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USG 350-81-9
81-02-16

COMMENTS OF GENERAL MOTORS CORPORATION

WITH RESPECT TO

NOISE EMISSION STANDARDS:
MEDIUM AND HEAVY TRUCKS

ONAC Docket 81-02

SUBMITTED TO

U. S. ENVIRONMENTAL PROTECTION AGENCY
STANDARDS AND REGULATIONS DIVISION

GENERAL MOTORS CORPORTATION

April 21, 1981

USG-350-81-9

Environmental Activities Staff
General Motors Corporation
General Motors Technical Center
Warren, Michigan 48090

April 21, 1981

Director
Standards and Regulations Division
ANR-490
U.S. Environmental Protection Agency
Washington, D.C. 20460

Attention: ONAC Docket 81-02 [Medium and Heavy Trucks]

Attached are five (5) copies of General Motors response to the Environmental Protection Agency's (EPA's) invitation for comments regarding deferral or rescission of the 80 dB Noise Emission Standard for Medium and Heavy Trucks (FR 8497, Vol. 46, January 27, 1981; FR 17558, Vol. 46, March 19, 1981).

In 1974, General Motors Corporation submitted comprehensive technical, economic and environmental analyses of the impact of noise standards proposed by the EPA for medium and heavy trucks (USG-350-74-22). It was our recommendation at that time to regulate trucks only to the 83 dB level. This recommendation was based on the marginal environmental benefit resulting from reducing noise levels further and the rapidly escalating cost of reducing truck noise below 83 dB.

Subsequently, in 1976, EPA promulgated an 80 dB noise standard for trucks, effective January 1, 1982.

On January 19, 1981, the EPA deferred the effective date of the 80 dB regulation to January 1, 1983 for economic reasons and invited further comment on the truck noise standard. We believe this action on the part of the EPA is most appropriate as it allows updating the technical, economic and environmental bases for the regulation.

General Motors has updated its original analyses which, in many instances, were based on projections. We now have costs which are much more realistic since they are based on experience and established technical requirements. The near term picture on the economics and technology of noise control at the 80 dB level for 1983 is obviously clearer now than it was five years ago; however, other requirements for diesel engines in years immediately subsequent to 1983 tend to obscure the exact nature of technology and economics required to attain the 80 dB level for medium and heavy trucks. This is so because there are major engine changes required to meet more demanding exhaust emission standards and to improve fuel economy in

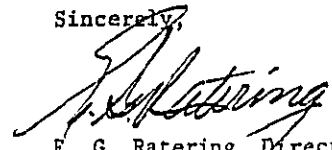
accordance with consumer demand. These redesigned engines are currently scheduled for the product line in 1986. They will incorporate new features to meet exhaust emission standards and the objective of improved fuel economy. It is our judgment at this time that these same features will complicate the technology and, therefore, the cost of noise control.

Neither industry nor the EPA considered these engine changes as far back as 1975. Unfortunately, even to this day, the technology required to control sound levels on these engines has not been evaluated or demonstrated. It is surely the responsibility of the EPA to consider the compounding effects of the multiplicity of regulations established by the EPA. For example, in this case regulation of exhaust emissions and noise levels, and the need for fuel economy tend to act negatively upon each other. Our attached comments provide more details on the nature of the engine changes as well as an assessment of the economics of reducing the power trains of our current product line to the 80 dB level.

Based on a sales volume of 322,000 trucks, the cost of noise control hardware to truck purchasers is estimated to be approximately $120 million the first year. The additional maintenance costs of these same trucks is estimated to be approximately $400 million during the life cycle of the truck (7 years). The average economic impact of the 80 dB standard will exceed $500 million per year. These estimates do not consider new engine configurations designed to reduce emissions and improve fuel economy, which will complicate noise control substantially.

Based on the cost of reducing sound levels below 83 dB, which would result in marginal environmental improvement, and the inability of industry and the EPA to define the technology and costs of controlling noise levels on future engines, it is the recommendation of General Motors that EPA retain the current 83 dB standard but reserve implementation of the 80 dB standard indefinitely, or until such time as the technology and costs of controlling noise on the new power trains have been properly evaluated. At that point in time, the benefits of the 80 dB standard could be appraised in terms of the better defined costs. General Motors believes this action is justified and necessary for the technical and economic reasons which are more fully described in the attachment.

