Environmental and Economic Impact Statement
Noise Emission Regulations for Truck-Mounted Solid Waste Compactors
This document presents an assessment of the expected environmental benefits and economic effects of the Noise Emission Regulations for Truck-Mounted Solid Waste Compactors. The information presented includes the statutory basis for the action, a summary of the regulation, a description of the existing truck-mounted solid waste compactor environment, the alternatives considered, the expected environmental benefits, the expected economic effects, and conclusions.
FINAL
ENVIRONMENTAL AND ECONOMIC IMPACT STATEMENT

NOISE EMISSION REGULATIONS FOR
TRUCK-MOUNTED SOLID WASTE COMPACTORS

August 1979

U.S. Environmental Protection Agency
Office of Noise Abatement and Control
Washington, D.C. 20460

This document has been approved for general availability.
It does not constitute a standard, specification, or regulation.
SUMMARY

Agency: U.S. Environmental Protection Agency
Office of Noise Abatement and Control (EPA/ONAC)

Action: Notice of Rulemaking (NRM) to establish noise emission limits for newly-manufactured truck-mounted solid waste compactors (TMSWC).

Description: 1. Truck-mounted solid waste compactors (refuse collection vehicles) manufactured after October 1, 1980 shall not emit a noise level (A-weighted) in excess of 79 decibels (the energy average of measurements made at four positions around the truck, at a distance of 7 meters from the vehicle surface, with the vehicle stationary, empty and operating through its compacting cycle at the maximum engine speed allowable for compaction). The not-to-exceed noise level is reduced to 76 decibels for vehicles manufactured after January 1, 1982.

2. The regulation requires that the manufacturer design and build each product so that its noise level will not degrade (increase) above the applicable level for a period (the Acoustical Assurance Period, or AAP) of 2 years or 5000 operating hours after delivery to the ultimate purchaser.

3. The regulation specifies a Low Noise Emission Product (LNMP) level of 71 decibels, effective October 1, 1979.

4. The regulation incorporates an enforcement program modeled after the enforcement provisions in the existing medium and heavy truck noise regulation. This program includes production verification, selective enforcement auditing, warranty, maintenance, compliance labeling, and antitampering provisions.

Benefits: 1. A 70 percent decrease is expected in the population exposed to noise levels above a yearly L_{dn} of 55 dB due to truck-mounted solid waste compactors.

2. A 74 percent reduction is expected in the severity and extent of annoyance and general adverse response to noise from compactor vehicles.

3. A 75-80% reduction is expected in the potential occurrence of sleep disturbances, sleep awakenings, and other activity interferences such as speech interference due to compactor vehicle noise.

4. An annual fuel savings of 2 million gallons of gasoline and 1.2 million gallons of diesel fuel is anticipated when the entire refuse collection vehicle fleet is in compliance.
Impacts:

1. The average list price of refuse collection vehicles may increase by 10.3 percent, based on the combined cost of compactor and chassis.

2. Demand for new truck-mounted solid waste compactors could decrease by as much as 2 percent, but total manufacturer revenue should remain unchanged due to increased prices.

3. The annualized cost to the collection industry is estimated to be approximately $21.5 million. This translates to an annual cost of less than 10 cents per person served in the United States.

4. Costs are expected to be passed through to the consumer and should cause an increase in annual residential refuse collection costs of no more than 50 cents per household served.
## CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>INTRODUCTION</td>
<td>1</td>
</tr>
<tr>
<td>REGULATORY ANALYSIS</td>
<td>1</td>
</tr>
<tr>
<td>ADDITIONAL INFORMATION</td>
<td>2</td>
</tr>
<tr>
<td>STATUTORY BASIS FOR ACTION</td>
<td>3</td>
</tr>
<tr>
<td>SUMMARY OF THE REGULATION</td>
<td>4</td>
</tr>
<tr>
<td>THE EXISTING TRUCK-MOUNTED SOLID WASTE COMPACTOR ENVIRONMENT</td>
<td>8</td>
</tr>
<tr>
<td>ALTERNATIVES CONSIDERED</td>
<td>12</td>
</tr>
<tr>
<td>ENVIRONMENTAL IMPACTS</td>
<td>17</td>
</tr>
<tr>
<td>ECONOMIC IMPACTS</td>
<td>21</td>
</tr>
<tr>
<td>CONCLUSIONS</td>
<td>25</td>
</tr>
<tr>
<td>EXHIBITS</td>
<td>27</td>
</tr>
</tbody>
</table>
INTRODUCTION

The U.S. Environmental Protection Agency (EPA) has issued a noise emission regulation for newly-manufactured truck-mounted solid waste compactors. This regulation is intended to alleviate the adverse health and welfare impacts on people, resulting from the noise of refuse compaction in residential neighborhoods.

This Environmental and Economic Impact Statement (EEIS) presents, in summary form, the benefits to be gained from the truck-mounted solid waste compactor noise standards, and the economic implications of this action. Also presented are the principal regulatory options which were considered by EPA. The information contained in this document addresses the principal issues involved with this rulemaking and EPA's continuing activities in promoting a quieter environment for all Americans.

