

Filter Selection

The filter selection exercise was the last activity in the focus groups, so the time allotted to the exercise and the method by which participants were presented with the filter models varied from group to group. Participants were asked to complete a “report card” provided by the DTSC, to grade each filter model on display on the following criteria: 1) Performance, 2) Design And Construction Materials, 3) Initial Purchase and On-going Service Costs, 4) Oil Sample Collection and Filter Change Services, and 5) Warranty.

On the report card, participants also stated the type of vehicle for which they would use HEOF, and at the end of the exercise stated which, if any, model they would most likely use for the stated vehicle type. Because the filter selection exercise was not conducted in the same manner for each group, grades assigned to particular filters may have been varyingly influenced by the amount of time spent reviewing the manufacturer information and OPPTD selection matrix, and discussing specific filter models with OPPTD/DTSC staff. While the comments and grades for specific filters are discussed below, the information collected from this exercise is primarily intended to help the OPPTD understand the selection process and the most important considerations for selection filters, rather than suggest that specific filters are superior to others. See Appendix B for report card data and comments.

Overall Ratings

A total of 30 participants completed a filter selection report card. Twenty-one stated the vehicle application for which they were evaluating the HEOF models; of those, 16 specified heavy vehicles, 2 specified medium vans or trucks, 1 specified light duty/passenger vehicles, and 2 specified a variety of vehicle types.

Of the 30 who completed a report card, 11 chose a preferred filter based on their evaluations; 5 chose PuraDYN, 4 chose OilGuard, and 3 chose the Fleetguard filter. Sixteen of the 23 who specified a vehicle type listed heavy vehicles. See Table 4.

- Table 4. Filter Selection--Filter Model Chosen by Vehicle Application Specified

FILTER MODEL	HEAVY	MEDIUM	LIGHT	VARIETY	NO VEHICLE SPECIFIED	TOTAL
Puradyn	4		1			5
OilGuard	2	1			1	4
Fleetguard	1				1	2
No filter chosen	9	1		2		12
Total	16	2	1	2	2	23

Many participants remarked that they could not give an informed opinion about estimated performance. Nevertheless, PuraDYN received higher ratings for estimated performance than others, but overall, OilGuard received the highest ratings.

Several participants mentioned they based their preference on familiarity or trust in a brand name; similarly, others expressed concern that they had not heard of the brand models on display, or mentioned that they would feel more comfortable using a filter if a trusted manufacturer (such as Cummings) produced it.

Important Factors in Choosing Filters

Initial and maintenance costs were cited as the most important selection criteria. FleetGuard was considered a good value relative to other models because the cost of the replacement elements was reasonable; OilGuard was also considered relatively well-priced and received higher marks than average.

Warranty of the filters and engine were among the top concerns. Several chose OilGuard because of its lifetime warranty, and since it comes OEM on some vehicles it was seen as having legitimacy among engine manufacturers. Several chose the PuraDYN because of its OEM letters stating that use of the filter would not invalidate the warranty. The Oil Purification Systems filter received higher than average ratings for warranty as well. However, the 12-month filter warranty on the PuraDYN was seen as insufficient; 5 to 10 years was suggested as an acceptable term for the filter warranty, since the filter is supposed to last the life of the vehicle.

Filter performance in terms of micron size and breadth of substances filtered was important, but not as important as the factors listed above. The PuraDYN was chosen by a few because it removed fuel, coolant, and water, and because of its additive replenishment feature. Several participants indicated they

would need more information about performance to assign grades for expected performance.

Easy, tidy maintenance with the least labor was a selling point. One participant commented that the PuradDYN filter element would be messy to drain, change and dispose of, while others thought the OilGuard filter element would be easy to drain oil from.

Installation concerns included mounting the unit and routing the filter lines. Some participants suggested that the vibration from the engine could tighten a spin-on filter beyond removability. Several expressed concern about the size of the filters, stating that for some vehicles the engine compartment would not accommodate extra equipment of the HEOF size. One said that on garbage and dump trucks, there would be risk of the filters getting knocked off. Some participants worried that modifying engines (such as by installing routing lines) would invalidate the warranty. The OilGuard was seen as a versatile filter in terms of installation.

Construction/Oil Sample Collection/Filter Change Services

The PuraDYN filter received relatively favorable ratings for its design and construction materials. Filtration Solutions received relatively high marks for construction and oil sample collection/filter change services; KleenOil and OilGuard also received better than average marks for oil sample collection/filter change services. In general, participants expressed preference for the spin-on models, because there are no elements to change. One participant chose FleetGuard specifically because of its spin-on design.

Barriers to Implementation of HEOF Technology

Institutional/Service Issues

The hassle factor. Participants commonly perceived that conducting and tracking oil analysis requires as much, if not more, labor than changing the oil and filter at regular intervals. The perception was that conducting an oil analysis rather than changing the oil would be a hassle, especially for those who thought that an oil analysis indicating an oil change was due would require them to bring the vehicle back into the shop to change the oil before its next scheduled service. In addition, several participants stated that their shops perform a host of services at every regular California Highway Patrol (CHP) Biennial Inspection of Terminals (BIT) safety inspection interval, including oil changes. Some organizations have the services scheduled on computer so changing the maintenance routine would mean a significant investment in system change. Several stated that changing scheduled maintenance might be manageable for a small fleet. After the filter selection exercise, one participant estimated the initial cost at half a million dollars for a fleet size of 800. Also, it is worth noting that one participant's organization is contractually obligated to change the oil at set intervals and that may prove to be a barrier in other fleets as well.

> "If you're talking about the whole fleet, to monitor extended life…the logistics would be enormous."- manager of an 800-vehicle fleet

"We don't run our business around the oil filter."

Convincing the mechanics not to change the oil was another commonly mentioned barrier. Some participants stated that they or their technicians would change any oil that looked dirty, regardless of what the oil analysis results showed. Others felt that they would have a hard time convincing their service technicians that they should not change the oil at the regularly scheduled intervals. One participant suggested that it's only out of habit that technicians change the oil so frequently, and using oil analysis may help to change their maintenance routines. One idea for overcoming this barrier:

- use intensive technician training to "instill confidence in the product and what it's supposed to do for the fleet."

"Most technicians just change it when it looks dirty."

"Most mechanics take oil that looks like coffee, they won't be convinced that it is still good oil by a test."

"The industry is locked in at 3,000 to 4,000 miles—you have a mindset to change out there."

