EXECUTIVE SUMMARY

To comply with the Clean Air Act (CAA) Section 211(b) legislation, a comprehensive literature search of twelve databases was conducted and resultant information was compiled on the health and welfare effects information pertaining to three types of emissions from diesel fuel and baseline gasoline. The work was performed according to specifications described in the final rule on fuel and fuel additives registration requirements (40 CFR Part 79). To this end, relevant information was identified, summarized, and compiled in text and tabular form, accompanied by bibliographies (with abstracts) for submission to the U.S. Environmental Protection Agency. Brief descriptions of the processes involved in this effort are provided.

Bibliographic databases (12) were selected for searching on the basis of content, scope, and relevancy to this effort. Justification for excluding certain databases from the searching process is provided. Databases were searched back either 30 years or to their origins for health or welfare effects information on the following emission entities: diesel fuel exhaust, gasoline evaporative emissions, and gasoline exhaust, as the three whole (primary) emissions; select fractions or classes of compounds (16) associated with these emissions (ethers, alcohols, hydrocarbons, ketones, and aldehydes as "speciated emissions" along with 11 select naphtha fractions); and numerous individual chemicals (173) found in these three primary emissions. For select chemicals (approximately 20) having enormous information bases in the open literature, comprehensive reviews were used to identify prior relevant studies, with literature searches providing information on more recent, post-review studies.

Search results were evaluated for relevancy to either health or welfare effects, and relevant citations (over 5000 for health and welfare) were identified. Information from studies identified as relevant and appropriate was then extracted to summary tables (up to 15 combined health and welfare effects tables may exist per chemical or whole emission) for a wide variety of health or welfare effects. Health tables present information ordered first by route of exposure (inhalation, oral, dermal, other routes) or *in vitro*/structure-activity relationship studies, and then, within each of those tables, by specific endpoint. Welfare tables present information ordered first by the type of welfare effect, and within each effect table, by subcategories specific to that type of effect. These tables (approximately 650 combined health and welfare tables) were then used to compile summary text.

For both health and welfare effects, summary text is ordered by primary emission type (namely, diesel fuel exhaust, gasoline evaporative emissions, and gasoline exhaust). Summary text provides interpretive general findings and conclusions (chiefly in regard to toxicity to humans and animals) for each primary emission, as well as for each individual chemical constituent within that primary emission. Health information also includes *in vitro* toxicity, metabolism, pharmacokinetics, and any structure-activity analyses. Welfare information includes fate and persistence, bioaccumulation potential, nuisance odor, visibility, and measured emission concentrations of each chemical entity.

A health effects bibliography and a welfare effects bibliography each provide relevant citations identified from searches, and include abstracts for all citations summarized in tables and text. It should be noted that the magnitude of the citations provided in the bibliographies may be greater than that of citations actually used within the summary tables for numerous chemicals. These additional citations reflect certain procedures used in screening citations and summarizing information and are not omissions.

Lastly, a complete copy of the 40 CFR Part 79 *Federal Register* notice is provided for easy reference.

TABLE 2-1 DIESEL EXHAUST: ROUTE-SPECIFIC HEALTH EFFECTS INFORMATION FOR CHEMICAL CONSTITUENTS

Chemical Name	Inhalation	Oral	Dermal	Other	In Vitro
Parental Emission					
Diesel Exhaust	X		X	X	X
Chemical Constituents					
Acetone	X	X	X	X	X
Acrolein	X	X	X	X	X
Benzaldehyde	X	X		X	X
Benzo(a)anthracene	X	X	X	X	X
Benzo(b)fluoranthene		X	X	X	X
Benzo(k)fluoranthene		X	X	X	X
Benzo(a)pyrene	X	X	X	X	X
1-Butene	X				X
cis-2-Butene	X				
trans-2-Butene					
Chrysene		X	X	X	X
Crotonaldehyde	X	X		X	X
Cyclopentadiene					
Cyclopentane			X		
Cyclopentene					
n-Decane	X		X		X
Dibenzo(a,h)anthracene (Found as Dibenz(a,h)anthrancene)		X	X	X	X
1,4-Diethylbenzene		X	X	X	
1,4-Dimethyl-2-ethylbenzene					
1,2-Dimethyl-4-ethylbenzene					
2,2-Dimethylhexane					
2,3-Dimethylhexane	X				
2,4-Dimethyloctane					
n-Dodecane			X		X
Ethane	X				
Ethene	X			X	X
Ethylbenzene	X	X	X	X	X
Ethyne	X				X
n-Hexanaldehyde	X	X		X	X
1-Hexene	X			X	X

