ENVIRONMENTAL CONTAMINANTS ENCYCLOPEDIA
JET FUEL A ENTRY

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COMPILERS/EDITORS:

ROY J. IRWIN, NATIONAL PARK SERVICE

WITH ASSISTANCE FROM COLORADO STATE UNIVERSITY
STUDENT ASSISTANT CONTAMINANTS SPECIALISTS:

MARK VAN MOUWERIK
LYNETTE STEVENS
MARION DUBLER SEESE
WENDY BASHAM

NATIONAL PARK SERVICE
WATER RESOURCES DIVISIONS, WATER OPERATIONS BRANCH
1201 Oakridge Drive, Suite 250
FORT COLLINS, COLORADO 80525

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Like a library or most large databases (such as EPA's national STORET water quality database), this document contains information of variable quality from very diverse sources. In compiling this document, mistakes were found in peer reviewed journal articles, as well as in databases with relatively elaborate quality control mechanisms [366,649,940]. A few of these were caught and marked with a "[sic]" notation, but undoubtedly others slipped through. The [sic] notation was inserted by the editors to indicate information or spelling that seemed wrong or misleading, but which was nevertheless cited verbatim rather than arbitrarily changing what the author said.

Most likely additional transcription errors and typos have been added in some of our efforts. Furthermore, with such complex subject matter, it is not always easy to determine what is correct and what is incorrect, especially with the "experts" often disagreeing. It is not uncommon in scientific research for two different researchers to come up with different results which lead them to different conclusions. In compiling the Encyclopedia, the editors did not try to resolve such conflicts, but rather simply reported it all.

It should be kept in mind that data comparability is a major problem in environmental toxicology since laboratory and field methods are constantly changing and since there are so many different "standard methods" published by EPA, other federal agencies, state agencies, and various private groups. What some laboratory and field investigators actually do for standard operating practice is often a unique combination of various standard protocols and impromptu "improvements." In fact, the interagency task force on water methods concluded that [1014]:

> It is the exception rather than the rule that water-quality monitoring data from different programs or time periods can be compared on a scientifically sound basis, and that...
>
> No nationally accepted standard definitions exist for water quality parameters. The different organizations may collect data using identical or standard methods, but identify them by different names, or use the same names for data collected by different methods [1014].

Differences in field and laboratory methods are also major issues related to (the lack of) data comparability from media other than water: soil, sediments, tissues, and air.

In spite of numerous problems and complexities, knowledge is often power in decisions related to chemical contamination. It is therefore often helpful to be aware of a broad universe of conflicting results or conflicting expert opinions rather than having a portion of this information arbitrarily censored by someone else. Frequently one wants to know of the existence of information, even if one later decides not to use it for a particular application. Many would like to see a high percentage of the information available and decide for themselves what to throw out, partly because they don't want to seem uniformed or be caught by surprise by potentially important information. They are in a better position if they can say: "I knew about that data, assessed it based on the following quality assurance criteria, and decided not to use it for this application." This is especially true for users near the end of long decision processes, such as hazardous site cleanups, lengthy ecological risk assessments, or complex natural resource damage assessments.

For some categories, the editors found no information and inserted the phrase "no information found." This does not necessarily mean that no information exists; it simply means that during our efforts, the editors found none. For many topics, there is probably information "out there" that is not in the Encyclopedia. The more time that passes without encyclopedia updates (none are planned at the moment), the more true this statement will become. Still, the Encyclopedia is unique in that it contains broad ecotoxicology information from more sources than many other reference documents. No updates of this document are currently planned. However, it is hoped that most of the information in the encyclopedia will be useful for some time to come even with out updates, just as one can still find information in the 1972 EPA Blue Book [12] that does not seem well summarized anywhere else.

Although the editors of this document have done their best in the limited time available to insure accuracy of quotes or summaries as being "what the original author said," the proposed interagency funding of a bigger project with more elaborate peer review and quality control steps never materialized.

> The bottom line: The editors hope users find this document useful, but don't expect or depend on perfection herein. Neither the U.S. Government nor the National Park Service make any claims that this document is free of mistakes.

The following is one chemical topic entry (one file among 118). Before utilizing this entry, the reader is strongly encouraged to read the README file (in this subdirectory) for an introduction, an explanation of how to use this document in general, an explanation of how to search for power key section headings, an explanation of the organization of each entry, an information quality discussion, a discussion of copyright issues, and a listing of other entries (other topics) covered.

See the separate file entitled REFERENC for the identity of numbered references in brackets.

HOW TO CITE THIS DOCUMENT: As mentioned above, for critical applications it is better to obtain and cite the original publication after first verifying various data quality assurance concerns. For more routine applications, this document may be cited as:

> **Irwin, R.J., M. VanMouwerik, L. Stevens, M.D. Seese**, and **W. Basham.** 1997. Environmental Contaminants Encyclopedia. National Park Service, Water Resources Division, Fort Collins, Colorado. Distributed within the Federal Government as an Electronic Document (Projected public availability on the internet or NTIS: 1998).

Jet Fuel A (Jet A, Commercial Jet Fuel)

Brief Introduction:

Br.Class: General Introduction and Classification Information:

Jet fuels, or turbine fuels, are one of the primary fuels for internal combustion engines worldwide and are the most widely available aviation fuel [743]. Jet fuel A, used for commercial and general aviation, is a petroleum distillate blended from kerosene fractions and used in civil aviation [560]. Jet fuel A is used for commercial and general aviation [743]. It is an operational fuel for commercial turboprop and turbojet aircraft in U.S. [560].

Because of its availability compared to gasoline during wartime, commercial illuminating kerosene was the fuel chosen for early jet engines. Consequently, the development of commercial jet aircraft following World War II centered primarily on the use of kerosene-type fuels [747].

In terms of refining crude oil, JP-A is a middle distillate. The middle distillates include kerosene, aviation fuels, diesel fuels, and fuel oil #1 and 2. These fuels contain paraffins (alkenes), cycloparaffins (cycloalkanes), aromatics, and olefins from approximately C9 to C20. Aromatic compounds of concern included alkylbenzenes, toluene, naphthalenes, and polycyclic aromatic hydrocarbons (PAHs). Compositions range from avgas and JP-4, which are similar to gasoline, to Jet A and JP-8, which are kerosene-based fuels [661]. Kerosene normally has a boiling range well above the boiling-point of benzene; accordingly, the benzene content of the kerosene fraction (and therefore jet fuel A) is usually below 0.02%. However, since wide-cut jet fuels (such as jet fuel 4) are made by blending with gasoline, they may contain more benzene (normally <0.5%) [747]. Jet A is not mixed with gasoline.

According to the US Coast Guard Emergency Response Notification System (ERNS), jet fuels JP-1 (kerosene), JP-4, and JP-5 are among the top spilled petroleum products in the United States [635].

See also: Jet Fuel, General entry.