Sincerely,



E. G. Ratering, Director
Product Noise Control

9BJG/224

Attachment

TECHNOLOGICAL REQUIREMENTS
TO ATTAIN 80 dB STANDARD

The 80 dB truck noise standard was originally promulgated by the EPA in April of 1976 (FR 15538, Vol. 41). Previously, in March 1976, the EPA published the Background Document for Medium and Heavy Truck Noise Emission Regulations (EPA-550/9-76-008).

In the abstract of this latter publication, EPA states: "This document presents and discusses the background data used by the agency in setting the standards contained in the regulation. Presented here is a comprehensive exposition on the most up-to-date available information on the environmental, technological, and economic aspects of medium and heavy truck noise."

Because the 80 dB standard is again being examined, it is worthwhile to review the original basis of the standard from the standpoint of technology.

The Noise Control Act of 1972 requires that the EPA, in setting noise standards, take into account "...the degree of noise reduction achievable through application of the best available technology..."

The EPA, as part of their evaluation, discussed their interpretation of "Best Available Technology" as follows:

> "The Noise Control Act requires that in setting noise emission standards for products distributed in commerce, the administrator take into account the level achievable through application of the "best available technology." The term "best available technology" is not defined. Based upon caselaw precedent relating to identical or similar language under other statutes, EPA believes that this term, as applied to the mass

> production of quiet products, refers to levels which can be achieved by application of conventional techniques and materials. Further, these levels need not be levels routinely achieved by products already on the market. At the same time, they cannot be levels EPA has arrived at by crystal ball inquiry.
>
> Accordingly, as applied to new medium and heavy trucks, EPA believes that the level achievable through application of the best available technology is the level which it can be reliably predicted, through the exercise of sound engineering analysis, that assembly line trucks of all classes subject to the standard will be able to meet by the effective date, through application of currently known noise attenuation techniques and materials." (Page 5-12, EPA - 550/9-76-008)

Clearly, the EPA perceives that the "best available technology" used for setting standards is based on a level of technology that can be "reliably predicted." Examination of "reliably predicted" technology for the 80 dB standard is illuminating.

In the EPA discussion of technology, it states: "However, the lead time for the 80 dBA regulation should be adequate to allow engines to be quieted so that partial enclosures (for engines) will be eliminated" (Pages 5-10, EPA-550/9-76-008).

The EPA technical prediction has not been fulfilled. It follows then that standards established using these predictions should be suspect.

It is apparent that EPA counted on substantial reductions in basic engine noise. In spite of major engineering programs on the part of industry and the EPA, there have been no substantial breakthroughs regarding reduced engine noise. Although changes to the engines have resulted in some reduction of basic engine noise, the need for shields and underpans has

not been eliminated. The following illustrations portray the type of noise control measures that will have to be built into Detroit Diesel Allison engines in order to meet the 80 dB standard.