Installation and maintenance difficulties were a concern not only for the cost of training technicians how to install the filters but because some models were seen as too large or cumbersome for the engine compartment. Others mentioned that in some vehicles, the only place with room to install the HEOF would require removing other parts to install, and it would be difficult to access the filter without removing the parts again. Some suggested that installing and maintaining the HEOF would require considerable technical training. Those who send vehicles to outside contractors for servicing suggested that the service contractors may not know how to service the HEOF or may just change the oil anyway. Suggestions for overcoming installation barriers were:

- choosing a smaller filter, and
- buying the HEOF as OEM equipment to bypass installation costs and difficulties.

Availability of replacement parts and filter elements was also a concern. If a vehicle is put out of service while waiting for an essential replacement of the filter part or element, it costs money. One participant asked if HEOF parts or elements are available at auto parts stores. A suggestion for overcoming the availability barrier was to:

- make HEOF systems available on vehicles as OEM equipment, assuming the manufacturers would have replacement parts readily available.

One issue that came up repeatedly was the **added cost and labor of filter element disposal**. Several participants stated that they already have to change and dispose of one filter and adding an HEOF element would just make it more

difficult, time consuming, expensive, and possibly messy. The suggestions to reduce disposal costs were:

- to provide reusable elements that only have to be drained and put back in the filter housing.
- to provide crushable replacement elements for less costly disposal.

Selling the idea to management was a barrier for several participants. Getting the buy-in of decision makers in the organization would take more cost/benefit information than is currently available. Specifically, they would need independent data that verify the manufacturers' claims about oil life extension and data that show the technology does not put engines at risk. Suggestions for overcoming this barrier were to:

- provide detailed cost/benefit data that allow management to estimate the length of time to recover investment costs through savings on oil and labor, and
- reuse the filters over the life of 2 or more vehicles to make the investment seem more valuable to those in charge of procurement.

Performance of emergency vehicles was also a concern in selling the idea of HOEF to management. Some managers of emergency and/or rescue vehicles said the available performance data is not sufficient to convince them that HEOF technology, i.e. extending the engine oil, would not affect the reliability of the vehicle. Several stated that regular oil change intervals are mandated for public safety vehicles and would not likely be considered for HEOF even if the technology were used on other vehicles in the fleet.

Cost Issues

Overall, participants remained unconvinced that using HEOF technology would save them enough money in oil, filters, and labor to justify the initial investment. Many insisted that HEOF would actually increase labor costs for maintenance.

Initial cost of equipment and installation was a general concern, but those who could accommodate the initial investment framed their concern in terms of length of time to recover their investment. In this regard, most stated they did not have enough knowledge about HEOF to decide if the technology is prohibitively expensive overall. Initial investment was of the greatest concern to those under severe budget constraints and those whose fleets are primarily low-mileage vehicles, since the length of time to recover the initial costs would be unacceptably long. There was also concern about whether the filters come with an installation kit or if installation equipment has to be purchased separately. Suggestions for overcoming the initial cost barrier included:

- Provide HEOF as OEM equipment to avoid installation costs. Several participants added that the purchase of HEOF as stock equipment would come out of a different budgetary source and would be easier to justify.
- Provide a cost break for government agencies or large fleet purchases.
- Reuse the filter on 2 or more vehicles.

- For vehicles with HEOF as OEM equipment, extend the engine warranty in conjunction with the claim that HOEF technology extends engine life. This would provide an incentive to buy OEM equipped vehicles for large, high mileage fleets.

Expense of oil analysis compared to relative cost of changing the oil was a significant concern. Many participants felt that labor costs of changing the oil are not expensive enough to necessitate a large investment in HEOF technology. In many cases, the regular filters and oil were seen as insignificant expenses relative to the overall fleet operation costs. Many heavy vehicles are mandated to undergo BIT inspections at 90-day intervals and are often scheduled for service at those intervals, and therefore are not specifically in the shop for an oil change based on mileage; participants felt that changing the oil at the 90-day intervals was simply easier and more cost-effective than conducting and tracking analyses and perhaps having to bring the vehicle in separately for an oil change. Others simply perceive the cost of oil, filter and labor associated with a regular scheduled oil change as less expensive than having to take a sample and check and track the results at a similar interval. When presented with the average cost of an oil analysis, combined with labor costs for collecting the sample and tracking the results, many participants said using HEOF would simply not save money.

> "If [the vehicle] is in [the shop], you are dropping the oil since it's up on the rack anyway."
>
> "Analysis is more expensive than a regular filter."
>
> "It may be easier just to change it than manage the process."
>
> "It boils down to disposal costs vs. analysis and labor."

Reduction of oil purchases was not considered a major incentive to use HEOF on its own except by those with extremely high mileage vehicles and/or vehicles with large crankcase capacities. As stated in the previous paragraph, many fleet managers perceive that labor costs for collecting oil analysis samples and tracking the results in addition to changing and disposing of the regular filter would offset any cost savings in oil purchases. Although a number of participants mentioned that they were already extending oil change intervals to save money, they felt they were doing so within a safe interval that would not harm the engine, and weren't necessarily convinced that the oil could safely be extended for large intervals. Similarly, **oil changes were seen as relatively cheap and necessary to avoid engine failure and warranty issues.** When confronted with very large oil change intervals reported by current users (e.g., 87,000 miles), many participants just stated that since oil changes are not prohibitively expensive, why take the chance on invalidating the warranty and going through the trouble of oil analysis just to save a few bucks? Some participants expressed fear that even if oil analysis showed the HEOF was performing well, any engine problem could ultimately be blamed on not servicing the vehicle according to manufacturer recommendations.

"I wouldn't go 87,000 miles just to save $200 in oil changes."

Warranty Issues

The core issue with engine manufacturer warranties and HEOF was the concern that exceeding manufacturers' recommended oil change intervals would invalidate the engine warranty, regardless of whether HEOF technology makes it safe to do so. When told that many engine manufacturers had provided letters stating that HEOF would not invalidate engine warranties, many insisted that any non-standard equipment installed on the engine could be grounds for warranty invalidation. Several recounted previous industry attempts at technologies in which engine oil did not have to be changed, and recalled that those products were not accepted by engine manufacturers either.

In general, participants regarded the recommended oil change intervals provided by manufacturers as unalterable while vehicles are still under warranty. The idea of using oil analysis and experienced judgment to decide when to change the oil was dubious to many participants. While a few operators are already using oil analysis to extend the life of their engine oil, most were skeptical of the large mileage intervals mentioned by OPPTD staff (60,000 miles and 87,000 miles). Compared to the perceived risk of invalidating a vehicle's warranty, costs associated with changing the oil every 4,000 to 6,000 miles were considered minor.

