Harding Lawson Associates

HLA

August 10, 1999

Indiana Department of Environmental Management
Office of Environmental Response
Voluntary Remediation Program
100 North Senate Avenue
P.O. Box 6015
Indianapolis, Indiana 46206-6015

IDEM Office of Land Quality - Fileroom Stamp
VRP Project Name: Honeywell
VRP#: 6980601 File Code: 300
Description: Phase II Comment Rebuttal
Confidential? _____Yes ✓ No
Deliberative?
_____Yes ✓ No

Attention: Ed Joniskan, Project Manager

Subject: IDEM's Phase II Review
AlliedSignal, Inc. 717 North Bendix Drive, South Bend, Indiana
VRP Site #6980601

Dear Mr. Joniskan:

On June 14th, the Indiana Department of Environmental Management (IDEM) provided AlliedSignal Inc. (AlliedSignal) with comments on the Voluntary Site Investigation (VSI) report and supporting documents for the AlliedSignal Industrial Complex, South Bend, Indiana. On behalf of AlliedSignal, Harding Lawson Associates, Inc. (HLA) has prepared this letter to address some of the key issues raised by the comments. A detailed response to each comment will be forthcoming.

This letter begins with a discussion of some administrative items, and then discusses the key issues presented in your June 14, 1999 comment letter. The letter concludes with a suggested approach moving forward.

Administrative Items

1. The first paragraph of the letter indicates that the Soil Management Report, dated November 1998, was reviewed. No comments on the report are provided in the letter. During our June 15th meeting, it was indicated that IDEM had not yet reviewed the report, but would do so. AlliedSignal would appreciate your review and comments on the document.

2. It appears that IDEM indirectly commented on the Semi-Annual Monitoring Report and VOC Recovery System Report through comments on the VSI. This is appropriate, and formal comments on each of these documents are not warranted.

3. Comment #1 indicates that IDEM did not receive the Work Plan, QAPP, or HASP. As discussed during our meeting, these documents were submitted to IDEM on two occasions. It is our understanding that you will contact us if you are unable to locate the documents.

4. During the June 15th meeting, AlliedSignal provided you a copy of the Alternatives Evaluation Report for the Area South of Carbon Brake, and the Naphtha Recovery System Enhancement Report. IDEM's review and comment on these reports would be appreciated.

#3025

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Engineering and
Environmental Services

39255 Country Club Drive, Suite B-25, Farmington Hills, MI 48331 248/489-8040 Fax: 248/489-8048

Key Issues

This section summarizes key issues that were discussed during the June 15th meeting:

1. Residential Cleanup Goals for Off-Site Groundwater/Off-Site Property Control

Several questions indicate the need for residential cleanup goals for off-site groundwater, unless AlliedSignal has "control of the property". As is consistent with a risk-based approach to site closure, it is our intent to eliminate potential future direct contact or ingestion of off-site groundwater exposure pathways through the use of an activity restriction attached to the property deed.

For the off-site properties, an activity restriction is already in-place through the St. Joseph County Health Department Well Drilling and Water Supply Systems Ordinance (Ordinance No. 101-98). The Ordinance requires that a permit be obtained before installation of a water supply well. A condition of the permit is that the well be installed hydraulically upgradient from any known pollution source with a minimum separation distance of 1,000 feet (24.20.04 D). Additionally, wells must have a minimum depth of 35 feet and an available drawdown of 20 feet. In the area of the off-site plume, the hydrogeology of the shallow aquifer, regardless of the presence of contamination, would preclude the installation of a water supply well. The depth to the bottom of the shallow aquifer is less than 35 feet, and at most locations there is less than 20 feet of saturated thickness. Page 4-12 of the RISC Technical Resource Guidance Document indicates that a local ordinance can serve as the means to restrict the activity and can take the place of an Environmental Notice record on property deeds.

O.K.
CHECK w/ TOM

not APPLICABLE

The concept of using the Ordinance to restrict the use of groundwater will be presented in the Remediation Work Plan. At this time, we suggest that you review Ordinance 101-98 and provide comment on its applicability to serve as the restriction.

2. Free Product Recovery

?