REGULATORY ANALYSIS

In arriving at the not-to-exceed noise standards for new refuse collection vehicles, the Agency considered various regulatory options in the light of available quieting technology, potential health and welfare benefits, and the attendant costs and economic effects of compliance with each option. The regulatory decisions involved in the rule were based on technical data and other information gathered by EPA from meetings with manufacturers, distributors and users, and from published data and public comments. This information has been
compiled and analyzed by EPA, and published in the form of a regulatory analysis entitled, "Regulatory Analysis of the Noise Emission Regulations for Truck-Mounted Solid Waste Compactors," (EPA 550/9-79-257). This document may be obtained upon request from:

Mr. Charles Mooney
EPA Public Information Center (PM-215)
U.S. Environmental Protection Agency
Washington, D.C. 20460

For the sake of brevity and simplicity the information contained in this EEIS is presented in summary form only. Persons wishing more detailed explanation and discussion of the facts and issues pertinent to the truck-mounted solid waste compactor noise rulemaking are encouraged to refer to the regulatory analysis.

The preamble and text of the regulation and additional copies of this EEIS can also be obtained from the above address.

ADDITIONAL INFORMATION

For further information related to the regulation, please contact:

Mr. Fred Mintz
Program Manager - Truck-Mounted Solid Waste Compactors
Office of Noise Abatement and Control (ANR-490)
U.S. Environmental Protection Agency
Washington, D.C. 20460
(703) 557-2710
STATUTORY BASIS FOR ACTION

Congress passed the Noise Control Act (NCA) of 1972 (Public Law 92-574), in part, as a result of their findings that inadequately controlled noise presents a growing danger to the health and welfare of the nation's population, particularly in urban areas. Through the NCA, the Congress established a national policy to "promote an environment for all Americans free from noise that jeopardizes their health or welfare". In pursuit of that policy, Congress stated in Section 2 of the Act that "while primary responsibility for control of noise rests with state and local governments, Federal action is essential to deal with major noise sources in commerce, control of which requires national uniformity of treatment." As part of this essential Federal action, Subsection 5(b)(1) of the Act requires that the Administrator of the U.S. Environmental Protection Agency, after consultation with the appropriate Federal agencies, publish a report or series of reports "identifying products (or classes of products) which in his judgement are major sources of noise." Section 6 of the Act requires the Administrator to publish proposed regulations for each product identified as a major source of noise and for which, in his judgement, noise standards are feasible. Such products fall into various categories, one of which is surface transportation equipment.

Inasmuch as a number of different types of transportation equipment operate at the same time, the quieting of one product type is often not in itself sufficient to adequately reduce transportation noise to a level necessary to protect public health or welfare. Accordingly, the EPA's noise regulatory program has developed a coordinated approach to controlling overall transportation noise in which various types of transportation equipment, alone or in combination, are evaluated to assess their contribution to transportation noise and its impact on the nation's population.
Under the mandate of the Noise Control Act and EPA's approach to the control of transportation noise, noise emission regulations were promulgated on March 31, 1976, for medium and heavy trucks (41 FR 15538). These regulations, however, only apply to trucks when they are in a pass-by mode. As long as a truck is standing still, for example to collect and compact refuse, the noise emission regulations for medium and heavy trucks do not apply.

In order to address this problem and to further control transportation noise, in accordance with Subsection 5(b)(1) of the Noise Control Act the Administrator published a report on May 28, 1975 (40 FR 23105) that identified truck-mounted solid waste compactors as a major source of noise. A Notice of Proposed Rulemaking (NPRM) to regulate noise emissions from truck-mounted solid waste compactors was published on August 26, 1977 (42 FR 43226). Public comment was solicited for 90 days and two public hearings were held (New York City on October 18, 1977, and Salt Lake City, Utah, on October 20, 1977). A detailed review and consideration of the comments that were received has been carried out prior to the issuance of the final rule.

The final regulation is intended to alleviate the adverse health and welfare impacts of the noise of refuse collection and compaction on people in areas at or near their residences. The regulation is also intended to establish a uniform national noise standard for truck-mounted solid waste compactors distributed in commerce, thereby eliminating inconsistent state and local noise source emission regulations that may impose an undue burden on the truck-mounted solid waste compactor manufacturer and user industries.

SUMMARY OF THE REGULATION

The regulation establishes standards for noise emissions resulting from the operation of newly-manufactured truck-mounted solid waste compactors. The standard specifies that those noise emissions shall be described in terms
of the energy-averaged A-weighted sound pressure level in dB, measured at a
distance of 7 meters (approximately 23 feet) from the front, rear, and side
surfaces of the truck-mounted solid waste compactor vehicle, using "slow"
meter response. For test purposes, the vehicle is stationary, empty, and
operated through its compacting cycle at the maximum engine speed allowable
for compaction.

To minimize market impacts from substitution of unregulated vehicles,
identical effective dates were set for all types of compactor vehicles subject
to the standards. Effective on the dates listed below, truck-mounted solid
waste compactor vehicles must not produce noise levels in excess of the levels
shown, when operated and evaluated according to the methodology provided in the
regulation.

**Regulatory Noise Emission Standards**

<table>
<thead>
<tr>
<th>Effective Date</th>
<th>Not-to-Exceed Noise Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>October 1, 1980</td>
<td>79 decibels</td>
</tr>
<tr>
<td>July 1, 1982</td>
<td>76 decibels</td>
</tr>
</tbody>
</table>

The EPA believes that the estimated health and welfare benefits from this
regulation can be attained only if the compactors conform to the prescribed
noise levels for a reasonable period of time. Therefore, in order to ensure the
realization of benefits from this regulation, the Agency requires that manufac-
turers design and build each product so that, when properly maintained and used,
its noise level will not degrade (increase) above the applicable level for a
specified period of time or use, from the date of the product's delivery to the
ultimate purchaser. This period is called the Acoustical Assurance Period
(AAP). In the case of truck-mounted solid waste compactors, the Acoustical
Assurance Period is two years or 5000 operating hours, whichever occurs first.
If a manufacturer anticipates that the noise level of his product will increase
during the AAP, then he must take into account this anticipated increase in noise level, termed the Noise Level Degradation Factor (NLDF), when making test measurements to show compliance with the applicable standard. He must demonstrate that his product's noise level does not exceed an amount equal to the regulatory level less the NLDF value.