Participants expressed concern that **modifying the engine for installation**, such as installing routing lines, could invalidate the manufacturers' engine warranty. When asked what would convince them of the safety of using HEOF without invalidating the engine warranty, participants suggested the following:

- **Install the filters after the warranty** on the engine has expired.
- **Provide filters as optional OEM equipment** so that their use would be covered under the engine warranty.
- **Filter manufacturers should provide the warranty**, replacing the engine if a failure due to lubrication issues ensued.
- Engine manufacturer warranties should **specify brands and/or models of filters** that could be used without invalidating the warranty. However, participants in one group agreed with the suggestion that a written verification that "use of HEOF does not invalidate the vehicle warranty" would suffice.
- **Engine manufacturers should specify oil change intervals** recommended when using HEOF technology, including the maximum mileage at which oil should be changed.
- The **filter manufacturer should recommend oil change intervals for vehicles equipped with HEOF**, including a maximum recommended oil change interval. However, the engine manufacturer was the preferred source for oil change recommendations.

- **Oil manufacturers should guarantee their oil life**, i.e. that the additives would not break down, if using HEOF.

- **Engine manufacturers' recommended oil change intervals could be based on standardized oil test parameters rather than on mileage.** Several participants stated they would feel comfortable using analysis instead of changing oil at regular intervals, if they had enough knowledge about oil analysis and if standard acceptable ranges within the test parameters were developed. If it were done this way, oil analysis results could stand as proof that oil quality was within the manufacturers' acceptable range in the event of a warranty dispute.

"You basically aren't going to do anything that risks your engine warranty. Period."

"It should come stock on vehicles, with necessary oil changes of 50,000 instead of 5,000 miles."

"…if [the engine manufacturer] backed the warranty assessed on the [oil analysis] parameters I would trust it."

"Something from the engine manufacturer stating that you can use this, spelling out what oil analysis results would be that you could continue using the oil in the engine. We are going to keep those records, and if we have a problem, we go to the manufacturer."

"If you have an engine filter, and the engine fails…you would need a specific brand name mentioned in the letter from the engine manufacturer."

Perceptual Barriers

Some participants voiced **concern about extending motor oil life**. Several stated they already use rerefined oil and/or reusable filters in their vehicles, and wondered if rerefined oil should be used with HEOF to extend oil life. Others remarked that no matter how clean the oil is, viscosity breaks down because of engine heat. However, several agreed that if an analysis showed an acceptable viscosity level, that would convince them that the oil was still viable. Some already use oil analysis to extend oil life; one mentioned that he can get an additional 2000 miles on his vehicles by using oil analysis, but balked when asked whether he would let it go to 87,000 miles if the analysis showed him the oil was still viable.

"I would want an analysis every 3 to 4 thousand miles. I wouldn't treat my own car that way."

Some participants felt that **HEOF technology is a fad**, expressing amusement at what they compared to the "toilet paper" filters of the 1970s. To help establish the legitimacy of HEOF technology, participants suggested:

- A performance study, perhaps sponsored by the engine manufacturers, would convince them that the technology was legitimate.
- The results of such a study could be detailed in trade magazine articles for widespread access to fleet managers.
- Offer HEOF technology as OEM equipment.

The cost of labor associated with oil analysis was another perceptual barrier. Although some participants agreed that the technology might save money in oil purchases, most were unconvinced that the labor saved from increasing intervals between oil changes would compensate for the additional labor involved in conducting and tracking oil analysis. Many expressed **concern that using HEOF would require vehicles to be in the shop for more down time than a regularly scheduled oil change**. Many participants said that oil analysis would require the vehicle to be brought into the shop to be serviced, and the vehicle would then need to be returned to the shop several days later if the results showed that an oil change was due. This would 1) add to labor costs, and 2) create logistic barriers, both for scheduling the oil change and taking the vehicle off the road twice. Participants perceived that ongoing filter maintenance keeps vehicles off the road for a longer time, regardless of whether it saves service time in oil changes. In short, the only cost savings that participants accepted were the savings on oil purchases and disposal, not labor.

Lack of cost benefit and performance data. When asked whether the DTSC data from the demonstration study would be trustworthy to convince industry technicians and mangers that the benefits of using HEOF outweigh the costs and that the technology is not harmful to the engine, most said they would consider the DTSC trustworthy, but stressed that they would have to see very detailed cost and performance data to be convinced that using the technology could save them money. At the conclusion of several groups, participants stated that they remained unconvinced and they would have to see actual cost/benefit data before they would consider using the technology. Cylinder/bearing wear and crank reflection were mentioned as important points of data to demonstrate the filter performance.

> "I would want to see a long range study first."
>
> "You'd have to trust the tester and the numbers."
>
> "The more detailed the cost benefit analysis, the more validity – show you did it thoroughly, by vehicle class. For government agencies the dollar amount isn't always most important. You would [also] have to quantify the environmental benefit."

Environmental Perspectives

Environmental benefits were a factor mentioned by some as a desirable ancillary benefit to using HEOF, but not enough of an incentive on their own to influence the decision to invest in HEOF. Willingness of organizations or companies to consider environmental benefits in a purchasing decision appears to be related to budgetary circumstances. Participants representing some state

and local government fleets whose budgets were not in dire circumstances reported having some latitude to consider environmental benefits in purchasing decisions. However, for many purchasing decisions, particularly among private fleets, environmental benefits are considered after cost and performance, if at all.

> "We're doing a good thing here but there's no benefit to us."—private fleet manager
>
> "Educate people about how the bypass filters roll into overall environmental measures."

Also, participants held a perception that the **environmental benefit of using rerefined oil and/or recycling is comparable to using HEOF**. They felt that frequent oil changes are not detrimental to the environment as long as the oil is recycled. In this context, using HEOF as a method of source reduction was not seen as superior in terms of environmental protection.

> "…in our case you're not reducing the waste stream so why use HE filters? So cost would still be a barrier."—rerefined oil user
>
> "The goal is to reduce oil stream but the way we're doing it now is fine – if we change the oil regularly we're doing fine." — private fleet manager who recycles used oil

Conclusions

Barriers

The most important barriers to using HEOF were initial costs, ongoing service costs, and warranty concerns. Lack of performance and cost benefit information, in addition to a general lack of knowledge about using oil analysis with HEOF technology, factor into many managers' reluctance to consider using HEOF.