Question #4 through #8 indicates that the success of the free product recovery system has not been supported with data. First, the exact source of the free product is difficult to determine. Results of unsaturated soil analytical results suggest that the source was likely underground storage tanks located in the Plant 6/16, Plant 14 and Plant 19 areas. A 40-acre, 1-to 10-foot-thick area of free product was estimated based upon visual observation of soil samples collected in the early 1980's. To address the free product, a recovery well system (consisting of a depression well and skimmer well) was installed in 1978. Four additional recovery well systems were installed in 1982.

What volumes?

By the early 1990's, free product was no longer recovered by the skimmer wells. This indicated that the recovery system had effectively removed the free product. To confirm effective product recovery, four monitoring wells were installed during the VSI in the area where the product plume previously existed. Free product was observed in only one of the monitoring wells, confirming that the majority of the product had been recovered.

It is important to recognize that the actual extent and thickness of the free product prior to naphtha recovery well installation is unknown because, at that time, monitoring wells did not exist in that area of the Complex. Considering this, knowledge as to the volume recovered is not useful in assessing the effectiveness of the recovery efforts. The focus should be on the current extent and thickness of free product.

?
hmm

Currently, free product is observed in only three localized areas of the site. These areas are discussed below.

The first area is in the southwest corner of Plant 3, just northeast of Plant 6/16. An apparent product thickness measurement taken with an electronic interface probe at well MW-6 indicated that approximately 1.34 feet of free product had accumulated in the well. Free product, measuring 0.49 feet thick, was also measured in the product collection well at RWB-22, located along the south side of Plant 6/16. To address the presence of free product in this area, the Naphtha Recovery System was enhanced through the installation of wells RWB-23E (a groundwater extraction well) and RWB-23P (a product recovery well) adjacent to monitoring well MW-6. Details on the construction of this well system are presented in the Construction Report provided during our July 15th meeting. The system has been fully operational since April 1999 and has recovered more than 300 gallons of free product.

A localized area of product measuring 0.20-feet thick or less has been observed at and northwest of Area 3/11, the area south of Carbon Brake. Investigations indicated that the free product is localized and thin. The product appears to be "trapped" within and below a high porosity, low permeability silt/clay unit that is encountered at the water table. The product was analyzed and no polychlorinated biphenyls (PCBs) were detected. Methods to recover free product in this area would have very high cost relative to the benefit gained in removing the thin, localized areas of product. The need to recover free product from this area requires further evaluation and will be addressed in the Remediation Work Plan.

Free-product was also encountered in monitoring well MW-8 located inside Plant 1 during the September 1997 Third Quarter groundwater monitoring event. Measurements made with a disposable bailer at that time indicated a free-product thickness of approximately 0.85 feet. No free-product was observed during drilling of the well in December 1996, or during sampling of the well in December 1996, February 1997 or June 1997. In April 1999, a vacuum truck was used to remove all groundwater and product from the well so that the potential recharge of free product into the well could be monitored. In May, product was measured in the well. This information suggests that this area of free product warrants further evaluation.

3. MSDS for Stoddard/Naphtha

Question #6 requests Material Safety Data Sheets (MSDS) for Stoddard and naphtha. MSDS and Military Specifications for Stoddard/naphtha and jet fuel (JP-4, JP-5, and JP-8) are enclosed with this letter.

During our site walkover, there were several questions regarding the composition of Stoddard/naphtha. In order to understand the analytical approach used in the VSI, it is important to understand the composition of these petroleum products.

Stoddard/naphtha is a petroleum mixture containing hydrocarbons from C_5 to C_{11}. The primary compounds of concern in Stoddard/naphtha are: benzene, n-propylbenzene, 1,2,4-trimethylbenzene, naphthalene, and acenaphthalenes. For the VSI, the USEPA Method 8260 VOC analysis was modified to include these constituents. Considering this, VOC analysis was specified when Stoddard/naphtha was of concern.

Jet fuels are made by blending naphtha, gasoline, and/or kerosene to meet specific military or commercial specification. Jet fuels have a broader range in hydrocarbons (C_4 to C_{16}). Jet fuels contain the compounds described above plus potentially benzene, toluene, ethylbenzene, and xylenes found in gasoline. During the VSI, a VOC analysis was conducted when jet fuels were of concern. Additionally, total petroleum hydrocarbon (TPH) analysis by gas chromatograph was performed due to the slightly larger hydrocarbon chain range. For the VSI, the analysis covered hydrocarbon chain ranges C_8 to C_{30}.