Br.Haz: General Hazard/Toxicity Summary:

Short-term hazards of the some of the lighter, more volatile and water soluble compounds (such as benzene compounds and toluene) in jet fuel include potential acute toxicity to aquatic life in the water column (especially in relatively confined areas) as well as potential inhalation hazards. Benzenes, toluene, and xylenes (all common components of jet fuels) tend to cause narcosis [878].

Jet fuels have moderate volatility and moderate solubility [777]. Jet fuels possess moderate to high acute toxicity to biota with product-specific toxicity related to the type and concentration of aromatic compounds [777]. Jet fuel spills could result in potential acute toxicity to some forms of aquatic life. Oil coating of birds, sea otters, or other aquatic life which come in direct contact with the spilled oil is another potential short-term hazard. Some of the same compounds found in gasoline are also found in jet fuels. As might be expected, there is therefore some overlap between the toxic effects potentially resulting from jet fuel spills and gasoline spills (see Gasoline entry). In the short term, spilled oil will tend to float on the surface; water uses threatened by spills include: recreation; fisheries; industrial, potable supply; and irrigation [608].

Jet A in the water column can depress Daphnia (zooplankton) populations for several weeks, resulting in algae blooms [877].

Two studies have been found on jet fuel in laboratory animals. In the first, subchronic exposure to unspecified doses produced tubular plugs in the male rat kidneys. The toxicity to the kidney may have been due to saturated branched aliphatic hydrocarbons [606].

Long-term potential hazards to humans of the some of the lighter, more volatile and water soluble compounds (such as benzenes, toluene, xylenes) in jet fuels would include contamination of groundwater. Long-term water uses threatened by spills include potable (ground) water supply.

Long-term effects may be associated with PAHs, alkyl PAHs, and alkyl benzene (such as xylene) constituents of jet fuel.0 Although PAHs, particularly heavy PAHs, do not make up a large percentage of jet fuels by weight, there are some PAHs in jet fuels, including naphthalene and alkyl naphthalenes [636,744]. Due to their relative persistence and potential for various chronic effects, PAHs, (and particularly the alkyl PAHs), can contribute to long-term (chronic) hazards of jet fuels in contaminated soils, sediments, and groundwaters.

> Further detail on potential risks for PAHs in this product: Acute toxicity is rarely reported in humans, fish, or wildlife, as a result of exposure to low levels of a single PAH compound. PAHs in general are more frequently associated with chronic risks. These risks include cancer and often are the result of exposures to complex mixtures of chronic-risk aromatics (such as PAHs, alkyl PAHs, benzenes, and alkyl benzenes), rather than exposures to low levels of a single compound. This product is an example of such a complex mixture (Roy Irwin, National Park Service, Personal Communication, 1996, based on an overview of literature on hand). See also: PAHs as a group entry.

Chronic human effects of some of the constituents in jet fuel (benzene, toluene, xylene, naphthalenes, alkyl benzenes, and various alkyl PAHs) include changes in the liver and harmful effects on the kidneys, heart, lungs, and nervous system. Increased rates of cancer, immunological, reproductive, fetotoxic, genotoxic effects have also been associated with some of the compounds found in jet fuel (see entries for details on individual compounds).

Exposure to jet fuel in the work environment occurs mainly during its production, transport and storage, as well as during refuelling and maintenance of aircraft. Most human exposure data refer to wide-cut aviation turbine fuel, which is more volatile and thus more likely to give rise to higher vapor concentrations than regular kerosene jet fuel types. Exposure to jet fuel vapors has been reported to cause neurobehavioral symptoms, including dizziness, headache, nausea and fatigue [747].

Commercial jet fuel can be a skin, eye, and respiratory irritant from acute exposures. Aspiration of a small amount can produce chemical pneumonitis. Repeated exposures can produce a defatting dermatitis [606].

Chronic exposure to commercial jet fuel may produce symptoms similar to those from acute exposure [606].

In a 1994 study of the biodegradation of the water soluble fraction (WSF) of Jet A, it was determined that the higher molecular weight PAHs tended to be the last to degrade and that biogenically produced metabolites may be causing biological impacts and system perturbations after many of the original hydrocarbons had degraded [878].

Some of the PAHs in this product can move into plants and some have either harmful or positive effects on plants (see PAHs as a group entry).

Many of the PAHs found in this product (see Chem.Detail section below) are phototoxic, that is they display greatly enhanced toxicity in sunlight or other UV source than elsewhere (see PAHs as a group entry).

A 1995 ATSDR (Human) Toxicology Profile summarizes information on jet fuels 6 and 7, two products which are different from this product but related to it [876].

See also: Jet Fuel, General entry.

Br.Car: Brief Summary of Carcinogenicity/Cancer Information:

Distillate fuel oils are not classifiable as to the carcinogenicity to humans [747]. However, certain carcinogenic effects have been associated with benzene and some of the other compounds found in jet fuel [609,766,767,893]. See Chem.Detail section for compounds in this product, then see entries for summaries of information on individual components of this mixture.

The debates on which PAHs, alkyl PAHs, and other aromatics typically in complex mixtures (such as this product) to classify as carcinogens, and the details of exactly how to perform both ecological and human risk assessments on such complex mixtures, are likely to continue. There are some clearly wrong ways to go about it, but defining clearly right ways is more difficult. Perhaps the most unambiguous thing that can be said about complex mixtures of PAHs, alkyl PAHs, and benzenes, is that such mixtures are often carcinogenic and possibly phototoxic. One way to approach site specific risk assessments would be to collect the complex mixture of PAHs and other lipophilic contaminants in a semipermeable membrane device (SPMD, also known as a fat bag) [894,895,896], retrieve the contaminant mixture from the SPMD, then test the mixture for carcinogenicity, general toxicity, phototoxicity, and other hazards (James Huckins, National Biological Service, and Roy Irwin, National Park Service, personal communication, 1996).

See Chem.Detail section for compounds in this product, then see entries on these compounds for summaries of information on individual components of this mixture. See also: PAHs as a group entry.

See also: Jet Fuel, General entry.

Br.Dev: Brief Summary of Developmental, Reproductive, Endocrine and Genotoxicity Information:

No embryotoxic, fetotoxic or teratogenic effect to Charles River CD rats was observed following inhalation exposure of 100 and 400 ppm jet fuel A from day 6 to 15 of gestation [747].

The results are mixed, but some immunological, reproductive, fetotoxic, and genotoxic effects have been associated with a few of the compounds found in jet fuel [609,764,765,766,767] (see Chem.Detail section for compounds in this product, then see entries for summaries of information on individual components of this mixture). For example, naphthalene, a hazardous compound found in this product, is an endocrine disrupter; when elevated in water, naphthalene has caused crawfish ovaries to shrink, resulting in fewer eggs and smaller offspring (Milton Fingerman, Tulane University, personal communication, 1996).