The DTSC/OPPTD demonstration project has the potential to provide cost/benefit information that, if promoted along with educational material on using oil analysis for preventative maintenance, could convince many fleet managers to adopt HEOF technology. Specifically, data should be compiled by vehicle class to relay the following information to fleet managers:

- labor costs to install and maintain HEOF;
- potential length of the oil life controlling for annual mileage, vehicle type, environmental factors, and oil type (synthetic vs. petroleum based, rerefined, weight, etc.);
- potential extension of engine life in mileage;
- performance data collected from ongoing oil analyses; and
- labor required to collect oil samples and track analysis results over time.

In addition, the DTSC should consider pursuing ways to influence vehicle manufacturers to offer HEOF technology as stock equipment. Availability of OEM HEOF technology would eliminate many of the most serious barriers to widespread use of HEOF, including engine warranty issues, initial cost justification, and installation costs.

Education about how to use oil analysis to assess filter performance will be essential to convince fleet managers and technicians that engine performance will not be compromised by using HEOF. Maintenance technicians need to see trustworthy performance data to feel comfortable extending the oil life and relying on oil analysis tests to indicate when an oil change is needed. Training on the proper method of tracking oil parameters over time to extend oil change intervals will correct the widespread belief that one "snapshot" analysis will tell a technician that the oil should be changed and when.

Suggestions for Promoting HEOF Technology to Fleet Managers

Results discussed throughout this report suggest that the following strategies for marketing HEOF technology to vehicle managers may be successful.

Because cost and warranty were the most important factors in selecting oil filters, general promotion material should focus heavily on cost/benefit data and provide nonbiased information about the effect of HEOF technology on engine warranties.

The DTSC may consider including testimonials of participants in the demonstration project in the resulting promotional material to legitimize and "make real" the cost/benefit data and other information obtained from the project. Specific examples of oil change intervals achieved by participants with various vehicle types may help to convince fleet managers that the technology is viable and will add credibility to manufacturers' claims.

Encouraging name brand recognition may also help to popularize the technology. The perception that the filters are a gimmick or passing fad may be overcome through familiarity with and trust in well-known filter brands; in fact, some participants chose filters in the filter selection exercise solely because they recognized and trusted the brand name.

To address perceptual barriers to HEOF implementation, the DTSC may want to consider providing a short but detailed fact sheet to counter prevalent myths about HEOF technology. The fact sheet should address potential misperceptions about oil analysis procedures, give nonbiased information about the effect of HEOF installation on engine warranties, and provide basic cost recuperation and performance data.

For managers who do not sell off their vehicles and have fleets that accrue high annual mileage, the DTSC should promote HEOF using data that support the claim of extended engine life.

For state and local government fleet managers, education about the superiority of source reduction of oil over recycling and/or using rerefined oil could be a selling point, if presented with cost/benefit data that show that initial costs can be recuperated in an acceptable time frame. Government fleet managers may have more budgetary latitude than private managers to invest in environmentally

conscious technology, and are inclined to weigh environmental benefits more heavily in their purchasing decisions than are private businesses.

For private fleet mangers and/or businesses, who may be less inclined to make purchasing decisions with the public interest at heart, a “green fleet” certification or similar program may provide incentives to use HEOF and other source reduction technology. Participants with certification could post a recognizable “green fleet” symbol on their vehicles and other advertising materials to attract customers concerned with supporting businesses committed to environmental protection. In conjunction with this strategy, however, cost recuperation would need to be demonstrated, as environmental benefits alone are unlikely to convince private fleet managers to invest in HEOF.

Appendix A
Moderator's Guide

Introduction (15 minutes)

Introduce facilitator, DTSC staff

Ground rules for the focus groups (speak one person at a time, no cell phones, session will be audiotaped)

Introductions of participants, including name, organization, and fleet size

Purpose of groups

(Show PowerPoint presentation on project background and goals)

The Department of Toxic Substances Control (DTSC) Office of Pollution Prevention and Technology Development (OPPTD) is conducting a project to encourage the use of High Efficiency Oil Filters (HEOF) by demonstrating the technology in State vehicles. This focus group is part of the study, and is intended to inform the demonstration by

a) validating the results of a Fleet Managers survey that some of you completed some months ago;

b) identifying barriers to use of the filters in fleets, and

c) generating ideas to overcome barriers to using these filters.

Assessment of group knowledge of the subject

Now, I'd like to discuss what you know about high efficiency oil filters. I'd like to generate a list of everything you know about high efficiency oil filters. What do you know about high efficiency oil filters?

By a show of hands, how many of you are using high efficiency oil filters for your fleet? How many of you have used them in the past, but are not currently using them? How many of you have never heard of HE Oil Filters?

(If anyone has not heard of HE filters, briefly explain what HE oil filters are and what they do)

Validation of survey results (20 minutes)

(Show PowerPoint slides on "barrier" survey results)

HE Oil Filter Selection Considerations results

Do these results make sense to you? If not, which considerations do you feel are most important and why?

PROBES:

Why do you think cost considerations were rated as important by fewer people than performance factors?

What does "decreasing engine wear" mean to you and why do you think it was rated as very important by so many survey respondents?

Why is oil analysis rated as the least important of all considerations?

What, if any, important considerations in selecting HE oil filters were not addressed here?

Length of time to recover investment

Why do you think so many respondents did not answer the question about the length of time they would allow to recover their investment? What does that question mean to you, and how would you have answered it?

Oil change intervals

For those of who are responsible for maintaining these vehicle types, do these oil interval changes seem appropriate to you?

PROBES: If not, what interval would you say is more appropriate for the vehicle type?

Test Plan Development (25 minutes)

Monitoring of oil condition (10 minutes)

(Show PowerPoint slide of oil analysis parameters, briefly explain what each)

Which of these parameters do you consider important in your oil test results?

Are there any other pieces of information that you would consider vital in your test results that we haven't included here?

If you were testing the performance of high efficiency oil filters on one or more of your vehicle fleets, (1) how often would you need to have the oil in your vehicles analyzed in order to feel confident that the HE oil filter is performing adequately—that is, that the oil is still vital?

Besides the (2) degree of oil monitoring and specifications for engine wear analysis, what (3) other factors do you feel would be required to successfully demonstrate the reliably and viability of this technology?

Test plan guidelines

As the DTSC/OPPTD plans for the filter demonstration, we would like your feedback about the plan and barriers to its implementation. For each, can you state whether this would present a barrier for your organization, and if so, what you suggest to overcome the barrier.

Are there any other barriers that you can think of?

(Probe on procurement and other institutional barriers.)