4. Groundwater Containment/Plume Stability

Some of the comments (Comments #10, #22) indicate concern that the on-site groundwater plume is not contained and that the off-site plume is not stable. First, note that Figure 5-4 in the VSI Report illustrates the groundwater flow pattern in May 1988, which is prior to the VOC Recovery System rehabilitation (conducted in 1997). Also, in early 1999, Naphtha well RWB-23 was placed on-line to further enhance groundwater containment (and free product recovery). The most recent measure of groundwater containment is illustrated on Figure 6 in the Naphtha Recovery System Enhancement Report, which was provided to you during our June 14th meeting.

We concur that the groundwater flow pattern in the area of VOC Recovery Wells EW-1 and EW-2 warrant further evaluation. We believe that the groundwater extraction rates from these two wells [typically 40 gallons per minute (gpm) and 30 gpm, respectively] should be sufficient to achieve containment. VOC concentrations in groundwater samples collected from downgradient monitoring wells further support containment (discussed below).

The interpreted groundwater flow pattern in this area is greatly influenced by the water level measurements from former VOC Recovery wells RW-3, RW-4, and RW-7. These former recovery wells likely have poor hydraulic communication with the aquifer because either: (a) the well screens were installed in a shallow, discontinuous clay lense (see Cross-Section I-I' in the VSI Report); or (b) the well screens became fouled during its operation as an extraction well. We have decided to abandon the wells RW-3, RW-4 and RW-7 and replace then with one properly constructed monitoring well between EW-1 and EW-2 and one monitoring well between EW-2 and S4a.

Plume stability has been evaluated through the construction of graphs illustrating VOC concentration in groundwater verses time. These graphs are included in the Semi-Annual Monitoring Reports, which are submitted to IDEM. Graphs for off-site monitoring well locations are provided on the attached figure. As shown on the graphs, VOCs concentrations in groundwater have been steadily decreasing. This indicates a shrinking plume.

5. Risk-Based Screening Levels Used During the VSI

Several of the questions (Questions #17 through #21 and #41) are related to the selection and use of risk-based screening levels (RBSLs). During our June 15th meeting, we discussed comparing all of the analytical results to the 1999 RISC Default Closure Levels. HLA and AlliedSignal have evaluated the benefits of adopting the final draft 1999 Default Closure Levels and associated guidance verses using the existing 1996 VRP Tier II Cleanup Goals and associated guidance. Based upon the evaluation, we intend to move forward using the existing 1996 VRP Tier II Cleanup Goals and associated guidance.

During the VSI, analytical data were compared to a mixture of USEPA, IDEM and other agency criteria as well as criteria developed by ABB (now HLA). Considering this, all analytical data will need to be compared to the 1996 IDEM VRP Tier II Cleanup Goals, where published. These criteria are provided on the attached table.

Before conducting the comparison, we request your concurrence with the criteria selected for the comparison. They are as follows:

(a) Off-site groundwater will be compared to the 1996 VRP Tier II Cleanup Goals for the residential scenario. Of note, the actual closure strategy for the site will involve establishing a compliance point at the downgradient boundary of the plume and restricting groundwater use within the plume. These criteria would be then applied at that compliance point.

(b) On-site groundwater will be compared to the 1996 VRP Tier II Cleanup Goals for the nonresidential scenario (i.e., commercial/industrial scenario). Of note, the closure strategy for the site will involve elimination of this pathway through a groundwater use restriction. As a result, the actual criteria (i.e., the Tier III criteria) used for site closure will be concentrations in groundwater beneath source areas that are protective of groundwater at the compliance point and vapor migration to indoor air. Based upon modeling conducted during the VSI, the Tier III on-site groundwater criteria will be higher than the non-residential Tier II Cleanup Goals. Considering this, the nonresidential Tier II Cleanup Goals provide a conservative screening of the analytical data to identify areas of concern. SCREEN VIA TIER II -> CLOSURE VIA TIER III