Jet fuel was mutagenic in the Ames test and in the mouse lymphoma assay and also induced structural chromosomal aberrations in the bone marrow of rats exposed at 100 ppm for 20 days or 400 ppm for 5 days [606].

See also: Jet Fuel, General entry.

Br.Fate: Brief Summary of Key Bioconcentration, Fate, Transport, Persistence, Pathway and Chemical/Physical Information:

Some fuel additives may contribute to environmental problems. In the past, additives containing lead were documented [608].

Many commercial jet fuels have basically the same composition as kerosene, but they are under more stringent specifications than those for kerosene [747].

Jet fuels and diesels are middle distillate petroleum hydrocarbon products of intermediate volatility and mobility [661]. As intermediate products, jet fuels have a combination of (mostly) lighter, less persistent and more mobile compounds as well as (some) heavier, more persistent and less mobile compounds. These two different groups are associated with two distinctly different patterns of fate/pathway concerns:

> The relatively lighter, more volatile, mobile, and water soluble compounds in Jet Fuel A will tend to fairly quickly evaporate into the atmosphere or migrate to groundwater. Benzenes, toluene, and xylenes (all common components of jet fuels) have mid range octanol water partition coefficients (log kow) and high volatility [878]. When exposed to oxygen and sunlight, most of these compounds will tend to break down relatively quickly. However, in

groundwater, many of these compounds tend to be more persistent than in surface water, and readily partition on an equilibria basis back and forth between water and solids (soil and sediment) media. Cleaning up groundwater without cleaning up soil contamination will usually result in a rebound of higher concentrations of these compounds partitioning from contaminated soils into groundwater (Roy Irwin, personal communication).

The compounds in jet fuel which will tend to be somewhat more persistent and more bound to solids particles will include the PAHs, alkyl PAHs, and alkyl benzenes. Higher concentrations of heavier PAHs will tend to be in adjacent contaminated soils than in groundwater, but cleaning up groundwater without cleaning up soil contamination will nevertheless usually result in at least some rebound of higher concentrations of these compounds partitioning from contaminated soils back into groundwater (Roy Irwin, personal communication).

See also: Jet Fuel, General entry.

Synonyms/Substance Identification:

Commercial Jet Fuel [606]
Turbo fuel A [747]
Jet A [607]
Jet A-1 [607]

NOTE: Other references say that Jet A and Jet A-1 are not exact synonyms [560,747]. Although both are petroleum distillates blended from kerosene fractions and used in civil and commercial aviation, Jet A-1 has a lower freezing point than Jet A [560].

Associated Chemicals or Topics (Includes Transformation Products):

Metabolites of some of the components of Jet A may be causing biological impacts and system perturbations after many of the original hydrocarbons have degraded; such effects can be caused by chronic low level releases of toxic metabolites, bioaccumulated toxicants from dying organisms, and lysed cellular material [878].

See also individual entries:

Jet Fuel, General
Kerosene (Fuel Oil No. 1, JP-1)
Jet Fuel 4
Jet Fuel 5
Jet Fuel 8

Naphthalene
Methyl Naphthalenes (various entries)
Xylenes, Total
Benzene
Ethylbenzene

Jet Fuels: Site Assessment-Related Information Provided by Shineldecker (Potential Site-Specific Contaminants that May be Associated with a Property Based on Current or Historical Use of the Property) [490]:

General Types of Associated Materials:

- Kerosene

Raw Materials, Intermediate Products, Final Products, and Waste Products Generated During Manufacture and Use:

- Benzene
- Ethyl benzene
- Hydrazine and derivatives
- Mercaptans
- Polynuclear aromatic hydrocarbons
- Toluene
- Xylenes

Water Data Interpretation, Concentrations and Toxicity (All Water Data Subsections Start with "W."):

W.Low (Water Concentrations Considered Low):

No information found; see Chem.Detail section for compounds in this product, then entries on these compounds for summaries of information on individual components of this mixture.

W.High (Water Concentrations Considered High):

No information found; see Chem.Detail section for compounds in this product, then see entries on these compounds for summaries of information on individual components of this mixture.

W.Typical (Water Concentrations Considered Typical):

No information found; see Chem.Detail section for compounds in this product, then see individual compound entries for summaries of information on individual components of this mixture.

W.Concern Levels, Water Quality Criteria, LC50 Values, Water Quality Standards, Screening Levels, Dose/Response Data, and Other Water Benchmarks:

W.General (General Water Quality Standards, Criteria, and Benchmarks Related to Protection of Aquatic Biota in General; Includes Water Concentrations Versus Mixed or General Aquatic Biota):

No information found; see Chem.Detail section for compounds in this product, then see individual compound entries for summaries of information on individual components of this mixture.

W.Plants (Water Concentrations vs. Plants):

No information found; see Chem.Detail section for compounds in this product, then see individual compound entries for summaries of information on individual components of this mixture.

W.Invertebrates (Water Concentrations vs. Invertebrates):

Although JP-A in the water column can depress Daphnia (zooplankton) populations for several weeks, resulting in algae blooms, effects were short lived, as Daphnia populations recovered by the second or third month of the experiment [877].

W.Fish (Water Concentrations vs. Fish):

No information found; see Chem.Detail section for compounds in this product, then see individual compound entries for summaries of information on individual components of this mixture.

W.Wildlife (Water Concentrations vs. Wildlife or Domestic Animals):

No information found; see Chem.Detail section for compounds in this product, then see individual compound entries for summaries of information on individual components of this mixture.

W.Human (Drinking Water and Other Human Concern Levels):

No information found; see Chem.Detail section for compounds in this product, then see individual compound entries for summaries of information on individual components of this mixture.

W.Misc. (Other Non-concentration Water Information):

No information found; see Chem.Detail section for compounds in this product, then see individual compound entries for summaries of information on individual components of this mixture.

Sediment Data Interpretation, Concentrations and Toxicity (All Sediment Data Subsections Start with "Sed."):

Sed.Low (Sediment Concentrations Considered Low):

No information found; see Chem.Detail section for compounds in this product, then see individual compound entries for summaries of information on individual components of this mixture.

Sed.High (Sediment Concentrations Considered High):

No information found; see Chem.Detail section for compounds in this product, then see individual compound entries for summaries of information on individual components of this mixture.

Sed.Typical (Sediment Concentrations Considered Typical):

No information found; see Chem.Detail section for compounds in this product, then see individual compound entries for summaries of information on individual components of this mixture.

Sed.Concern Levels, Sediment Quality Criteria, LC50 Values, Sediment Quality Standards, Screening Levels, Dose/Response Data and Other Sediment Benchmarks:

Sed.General (General Sediment Quality Standards, Criteria, and Benchmarks Related to Protection of Aquatic Biota in General; Includes Sediment Concentrations Versus Mixed or General Aquatic Biota):

No information found; see Chem.Detail section for compounds in this product, then see individual compound entries for summaries of information on individual components of this mixture.