1983 HEAVY DUTY NOISE REDUCTION KIT 6L-71T

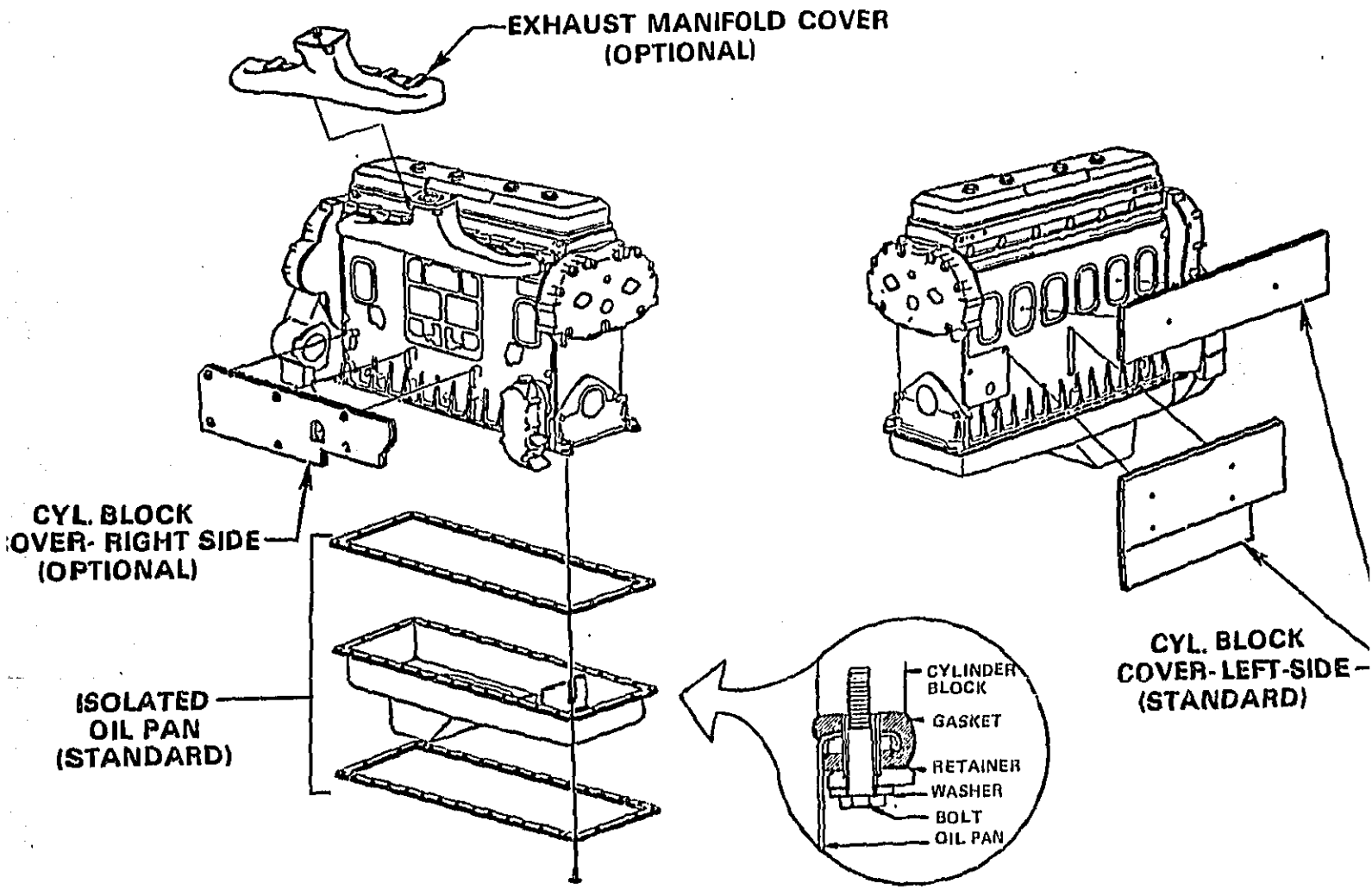


FIGURE 1

1982/83 MEDIUM DUTY
8.2 LITER

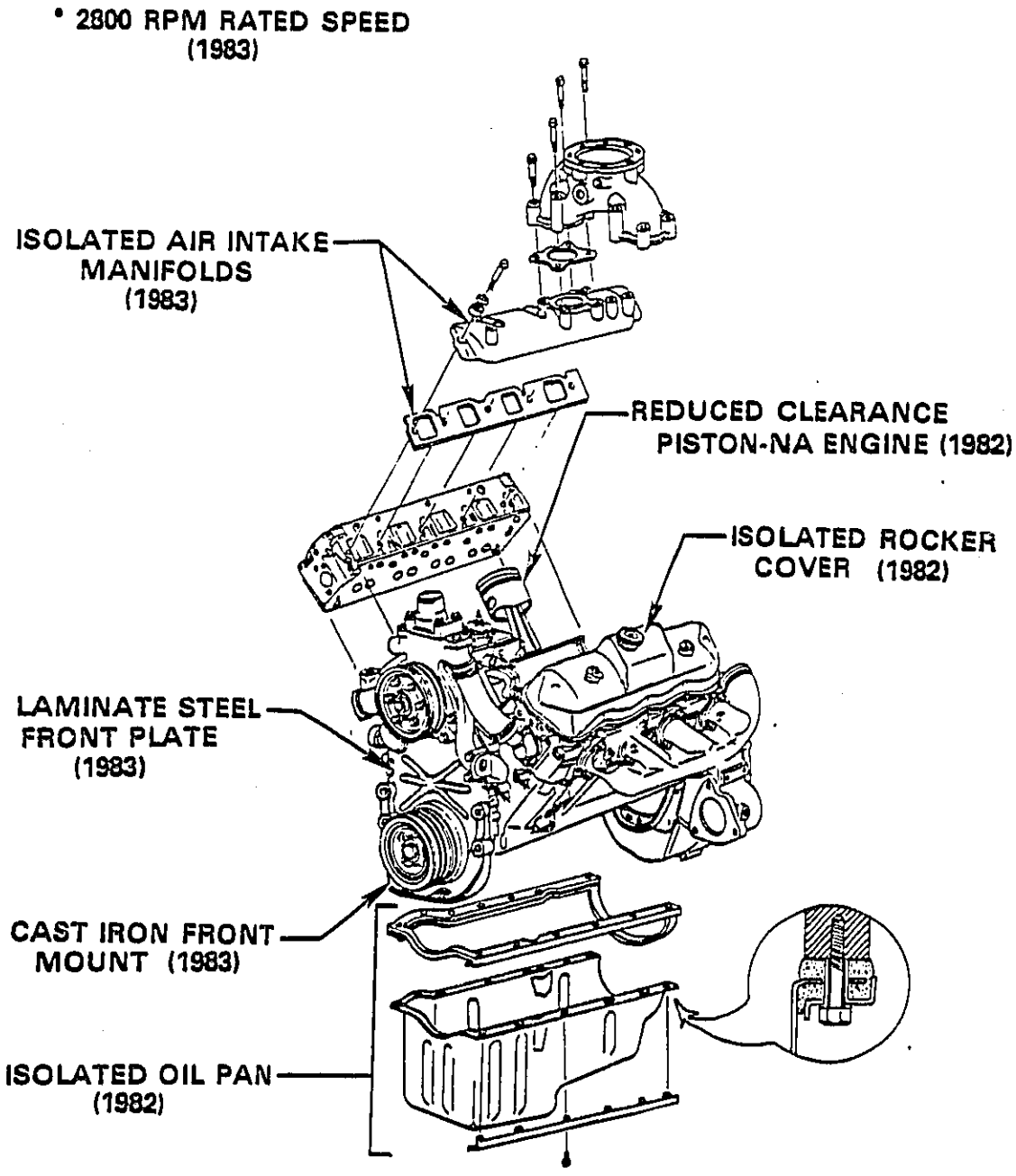


FIGURE 2

1983 HEAVY DUTY NOISE REDUCTION KIT
6V-92TA, 8V-92TA, 8V-71TA

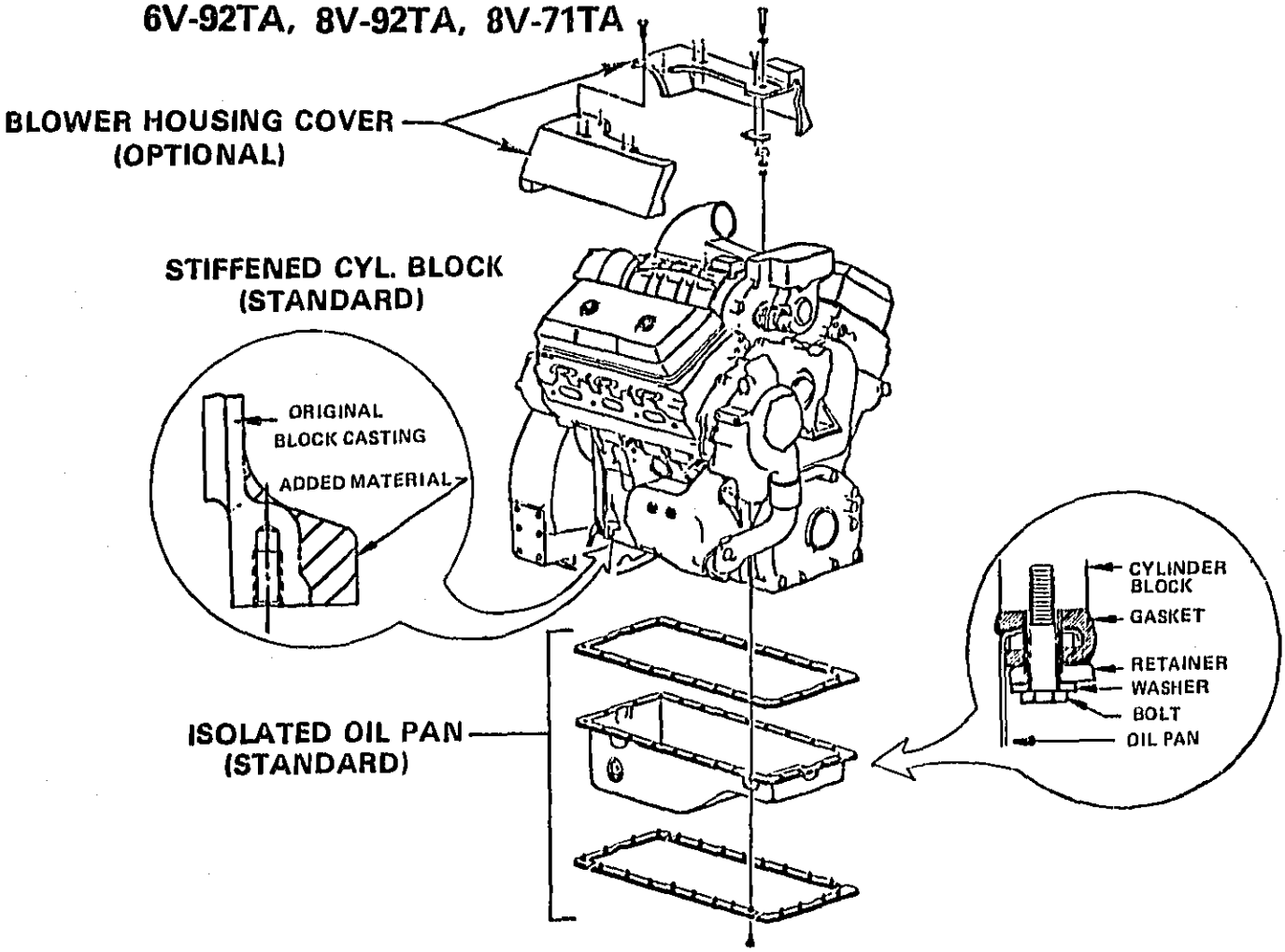


FIGURE 3

Extended side shields, fender shields, transmission shields and belly pans not required today are commonly required for noise control at the 80 dB level of regulation. There is no newly developed engine noise control technology that will obviate the use of these measures. To the contrary, there are indications that changes being made to engines in order to achieve better fuel economy and lower exhaust emissions may exacerbate the problems of noise control.