CHECK

(c) On-site soils will be compared to the 1996 VRP Tier II Cleanup Goals for the nonresidential scenario. Of note, the closure strategy for the site will involve using a Tier III modeling approach to determine soil concentrations protective of groundwater at the off-site compliance point. Based upon modeling conducted during the VSI, the Tier III soil criteria will be higher than the non-residential Tier II Cleanup Goals. Considering this, the nonresidential Tier II Cleanup Goals provide a conservative screening of the analytical data to identify areas of concern. Screen Tier II -> closure via TIER III

(d) As indicated on the attached table, cleanup goals were not published for several of the compounds of concern at this site. Prior to conducting the comparison, HLA will calculate these criteria using the algorithms, exposure durations, exposure frequencies, and chemical properties published in the 1996 VRP Resource Guide. We suggest that the most currently available dose-response data be used.

(e) TPH analyses conducted in areas where jet fuel is of concern will be compared to the 1996 VRP maximum upper limit for total volatile compounds of 1,000 mg/kg. For areas where lube oils are of concern, the TPH analyses will be compared to the 1996 VRP maximum upper limit for total semivolatile compounds of 10,000 mg/kg. MAX LEVELS ?

Please be aware that over 2,000 laboratory analyses were performed during the VSI. A considerable amount of time will be required to complete the comparison. Therefore, AlliedSignal requests your concurrence that the agreed upon criteria will serve as the Tier I criteria for the site and the existing data will not have to be compared at a future date due to potential changes in criteria. ?

As discussed above, closure of many areas of this site will involve a site-specific risk assessment (i.e., Tier III analysis). The initial comparison to the 1996 Tier II Cleanup Objectives will be used to confirm that the AOCs selected in the VSI Report for Tier II evaluations[1] were appropriate. The results of the comparison to the 1996 Cleanup Objectives will be appended to future planning documents for the project.

6. Risk-Based TPH Criteria

Questions #42, #44, #45, and #46 relate the site-~~specific TPH~~ criteria developed for the project. As indicated above, ~~1,000 mg/kg will be used~~ as the Tier I criteria for TPH when jet fuel is of concern. Where lube oil is of concern, 10,000 mg/kg will be used as the Tier I criteria. This is consistent with the 1996 VRP Resource Guide. ?
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7. Threshold Concentration Limits

Questions #43 and #47 discuss apparent contradictions in threshold limit values. It is important to realize that at the time the VSI was conducted, the topic of threshold concentration limits was under debate through public comment on the draft RISC. While the VRP offered 1,000 mg/kg for total VOCs and 10,000 mg/kg for semi-volatile organic compounds, the first draft of RISC in October 1997 was using the health-protective level for construction workers, the soil saturation limit, or 1,000 parts per million (ppm). In the February 1999 Interim Draft Revision 1 RISC document, the guidance moved towards soil saturation limits, soil attenuation capacity, and toxicity characteristics. As discussed above, the maximum upper limits presented in the 1996 VRP ~~Resource Guide will be~~ used at this site (i.e., 1,000 mg/kg for total VOCs and 10,000 mg/kg for semi-volatile organic compounds).

8. Delineating Impacts to EQLs

hold over when directed down RISC path!

Questions #11 and #27 suggest that constituents in soil and groundwater should be delineated to estimated quantitation limits (EQL). We hope that after visiting the site and evaluating the distances between AOCs, the spatial relationships between borings within AOCs, and understanding the concentrations present, that IDEM will realize the impracticality of delineating constituents to EQL. The cost to do so is clearly not worth the benefit gained by the delineation. These funds are better spent on remediation efforts.

As you begin to understand the framework for the risk-based closure at this site (e.g., industrial site use, groundwater use restriction, and soil management plan), it should become evident that the site-specific Tier III analysis will likely result in soil cleanup criteria in the parts per million (ppm) range. As a result, the delineation of constituents in soil to low parts per billion (ppb) is inappropriate. For off-site groundwater, delineation of constituents to the 1996 Tier II Cleanup Goals for the residential scenario is appropriate.

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[1] Under current RISC guidance, the VSI's Tier II analysis would be considered Tier III because site-specific transport modeling was conducted. For clarity, the Tier II designation was retained in this letter. This designation will be changed to Tier III in the Remediation Work Plan.