Sed.Plants (Sediment Concentrations vs. Plants):

No information found; see Chem.Detail section for compounds in this product, then see individual compound entries for summaries of information on individual components of this mixture.

Sed.Invertebrates (Sediment Concentrations vs. Invertebrates):

No information found; see Chem.Detail section for compounds in this product, then see individual compound entries for summaries of information on individual components of this mixture.

Sed.Fish (Sediment Concentrations vs. Fish):

No information found; see Chem.Detail section for compounds in this product, then see individual compound entries for summaries of information on individual components of this mixture.

Sed.Wildlife (Sediment Concentrations vs. Wildlife or Domestic Animals):

No information found; see Chem.Detail section for compounds in this product, then see individual compound entries for summaries of information on individual components of this mixture.

Sed.Human (Sediment Concentrations vs. Human):

No information found; see Chem.Detail section for compounds in this product, then see individual compound entries for summaries of information on individual components of this mixture.

Sed.Misc. (Other Non-concentration Sediment Information):

No information found; see Chem.Detail section for compounds in this product, then see individual compound entries for summaries of information on individual components of this mixture.

Soil Data Interpretation, Concentrations and Toxicity (All Soil Data Subsections Start with "Soil."):

Soil.Low (Soil Concentrations Considered Low):

No information found; see Chem.Detail section for compounds in this product, then see individual compound entries for summaries of information on individual components of this mixture.

Soil.High (Soil Concentrations Considered High):

No information found; see Chem.Detail section for compounds in this product, then see individual compound entries for summaries of information on individual components of this mixture.

Soil.Typical (Soil Concentrations Considered Typical):

No information found; see Chem.Detail section for compounds in this product, then see individual compound entries for summaries of information on individual components of this mixture.

Soil.Concern Levels, Soil Quality Criteria, LC50 Values, Soil Quality Standards, Screening Levels, Dose/Response Data and Other Soil Benchmarks:

Soil.General (General Soil Quality Standards, Criteria, and Benchmarks Related to Protection of Soil-dwelling Biota in General; Includes Soil Concentrations Versus Mixed or General Soil-dwelling Biota):

No information found; see Chem.Detail section for compounds in this product, then see individual compound entries for summaries of information on individual components of this mixture.

Soil.Plants (Soil Concentrations vs. Plants):

No information found; see Chem.Detail section for compounds in this product, then see individual compound entries for summaries of information on individual components of this mixture.

Soil.Invertebrates (Soil Concentrations vs. Invertebrates):

No information found; see Chem.Detail section for compounds in this product, then see individual compound entries for summaries of information on individual components of this mixture.

Soil.Wildlife (Soil Concentrations vs. Wildlife or Domestic Animals):

No information found; see Chem.Detail section for compounds in this product, then see individual compound entries for summaries of information on individual components of this mixture.

Soil.Human (Soil Concentrations vs. Human):

No information found on this complex and variable mixture. See Chem.Detail section for chemicals found in this product, then look up information on each hazardous compound. Some individual compounds found in petroleum products have low-concentration human health benchmarks for soil (see individual entries).

Soil.Misc. (Other Non-concentration Soil Information):

As of 1996, several States were considering allowing natural attenuation (the "do nothing and let nature clean up the mess through bioremediation" option) to proceed near leaking storage tanks in situations where drinking water was not being impacted and where human rather than environmental resources were the main resources in the immediate area (Roy Irwin, National Park Service, personal communication, 1996).

Others would point out that petroleum product spills into soils are not necessarily a trivial environmental threat related to ecotoxicology (emphasis on living things other than humans), due to the many hazardous compounds in the product (see Chem.Detail section below).

Exposure to petroleum-source contamination in soils is predominantly of concern through a number of possible exposure pathways, including dermal contact with soil, ingestion of soil, inhalation of soil particulates, and ingestion of contaminated groundwater [824].

No other information found; see Chem.Detail section for compounds in this product, then see individual compound entries for summaries of information on individual components of this mixture.

Tissue and Food Concentrations (All Tissue Data Interpretation Subsections Start with "Tis."):

Tis.Plants:

A) As Food: Concentrations or Doses of Concern to Living Things Which Eat Plants:

No information found; see Chem.Detail section for compounds in this product, then see individual compound entries for summaries of information on individual components of this mixture.

B) Body Burden Residues in Plants: Typical, Elevated, or of Concern Related to the Well-being of the Organism Itself:

No information found; see Chem.Detail section for compounds in this product, then see individual compound entries for summaries of information on individual components of this mixture.

Tis.Invertebrates:

A) As Food: Concentrations or Doses of Concern to Living Things Which Eat Invertebrates:

No information found; see Chem.Detail section for compounds in this product, then see individual compound entries for summaries of information on individual components of this mixture.

B) Concentrations or Doses of Concern in Food Items Eaten by Invertebrates:

No information found; see Chem.Detail section for compounds in this product, then see individual compound entries for summaries of information on individual components of this mixture.

C) Body Burden Residues in Invertebrates: Typical, Elevated, or of Concern Related to the Well-being of the Organism Itself:

No information found; see Chem.Detail section for compounds in this product, then see individual compound entries for summaries of information on individual components of this mixture.

Tis.Fish:

A) As Food: Concentrations or Doses of Concern to Living Things Which Eat Fish (Includes FDA Action Levels for Fish and Similar Benchmark Levels From Other Countries):

No information found; see Chem.Detail section for compounds in this product, then see individual compound entries for summaries of information on individual components of this mixture.

B) Concentrations or Doses of Concern in Food Items Eaten by Fish:

No information found; see Chem.Detail section for compounds in this product, then see individual compound entries for summaries of information on individual components of this mixture.

C) Body Burden Residues in Fish: Typical, Elevated, or of Concern Related to the Well-being of the Organism Itself:

No information found; see Chem.Detail section for compounds in this product, then see individual compound entries for summaries of information on individual components of this mixture.

Tis.Wildlife: Terrestrial and Aquatic Wildlife, Domestic Animals and all Birds whether aquatic or not:

A) As Food: Concentrations or Doses of Concern To Living Things Which Eat Wildlife, Domestic Animals, or Birds:

No information found; see Chem.Detail section for compounds in this product, then see individual compound entries for summaries of information on individual components of this mixture.

B) Concentrations or Doses of Concern in Food Items Eaten by Wildlife, Birds, or Domestic Animals (Includes LD50 Values Which do not Fit Well into Other Categories, Includes Oral Doses Administered in Laboratory Experiments):

Information from RTECS [607]:

LDLO/LCLO - LOWEST PUBLISHED LETHAL DOSE/CONC

RABBIT: LDLo; ROUTE: Skin; DOSE: 8 gm/kg; TOXIC EFFECTS: LIVER - Other changes; REFERENCE: United States Environmental Protection Agency, Office of Pesticides and Toxic Substances 8EHQ-0181-0377.