The 80 dB standard promulgated in 1976 on the basis of predicted technical progress should be reconsidered on the basis of the actual technology available today.

General Motors has completed the production design for 80 dB medium and heavy trucks. These designs are based on actual prototype tests and will be released for production in order to meet the 80 dB noise standard currently required by January 1, 1983, if that deadline is not vacated.

The following is a summary of further changes required to meet the 80 dB level of regulation which are in addition to those changes already made to meet the 83 dB level:

	Medium Duty Truck
Engine Type	Added Treatment
Gasoline	Viscous Fan Drive. Low overshoot governor.
Diesel	Belly pan with absorptive material.
	Transmission shield.
	Fender shields.
	Double wall exhaust pipe.
	Improved muffler.

	Improved transmissions: more gear teeth, finer tooth surface finish, stiffer casings.
	Engine treatment: isolated air intake manifold, dampened front cover plate, cast front mount, treated valve covers, reduced rpm.
	Heavy Duty Truck (Over 26,000 lbs. GVWR)
Engine Type	Added Treatment
Gasoline	Gasoline engines are being eliminated from the heavy duty trucks in the transition to more fuel efficient diesel engines.
Diesel	Expanded use of fender shields.
	Lower cab shields. *
	Double wall exhaust pipe. *
	Improved exhaust muffler.
	Improved transmissions: more gear teeth, finer tooth surface finish, stiffer casings.
	Belly pan.*
	Transmission shield.*
	Back of cab enclosure.*
	Engine treatment: isolated oil pan, exhaust manifold cover, cylinder block cover, stiffened block, anti-slap pistons, blower housing cover.