Filter Selection (45 minutes)

(Hand out filter selection matrices and report cards)

Please feel free to ask the DTSC staff if you have any questions about the models. As we show and describe each model, please fill out the "filter report card" for the criteria listed. For any grade of C or below, please briefly explain why in the comments section.

(After each model is passed around)

Did anyone give a grade of C or below? Why?

(List barriers on a flip chart and discuss)

Wrap-up and evaluation (15 minutes)

Now that we've spent the last two hours discussing high efficiency oil filters, the demonstration project, and filter selection, what's your general reaction to what you've heard and discussed?

Is there anything we didn't discuss about HE oil filters?

What advice would you give us or DTSC on how to market these products to fleet managers?

Appendix B
Filter Selection Data

• Table 5. Filter Selection--Vehicle Type and Oil Filter Selected

#	Date	Vehicle Type	Oil Filter Chosen
1	6/28/2004	Diesel Tractor	Oil Guard
2	6/28/2004	School Bus	Fleet Guard Centriguard
3	6/28/2004	School Bus	
4	6/28/2004	Medium Duty Trucks	
5	6/28/2004	Urban Bus Applications	
6	6/28/2004	TRK 720,000 and Buses	Oil Guard
7	6/28/2004	Wide ? Fleet & light duty	Need to study to a greater extent- would depend on application
8	6/23/2004		Oil Guard
9	6/23/2004	Large Trucks or High Mileage Vehicles	
10	6/23/2004		
11	6/23/2004		Fleetguard
12	5/25/2004 am		
13	5/25/2004 am		
14	5/25/2004 am		
15	5/25/2004 am	Heavy Trucks	
16	5/25/2004	Semi Tractors	
17	5/25/2004	Heavy Duty Truck	
18	5/25/2004	Heavy Duty (large oil sump)	
19	5/25/2004		
20	6/21/2004	High mileage patrol cars and other equipment	
21	6/21/2004	Heavy Duty Diesel/Stationary Engine Application	
22	6/21/2004	Over the road large quart cap.	Puradyn
23	6/21/2004	Stationary Power Plants & Large Vessels & Trucks	
24	6/21/2004	Passenger Vehicles/Small Trucks	Puradyn
25	6/21/2004		
26	6/21/2004	12-14 Passenger (P.E.) Vans	Oil Guard
27	6/21/2004		
28	6/21/2004	Heavy Duty Truck and Off Road Equipment	Puradyn
29	6/21/2004	Equipment that holds 40 Qts or more	Puradyn Because of Warranty
30	6/21/2004	10 Wheel or 18 Wheel Dumptruck	Puradyn

- Table 6. Filter Selection Comments

#	Date	Comments
1	6/28/2004	
2	6/28/2004	
3	6/28/2004	Oil Sample Collection and Filter Change Services: Filter Change Only
4	6/28/2004	
5	6/28/2004	Design And Construction Materials: Puradyn seems messy to get rid of element. Cleanoil-easy to (catch) though. Initial Purchase and On-Going Service Costs: Too High
6	6/28/2004	Design and Construction Materials for Premo Lubrication "Too much to install D" and for Fleetguard Venturi Combo "No Drain C"
7	6/28/2004	
8	6/23/2004	
9	6/23/2004	Performance: The Puradyn seems to give the most "Bang for the Buck" / Design and Construction Materials: Prefer Spin-on design / Initial Purchase and On-going Service Costs: Initial cost varies widely within each design, but the range seems similar.
10	6/23/2004	Find it hard to rate. The expense of oil and oil filters are not a big concern. We do use re-refined motor oil! -City of Berkeley
11	6/23/2004	
12	5/25/2004 am	
13	5/25/2004 am	
14	5/25/2004 am	
15	5/25/2004 am	Serviceability: Filtakleen element hard to remove. Warranty: Poor warranty, perfect filtration
16	5/25/2004 pm	
17	5/25/2004 pm	
18	5/25/2004 pm	Estimated Performance: paper, synthetic
19	5/25/2004 pm	
20	6/21/2004	Design and Construction: OPS design has too many fittings and potential for leaks.
21	6/21/2004	
22	6/21/2004	
23	6/21/2004	Warranty: No Idea
24	6/21/2004	Design and Construction Materials: (on oilguard) Resiu Filter (throwaway) negate the environmental benefit of using less oil.
25	6/21/2004	
26	6/21/2004	
27	6/21/2004	
28	6/21/2004	Performance: Micron Filtration Additive Replenish
29	6/21/2004	
30	6/21/2004	

• Table 7. Filtakleen Ratings

#	Date	Vehicle Type	Filtakleen				
			1	2	3	4	5
1	6/28/2004	Diesel Tractor					
2	6/28/2004	School Bus	A	B	B	A	A
3	6/28/2004	School Bus	A	C	C	C	B
4	6/28/2004	Medium Duty Trucks					
5	6/28/2004	Urban Bus Applications	C	C	D	C	C
6	6/28/2004	TRK >20,000 and Buses	B	B	C	C	A
7	6/28/2004	Wide variety fleet & light duty also	B	B	C	B	C
8	6/23/2004		B	B	C	B	C
9	6/23/2004	Large Trucks or High Mileage Vehicles	A	C	B	C	C
10	6/23/2004						
11	6/23/2004		B	C	D	C	C
12	5/25/2004 am		A	B	A	A	X
13	5/25/2004 am		B	B	C	B	D
14	5/25/2004 am		X	B	B	B	
15	5/25/2004 am	Heavy Trucks	C	D	C	F	C
16	5/25/2004 pm	Semi Tractors					
17	5/25/2004 pm	Heavy Duty Truck					
18	5/25/2004 pm	Heavy Duty (large oil sump)	B	B	A	A	X
19	5/25/2004 pm		B	D	B	C	C
20	6/21/2004	High mileage patrol cars and other equipment					
21	6/21/2004	Heavy Duty Diesel/Stationary Engine Application	A	B	B	B	C
22	6/21/2004	Over the road large quart cap.	B	B	B	F	X
23	6/21/2004	Stationary Power Plants & Large Vessels & Trucks	A	A	X	A	X
24	6/21/2004	Passenger Vehicles/Small Trucks	C	B	B	C	D
25	6/21/2004		C	C	B	F	X
26	6/21/2004	12-14 Passenger (P.E.) Vans	C	C	F	F	C
27	6/21/2004		F	C	F	F	C
28	6/21/2004	Heavy Duty Truck and Off Road Equipment	C	B	C	C	B
29	6/21/2004	Equipment that holds 40 Qts or more	A-	C+	C		C
30	6/21/2004	10 Wheel or 18 Wheel Dumptruck	C	A	B	B	B