LD50/LC50 - LETHAL DOSE/CONC 50% KILL

RAT: LD50; ROUTE: Oral; DOSE: 25 gm/kg; REFERENCE: Acute Toxicity Data. Journal of the American College of Toxicology, Part B 1:29, 1990.

C) Body Burden Residues in Wildlife, Birds, or Domestic Animals: Typical, Elevated, or of Concern Related to the Well-being of the Organism Itself:

No information found; see Chem.Detail section for compounds in this product, then see individual compound entries for summaries of information on individual components of this mixture.

Tis.Human:

A) Typical Concentrations in Human Food Survey Items:

No information found; see Chem.Detail section for compounds in this product, then see individual compound entries for summaries of information on individual components of this mixture.

B) Concentrations or Doses of Concern in Food Items Eaten by Humans (Includes Allowable Tolerances in Human Food, FDA, State and Standards of Other Countries:

No information found; see Chem.Detail section for compounds in this product, then see individual compound entries for summaries of information on individual components of this mixture.

C) Body Burden Residues in Humans: Typical, Elevated, or of Concern Related to the Well-being of Humans:

No information found; see Chem.Detail section for compounds in this product, then see individual compound entries for summaries of information on individual components of this mixture.

Tis.Misc. (Other Tissue Information):

No information found; see Chem.Detail section for compounds in this product, then see individual compound entries for summaries of information on individual components of this mixture.

Bio.Detail: Detailed Information on Bioconcentration, Biomagnification, or Bioavailability:

No information found; see Chem.Detail section for compounds in this product, then see individual compound entries for summaries of information on individual components of this mixture.

Interactions:

No information found; see Chem.Detail section for compounds in this product, then see individual compound entries for summaries of information on individual components of this mixture.

Uses/Sources:

No information found; see Chem.Detail section for compounds in this product, then see individual compound entries for summaries of information on individual components of this mixture.

Forms/Preparations/Formulations:

No information found; see Chem.Detail section for compounds in this product, then see individual compound entries for summaries of information on individual components of this mixture.

Chem.Detail: Detailed Information on Chemical/Physical Properties:

Caution: Every individual petroleum product has a unique "fingerprint," or distinct set of constituents most commonly identified by a gas chromatograph analysis. Due to the varying properties of the same general category of a petroleum product (each source and weathering stage of Jet Fuel A has a unique gas chromatograph "fingerprint"), careful assessment of the toxicity, specific gravity, and other physical characteristics of each individual oil must be taken into consideration to determine the exact effects of the product on the environment. Therefore, the below comments on Jet Fuel A are to be considered as representative, but not absolute values typical of every batch of the product with the same name.

As stated in the introduction, PAHs (particularly heavy PAHs) do not make up a large percentage of jet fuels by weight, but there are some PAHs in jet fuels, including naphthalene and alkyl naphthalenes [636,744,747]. Since PAHs are important hazardous components of this product, risk assessments should include analyses of PAHs and alkyl PAHs utilizing the NOAA protocol expanded scan [828] or other rigorous GC/MS/SIM methods.

Because JP-A can be derived from different stocks of crude oil, there is considerable variability in the concentrations of major components between JP-A samples from different crudes. That is why petroleum product specifications list "ranges," and "max" or "min" values, instead of absolute numbers. The following table lists specifications for JP-A. For a comparison of the specifications for four common jet fuels (namely JP-1, JP-4, JP-5, and JP-A), see the Jet Fuel, General entry [635,637].

Benzenes, toluene, and xylenes (all common components of jet fuels) have high volatility and mid range octanol water partition coefficients [878]. Jet A does not contain methylcyclohexane [796].

Physicochemical information from Environment Canada on JP-A [560]:

NOTE: In this section, for properties with more than one value, each value came from its own source; in other words, if API Gravity at 60 F was measured several times and several different answers were obtained, all of the answers are provided [560]:

API GRAVITY (60/60 degrees F) [560]:

NOTE: API gravity = (141.5/specific gravity [60/60 degrees F]) - 131.5, where specific gravity [60/60 degrees F] is the oil density at 60 degrees F divided by the density of water at 60 degrees F.

36.8 to 50.9
42.0

DENSITY (g/mL) [560]:

For temperatures of oil (T) between 0 and 30 C:
Density = 0.97871 - 0.000710 T

NOTE: The densities of crude oils and oil products are dependent on the temperature and degree of weathering. The following density values are at "0% Weathering Volume" - in other words, fresh JP-A.

Temp(C)	Density (at 0% Weathering Volume)
15	0.775 to 0.840 0.7753 to 0.8398
15.6	0.816

HYDROCARBON GROUP [560]:

NOTE: The main constituents of oil are generally grouped into the below categories. Asphaltene content increases with increasing weathering, as does wax content.

Hydrocarbon Group Analysis:

Aromatics	20 (Vol%)
	max 25 (Vol%)
	16 (Vol %)

Principle Characteristics of Selected Military Aircraft Turbine Fuels [637]:

CHARACTERISTIC	JP-A
API Gravity, max	39-51
Flash point, F, min	110
Viscosity, centistokes at:	
-30 F, max	15
-40 F, max	--
Freezing point, F, max	-40
Total sulfur, % max	0.3
Total aromatics, % max	20
Olefins**, % max	--
Total potential residue, mg/100 ml, max	14

** Olefins (alkenes and cycloalkenes) are generated by cracking operations during the refining process [558]. Olefins are normally present in straight-run kerosene at concentrations of about 1% or less because olefins are essentially eliminated by the hydrotreating processes used in finishing kerosene [747].

The following table list some measured physical properties and compositions of a representative samples of jet fuel A. For a comparison to other jet fuels, see the Jet Fuel, General entry [747]:

CHARACTERISTIC	JP-A
API Gravity	42.3
Viscosity, centistokes at:	
-20 C	5.48
Freezing point, degrees C	-45
Sulfur, % weight	0.035
Naphthalenes, % weight	1.59
Aromatic content, % vol	18.5
Olefins content, % vol	1.0

The following table lists some of the components of a sample of jet fuel A. This analysis was performed on fresh petroleum [796]:

CONSTITUENT	COMPOSITION (% volume)
Methyl Alkanes	3.77
Cycloalkanes	0.79
Simple Alkanes	53.7
Includes:	
Decane	16.5
Undecane	36
Monocyclic Aromatic Hydrocarbons	31.8
Includes:	
Benzene	0.02
Butylbenzene	2
1,2-Diethylbenzene	0.24
1,2-Diethyl-3-propylbenzene	5.4
1,4-Diethyl-2-ethylbenzene	0.2
Ethylbenzene	0.02
1-Methyl-4-propylbenzene	3.3
Propylbenzene	3-5
1,2,4,5-Tetramethylbenzene	9
Toluene	trace
1,2,3-Trimethylbenzene	6.6
Xylenes	0.07
Polycyclic Aromatic Hydrocarbons	0.63
Includes:	
Naphthalene	0.14
2-Methylnaphthalene	0.34
1,3-Dimethylnaphthalene	0.15

Additional Physicochemical information from Environment Canada on JP-A [560]:

> NOTE: In this section, for properties with more than one value, each value came from its own source; in other words, if API Gravity at 60 F was measured several times and several different answers were obtained, all of the answers are provided [560]:

VISCOSITY

NOTE: The viscosities of crude oils and oil products are dependent on the temperature and degree of weathering. The following viscosity values are at "0% Weathering Volume" - in other words, fresh JP-A.