As it turns out, the new class of diesel engines that will be used widely in medium duty trucks pose severe engineering difficulties in reducing noise levels. These engines were not even considered by the EPA or for that matter, by GM, in its evaluation of technology in 1975 and 1976 because they were not in existence as production engines.

We do not contend that the current line of engines and trucks cannot be made to comply with an 80 dB noise standard, but it is apparent that the treatment required is much more extensive than what had been predicted.

*Required on some models.

Future Engine Changes

During the 1975 evaluation of noise control technology upon which the current standard is based, neither the EPA nor industry gave any consideration to changes that might occur in future engines. The impact of higher oil prices had not become fully apparent and the standards for future exhaust emissions were not yet established.

There are changes planned for future diesel engines for the purposes of improved fuel economy and emissions control which we believe will increase the noise level of the engines and also possibly change the technology that may be used to reduce overall truck noise. That is not to say that the noise levels cannot be controlled, but it should be recognized that the technology and therefore the costs of noise control are not defined at this point in time.

Engine Revisions for Fuel Economy and Emissions

Charge Air Cooling

Perhaps the most far reaching change planned for future diesel engines is the concept of charge air cooling.

Air compressed by the turbocharger for combustion has a nominal temperature of 310°F. In order to achieve better engine efficiency and lower emissions, the temperature of this air must be reduced substantially (to 125°F) before the cylinders are "charged" with air. This is accomplished with an inter-cooler which is essentially an air-to-air or air-to-liquid cooling radiator designed to extract heat from the charge air (see Figure 4).

CHASSIS MOUNTED COOLING SYSTEM (CMCS)