Under the authority of Section 15 of the Noise Control Act, the regulation specifies a Low Noise Emission Product (LN(EP) level of 71 dB determined by the measurement methodology prescribed in the standard, effective October 1, 1979. That is, for a product to be qualified as a LN(EP), its noise level must not exceed 71 dB. The LN(EP) program provides manufacturers with incentives for reducing the noise level of their products below the regulated noise level. The Federal government is authorized to purchase LN(EPs) in lieu of those like products which just meet the regulated levels. The Federal government is further authorized to pay up to a twenty-five percent premium over the retail price of the least expensive product of like type.

The regulation also incorporates an enforcement program which includes production verification, selective enforcement auditing, warranty, maintenance, compliance labeling and antitampering provisions. Production verification means that prior to the distribution into commerce of any truck-mounted solid waste compactor vehicle, a manufacturer must submit information to EPA which demonstrates that his product conforms to the standards. Selective enforcement auditing means that in response to an administrative request, a statistical sample of truck-mounted solid waste compactors must be tested to determine if the units, as they are produced, meet the standard.

EPA wishes to avoid placing an excessive testing burden on distributors who assemble a compactor vehicle by mounting a compactor body on a truck chassis. These distributors (who are "manufacturers" under the Noise Control Act and therefore are otherwise subject to all provisions of the regulation) are permitted to rely on the production verification tests of the compactor...
body manufacturer if the distributor faithfully follows assembly instructions provided by the compactor body manufacturer.

Current Federal regulations applicable to truck chassis noise are the EPA Noise Emission Standards for Motor Carriers Engaged in Interstate Commerce (39 FR 38208) and the EPA Noise Emission Standards for Medium and Heavy Trucks (41 FR 15538). The U.S. Bureau of Motor Carrier Safety of the U.S. Department of Transportation has issued regulations for the purpose of establishing measurement procedures and methodologies for determining whether in-use commercial motor vehicles conform to the Federal Interstate Motor Carrier Noise Emission Standards.

Under the authority of the Noise Control Act of 1972 this regulation establishes a uniform national standard for newly-manufactured truck-mounted solid waste compactor vehicles that preempts, after its effective date, all state and local new source emission regulations that are not identical with the Federal regulation.

However, since primary responsibility for control of noise rests with state and local governments, nothing in the Act or this regulation precludes or denies the right of any state or political subdivision from establishing and enforcing controls on environmental noise through the licensing, regulation or restriction of the use, operation or movement of any product or combination of products. Furthermore, Section 6(f) of the Act, as amended, gives a state or political subdivision the right to petition the Administrator of EPA to revise the standard on the grounds that a more stringent standard is necessary to protect the public health and welfare.

The noise controls which are reserved to state and local authority include, but are not limited to, the following:

1. Control on the manner of operation of products
2. Controls on the time of day during which products may be operated
3. Controls on the places in which products may be operated
4. Controls on the number of products which may be operated together
5. Controls on noise emissions from the property on which products are used
6. Controls on the licensing of products
7. Controls on environmental noise levels.

By use of the noise controls reserved to them, state and local governments will be able to supplement Federal noise emission standards and to effect near term relief from truck-mounted solid waste compactor noise.

THE EXISTING TRUCK-MOUNTED SOLID WASTE COMPACTOR ENVIRONMENT

A truck-mounted solid waste compactor is defined, for purposes of this regulation, as a vehicle that is comprised of a mechanically powered truck cab and chassis or trailer, and equipped with a body and machinery for receiving, compacting, transporting, and unloading solid waste. The body, which includes a waste-receiving hopper, houses machinery which typically consists of hydraulic actuators (rams) with the necessary hydraulic pump(s), valves, piping, and controls and auxiliary engines, where used. The hydraulic actuators operate various components that sweep the waste matter into the container portion of the body and compact it. Power generally is drawn from the truck engine by means of a power take-off (PTO) unit that is coupled by gears or other mechanical connection to the transmission, engine drive shaft, or fly wheel. Auxiliary gasoline or diesel engines may be used in place of the truck engine and PTO.

Figure 1 shows line drawings of a front loader, a side loader and a rear loader. Details regarding identification of these machines as candidates for regulation, their design features and functional characteristics are contained in the regulatory analysis, "Regulatory Analysis of the Noise Emission Regulations for Truck-Mounted Solid Waste Compactors."
Figure 1
Types of Truck-Mounted Solid Waste Compactors
The following are the major types of truck-mounted solid waste compactors:

1. **Front Loader**  This type of compactor body utilizes front mounted hydraulic lift arms to lift and dump waste containers into an access door in the top of the body. Wastes are typically ejected through the tailgate of the body.