Kinematic Viscosity (mm2/sec or cSt):

Temp(C)	Kinematic Viscosity (at 0% Weathering Volume)
-34.4	7.9
-20	max 8.0
	max 8.0
0	2.1
15	1.6

FIRE AND REACTIVITY

Flash Point (C):

min 38
min 38
46

Smoke Point (mm):

min 20
min 18
23

Heat Content (MJ/Kg):

min 42.8

DISTILLATION

NOTE: Distillation data provides an indication of an oil's volatility and relative component distribution. Distillation data is reported as volume % recovered.

Distillation (C):

(Vol%)	Vapor Temp
IBP	163
10	max 204
	max 204
	179
20	184
50	203
90	232
FBP	max 300
	max 300
	259

NOTE: IBP = initial boiling point
FBP = final boiling point

NON-METAL CONTENT

Sulphur (Weight %):

max 0.3
max 0.3
0.05

OTHER
Freezing Point (C):

max -40
max -40
-44

Fate.Detail: Detailed Information on Fate, Transport, Persistence, and/or Pathways:

The biodegradation of the water soluble fraction (WSF) of Jet A was summarized by Markiewicz in 1994 using concentrations of 0.0, 1.5 and 15% WSF [878]. Higher molecular weight PAHs tended to be the last to degrade [878].

No other information found; see Chem.Detail section for compounds in this product, then see individual compound entries for summaries of information on individual components of this mixture.

See also: Jet Fuel, General entry.

Laboratory and/or Field Analyses:

The relative proportions of hazardous compound constituents present in petroleum-based oil contamination is typically quite variable. The lab analyses most appropriate for measuring different types of oil contamination depend upon the type of oil involved and the reason for measuring the contamination.

In choosing a lab method, it should be kept in mind that this product (as well as Diesel, No. 2 Fuel Oils, and Light Crudes) can be expected to exhibit the following characteristics [741]:

-Moderately volatile; will leave residue (up to 1/3 of spilled amount)
-Moderate concentrations of toxic (soluble) compounds
-Will "oil" intertidal resources with long-term contamination potential
-Has potential for subtidal impacts (dissolution, mixing, sorption onto suspended sediments)
-No dispersion necessary
-Cleanup can be very effective

EPA method 8240 is not the only "standard method" used for jet fuel compounds which is inadequate for assessing biological effects. Recent (1991) studies have indicated that EPA approved methods used for oil spill assessments (including total petroleum hydrocarbons method 418.1, semivolatile priority pollutant organics methods 625 and 8270, and volatile organic priority pollutant methods 602, 1624, and 8240) are all inadequate for generating scientifically defensible information for Natural Resource Damage Assessments [468]. Problems with these methods were further elucidated by Douglas et al. in 1992 [657]. These general organic chemical methods are deficient in chemical selectivity (types of constituents analyzed) and sensitivity (detection limits); the deficiencies in these two areas lead to an inability to interpret the environmental significance of the data in a scientifically defensible manner [468].

Since PAHs and alkyl PAHs are important hazardous components of this product, risk assessments should include analyses of PAHs and alkyl PAHs utilizing the NOAA protocol expanded scan [828] or other rigorous GC/MS/SIM methods.

Less rigorous scanning methods for various PAHs in drinking water have included High pressure liquid chromatography (EPA 550, 550.1); gas chromatographic/mass spectrometry (EPA 525): PQL= 0.0002 mg/L [893].

Some labs use screening HPLC fluorescence methods to screen for alkylated naphthalenes and dibenzothiophenes that fluoresce at naphthalene wavelengths and the alkylated phenanthrenes that fluoresce at phenanthrene wavelengths [521]. Other HPLC/fluorescence scans are used to examine fish bile directly for the presence of metabolites of PAHs such as naphthalene [523].

Decision Tree (dichotomous key) for selection of lab methods for measuring contamination from light crude oils and middle distillate petroleum products including jet fuels (Roy Irwin, National Park Service, Personal Communication, 1996):

1a. Your main concern is biological effects of petroleum products...2

1b. Your main concern is cleanup or remediation but no ecological or human resources are at risk............3

2a. The resource at risk is primarily humans via a drinking water pathway, either the contamination of groundwater used for drinking water, or the fresh* or continuing contamination of surface waters used as drinking water, or the risk is primarily to aquatic species in confined** surface waters from a fresh* spill, or the risk is to surface waters re-emerging from contaminated groundwater resources whether the spill is fresh* or not; the medium and/or pathway of concern is water rather than sediments, soil, or tissues 4

2b. The resource at risk is something else.....................5

3a. The spilled substance is a fresh* oil product of known composition: If required to do so by a regulatory authority, perform whichever Total Petroleum Hydrocarbon (TPH) analysis specified by the regulator. However, keep in mind that due to its numerous limitations, the use of the common EPA method 418.1 for Total Petroleum Hydrocarbons is not recommended as a stand-alone method unless the results can first be consistently correlated (over time, as the oil ages) with the better NOAA protocol expanded scan*** for polycyclic aromatic hydrocarbons (PAHs) and alkyl PAHs. If not required to perform an EPA method 418.1-based analysis for TPH, instead perform a Gas Chromatography/Flame Ionization Detection (GC/FID) analysis for TPH using the spilled substance as a calibration standard. GC/FID methods can be sufficient for screening purposes when the oil contamination is fresh*, unweathered oil and when one is fairly sure of the source [657]. If diesel 1D was spilled, perform TPH-D (1D) using California LUFT manual methods (typically a modified EPA method 8015) [465] or a locally available GC/FID method of equal utility for the product spilled. However, no matter which TPH method is used, whether based on various GC/FID or EPA method 418.1 protocols, the investigator should keep in mind that the effectiveness of the method typically changes as oil ages, that false positives or false negatives are possible, and that the better Gas Chromatography-Mass Spectrometry-Selected Ion Mode (GC/MS/SIM) scans (such as the NOAA expanded scan***) should probably be performed at the end of remediation to be sure that the contamination has truly been cleaned up.