Selection Criteria:

1. Performance
2. Design And Construction Materials
3. Initial Purchase and Ongoing Service Costs
4. Oil Sample Collection and Filter Change Services
5. Warranty

• Table 8. FIltration Solutions Ratings

#	Date	Vehicle Type	Filtration Solutions				
			1	2	3	4	5
1	6/28/2004	Diesel Tractor					
2	6/28/2004	School Bus	B	B	C	A	B
3	6/28/2004	School Bus	A	B	D	C	A
4	6/28/2004	Medium Duty Trucks	C	B	D	B	A
5	6/28/2004	Urban Bus Applications	B	C	D	C	B
6	6/28/2004	TRK 720,000 and Buses	B	B	C	B	B
7	6/28/2004	Wide ? Fleet & light duty	B	B	C	B	A
8	6/23/2004		B	B	D	C	C
9	6/23/2004	Large Trucks or High Mileage Vehicles	A		B	C	A
10	6/23/2004						
11	6/23/2004		B	C	D	C	B
12	5/25/2004 am		A	A	A	A	X
13	5/25/2004 am		B	B	B	B	C
14	5/25/2004 am		X	A	B	B	
15	5/25/2004 am	Heavy Trucks	B	B	C	B	C
16	5/25/2004 pm	Semi Tractors					
17	5/25/2004 pm	Heavy Duty Truck	B	B	B	B	X
18	5/25/2004 pm	Heavy Duty (large oil sump)	B	B	A	B	X
19	5/25/2004 pm		Good B	Good B	B	C	C
20	6/21/2004	High mileage patrol cars and other equipment	B	B	C	C	B
21	6/21/2004	Heavy Duty Diesel/Stationary Engine Application	B	B	C	B	B
22	6/21/2004	Over the road large quart cap.	B	B	D	X	X
23	6/21/2004	Stationary Power Plants & Large Vessels & Trucks	A	A	X	X	X
24	6/21/2004	Passenger Vehicles/Small Trucks	C	B	C	B	B
25	6/21/2004		C	C	C	B	X
26	6/21/2004	12-14 Passenger (P.E.) Vans	C	C	D	B	C
27	6/21/2004		X	X	X	X	X
28	6/21/2004	Heavy Duty Truck and Off Road Equipment	D	B	C	B	C
29	6/21/2004	Equipment that holds 40 Qts or more	B+	B-	C	B+	A
30	6/21/2004	10 Wheel or 18 Wheel Dumptruck	C	A	C	B	B

Selection Criteria:

1. Performance
2. Design And Construction Materials
3. Initial Purchase and Ongoing Service Costs
4. Oil Sample Collection and Filter Change Services
5. Warranty

• Table 9. Kleenoil Ratings

#	Date	Vehicle Type	Kleenoil				
			1	2	3	4	5
1	6/28/2004	Diesel Tractor					
2	6/28/2004	School Bus	B	C	C	A	A
3	6/28/2004	School Bus	A	C	D	D	A
4	6/28/2004	Medium Duty Trucks	A	B	C	A	A
5	6/28/2004	Urban Bus Applications	C	C	D	C	B
6	6/28/2004	TRK 720,000 and Buses	B	C	C	C	B
7	6/28/2004	Wide ? Fleet & light duty	B	B	B	B	A
8	6/23/2004		A	B	C	D	A
9	6/23/2004	Large Trucks or High Mileage Vehicles	A	C	B	C	A
10	6/23/2004						
11	6/23/2004		C	C	C	B	B
12	5/25/2004 am		A	B	A	B	X
13	5/25/2004 am		A	A	C	B	C
14	5/25/2004 am		X	A	B	B	
15	5/25/2004 am	Heavy Trucks	C	D	C	D	B
16	5/25/2004 pm	Semi Tractors					
17	5/25/2004 pm	Heavy Duty Truck	B	B	B	B	X
18	5/25/2004 pm	Heavy Duty (large oil sump)	B	A	B	B	X
19	5/25/2004 pm		B	C	C	B	C
20	6/21/2004	High mileage patrol cars and other equipment	C	B	C	A	A
21	6/21/2004	Heavy Duty Diesel/Stationary Engine Application	A	A	C	B	A
22	6/21/2004	Over the road large quart cap.	A	B	C	A	A
23	6/21/2004	Stationary Power Plants & Large Vessels & Trucks	A	A	X	A	X
24	6/21/2004	Passenger Vehicles/Small Trucks	B	B	B	B	B
25	6/21/2004		C	A	C	B	X
26	6/21/2004	12-14 Passenger (P.E.) Vans	C	B	F	B	A
27	6/21/2004		F	F	F	C	D
28	6/21/2004	Heavy Duty Truck and Off Road Equipment	C	B	C	B	A
29	6/21/2004	Equipment that holds 40 Qts or more	B-	B	C	B+	A+
30	6/21/2004	10 Wheel or 18 Wheel Dumptruck	C	B	C	B	B

Selection Criteria:

1. Performance
2. Design And Construction Materials
3. Initial Purchase and Ongoing Service Costs
4. Oil Sample Collection and Filter Change Services
5. Warranty

• Table 10. OilGuard Ratings

#	Date	Vehicle Type	Oilguard				
			1	2	3	4	5
1	6/28/2004	Diesel Tractor	B	C	B	B	A
2	6/28/2004	School Bus	B	C	B	A	B
3	6/28/2004	School Bus	A	B	B	B	A
4	6/28/2004	Medium Duty Trucks	A	A	A	A	A
5	6/28/2004	Urban Bus Applications	B	B	D	C	B
6	6/28/2004	TRK 720,000 and Buses	B	B	B	C	B
7	6/28/2004	Wide ? Fleet & light duty	B	B	B	D	A
8	6/23/2004		B	B	A	B	A
9	6/23/2004	Large Trucks or High Mileage Vehicles	A	B	B	C	A
10	6/23/2004						
11	6/23/2004		B	B	C	B	C
12	5/25/2004 am		A	A	A	A	X
13	5/25/2004 am		B	B	B	B	C
14	5/25/2004 am		X	B	B	B	
15	5/25/2004 am	Heavy Trucks	C	D	C	C	B
16	5/25/2004 pm	Semi Tractors					
17	5/25/2004 pm	Heavy Duty Truck	C	B	B	B	X
18	5/25/2004 pm	Heavy Duty (large oil sump)	B	C	A	A	X
19	5/25/2004 pm		B	D	B	C	C
20	6/21/2004	High mileage patrol cars and other equipment	B	C	A	A	B
21	6/21/2004	Heavy Duty Diesel/Stationary Engine Application	A	A	A	B	A
22	6/21/2004	Over the road large quart cap.	C	B	B	A	A
23	6/21/2004	Stationary Power Plants & Large Vessels & Trucks		A	X	X	X
24	6/21/2004	Passenger Vehicles/Small Trucks	B	B	A	B	A
25	6/21/2004		C	B	B	F	B
26	6/21/2004	12-14 Passenger (P.E.) Vans	B	B	B	B	A
27	6/21/2004						
28	6/21/2004	Heavy Duty Truck and Off Road Equipment	B	B	B	B	A
29	6/21/2004	Equipment that holds 40 Qts or more	B	B	B	B+	A+
30	6/21/2004	10 Wheel or 18 Wheel Dumptruck	C	A	A	B	B