Chemical Name	Inhalation	Oral	Dermal	Other	In Vitro
cis-3-Hexene					
Indeno(1,2,3-c,d)pyrene		X	X	X	X
Isobutyraldehyde					X
Isobutylbenzene					
1-Methyl-2-Isopropylbenzene		X			
1-Methyl-3-Isopropylbenzene					
Methane	X				X
2-Methylbutane	X	X			X
3-Methyl-1,3-butadiene	X			X	X
2-Methyl-2-butene	X				X
1-Methyl-2-ethylbenzene	X		X		X
1-Methyl-3-ethylbenzene	X		X		X
1-Methyl-4-ethylbenzene	X		X		X
3-Methylpentane	X	X			X
2-Methyl-1-pentene					
3-Methyl-1-pentene					
4-Methyl-1-pentene					
1-Methyl-2-tert-butyl benzene					
MEK - Methylethyl ketone	X	X	X	X	X
7-Nitrobenzo(a)anthracene				X	X
6-Nitrobenzo(a)pyrene			X	X	X
6-Nitrochrysene			X	X	X
2-Nitrofluorene		X	X	X	X
1-Nitropyrene	X	X	X	X	X
n-Nonane	X		X	X	X
trans-4-Octene					
n-Pentylbenzene					
1-Pentene	X				X
trans-2-Pentene		X			X
Propene	X			X	X
Propionaldehyde	X		X	X	X
1-Tertbutyl-3,5-dimethylbenzene					
1,2,4-Trimethylbenzene	X	X	X		X
1,3,5-Trimethylbenzene	X	X	X		X
Toluene	X	X	X	X	X
n-Undecane	X		X		X
Xylenes	X	X	X	X	X

TABLE 3-1 GASOLINE EVAPORATIVE EMISSIONS: ROUTE-SPECIFIC HEALTH INFORMATION FOR CHEMICAL CONSTITUENTS

Chemical Name	Inhalation	Oral	Dermal	Other	In Vitro
Parental Emission					
Gasoline Evaporative	X				
Chemical Constituents					
n-Butane	X		X		X
cis-2-Butene	X				
trans-2-Butene					
Cyclohexane	X	X	X	X	X
Cyclopentadiene					
Cyclopentene					
Diisopropyl ether	X				X
2,2-Dimethylbutane			X		X
2,3-Dimethylbutane		X	X		X
3,3-Dimethylbutane (Found as 2,2-dimethylbutane)					
cis-1,3-Dimethylcyclohexane					
trans-1,3-Dimethylcyclohexane			X		
1,1-Dimethylcyclopentane					
trans-1,2-Dimethylcyclopentane					
cis-1,3-Dimethylcyclopentane					
trans-1,3-Dimethylcyclopentane					
3,5-Dimethylheptane					
2,3-Dimethylhexane	X				
2,4-Dimethylhexane					
2,5-Dimethylhexane		X			X
2,6-Dimethyloctane					
2,3-Dimethylpentane	X	X			X
2,4-Dimethylpentane			X		
2,3-Dimethyl-1-pentene					
2,4-Dimethyl-1-pentene					
2,3-Dimethyl-cis-2-pentene (Found as 2,3-dimethyl-2-pentene)					
2,4-Dimethyl-cis-2-pentene (Found as 2,4-Dimethyl-2-pentene)					
3,4-Dimethyl-cis-2-pentene (Found as 3,4-Dimethyl-2-pentene)					