2. **Side Loader**  Side loader compactor bodies vary. However, wastes are generally deposited manually into a hopper through an access door in the side wall. Packer plates sweep the wastes from the hopper into the body and compress the materials against an interior wall in the same manner as front loaders. Some side loaders are equipped to hydraulically lift and dump waste containers. Ejection of wastes is usually through a tailgate in the body. Some side loader models do not use their packer plate for ejection, but rather hydraulically lift the front end of the body and dump the waste through the tailgate in much the same fashion as a dump truck.

3. **Rear Loader**  This is a compactor body on which the hopper is located on the rear section. Wastes are generally loaded manually into the hopper, although some models have the capability to hydraulically lift and dump containers. The packer plate sweeps the wastes from the hopper into the body and compresses the waste against an interior wall surface. In most models, a hydraulically driven plate is used for tailgate waste ejection.

Based on noise measurements conducted by, and on behalf of, the Environmental Protection Agency, energy-averaged A-weighted sound pressure levels of today's truck-mounted solid waste compactors were found to range from 74 to 92
decibels at seven meters. However, EPA's studies revealed that approximately ten percent of all newly-manufactured compactor vehicles currently incorporate some degree of intentional quieting. The noise levels of these "quieted" vehicles range from 74 to 85 decibels. It is estimated however, that 80% of the current compactor vehicle fleet have noise levels in excess of 80 decibels.

The Environmental Protection Agency has identified a yearly $L_{dn}$ of 55 dB as the environmental noise level requisite to protect public health and welfare with an adequate margin of safety; $L_{dn}$ being the Day-Night Sound Level which is the A-weighted equivalent sound level for a 24-hour period with an additional 10 dB weighting imposed on the equivalent sound levels occurring during nighttime hours (10 p.m. to 7 a.m.). The current compactor vehicle fleet on U.S. city streets comprises more than 80,000 vehicles. Because of their numbers and noise levels it is estimated that approximately 19.7 million people are exposed to environmental noise levels in excess of a yearly $L_{dn}$ of 55 dB due to these vehicles. These levels are high enough to jeopardize the health or welfare of those 19.7 million people by causing general annoyance, interference with speech communication and other social activities, and sleep disturbance and awakening.

In suburban single-family residential areas, refuse collection events occur once or twice a week and are frequently brief in duration. Consequently, they make only a modest contribution to the overall suburban area environmental noise. However, the situation is quite different in high-density urban areas. Here, the refuse collection process is repetitious with the vehicle standing in one place for periods as great as 30 minutes, several times a week, because of the amount of refuse generated in a relatively small area. Frequently this
collection occurs during the night and very early morning hours to minimize traffic problems. Therefore the bulk of the environmental noise impact, in terms of general annoyance, activity interference, and sleep disruption, occurs in such densely populated areas.

Nevertheless, significant impact, in the form of individual intrusive events, also is caused by refuse collection in less densely populated residential areas. In such areas, the noise of compaction stands out above the relatively low ambient environmental noise levels, being sufficiently intense to cause incidents of general annoyance, sleep disturbance and other activity interference for many persons in medium and low density areas.

These single event noise intrusions become particularly important in light of other regulations and efforts to reduce the noise from other urban noise sources. Without a reduction in emissions from refuse compactors, these units may very well stand out as one of the more intrusive noise sources in our environment.

ALTERNATIVES CONSIDERED

Section 6 of the Noise Control Act of 1972 requires the Administrator to set regulations for each product which he has identified under Subsection 5(b)(1) of the Act as a major source of noise and for which noise emission standards are feasible. Specialty auxiliary equipment on trucks (of which truck-mounted solid waste compactors are one category) was identified as a major source of noise on May 28, 1975 (40 FR 23069).

Following this identification, comprehensive studies were performed to evaluate truck-mounted solid waste compactor noise emission levels necessary to protect the public health and welfare, taking into account the magnitude
and condition of use, the degree of noise reduction achievable through application of the best available technology, and the cost of compliance. The Agency carried out detailed investigations of compactor design, manufacturing and assembly processes, noise measurement methodologies, available noise control technology, costs attendant to noise control methods, costs to test machines for compliance, costs of recordkeeping, possible economic impacts, and the potential environmental and health and welfare benefits associated with the application of various noise control measures.

The results of the Agency's studies show that the regulation of truck-mounted solid waste compactor noise is feasible through the application of available noise control technology taking cost of compliance into account. This has been amply demonstrated by the wide-spread use of quiet refuse collection vehicles in a number of communities including New York City, San Diego, California, and San Francisco, California. The Exhibits at the end of this document contain an article that describes the quiet San Diego refuse collection fleet and an advertisement for a quiet refuse collection vehicle. Both of these exhibits were drawn from trade journals and exemplify the feasibility of noise emission standards for newly-manufactured truck-mounted solid waste compactors.

In addition, no evidence has been received to indicate that truck-mounted solid waste compactors are no longer a major noise source. Therefore, based on the requirements of the Noise Control Act, the Administrator must issue a new-product noise emission regulation.

Within the context of the Noise Control Act, the only alternative open to the Administrator is the selection of the specific regulatory scheme. A
range of regulatory levels and effective dates were considered by the Agency in the formulation of the NPRM. The final regulatory levels and effective dates were chosen on the basis of maximum benefits and minimal adverse economic effects. The Agency concluded that reducing the noise limits below values established by this regulation would provide only marginal gains in benefits, considering the other noises (not susceptible to Federal control) that are associated with refuse collection activities.