Selection Criteria:

1. Performance
2. Design And Construction Materials
3. Initial Purchase and Ongoing Service Costs
4. Oil Sample Collection and Filter Change Services
5. Warranty

• Table 11. Oil Purification Systems

#	Date	Vehicle Type	Oil Purification Systems				
			1	2	3	4	5
1	6/28/2004	Diesel Tractor					
2	6/28/2004	School Bus	B	C	C	C	A
3	6/28/2004	School Bus	A	B	D	D	A
4	6/28/2004	Medium Duty Trucks	B	B	C	C	B
5	6/28/2004	Urban Bus Applications	C	C	D	C	C
6	6/28/2004	TRK 720,000 and Buses	B	C	C	B	C
7	6/28/2004	Wide ? Fleet & light duty	B	B	C	B	A
8	6/23/2004		B	B	D	B	C
9	6/23/2004	Large Trucks or High Mileage Vehicles	A	C	B	B	A
10	6/23/2004						
11	6/23/2004		B	A	B	B	C
12	5/25/2004 am		C	C	C	C	X
13	5/25/2004 am		B	C	C	B	B
14	5/25/2004 am		X	C	D	C	
15	5/25/2004 am	Heavy Trucks	C	D	C	C	C
16	5/25/2004 pm	Semi Tractors					
17	5/25/2004 pm	Heavy Duty Truck					
18	5/25/2004 pm	Heavy Duty (large oil sump)	A	A	C	B	X
19	5/25/2004 pm		B	B	C	C	B
20	6/21/2004	High mileage patrol cars and other equipment	B	D	C	C	B
21	6/21/2004	Heavy Duty Diesel/Stationary Engine Application	B	B	B	B	B
22	6/21/2004	Over the road large quart cap.	A	A	C	X	A
23	6/21/2004	Stationary Power Plants & Large Vessels & Trucks		A	X	X	X
24	6/21/2004	Passenger Vehicles/Small Trucks	C	C	B	B	B
25	6/21/2004		B	A	B	B	X
26	6/21/2004	12-14 Passenger (P.E.) Vans					
27	6/21/2004		X	X	X	X	X
28	6/21/2004	Heavy Duty Truck and Off Road Equipment	B	B	B	B	A
29	6/21/2004	Equipment that holds 40 Qts or more	A	B	B	B+	B+
30	6/21/2004	10 Wheel or 18 Wheel Dumptruck	B	B	C	C	B

Selection Criteria:

1. Performance
2. Design And Construction Materials
3. Initial Purchase and Ongoing Service Costs
4. Oil Sample Collection and Filter Change Services
5. Warranty

• Table 12. Perfect Filtration Ratings

#	Date	Vehicle Type	Perfect Filtration				
			1	2	3	4	5
1	6/28/2004	Diesel Tractor					
2	6/28/2004	School Bus	B	C	C	C	A
3	6/28/2004	School Bus	A	B	D	D	A
4	6/28/2004	Medium Duty Trucks	B	B	C	C	B
5	6/28/2004	Urban Bus Applications	C	C	D	C	C
6	6/28/2004	TRK 720,000 and Buses	B	C	C	B	C
7	6/28/2004	Wide ? Fleet & light duty	B	B	C	B	A
8	6/23/2004		B	B	D	B	C
9	6/23/2004	Large Trucks or High Mileage Vehicles	A	C	B	B	A
10	6/23/2004						
11	6/23/2004		B	A	B	B	C
12	5/25/2004 am		C	C	C	C	X
13	5/25/2004 am		B	C	C	B	B
14	5/25/2004 am		X	C	D	C	
15	5/25/2004 am	Heavy Trucks	C	D	C	C	C
16	5/25/2004 pm	Semi Tractors					
17	5/25/2004 pm	Heavy Duty Truck					
18	5/25/2004 pm	Heavy Duty (large oil sump)	A	A	C	B	X
19	5/25/2004 pm		B	B	C	C	B
20	6/21/2004	High mileage patrol cars and other equipment	B	D	C	C	B
21	6/21/2004	Heavy Duty Diesel/Stationary Engine Application	B	B	B	B	B
22	6/21/2004	Over the road large quart cap.	A	A	C	X	A
23	6/21/2004	Stationary Power Plants & Large Vessels & Trucks		A	X	X	X
24	6/21/2004	Passenger Vehicles/Small Trucks	C	C	B	B	B
25	6/21/2004		B	A	B	B	X
26	6/21/2004	12-14 Passenger (P.E.) Vans					
27	6/21/2004		X	X	X	X	X
28	6/21/2004	Heavy Duty Truck and Off Road Equipment	B	B	B	B	A
29	6/21/2004	Equipment that holds 40 Qts or more	A	B	B	B+	B+
30	6/21/2004	10 Wheel or 18 Wheel Dumptruck	B	B	C	C	B

Selection Criteria:

1. Performance
2. Design And Construction Materials
3. Initial Purchase and Ongoing Service Costs
4. Oil Sample Collection and Filter Change Services
5. Warranty