9. Surface Soil Sampling

Questions #33 and #34 are in regards to the analysis of surface soil samples. The first question relates to an apparent misunderstanding of the definition of "surface soil". Again, it is important to understand that, while the VSI field work was on-going, the definition of surface soil was under debate through public comment on the draft RISC. An IDEM Policy Recommendation, dated October 4, 1996 (the time when the majority of the VSI field work was on-going), indicated that surface soil would be defined as 0-12 inches for all contaminants. Prior to the Policy Recommendation, the VRP guidance defined surface soil as the upper 2 feet. The draft RISC document, issued in October 1997 (the time at which the VSI Risk Evaluation was on-going), also indicated that surface soil was 0-12 inches (see Page 67 of the document). The most recent RISC document, dated February 1999, defines surface soil as 0-6 inches.

More importantly, it should have been evident during your recent site visit that there are only two areas at the AlliedSignal Industrial Complex where a surface soil exists at an AOC. These areas are Area 3/11, the area south of Carbon Brake, and the former UST area at Plant 6/16. Pavement exists at all other areas. At Area 3/11, surface soil impacts are being delineating to appropriate criteria. For the Plant 6/16 area, surface soil samples were collected and the analytical results were non-detectable (indicating an incomplete exposure pathway and no further need for evaluation).

what ?

The comment that potential future exposure to surface soils exists because the pavement could be removed warrants further discussion. To address potential future surface soil exposure, the Remediation Work Plan will indicate that a Soil Management Plan will be recorded on the property deed for the Complex. The Plan will require that pavement remain in-place and be properly maintained unless a strict Excavation Policy is followed. The Policy will establish procedures to protect health, safety, and environmental exposure during any excavation projects, and will ensure that any excavated soils are properly managed and disposed. In fact, as discussed during your site visit, an Soil Excavation and Demolition Policy already exists at the Complex. Considering that the pavement serves as an engineering control and that the Soil Management Plan will serve as an activity restriction, the need to sample soils immediately below pavement as part of the VSI is unnecessary.

NOT EXPOSURE BUT LEACHABILITY TO GROUNDWATER - ISSUE!

10. Unfiltered Groundwater Sampling for Metals Analysis

During the July 15th meeting, IDEM indicated that groundwater samples for metals analysis should be unfiltered. To collect representative, unfiltered groundwater samples for metals analysis requires that "low-flow" sampling techniques be used. The labor and equipment costs associated with low flow sampling are nearly double that of the current sampling techniques used at the site. Considering this, we suggest that low flow sampling of groundwater for metals be conducted only in areas where previous sampling or manufacturing processes indicate that metals may be of concern. Also, we suggest that an agreement be reached on the number of sampling events necessary to demonstrate whether or not metals are of concern. ✓ ✓

negotiated during RWP or COMPLETION REPORT

11. Questions Related to the Tier II Evaluation in the VSI

Several questions in regards to the Tier II Risk Evaluation are presented in the VSI Report. As previously discussed, the need to revise the Tier II Risk Evaluation will be considered after completion of the comparison to the 1996 VRP Tier II Cleanup Goals. Of note, there are comments in the IDEM letter that suggests that the approach to the Tier II Risk Evaluation will require some discussion. Their comments include: (a) the selection of constituents of concern; (b) summing exposures across AOCs; (c) the calculation of 95 percent upper confidence limits; and (d) inputs to the vapor migration and leaching models.

Suggested Actions Moving Forward

AlliedSignal and HLA recommend the following actions moving forward:

- Obtain agreement on the selected 1996 VRP Tier II Cleanup Goals for comparison to existing analytical data (as described on Page 5 of this letter).
- Compare the existing site data to agreed upon 1996 VRP Tier II Cleanup Goals, and update Figures 5-10 through 5-29 of the VSI Report to denote sampling locations where the 1996 VRP Tier II Cleanup Goals were exceeded.
- Use the comparison to identify which AOCs warrant development of site-specific Tier III cleanup criteria. Ideally, the selected AOCs will be the same AOCs that were selected for the human health risk assessment presented in the VSI Report.
- Obtain agreement on the approach to developing Tier III cleanup criteria (i.e., address IDEM's comments on the human health risk assessment presented in the VSI Report). Adjust the existing calculations, if necessary, and compare analytical data from the subset of AOCs to the Tier III criteria.