Chemical Name	Inhalation	Oral	Dermal	Other	In Vitro
Ethanol	X	X	X	X	X
Ethylbenzene	X	X	X	X	X
Ethylcyclopentane					
3-Ethylpentane					
3-Ethyl-cis-2-pentene (Found as 3-Ethyl-2-pentene)					
n-Heptane	X		X		X
1-Heptene	X				
cis-2-Heptene					
trans-2-Heptene					
n-Hexane	X	X	X	X	X
1-Hexene	X			X	X
cis-2-Hexene (Found as 2-Hexene)					
trans-2-Hexene					
cis-3-Hexene					
2-Methylbutane	X	X			X
3-Methyl-1,3-butadiene	X			X	X
2-Methyl-1-butene					
2-Methyl-2-butene	X				X
3-Methyl-1-butene					
2-Methyl-cyclopentadiene					
Methyl-cyclopentane	X	X	X		X
1-Methyl-cyclopentene					
Methyl-cyclohexane	X	X	X		X
1-Methyl-2-ethylbenzene	X		X		X
1-Methyl-3-ethylbenzene	X		X		X
1-Methyl-4-ethylbenzene	X		X		X
1-Methyl-1-ethylcyclopentane					
1-Methyl-3-trans-ethylcyclopentane					
1-Methyl-3-cis-ethylcyclopentane (Found as 1-methyl-3-ethylcyclopentane)					
2-Methyl-3-ethylpentene					
2-Methylheptane	X	X	X		X
3-Methylheptane		X	X		
4-Methylheptane		X			
2-Methylhexane		X	X		X

Chemical Name	Inhalation	Oral	Dermal	Other	In Vitro
3-Methylhexane		X	X		X
2-Methyl-2-hexene					
2-Methyl-trans-3-hexene (Found as 2-Methyl-3-hexene)					
3-Methyl-trans-3-hexene					
3-Methyl-cis-3-hexene (Found as 3-Methyl-3-hexene)					
5-Methyl-1-hexene					
5-Methyl-trans-2-hexene (Found as 5-Methyl-2-hexene)					
2-Methylpentane	X	X	X		X
3-Methylpentane	X	X			X
2-Methyl-1-pentene					
2-Methyl-2-pentene		X			X
3-Methyl-1-pentene					
3-Methyl-cis-2-pentene (Found as 3-Methyl-2-pentene)					
3-Methyl-trans-2-pentene (Found as 3-Methyl-2-pentene)					
4-Methyl-cis-2-pentene					
4-Methyl-trans-2-pentene					
2-Methylpropane					X
2-Methylpropene	X				X
2-Methyloctane	X				X
n-Octane	X	X	X	X	X
1-Octene	X			X	X
cis-4-Octene					
1,3-cis-Pentadiene		X			X
1,3-trans-Pentadiene		X			X
n-Pentane	X	X			X
1-Pentene	X				X
cis-2-Pentene					
trans-2-Pentene		X			X
Tertiary amyl methyl ether	X	X		X	X
Tertiary butyl alcohol	X	X	X	X	X
1,1,3,4-tetramethylcyclopentane (trans)					
1,2,4-Trimethylbenzene	X	X	X		X
1,3,5-Trimethylbenzene	X	X	X		X

Chemical Name	Inhalation	Oral	Dermal	Other	In Vitro
1-trans-2-cis-3-Trimethylcyclopentane (Found as 1,2,3-Trimethylcyclopentane)					
1-trans-2-cis-4-Trimethylcyclopentane (Founds as 1,2-4-Trimethylcyclopentane)					
2,3,5-Trimethylhexane			X		
2,4,4-Trimethylhexane			X		
2,2,3-Trimethylpentane	X	X			
2,2,4-Trimethylpentane	X	X		X	X
2,3,4-Trimethylpentane	X	X	X		X
Toluene	X	X	X	X	X
Xylenes	X	X	X	X	X
Fractions					
Naphtha (various)	X				