Several examples of other regulatory options that were considered are given below:

- Not-to-exceed noise level of 71 dB in 1982 - We estimate that this option would have provided a further decrease in adverse impact of only six percent from that offered by the 76 dB standard. In light of present day noise control technology, it was highly likely that this option would have precluded the near term use of diesel powered truck chassis.

- Not-to-exceed noise level of 74 dB in 1982 - This option was estimated to yield an additional four percent decrease in the severity and extent of impact from that offered by the 76 dB standard. In order for truck-mounted solid waste compactors to meet a 74 dB standard, it was estimated that the noise level of the truck chassis would probably need to be less than 79 dB as determined by the pass-by noise test procedure of the current Federal regulation for medium and heavy trucks. The present Federal noise standard for trucks over 10,000 pounds is 80 dB in 1982. It should be noted that, in this pass-by test, the truck engine is operating at maximum rated speed, and the noise measurement is made at a distance of 50 feet (15 meters). The noise measurement for the
truck-mounted solid waste compactor vehicle is made at a distance of seven (7) meters, and the truck engine is expected to be operating at a relatively low speed (since reducing engine speed is the most cost-effective way of reducing the noise emissions). Therefore, the noise levels for the two types of tests are not directly comparable.

Based on the existing Federal truck chassis pass-by noise regulation of 80 dB in 1982, the best achievable standard for a compactor mounted on a diesel chassis would be 75 dB. This would reduce the environmental noise impact by two percent more than a 76 dB standard. However, such a regulation would require the use of a quiet hydraulic pump which is not expected to be available in production quantities until a substantial market has developed. This would entail an estimated increase in annualized cost of eight (8) percent. The incremental costs would be less than one-third as effective in reducing noise impact as the costs estimated for the regulatory option.

A less stringent standard, for example 80 dB in 1982, would provide a substantial reduction in noise impact at a relatively low cost. However, it is not a viable alternative because it does not represent the application of best available technology as required under the Noise Control Act.

The reliance on local curfews was advocated as a "no-cost" alternative to Federal noise emission standards by several commenters to the Notice of Proposed Rulemaking (NPRM), and thus deserves discussion. The Agency believes curfews simply serve to transfer some of the noise impact from nighttime hours to daytime hours. They are not a substitute for a noise emission standard that will reduce the total noise emission and thus the public exposure. In addition, curfews can only be implemented at the local level and thus do not provide national uniformity of treatment.
Although curfews are often represented as being cost-free, they can in reality be very costly by impairing the efficiency of refuse collection activity. In heavily concentrated metropolitan areas (where much of the noise impact of refuse collection occurs) a curfew often forces the refuse collection vehicles out onto the streets during times of greatest traffic congestion. This produces inefficiencies due to both lower productivity per unit time of the refuse crews and greater fuel demands, to say nothing of the impact on traffic flow in commercial areas. For example, a refuse collectors' trade association in Chicago estimates increased costs of operation, due to inefficiencies caused by a curfew in Chicago, at $50 per refuse collection vehicle per day; this includes an extended work day, a reduction in the vehicle loads per day, and increased fuel costs due to operations during peak traffic hours. For the estimated 2000 independent refuse collection vehicles in Chicago, this could represent a cost of $100,000 per day, or about $30 million annually. Even allowing for some exaggeration of the cost factor, this clearly indicates that a curfew is not cost free and quite probably is not cost effective.

Several commenters to the Notice of Proposed Rulemaking (NPRM) stated either that refuse container noise should be regulated as part of the standard or that refuse container noise should be regulated instead of noise from truck-mounted solid waste compactors. The Agency agrees that in some cases, container noise contributes substantially to refuse collection noise. However, its presence or absence does not diminish the beneficial effects of controlling compaction noise. Also, it does not appear feasible to regulate container noise by a national performance standard. Since container noise arises primarily from handling (or, sometimes, mishandling) by collection personnel, it is best controlled by local in-use regulation of permissible types of containers, e.g., plastic garbage containers or garbage bags.
Prescription of any in-use, operational controls is available to communities desiring further reduction of the noise impact from truck-mounted solid waste compactors.

ENVIRONMENTAL IMPACTS

Health and Welfare

Compliance with the Federal standards will, on the average, reduce noise emissions from truck-mounted solid waste compactors by 6.5 dB from present day levels. Compared to the noisier units in service today, some unit reductions will be 14 dB or more. The EPA estimates that approximately 19.7 million persons currently are exposed to residential neighborhood noise levels above the day-night sound level ($L_{dn}$) of 55 dB due to the operation of truck-mounted solid waste compactors. The Agency believes that the entire refuse collection fleet will be in compliance with the noise standards by 1991. As a result, approximately six million persons will remain exposed to $L_{dn}$ greater than 55 dB. This represents an approximate 70 percent decrease of the population exposed to levels exceeding that identified by EPA. However, the six million persons who still remain above the identified level will also receive benefits in the form of varying levels of reduction in their exposure.

The reduction in extent and severity of impact is also evaluated in terms of annoyance and general adverse response, as well as other effects due to individual noise events, such as sleep disturbance and activity interference. In order to assess the general adverse response and annoyance from these types of noise events, the Agency uses a fractional impact analysis technique. This technique involves evaluating the "level-weighted population" ($LWP$) exposed to a noise source and is illustrated in Figure 2. The computation of $LWP$

* The agency has determined that an $L_{dn}$ of 55 dB or lower is requisite for the protection of the public health and welfare with an adequate margin of safety. The basis for this determination is presented in the EPA publication, "Information on Levels of Environmental Noise Necessary to Protect Public Health and Welfare with an Adequate Margin of Safety."
allows one to combine the number of people jeopardized by noise above an L_{dn} of 55 dB with the degree of impact at different noise levels. The circle in Figure 2 is a source which emits noise to a populated area. The various partial amounts of shading represent various degrees of partial impact by the noise. The partial impacts are summed to give the LWP. In this example, six people who are adversely affected by the noise (partially shaded) result in a "level weighted population" (LWP) of two (totally shaded).