After completing these activities, the need for additional investigation or the preparation of a Remediation Work Plan can be determined.

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At this point, we need your concurrence on the selected 1996 VRP Tier II Cleanup Goals before we can conduct the criteria comparison and continue moving towards development of the Remediation Work Plan. Considering this, we would greatly appreciate your review and comment on the selected criteria within two weeks.

Please contact Ray White at (219) 231-3412 to discuss the course of action going forward.

Sincerely,

Donald A. Walsh
Associate Project Manager

1-248-489-8040 ext. 3025

enclosure

cc: Ray White, AlliedSignal

32106674
STODDARD

ASHLAND CHEMICAL COMPANY
DIVISION OF ASHLAND OIL, INC.
P.O. BOX 2219, COLUMBUS, OHIO 43216
(614) 889-3333

THIS MSDS COMPLIES WITH 29 CFR 1910.1200 (THE HAZARD COMMUNICATION STANDARD)

24-HOUR EMERGENCY TELEPHONE: 1-800-ASHLAND OR 1-800-274-5263

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PRODUCT NAME: NAPHTHOL SPIRITS 66/3
CAS NUMBER: 8052-41-3

DATA SHEET NO: 0013947-006.001
PREPARED: 05/25/94
SUPERSEDES: 02/02/94
PRINT DATE: 08/03/94

SECTION I-PRODUCT IDENTIFICATION

GENERAL OR GENERIC ID: ALIPHATIC HYDROCARBON

SECTION II-COMPONENTS

IF PRESENT, IARC, NTP AND OSHA CARCINOGENS AND CHEMICALS SUBJECT TO THE REPORTING REQUIREMENTS OF SARA TITLE III SECTION 313 ARE IDENTIFIED IN THIS SECTION. SEE DEFINITION PAGE FOR CLARIFICATION

INGREDIENT	PERCENT	NOTE
ALIPHATIC HYDROCARBONS (STODDARD TYPE) CAS #: 8052-41-3 PEL: 100 PPM	>95 TLV: 100 PPM	(1)

(1): NIOSH RECOMMENDS A LIMIT OF 350 MG/CUM - 8 HOUR TIME WEIGHTED AVERAGE, 1800 MG/CUM AS DETERMINED BY A 15 MINUTE SAMPLE.

SECTION III-PHYSICAL DATA

PROPERTY	REFINEMENT	MEASUREMENT
BOILING POINT	FOR PRODUCT	315.00 DEG F (157.22 DEG C) @ 760.00 MMHG

CONTINUED ON PAGE: 2

SECTION III-PHYSICAL DATA (CONTINUED)

PROPERTY	REFINEMENT	MEASUREMENT
VAPOR PRESSURE	FOR PRODUCT	3.00 MMHG @ 68.00 DEG F (20.00 DEG C)
SPECIFIC VAPOR DENSITY	AIR = 1	4.70
SPECIFIC GRAVITY		.770 - .788 @ 60.00 DEG F (15.55 DEG C)
PERCENT VOLATILES		100.00%
EVAPORATION RATE	(BUTYL ACETATE = 1)	.20

SECTION IV-FIRE AND EXPLOSION INFORMATION

FLASH POINT 105.0 DEG F
(40.6 DEG C)

EXPLOSIVE LIMIT (PRODUCT) LOWER - 1.0%

EXTINGUISHING MEDIA: REGULAR FOAM OR WATER FOG OR CARBON DIOXIDE OR DRY CHEMICAL

HAZARDOUS DECOMPOSITION PRODUCTS: MAY FORM TOXIC MATERIALS:, CARBON DIOXIDE AND CARBON MONOXIDE, VARIOUS HYDROCARBONS, ETC.

FIREFIGHTING PROCEDURES: WEAR SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE OPERATED IN THE POSITIVE PRESSURE DEMAND MODE WHEN FIGHTING FIRES.

SPECIAL FIRE & EXPLOSION HAZARDS: VAPORS ARE HEAVIER THAN AIR AND MAY TRAVEL ALONG THE GROUND OR BE MOVED BY VENTILATION AND IGNITED BY HEAT, PILOT LIGHTS, OTHER FLAMES AND IGNITION SOURCES AT LOCATIONS DISTANT FROM MATERIAL HANDLING POINT.