TABLE 4-1 GASOLINE EXHAUST: ROUTE-SPECIFIC HEALTH EFFECTS INFORMATION FOR CHEMICAL CONSTITUENTS

Chemical Name	Inhalation	Oral	Dermal	Other	In Vitro
Parental Emission					
Gasoline Exhaust	X				X
Chemical Constituents					
Acetone	X	X	X	X	X
Acrolein	X	X	X	X	X
Benzaldehyde	X	X		X	X
Benzo(a)anthracene	X	X	X	X	X
Benzo(b)fluoranthene		X	X	X	X
Benzo(k)fluoranthene		X	X	X	X
Benzo(a)pyrene	X	X	X	X	X
n-Butane	X		X		X
1-Butene	X				X
cis-2-Butene	X				
trans-2-Butene					
n-Butyraldehyde	X		X		X
n-Butylbenzene	X		X	X	X
Chrysene		X	X	X	X
Crotonaldehyde	X	X		X	X
Cyclohexane	X	X	X	X	X
Cyclopentadiene					
Cyclopentane			X		
Cyclopentene					
Dibenzo(a,h)anthracene (Found as Dibenz(a,h)anthrancene)		X	X	X	X
1,2-Diethylbenzene	X	X	X		
1,3-Diethylbenzene		X	X		
1,4-Diethylbenzene		X	X	X	
2,2-Dimethylbutane			X		X
2,3-Dimethylbutane		X	X		X
3,3-Dimethylbutane (Found as 2,2-dimethylbutane)					
trans-1,2-Dimethylcyclopentane					
cis-1,3-Dimethylcyclopentane					
2,2-Dimethylhexane					
2,3-Dimethylhexane	X				

Chemical Name	Inhalation	Oral	Dermal	Other	In Vitro
2,4-Dimethylhexane					
2,5-Dimethylhexane		X		X	
2,4-Dimethyloctane					
2,3-Dimethylpentane	X	X			X
2,4-Dimethylpentane			X		
3,3-Dimethylpentane		X			
Ethane	X				
Ethene	X			X	X
Ethylbenzene	X	X	X	X	X
Ethyne	X				X
ETBE (Also found as Ethyl-tertiary-butyl ether)	X				X
n-Heptane	X		X		X
n-Hexane	X	X	X	X	X
1-Hexene	X			X	X
cis-2-Hexene (Found as 2-Hexene)					
trans-2-Hexene					
Indan		X			X
Indeno(1,2,3-c,d)pyrene		X	X	X	X
Isopropylbenzene	X	X		X	X
Methane	X				X
2-Methylbutane	X	X			X
3-Methyl-1,3-butadiene	X			X	X
2-Methyl-1-butene					
2-Methyl-2-butene	X				X
3-Methyl-1-butene					
Methyl-cyclopentane	X	X	X		X
Methyl-cyclohexane	X	X	X		X
1-Methyl-2-ethylbenzene	X		X		X
1-Methyl-3-ethylbenzene	X		X		X
1-Methyl-4-ethylbenzene	X		X		X
2-Methylheptane	X	X	X		X
3-Methylheptane		X	X		
4-Methylheptane		X			
2-Methylhexane		X	X		X
3-Methylhexane		X	X		X

Chemical Name	Inhalation	Oral	Dermal	Other	In Vitro
2-Methylpentane	X	X	X		X
3-Methylpentane	X	X			X
2-Methyl-1-pentene					
2-Methyl-2-pentene		X			X
3-Methyl-trans-2-pentene (Found as 3-Methyl-2-pentene)					
2-Methylpropane					X
2-Methylpropene	X				X
3-Methyloctane					
4-Methyloctane					
1-Methyl-3-n-propyl-benzene (Found as 1-Methyl- 3-propylbenzene)					
MEK - Methyl ethyl ketone	X	X	X	X	X
MTBE - Methyl-tertiary-butyl-ether	X	X	X	X	X
Naphthalene	X	X	X	X	X
7-Nitrobenzo(a)anthracene				X	X
6-Nitrobenzo(a)pyrene			X	X	X
6-Nitrochrysene			X	X	X
2-Nitrofluorene		X	X	X	X
1-Nitropyrene	X	X	X	X	X
n-Nonane	X		X	X	X
n-Octane	X	X	X	X	X
n-Pentanaldehyde	X		X		X
n-Pentane	X	X			X
1-Pentene	X				X
cis-2-Pentene					
trans-2-Pentene		X			X
Propadiene	X				
Propane	X				X
Propene	X			X	X
Propyne					
n-Propylbenzene	X		X	X	X
Propionaldehyde	X		X	X	X
Styrene	X	X	X	X	X
1,2,3,4-tetra-methylbenzene					
1,2,3-Trimethylbenzene	X		X		X
1,2,4-Trimethylbenzene	X	X	X		X

Chemical Name	Inhalation	Oral	Dermal	Other	In Vitro
1,3,5-Trimethylbenzene	X	X	X		X
2,2,5-Trimethylhexane		X	X		X
2,3,4-Trimethylpentane	X	X	X		X
Toluene	X	X	X	X	X
Tolualdehyde		X			X
n-Undecane	X		X		X
Xylenes	X	X	X	X	X