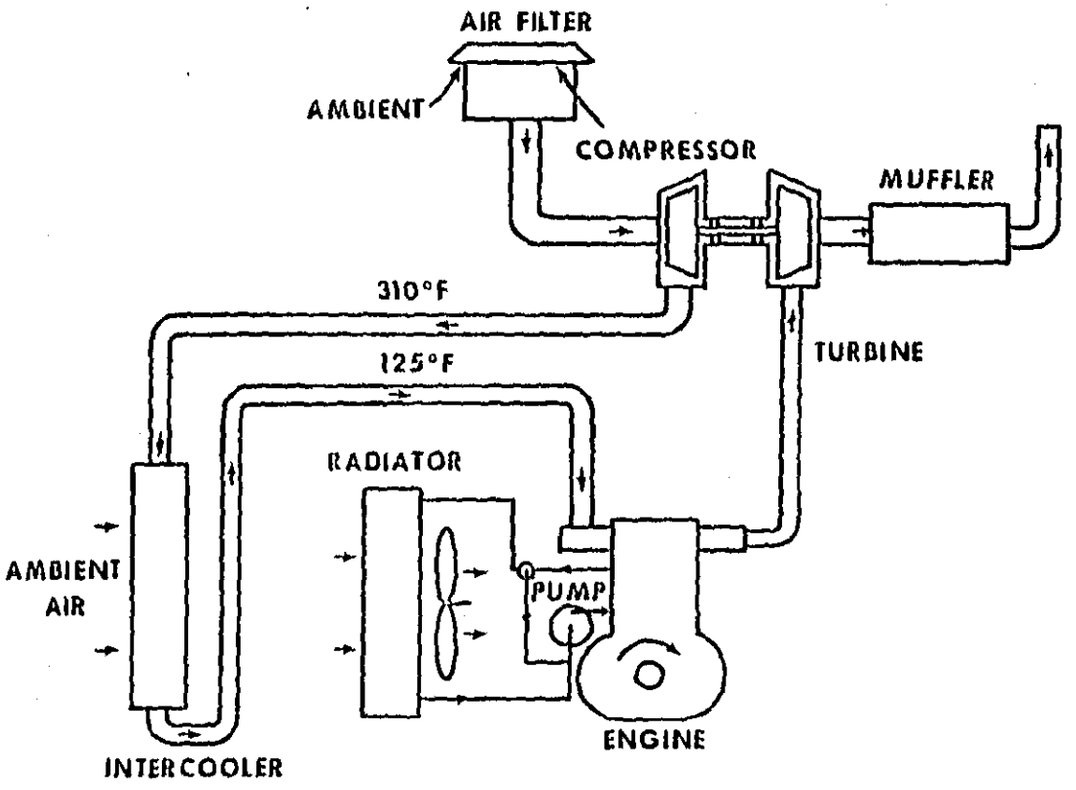


FIGURE 4

The intercooler may be located in front of the engine cooling radiator in the engine compartment. Given that no other changes are made, this will restrict the flow of air to the engine cooling radiator and also increase the temperature of the air for engine cooling purposes. Therefore, it may be necessary to increase the size of the fan and also the drive ratio. Fan clutch devices are used on all these vehicles and it is predictable that the duty cycle of the fan will increase. This may increase sound levels of the vehicle. It will be necessary to run tests with these very new engines installed in vehicles in order to determine the extent of any problems with cooling or fan duty cycles.

Reduction of the temperature of charge air is critical to achieving the desired fuel economy and emissions control. It follows that the flow of cooling air for the intercooler and the engine radiator is critical also. The effect of engine noise shields and belly pans on this air flow has yet to be determined.

Combustion noise in an engine generally increases with decreasing charge air temperature. Higher pressures are generated within the engine. The phenomenon of increased noise levels on some engines when testing on very cold days has been observed. The effect of charge air cooling is likely to be similar and may even be exacerbated when operating in frigid weather.

We do not portray the above as insurmountable problems, but clearly the technology to control noise on these engines has not yet been demonstrated nor can costs be predicted at this time.

Electronic Control System

Electronic control systems will be applied to diesel engines which will provide optimum injection timing. Electronic control may provide more overall advance and would tend to increase combustion noise.

Better control of fuel input during engine acceleration may provide higher transient fuel rates with better vehicle performance and potentially higher transient exhaust noise.

As newly developed engines become available, they must be tested and evaluated as to the impact on noise.

Exhaust Gas Recirculation (EGR) 4 Cycle 8.2L Engine

It is expected that the higher cylinder air inlet temperatures associated with exhaust gas recirculation (EGR) will tend to lower the combustion and exhaust noise. The effect on engine mechanical noise is unknown.

By-Pass Blower - 2 Cycle Engine

The use of a controlled by-pass around the Roots-type scavenging blowers on the 2-cycle turbocharged engines is planned. This permits the engine-driven blower to provide scavenging and combustion air during light load and transient operations while exhaust energy to the turbocharger is low. At higher loads, the by-pass opens, reducing blower parasitic load and excess combustion air to the engine, both of which benefit the brake specific NOx emissions (g/bhp-hr).

The by-pass mode may result in more mechanical engine noise, but it may lower combustion noise due to the resultant lower peak cylinder pressures. The blower by-pass effect on exhaust noise is not known.

Conclusion

In summary, it is quite probable that the changes made on engines to improve fuel economy and reduce emissions will increase truck passby noise. It is our contention that the 80 dB truck standard should be rescinded until such time that these new engines have been evaluated and the technology to reduce noise is developed.

Maintenance and Serviceability

Addition of noise control hardware to trucks affects maintenance costs because of the additional cost of these components when it is necessary to replace them, and also because of the interference of these components with routine maintenance actions.

The addition of engine and transmission shields interferes with inspection, lubrication and maintenance actions. It may be necessary to remove these shields in order to perform these maintenance actions and the time spent removing and replacing these shields is an additional cost to the user and ultimately to the consumer. Such routine actions as servicing brake plumbing, draining the radiator core or checking transmission lubrication levels will take more time.

Shields and belly pans do not form a functional part of the vehicle and, in fact, will be perceived by maintenance personnel as an impediment. It will be a natural reaction on the part of maintenance personnel to discard these parts the first time they are removed for a maintenance action. Even during a well disciplined experimental program conducted by the EPA and industry, there were problems keeping the shielding installed. Aside from the penalty of significantly increased maintenance costs if the vehicle is maintained properly, there is this valid concern that if the engine and transmission shields are removed for maintenance operations, they will not replaced. This may be done deliberately or accidentally. Regardless of the reason, the result will be the same. The truck buyer and his customer will have paid the price for noise control but society will not have received the benefit.