NEVER USE WELDING OR CUTTING TORCH ON OR NEAR DRUM (EVEN EMPTY) BECAUSE PRODUCT (EVEN JUST RESIDUE) CAN IGNITE EXPLOSIVELY.

NFPA CODES: HEALTH- 0 FLAMMABILITY- 2 REACTIVITY- 0

SECTION V-HEALTH HAZARD DATA

PERMISSIBLE EXPOSURE LIMIT	100 PPM
THRESHOLD LIMIT VALUE	100 PPM

CONTINUED ON PAGE: 3

SECTION V-HEALTH HAZARD DATA (CONTINUED)

EFFECTS OF ACUTE OVEREXPOSURE:

EYES - EXPOSURE TO LIQUID OR VAPOR CAUSES EYE IRRITATION. SYMPTOMS MAY INCLUDE STINGING, TEARING, REDNESS, AND SWELLING.

SKIN - PROLONGED OR REPEATED CONTACT CAN CAUSE MODERATE IRRITATION, DEFATTING, DERMATITIS.

BREATHING - EXCESSIVE INHALATION OF VAPORS CAN CAUSE NASAL AND RESPIRATORY IRRITATION, CENTRAL NERVOUS SYSTEM EFFECTS INCLUDING DIZZINESS, WEAKNESS, FATIGUE, NAUSEA, HEADACHE AND POSSIBLE UNCONSCIOUSNESS, AND EVEN DEATH.

SWALLOWING - CAN CAUSE GASTROINTESTINAL IRRITATION, NAUSEA, VOMITING, AND DIARRHEA. ASPIRATION OF MATERIAL INTO THE LUNGS CAN CAUSE CHEMICAL PNEUMONITIS WHICH CAN BE FATAL.

FIRST AID:

IF ON SKIN: THOROUGHLY WASH EXPOSED AREA WITH SOAP AND WATER. REMOVE CONTAMINATED CLOTHING. LAUNDER CONTAMINATED CLOTHING BEFORE RE-USE.

IF IN EYES: FLUSH WITH LARGE AMOUNTS OF WATER, LIFTING UPPER AND LOWER LIDS OCCASIONALLY, GET MEDICAL ATTENTION.

IF SWALLOWED: DO NOT INDUCE VOMITING, KEEP PERSON WARM, QUIET, AND GET MEDICAL ATTENTION. ASPIRATION OF MATERIAL INTO THE LUNGS DUE TO VOMITING CAN CAUSE CHEMICAL PNEUMONITIS WHICH CAN BE FATAL.

IF BREATHED: IF AFFECTED, REMOVE INDIVIDUAL TO FRESH AIR. IF BREATHING IS DIFFICULT, ADMINISTER OXYGEN. IF BREATHING HAS STOPPED GIVE ARTIFICIAL RESPIRATION. KEEP PERSON WARM, QUIET AND GET MEDICAL ATTENTION.

EFFECTS OF CHRONIC OVEREXPOSURE:

OVEREXPOSURE TO THIS MATERIAL (OR ITS COMPONENTS) HAS BEEN SUGGESTED AS A CAUSE OF THE FOLLOWING EFFECTS IN HUMANS, AND MAY AGGRAVATE PRE-EXISTING DISORDERS OF THESE ORGANS:, CENTRAL NERVOUS SYSTEM EFFECTS

SECTION VI-REACTIVITY DATA

HAZARDOUS POLYMERIZATION: CANNOT OCCUR
STABILITY: STABLE
INCOMPATIBILITY: AVOID CONTACT WITH:, STRONG OXIDIZING AGENTS

SECTION VII-SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED:

CONTINUED ON PAGE: 4

SECTION VII-SPILL OR LEAK PROCEDURES (CONTINUED)

SMALL SPILL: ABSORB LIQUID ON VERMICULITE, FLOOR ABSORBENT, OR OTHER ABSORBENT MATERIAL AND TRANSFER TO HOOD.