EPA estimates that the "level-weighted population" will decrease from about 2,110,000 in the base year, 1976, to about 540,000 in 1991. The decrease in LWP from 2,110,000 to 540,000 represents approximately a 74 percent reduction of the impact in severity and extent of general adverse response (annoyance) to noise from truck-mounted solid waste compactors. Part of the estimated reduction in impact is due to the effect of recently promulgated noise standards for medium and heavy trucks. In 1991, the reduced truck noise alone will account for an estimated reduction of 630,000 in "level-weighted population" impacted by refuse collection noise. The balance of the estimated reduction, 940,000 in level-weighted population, is due entirely to the compactor noise regulation. This represents an improvement of approximately 149 percent over the benefits that are anticipated from refuse vehicles from the current Federal noise regulation for medium and heavy trucks.

The intrusive nature of the noise impact of refuse collection vehicles was assessed by the Agency through a single-event noise exposure analysis related to sleep awakening, sleep disturbance, and speech interference. The analysis confirmed that the noise emission regulation for truck-mounted solid waste compactors should result in an estimated 75-80% reduction in the occurrences of sleep disturbance, sleep awakening, and interference with other activities such as speech.
Figure 2

Level Weighted Population:
A Method to Account for the Extent and
Severity of Noise Impact
Thus, in conjunction with the benefits brought about by the medium and heavy truck noise regulation, the truck-mounted solid waste compactor noise regulation should provide health and welfare benefits of major proportions.

**Energy**

The regulation is expected to have a positive impact on energy resources. The anticipated use of slower engine speeds during compaction, a likely component of the noise control technology, is expected to produce an annual fuel savings of 2 million gallons of gasoline and 1.2 million gallons of diesel fuel when the entire refuse collection vehicle fleet has been replaced with vehicles that comply with the regulation.

**Air Quality**

The regulation is anticipated to have no adverse impact on air quality. Using slower engine speeds during compaction, a component of the noise control technology, could, in fact, result in a reduction in air pollutant emissions from compactor vehicles and a consequent improvement in air quality. However, the Agency has not quantified this potential benefit.

**Land Use**

There are potential benefits in the form of reduced noise exposure to residents in close proximity to land-fill areas. The same components used for refuse compaction during collection operations are used to expel the refuse from the compactor body. Considering that land-fill operations are generally continuous throughout the day with multiple unloading operations occurring simultaneously, the reduction in noise impacts on workers and residents could be substantial. The Agency has not quantified this potential benefit.
Water Quality

The regulation is expected to have no adverse impact on water quality or supply.

Solid Waste Disposal Requirements

No adverse effects on solid waste disposal requirements are expected due to the promulgation of the regulation.

Wildlife

The regulation is expected to have no adverse effects on wildlife. In fact, in rural collection areas and in areas where wildlife are in close proximity to land-fill areas, potential benefits are expected in the form of reduced noise exposure to the wildlife of those areas. The Agency has not quantified these potential benefits.

ECONOMIC IMPACTS

The establishment of noise standards for newly-manufactured truck-mounted solid waste compactors gives rise to expenditures which would otherwise not be directly incurred by the private and public sectors in the absence of curfews. However, noise pollution currently costs the American taxpayer many millions of dollars in hidden costs associated with decreased productivity, higher medical costs, and property value depreciation. One of the effects of a standard-setting, noise regulation is that, by reducing noise pollution, hidden costs are also reduced. However, visible costs are imposed on those responsible for the pollution. It should be understood that the option of not paying for noise pollution costs is unavailable. The only question is, in what form do we pay those costs?

Recognizing that certain expenditures are necessary to protect the public health and welfare from inadequately controlled noise, the Agency performed analyses to estimate the magnitude and potential impact of these expenditures.
Examined in the analyses were the structure of the industry, the estimated cost of abatement by compactor type, the price elasticity of demand, the capital and annual costs of enforcement, the impact of enforcement on annual operating and maintenance costs, and the indirect impacts of the proposed regulations.

**Price**

The cost impact of quieting compactors to meet the regulatory standard may be expressed in terms of increased list price. The Agency's studies indicate that average list price increases for the refuse collection vehicle can range from about 6.4 to 12.8 percent, depending on machine type and size (this estimated increase does not account for possible inflationary affects). This should result in an overall average list price increase of about 10.3 percent for the various combinations of compactor bodies and chassis-cab units. There are indications that a few small firms in the industry, by virtue of their small market share and related financial and operation factors, would incur higher manufacturing costs resulting in slightly higher list price increases. The price elasticity of demand, that is, the reduction in sales due to increased list price, for this equipment is estimated to be -0.2, or a possible decrease in sales of about 2 percent. However, the total revenue to the industry should not decrease as a result of price increases. In view of the current purchasing specifications of several major municipalities with respect to garbage truck noise level and their willingness to pay a premium for quiet trucks, a possible two percent decrease in demand must be considered a worst case impact.