3b. The spilled product is not fresh* or the contamination is of unknown or mixed composition........................6

4. Analyze for Benzene, Toluene, Ethyl Benzene, and Toluene (BTEX) compounds in water as part of a broader scan of volatiles using EPA GC/MS method 8240. The standard EPA GC/MS method 8240 protocol will be sufficient for some applications, but the standard EPA method 8240 (and especially the less rigorous EPA BTEX methods such as method 8020 for soil and method 602 for water) are all inadequate for generating scientifically defensible information for Natural Resource Damage Assessments [468]. The standard EPA methods are also inadequate for risk assessment purposes. Thus, when collecting information for possible use in a Natural Resource Damage Assessment or risk assessment, it is best to ask the lab to analyze for BTEX compounds and other volatile oil compounds using a modified EPA GC/MS method 8240 method using the lowest possible Selected Ion Mode detection limits and increasing the analyte list to include as many alkyl BTEX compounds as possible. Also analyze surface or (if applicable) ground water samples for polycyclic aromatic hydrocarbons (PAHs) and alkyl PAHs using the NOAA protocol expanded scan*** modified for water samples using methylene chloride extraction. If the contaminated water is groundwater, before the groundwater is determined to be remediated, also analyze some contaminated sub-surface soils in contact with the groundwater for BTEX compounds (EPA GC/MS method 8240), and PAHs (NOAA protocol expanded scan***). The magnitude of any residual soil contamination will provide insight about the likelihood of recontamination of groundwater resources through equilibria partitioning mechanisms moving contamination from soil to water.

5a. The medium of concern is sediments or soils.................6

5b. The medium of concern is biological tissues.................7

6. Perform the NOAA protocol expanded scan*** for polycyclic aromatic hydrocarbons (PAHs) and alkyl PAHs. If there is any reason to suspect fresh* or continuing contamination of soils or sediments with lighter volatile compounds, also perform EPA GC/MS method 8240 using the lowest possible Selected Ion Mode (SIM) detection limits and increasing the analyte list to include as many alkyl Benzene, Toluene, Ethyl Benzene, and Xylene (BTEX) compounds as possible.

7a. The problem is direct coating (oiling) of wildlife or plants with spilled oil product....................................8

7b. The problem is something else...............................9

8. Perform NOAA protocol expanded scan*** for polycyclic aromatic hydrocarbons (PAHs) and alkyl PAHs and/or GC/FID fingerprinting of the coating oil only if necessary to identify the source or exact oil. If the source is known and no confirmation lab studies are necessary: dispense with additional chemical laboratory analyses and instead document direct effects of coating: lethality, blinding, decreased reproduction from eggshell coating, etc., and begin cleaning activities if deemed potentially productive after consolations with the Fish and Wildlife Agencies.

9a. The concern is for impacts on water column organisms such as fish or plankton)..10

9b. The concern is for something else (including benthic organisms)..11

10. If exposure to fish is suspected, an HPLC/Fluorescence scan for polycyclic aromatic hydrocarbon (PAH) metabolites in bile may be performed to confirm exposure [844]. For bottom-dwelling fish such as flounders or catfish, also analyze the bottom sediments (see Step 6 above). Fish which spend most of their time free-swimming above the bottom in the water column can often avoid toxicity from toxic petroleum compounds in the water column, but if fish are expiring in a confined** habitat (small pond, etc.), EPA GC/MS method 8240 and the NOAA protocol expanded scan*** for PAHs could be performed to see if Benzene, Toluene, Ethyl Benzene, and Xylene (BTEX), naphthalene, and other potentially toxic compounds are above known acute toxicity benchmark concentrations. Zooplankton populations impacted by oil usually recover fairly quickly unless they are impacted in very confined** or shallow environments [835] and the above BTEX and PAH water methods are often recommended rather than direct analyses of zooplankton tissues.

11a. The concern is for benthic invertebrates: analyze invertebrate whole-body tissue samples and surrounding sediment samples for polycyclic aromatic hydrocarbons (PAHs) and alkyl PAHs using the NOAA protocol expanded scan***. If the spill is fresh* or the source continuous, risk assessment needs may also require that the sediments which form the habitat for benthic invertebrates be analyzed for Benzene, Toluene, Ethyl Benzene, and Xylene (BTEX) and other volatile compounds using EPA GC/MS method 8240 or modified EPA method 8240 in the Selected Ion Mode (SIM). Bivalve invertebrates such as clams and mussels do not break down PAHs as well or as quickly as do fish or many wildlife species. They are also less mobile. Thus, bivalve tissues are more often directly analyzed for PAH residues than are the tissues of fish or wildlife.

11b. The concern is for plants or for vertebrate wildlife including birds, mammals, reptiles, and amphibians: polycyclic aromatic hydrocarbons (PAHs) and other petroleum hydrocarbons break down fairly rapidly in many wildlife groups and tissues are not usually analyzed directly. Instead direct effects are investigated and water, soil, sediment, and food items encountered by wildlife are usually analyzed for PAHs and alkyl PAHs using the NOAA protocol expanded scan***. If the spill is fresh* or the source continuous, risk assessment needs may also require that these habitat media also be analyzed for Benzene, Toluene, Ethyl Benzene, and Xylene (BTEX) and other volatile compounds using EPA GC/MS method 8240 or modified EPA method 8240 in the Selected Ion Mode (SIM). Less is known about plant effects. However, the same methods recommended above for the analyses of water (Step 4 above) and for sediments or soils (Step 6 above) are usually also recommended for these same media in plant or wildlife habitats. If wildlife or plants are covered with oil, see also Step 8 (above) regarding oiling issues.

* Discussion of the significance of the word "fresh": The word "fresh" cannot be universally defined because oil breaks down faster in some environments than in others. In a hot, windy, sunny, oil-microbe-rich, environment in the tropics, some of the lighter and more volatile compounds (such as the Benzene, Toluene, Ethyl Benzene, and Xylene compounds) would be expected to disappear faster by evaporation into the environment and by biodegradation than in a cold, no-wind, cloudy, oil-microbe-poor environment in the arctic. In certain habitats, BTEX and other relatively water soluble compounds will tend to move to groundwater and/or subsurface soils (where degradation rates are typically slower than in a sunny well aerated surface environment). Thus, the judgement about whether or not oil contamination would be considered "fresh" is a professional judgement based on a continuum of possible scenarios. The closer in time to the original spill of non-degraded petroleum product, the greater degree the source is continuous rather than the result of a one-time event, and the more factors are present which would retard oil evaporation or breakdown (cold, no-wind, cloudy, oil-microbe-poor conditions, etc.) the more likely it would be that in the professional judgement experts the oil would be considered "fresh." In other words, the degree of freshness is a continuum which depends on the specific product spilled and the specific habitat impacted. Except for groundwater

resources (where the breakdown can be much slower), the fresher the middle distillate oil contamination is, the more one has to be concerned about potential impacts of BTEX compounds, and other lighter and more volatile petroleum compounds.