• Table 13. Premo Lubrication Ratings

#	Date	Vehicle Type	Premo Lubrication				
			1	2	3	4	5
1	6/28/2004	Diesel Tractor					
2	6/28/2004	School Bus	A	A	B	B	B
3	6/28/2004	School Bus	B	A	C	A	A
4	6/28/2004	Medium Duty Trucks	C	C	B	D	D
5	6/28/2004	Urban Bus Applications	C	C	D	C	C
6	6/28/2004	TRK 720,000 and Buses	B	D	C	C	C
7	6/28/2004	Wide ? Fleet & light duty	B	A	C	B	C
8	6/23/2004		B	A	B	C	C
9	6/23/2004	Large Trucks or High Mileage Vehicles	A	B	B	A	D
10	6/23/2004						
11	6/23/2004		C	C	D	C	C
12	5/25/2004 am		A	A	A	A	X
13	5/25/2004 am		B	B	C	B	C
14	5/25/2004 am		X	B	B	A	
15	5/25/2004 am	Heavy Trucks	B	C	C	C	D
16	5/25/2004 pm	Semi Tractors	C	B	B	A	B
17	5/25/2004 pm	Heavy Duty Truck	A	B	A	A	
18	5/25/2004 pm	Heavy Duty (large oil sump)	B	B	B	A	X
19	5/25/2004 pm		A	C	C	C	C
20	6/21/2004	High mileage patrol cars and other equipment					
21	6/21/2004	Heavy Duty Diesel/Stationary Engine Application	B	B	B	B	C
22	6/21/2004	Over the road large quart cap.	C	A	C	A	X
23	6/21/2004	Stationary Power Plants & Large Vessels & Trucks	A	A	X	C	X
24	6/21/2004	Passenger Vehicles/Small Trucks	F	F	F	F	F
25	6/21/2004		B	A	B	B	X
26	6/21/2004	12-14 Passenger (P.E.) Vans	A	B	C	B	B
27	6/21/2004		D	C	F	F	
28	6/21/2004	Heavy Duty Truck and Off Road Equipment	C	B	B	B	C
29	6/21/2004	Equipment that holds 40 Qts or more	B+	B	C	B	C
30	6/21/2004	10 Wheel or 18 Wheel Dumptruck	B	C	B	B	C

Selection Criteria:

1. Performance
2. Design And Construction Materials
3. Initial Purchase and Ongoing Service Costs
4. Oil Sample Collection and Filter Change Services
5. Warranty

• Table 14. Puradyn Ratings

#	Date	Vehicle Type	Puradyn				
			1	2	3	4	5
1	6/28/2004	Diesel Tractor					
2	6/28/2004	School Bus	B	Solid A	Costly B	A	A
3	6/28/2004	School Bus	A	C	C	D	D
4	6/28/2004	Medium Duty Trucks	A	C	C	D	D
5	6/28/2004	Urban Bus Applications	C	C	D	C	C
6	6/28/2004	TRK 720,000 and Buses	A	C	C	C	A
7	6/28/2004	Wide ? Fleet & light duty	B	A	C	A	A
8	6/23/2004		C	A	C	B	C
9	6/23/2004	Large Trucks or High Mileage Vehicles	A	B	B	B	D
10	6/23/2004						
11	6/23/2004		B	C	D	C	D
12	5/25/2004 am		A	B	C	C	X
13	5/25/2004 am		B	C	B	B	B
14	5/25/2004 am		X	C	C	C	
15	5/25/2004 am	Heavy Trucks	C	C	C	C	D
16	5/25/2004 pm	Semi Tractors	B	B	B	B	D
17	5/25/2004 pm	Heavy Duty Truck	B	B	C	B	X
18	5/25/2004 pm	Heavy Duty (large oil sump)	A	A	B	B	X
19	5/25/2004 pm		A	B	D	C	C
20	6/21/2004	High mileage patrol cars and other equipment	A	A	C	A	A
21	6/21/2004	Heavy Duty Diesel/Stationary Engine Application	A	A	B	B	C
22	6/21/2004	Over the road large quart cap.	A	A	C	A	A
23	6/21/2004	Stationary Power Plants & Large Vessels & Trucks		A	X	X	X
24	6/21/2004	Passenger Vehicles/Small Trucks	B	B	B	B	D
25	6/21/2004		A	A	B	A	B
26	6/21/2004	12-14 Passenger (P.E.) Vans	A	D	F	B	A
27	6/21/2004		X	X	X	X	X
28	6/21/2004	Heavy Duty Truck and Off Road Equipment	A	A	B	B	A
29	6/21/2004	Equipment that holds 40 Qts or more	A	B+	C	B+	B
30	6/21/2004	10 Wheel or 18 Wheel Dumptruck	A	A	B	B	A

Selection Criteria:

1. Performance
2. Design And Construction Materials
3. Initial Purchase and Ongoing Service Costs
4. Oil Sample Collection and Filter Change Services
5. Warranty

• Table 15. Fleetguard Venturi Combo Ratings

#	Date	Vehicle Type	Fleetguard Venturi Combo				
			1	2	3	4	5
1	6/28/2004	Diesel Tractor	A	B	B	B	A
2	6/28/2004	School Bus	B	A	A	A	B
3	6/28/2004	School Bus	D	B	A		B
4	6/28/2004	Medium Duty Trucks	B	B	D	C	D
5	6/28/2004	Urban Bus Applications	B	C	B	B	B
6	6/28/2004	TRK 720,000 and Buses	B	C	B	B	B
7	6/28/2004	Wide ? Fleet & light duty	B	B	C	C	D
8	6/23/2004		C	C	B	D	B
9	6/23/2004	Large Trucks or High Mileage Vehicles					
10	6/23/2004		B	B	C	B	C
11	6/23/2004						
12	5/25/2004 am						
13	5/25/2004 am						
14	5/25/2004 am						
15	5/25/2004 am	Heavy Trucks					
16	5/25/2004 pm	Semi Tractors					
17	5/25/2004 pm	Heavy Duty Truck					
18	5/25/2004 pm	Heavy Duty (large oil sump)					
19	5/25/2004 pm						
20	6/21/2004	High mileage patrol cars and other equipment					
21	6/21/2004	Heavy Duty Diesel/Stationary Engine Application					
22	6/21/2004	Over the road large quart cap.					
23	6/21/2004	Stationary Power Plants & Large Vessels & Trucks					
24	6/21/2004	Passenger Vehicles/Small Trucks					
25	6/21/2004						
26	6/21/2004	12-14 Passenger (P.E.) Vans					
27	6/21/2004						
28	6/21/2004	Heavy Duty Truck and Off Road Equipment					
29	6/21/2004	Equipment that holds 40 Qts or more					
30	6/21/2004	10 Wheel or 18 Wheel Dumptruck					

NOTE: This model was only rated by participants in the June 28 session in San Diego.

Selection Criteria:

1. Performance
2. Design And Construction Materials
3. Initial Purchase and Ongoing Service Costs
4. Oil Sample Collection and Filter Change Services
5. Warranty