Some pre-buying of unregulated refuse vehicles is expected to occur prior to the effective date(s) of the regulation. However, the Agency believes this activity will be limited to the available excess production capacity of the industry which is estimated at about 4,000 units, almost entirely rear loaders.
Capital Costs

Capital equipment costs represent a small portion (about five (5) percent) of the annual operating budget for the typical refuse collection and disposal firm. Consequently, the expected increase of about ten (10) percent in the list price of a compactor vehicle due to the regulation should result in increased operating costs of less than 0.5 percent (5% x 10%).

The increase in the annualized cost to the collector industry as a result of the implementation of this regulation is estimated to be $21.5 million. The Agency expects these costs to be totally passed through to the end user of waste collection services. The EPA estimates that, for residential refuse collection with costs in the range of $100 per household per year, the increase in annual cost per household served should be no more than 50 cents due to the promulgation of this regulation.

Maintenance and Operating Costs

Maintenance costs for compactor vehicles are expected to increase slightly due to the requirements of the regulation. This increase is expected to be on the order of $45 annually for front loaders and $78 annually for side and rear loaders. The maintenance cost increases for side and rear loaders are expected to be due largely to maintenance on the clutch of the added direct drive power take-off and on the impact reducing material added to the loading hoppers. Front loaders are assumed to employ a flywheel power take-off which will require no significant increase in maintenance costs. The increased maintenance costs for front loaders are expected, therefore, to be due largely to the expected maintenance on the impact reducing material added to the loading hoppers.

The changes in compactor operating conditions associated with the noise control treatment are expected to result in fuel savings due to the slower
speed of the engine. The estimated annual savings when the entire fleet is in compliance are expected to be about 2 million gallons of gasoline and 1.2 million gallons of diesel fuel. The savings due to reduced fuel usage are expected to be greater than the expected increase in maintenance costs. Due to the rapidly rising costs of both gasoline and diesel fuel, the net savings in operating costs, taking into account possible increases in maintenance costs, may be substantial.

Industry Structure

No significant change in industry profits is expected to occur over a 22 year period. Industry growth is not expected to be significantly impacted due to the noise abatement regulation. Adequate lead time has been provided to allow for proper planning and to avoid adverse conditions in the industry.

Suppliers

Some component suppliers may increase their sales depending on their ability to reduce the noise emissions of their products. This should contribute to the reduction in overall machine noise. Furthermore, those suppliers specializing in the manufacture of sound damping and sound absorptive materials and other products required for noise abatement would be expected to experience significant increased sales. The Agency has not quantified this benefit.

Employment

Employment is not expected to change significantly. Persons who might be affected by reduction of production due to the regulation amount to less than two percent of the industry's employee population of about 2900 persons. However, an offsetting increase in employment is expected to occur due to the new testing and compliance activity and procurement of noise control components and materials resulting from the regulation.
**Exports and Imports**

Since the noise control treatment generally represents add-on materials or substitute components or both, machines for export generally can be produced without noise control treatment. Units produced solely for export need not comply with U.S. noise standards. Consequently, the impact on exports should be minimal. However, all imported compactors will be subject to the regulation. Therefore, domestic and foreign manufacturers will be affected equally and no adverse competitive impact should result. Consequently, the regulation should have no appreciable impact on the U.S. balance of trade.

**Macroeconomic Impacts**

No macroeconomic impact is expected as a result of noise abatement regulations on the truck-mounted solid waste compactor body industry due to the minor size of the industry, and the low overall costs associated with this regulation.

**Taxes**

There may be an indirect increase in local taxes where collection services are provided by municipal fleets but the amount of the increase to the individual consumer and taxpayer is expected to be insignificant.

**CONCLUSIONS**

The Agency has concluded that at this time the regulatory levels and schedule promulgated represent adequate noise reduction standards for truck-mounted solid waste compactor vehicles. Implementation of the regulations is expected to result in a substantial reduction in the number of people impacted by compactor noise.

The technology to achieve the selected levels has been demonstrated.
The effective dates for the noise level limits are coordinated with existing Federal noise standards for medium and heavy trucks. The Agency believes that the time schedule for application of the noise standards, corresponding with reduced noise limits for trucks, should allow the manufacturers the lead time requisite to incorporate the necessary design and component changes without significant disruption to production or the marketplace.

The cost of compliance and possible economic effects have been considered and are believed to be reasonable.
EXHIBITS

Exhibit 1. MAXON Industries Advertisement for a Quiet Refuse Collection Vehicle

MAXON EAGLE SL

Introducing... The First Integrated Vehicle Ever Built for Refuse Collection

Now, for the first time – a vehicle engineered without compromise for the sole purpose of efficient, reliable refuse collection, we introduce the Maxon Eagle SL – a self-loader body, refuse cart, and cross body designed and built as a single unit system – the complete vehicle ready now for delivery.

Every feature – suspension, braking, cooling, springing, frame reinforcement, weight distribution, built-in dual drive, overstated window trim, low profile, 11-second completion cycle, instrumentation, safety features, diagnostic fit, center – everything to the last detail specified to meet the rigorous demands of refuse service and includes its standard equipment. There’s never been a vehicle like it before. And no hybrid body/cross combination even comes close.

REFUSE CAB, CHASSIS AND SIDE LOADER BODY ENGINEERED & BUILT AS AN INTEGRATED SYSTEM

Low 4"1/2" Pickup Height
The lowest riding refuse truck in the industry, vehicle combines the Eagle's ideal design concept, matching the pickup body to the pneumatic power of the engine.