At the time the 80 dB standard was established, the EPA believed that development of "quiet engines" would obviate the use of removable engine shields. This has not proved to be the case and therefore the requirement for the 80 dB standard should be reexamined in light of current knowledge.

United Parcel Service Quiet Tractors

The United Parcel Service (UPS) "Quiet Truck Program" is a joint venture that has involved the main truck suppliers for UPS (GMC and Mack) and the main engine suppliers (Cummins and Mack). The purpose of this program was to develop a practical quiet diesel tractor with a noise level approaching 75 db.

Two prototypes built to UPS specifications by GMC and Mack were put into service in early 1979 and in 1980, five Mack and five GMC "second generation" quiet tractors were put into service.

The UPS service organization has kept detailed records of the additional service costs experienced because of noise control features that were designed to cause minimum interference with service.

UPS reported that in the first year of service, the added maintenance cost for the Mack tractor was $305 and the GMC tractor $312. They expect these costs to increase dramatically in subsequent years as very little maintenance is performed on an engine in the first year. UPS used a labor cost of $25 per hour which is a nominal present day figure. These figures apply to cab-over-engine vehicles and are used in our economic evaluation.

General Motors has estimated the increased service costs to be expected on 80 dB vehicles over a seven-year period. These costs range from a $10 to $2687 increase for seven years, depending upon the engine and truck model. Those trucks requiring engine belly pans and/or back-of-cab engine enclosures will experience very substantial increases in maintenance costs. GM estimates an average increase in service costs of $200 to $400 per year, depending upon the model. This compares favorably with the costs actually experienced by UPS on their "quiet" trucks.

The GM estimates are conservative in that the cost of cleaning debris from belly pans is not included and increased cost due to accident damage of

noise control parts is not included. Experience has shown that belly pans are susceptible to accident damage. There will also be lost time when mechanics drop tools and parts in the belly pan necessitating removal. This cost has not been calculated. These factors are among the reasons we believe that in many cases belly pans will be permanently removed from vehicles so equipped.

Economic Impact of 80 dB Noise Standard

There are two major costs associated with reducing the noise level of a truck from 83 dB to 80 dB. The first is the added hardware cost and the second, and by far the greatest, is the increased cost of maintenance during the life of the truck. For purposes of this study, seven years has been used as the average life of a truck (MVMA Motor Vehicle Facts and Figures 1980). Increased maintenance costs due to noise control hardware have been developed for that period of time.

The cost of hardware to reduce noise levels of trucks varies considerably depending upon the power train and the truck model. General Motors estimated costs for various models in our current product line and then developed a single sales weighted average figure for the cost of noise control hardware.

We estimate the average increase in price to the new truck purchaser for all medium and heavy trucks will be $365 (1981 economics) if the 80 dB standard is to be met. This figure is somewhat lower than EPA estimates but it is based upon well established design requirements. In this study, we have used this figure as being representative of what industry price increases would be in determining total economic impact. We believe the figure to be conservative so that the economic impact is possibly understated.

Service costs are stated for a seven year life cycle. It is not feasible to develop service costs for a short time span as some replacement or

service operations may occur only once or twice in the life cycle of the vehicle. We have estimated the average increase in service cost to be $1225 over a seven year period. Again this is a sales weighted average. The labor cost used is $25/hour which approximates the current average labor cost to repair medium and heavy duty trucks. It is also the same labor cost used by United Parcel Service (UPS) in their service cost study.

For purposes of developing total economic impact of the 80 dB truck noise standard, the General Motors forecast for truck unit sales was used.

General Motors estimates that total industry sales for a seven year period, 1983 through 1989, will be 2,528,000 medium and heavy trucks.

Unit Cost to Consumer Per Truck (Medium and Heavy)

Initial Purchase Price Increase	$ 365.00
Increased Lifetime Service Cost (7 years)	$1225.00
Total Lifetime Cost Increase	$1590.00
Life Cycle Economic Impact of Trucks Purchased in a Seven Year Period. $1590 x 2,528,000 unit sales	$ 4.00 Billion

We conclude that the current cost of achieving an 80 dB level is excessive for the marginal environmental benefit.

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4/16/81