To assist the reader in making decisions based on the continuum of possible degrees of freshness, the following generalizations are provided: Some of the lightest middle distillates (such as Jet Fuels, Diesel, No. 2 Fuel Oil) are moderately volatile and soluble and up to two-thirds of the spill amount could disappear from surface waters after a few days [771,835]. Even heavier petroleum substances, such as medium oils and most crude oils will evaporate about one third of the product spilled within 24 hours [771]. Typically the volatile fractions disappear mostly by evaporating into the atmosphere. However, in some cases, certain water soluble fractions of oil including Benzene, Toluene, Ethyl Benzene, and Xylene (BTEX) compounds move down into groundwater. BTEX compounds are included in the more volatile and water soluble fractions, and BTEX compounds as well as the lighter alkanes are broken down more quickly by microbes than heavier semi-volatiles such as alkyl PAHs and some of the heavier and more complex aliphatic compounds. Thus after a week, or in some cases, after a few days, there is less reason to analyze surface waters for BTEX or other volatile compounds, and such analyses should be reserved more for potentially contaminated groundwaters. In the same manner, as the product ages, there is typically less reason to analyze for alkanes using GC/FID techniques or TPH using EPA 418.1 methods, and more reason to analyze for the more persistent alkyl PAHs using the NOAA protocol expanded scan***.

** Discussion of the significance of the word "confined": Like the word "fresh" the word "confined" is difficult to define precisely as there is a continuum of various degrees to which a habitat would be considered "confined" versus "open." However, if one is concerned about the well-being of ecological resources such as fish which spend most of their time swimming freely above the bottom, it makes more sense to spend a smaller proportion of analytical funding for water column and surface water analyses of Benzene, Toluene, Ethyl Benzene, and Xylene (BTEX) and other volatile or acutely toxic compounds if the spill is in open and/or deep waters rather than shallow or "confined" waters. This is because much of the oil tends to stay with a surface slick or becomes tied up in subsurface tar balls. The petroleum compounds which do pass through the water column often tend to do so in small concentrations and/or for short periods of time, and fish and other pelagic or generally mobile species can often swim away to avoid impacts from spilled oil in "open waters." Thus in many large oil spills in open or deep waters, it has often been difficult or impossible to attribute significant impacts to fish or other pelagic or strong swimming mobile species in open waters. Lethality has most often been associated with heavy exposure of juvenile fish to large amounts of oil products moving rapidly into shallow or confined waters [835]. Different fish species vary in their sensitivity to oil [835]. However, the bottom line is that in past ecological assessments of spills, often too much money has been spent on water column analyses in open water settings, when the majority of significant impacts tended to be concentrated in other habitats, such as benthic, shoreline, and surface microlayer habitats.

*** The lab protocols for the expanded scan of polycyclic aromatic hydrocarbons (PAHs) and alkyl PAHs have been published by NOAA [828].

End of Key.

It is important to understand that contaminants data from different labs, different states, and different agencies, collected by different people, are often not very comparable (see also, discussion in the disclaimer section at the top of this entry).

As of 1997, the problem of lack of data comparability (not only for water methods but also for soil, sediment, and tissue methods) between different "standard methods" recommended by different agencies seemed to be getting worse, if anything, rather than better. The trend in quality assurance seemed to be for various agencies, including the EPA and others, to insist on quality assurance plans for each project. In addition to quality control steps (blanks, duplicates, spikes, etc.), these quality assurance plans call for a step of insuring data comparability [1015,1017]. However, the data comparability step is often not given sufficient consideration. The tendency of agency guidance (such as EPA SW-846 methods and some other new EPA methods for bio-concentratable substances) to allow more and more flexibility to select options at various points along the way, makes it harder in insure data comparability or method validity. Even volunteer monitoring programs are now strongly encouraged to develop and use quality assurance project plans [1015,1017].

At minimum, before using contaminants data from diverse sources, one should determine that field collection methods, detection limits, and lab quality control techniques were acceptable and comparable. The goal is that the analysis in the concentration range of the comparison benchmark concentration should be very precise and accurate.

It should be kept in mind that quality control field and lab blanks and duplicates will not help in the data quality assurance goal as well as intended if one is using a method prone to false negatives. Methods may be prone to false negatives due to the use of detection limits that are too high, the loss of contaminants through inappropriate handling, or the use of inappropriate methods. The use of inappropriate methods is particularly common related to oil products.

Additional Detail on Screening Methods Sometimes used for Jet Fuels:

Discussion of GC/FID Methods:

While a screening analysis such as GC/FID should be adequate for mid-range products such as diesels and possibly jet fuels, lighter gasoline fractions will be lost in a GC/FID analysis (which uses extraction and burning) [657]. Therefore, wide-cut jet fuels, such as JP-4 and Jet B which are usually made by blending with some of the gasoline fractions, would need to be analyzed for volatile organic components using EPA method 8240. Kerosene (a key component of jet fuels) in the C9 to C16 range normally has a boiling range well above the boiling-point of benzene; accordingly, the benzene content of the kerosene fraction is usually below 0.02% [747]. However, since wide-cut jet fuels are made by blending with gasoline, they may contain more benzene (normally <0.5%) and need to be analyzed for volatiles [747].

Discussion of Method 8015:

EPA Method 8015 (for Non-halogenated Volatile Organics) is a gas chromatographic method sometimes recommended for the analysis of volatile and semivolatile compounds. It can be used to characterize light and midrange petroleum distillates such as gasoline, diesel, fuel oil, and kerosene. This method can be used to obtain some gross fingerprint information for differentiation between petroleum products, as well as detailed information that can be used to differentiate between different batches of the same product. The major limitation of Method 8015 is its inability to detect nonvolatile compounds. The State of California recommends a "modified method 8015" (different from EPA's method 8015 and also different from EPA method 418.1) for gasoline, kerosene, diesel oil, or other fuels in soil and groundwater, as specified in the Leaking Underground Fuel Tank Manual [465].

Discussion of Fluorescent Scans, Method 8270 (unmodified) and Other Misc. Scans:

Aromatics can be present from about 10 to 20% of a kerosene product, depending on the source of crude oil. Depending on the source, dinuclear aromatic naphthalenes, with two benzene rings in a condensed structure, are also likely to be present in kerosene in the concentration range of 0.1% to 3%. However, the 300 degrees C maximum final boiling range tends to exclude the presence of high-boiling three to seven-ring polycyclic aromatic hydrocarbons [747] (for example, see the entry entitled Jet Fuel 4 for the composition of a representative jet fuel 4). Although large amounts of PAHs are typically not found in jet fuels, they are among the most persistent and hazardous compounds after the spill has aged. However, each situation is different, and various screening methods may sometimes be substituted for the NOAA Protocol Expanded Scan for PAHs and Alkyl Homologues of PAHs Using Gas Chromatography-Mass Spectrometry with

Selective Ion Mode Enhanced Detection Limits (GC/MS/SIM), when shown to be effective at a given site.

See also: Jet Fuel, General entry.

See also: Oil Spills entry for detail on field protocols and study designs.

See also: PAHs as a group entry.

See also: the 1995 ATSDR (Human) Toxicology Profile on jet fuels 6 and 7, two products which are different from this product but related to it [876].