Built-in Loading Compaction
The zero clearance loading compartment with front mount Sashbrush Street Pump provides the ideal combination of rumble, and body structure stiffness when the loader needs it.

60,000 lb. Frame
The Maxon Eagle SL is a product of years of research, development, and testing. The result is a frame that can handle the weight and stresses of refuse collection.

Maximum Maneuverability
Top Operating Efficiency
The Maxon Eagle SL is fully integrated with a Dual Drive System. It's a self-loader body that moves like a truck, but operates like a car. The result is a vehicle that is easy to maneuver, and also provides the power and performance needed to get the job done.

New! Reliable Performance
The Maxon Eagle SL is designed and built to withstand the rigors of refuse collection. It features a powerful engine and transmission, as well as durable components that are built to last.

Unequaled Cooling Efficiency
The Maxon Eagle SL is equipped with a cooling system that is designed to keep the engine cool, even in the hottest weather.

Write for FREE Brochure
For more information about the Maxon Eagle SL, including specifications and pricing, please write for a FREE brochure.
SILENT RUNNING—San Diego's RCVs

Responding to pressure from city officials, San Diego's General Services Department engineers an RCV that makes noisy, grinding trash trucks a thing of the past.

By BERT GOLDSTEIN, Field Editor

San Diego's General Services Department, looking for a quieter and less noisy collection vehicle, recently purchased a new model from Master Truck, a local equipment manufacturer. The new collection vehicle is equipped with a 5-cubic-yard capacity hopper and a rear-mounted collector.

San Diego's General Services Department is one of the few cities in the country that has an RCV fleet. The department currently operates 12 RCVs, which are used primarily for trash collection in residential areas.

The new RCV is equipped with a hydraulic lift system that allows the driver to lift the hopper and empty it into a container. The hopper is made of stainless steel and is designed to last for at least 10 years.

According to city officials, the new RCV is much quieter than the older models, which made a loud grinding noise when emptying the hopper. The new RCV also requires less maintenance, which should result in lower operating costs.

In addition to the new RCV, the city is also considering the purchase of a new RCV with a larger capacity hopper, which would allow it to collect more trash at one time.

The city is also exploring the possibility of using RCVs for other purposes, such as collecting recyclables and yard waste. The city hopes to have a decision on this matter within the next few months.

The new RCVs are expected to be delivered by the end of the year, and the city is looking forward to seeing the benefits of using the new technology in its collection fleet.
RCVs
term design and engineering the truck from the ground up for the General Motors' Department well beyond what city officials had asked for in a truck that not only meets noise and pollution standards but also sets the standard for the future.

San Diego's General Services Department maintains a fleet of 56 vehicles that operate over 2,500 miles of unsurfaced streets. Operating two a week, each truck averages 548 to 1,000 miles a month. As governmental pressure increases, however, J-shaft vehicles are available to San Diego as well as hundreds of other U.S. cities because more remote and trash truck mileage increases annually.

San Diego's HVP fleet includes 27 tridem-haulers, best for a one-man operation, and the balance is two-man haulers with two-man crews. A few specialized front-end loaders are maintained for industrial use. Brown projects that by the end of the present contract, at least 80% of the city's trucks collecting will be modern, low-noise master units. If he's right, San Diego will have more of these super-quiet trucks than any other city in the country.

San Diego's first combination were equipped with PTOs driving all the front of the truck, Brown said.

Recalling the city's earlier experience with these PTOs, Brown said that at that stage of their development, there were several drawbacks. They were subject to premature engine and transmission failure, and were unable to maintain the desirable gasoline. They also included parking on the gas.

"Tanking on the go is important when you make up to 600 stops per day," Brown said.

"Then we added the auxiliary diesel which produced the 50 or more horsepower needed for the hydraulic compression system. This 
engine and its high-pressure pump were selected for its economy and durability, without any complications. We began to phase out that type and started using a crankshaft-driven hydraulic pump to power the compression-type facility. That is an expensive device. It is practical to install the pump directly on the engine, instead, the pump was mounted on a frame truck and driven by a coupling from the engine crankshafts. Here we are at a crossroads," Brown said, "in which between the engine and the high-pressure hydraulic pump. We began experimenting a high percentage of failures of different kinds of high-pressure couplings which couldn't be kept in alignment, not effectively dampened from the included vibration.

"Technology finally came to the rescue with the hydraulic PTO. The system is always engaged so we can connect the engine to the unit shaft of the PTO and the direct gear of the PTO is always engaged to the driving gear of the transmission. It provides an acceptable drive mechanism in conjunction with the existing hydraulic system. The engine is run at slightly over idle speed. On earlier PTOs, it was about 2,500 rpm. Now it is usually 700 to 1,000 rpm, with a maximum of 1,000 rpm.

"We went from a 17-gallon pressure tank to a 45-gallon tank in the rear and with the 3,500 to 4,000 psi and pressure can run up to 2,500 psi; but it can be adjusted in full an hydraulic pressure. A good mechanical we found," Brown explained.

"When we started out the diesel engines, we tried 35 gallons of fuel per hour of about 60 gallons a week. That was a big step. The last available we used were aliner, all-enclosed tricycle chutes, Brown said.

-- Commercial Car Journal, Jan 17, 1969
Above: These garbage trucks in San Diego carry both a fendered trash body (left) and a semi-beaver with added engine (right). Photo by Paul Theobald.