LARGE SPILL: ELIMINATE ALL IGNITION SOURCES (FLARES, FLAMES INCLUDING PILOT LIGHTS, ELECTRICAL SPARKS). PERSONS NOT WEARING PROTECTIVE EQUIPMENT SHOULD BE EXCLUDED FROM AREA OF SPILL UNTIL CLEAN-UP HAS BEEN COMPLETED. STOP SPILL AT SOURCE. PREVENT FROM ENTERING DRAINS, SEWERS, STREAMS OR OTHER BODIES OF WATER.PREVENT FROM SPREADING. IF RUNOFF OCCURS, NOTIFY AUTHORITIES AS REQUIRED. PUMP OR VACUUM TRANSFER SPILLED PRODUCT TO CLEAN CONTAINERS FOR RECOVERY. ABSORB UNRECOVERABLE PRODUCT.TRANSFER CONTAMINATED ABSORBENT, SOIL AND OTHER MATERIALS TO CONTAINERS FOR DISPOSAL.

PREVENT RUN-OFF TO SEWERS, STREAMS OR OTHER BODIES OF WATER. IF RUN-OFF OCCURS, NOTIFY PROPER AUTHORITIES AS REQUIRED, THAT A SPILL HAS OCCURED.

WASTE DISPOSAL METHOD:

SMALL SPILL: ALLOW VOLATILE PORTION TO EVAPORATE IN HOOD. ALLOW SUFFICIENT TIME FOR VAPORS TO COMPLETELY CLEAR HOOD DUCT WORK. DISPOSE OF REMAINING MATERIAL IN ACCORDANCE WITH APPLICABLE REGULATIONS.

LARGE SPILL: DESTROY BY LIQUID INCINERATION.

CONTAMINATED ABSORBENT MAY BE DEPOSITED IN A LANDFILL IN ACCORDANCE WITH LOCAL, STATE AND FEDERAL REGULATIONS.

SECTION VIII-PROTECTIVE EQUIPMENT TO BE USED

RESPIRATORY PROTECTION: IF WORKPLACE EXPOSURE LIMIT(S) OF PRODUCT OR ANY COMPONENT IS EXCEEDED (SEE SECTION II), A NIOSH/MSHA APPROVED AIR SUPPLIED RESPIRATOR IS ADVISED IN ABSENCE OF PROPER ENVIRONMENTAL CONTROL. OSHA REGULATIONS ALSO PERMIT OTHER NIOSH/MSHA RESPIRATORS (NEGATIVE PRESSURE TYPE) UNDER SPECIFIED CONDITIONS (SEE YOUR INDUSTRIAL HYGIENIST). ENGINEERING OR ADMINISTRATIVE CONTROLS SHOULD BE IMPLEMENTED TO REDUCE EXPOSURE.

VENTILATION: PROVIDE SUFFICIENT MECHANICAL (GENERAL AND/OR LOCAL EXHAUST) VENTILATION TO MAINTAIN EXPOSURE BELOW TLV(S).

PROTECTIVE GLOVES: WEAR RESISTANT GLOVES SUCH AS:, NITRILE RUBBER

EYE PROTECTION: CHEMICAL SPLASH GOGGLES IN COMPLIANCE WITH OSHA REGULATIONS ARE ADVISED; HOWEVER, OSHA REGULATIONS ALSO PERMIT OTHER TYPE SAFETY GLASSES. CONSULT YOUR SAFETY REPRESENTATIVE.

OTHER PROTECTIVE EQUIPMENT: TO PREVENT REPEATED OR PROLONGED SKIN CONTACT, WEAR IMPERVIOUS CLOTHING AND BOOTS.

SECTION IX-SPECIAL PRECAUTIONS OR OTHER COMMENTS

CONTINUED ON PAGE: 5

SECTION IX-SPECIAL PRECAUTIONS OR OTHER COMMENTS (CONTINUED)

CONTAINERS OF THIS MATERIAL MAY BE HAZARDOUS WHEN EMPTIED. SINCE EMPTIED CONTAINERS RETAIN PRODUCT RESIDUES (VAPOR, LIQUID, AND/OR SOLID), ALL HAZARD PRECAUTIONS GIVEN IN THE DATA SHEET MUST BE OBSERVED.

WARNING!!! SUDDEN RELEASE OF HOT ORGANIC CHEMICAL VAPORS OR MISTS FROM PROCESS EQUIPMENT OPERATING AT ELEVATED TEMPERATURE AND PRESSURE, OR SUDDEN INGRESS OF AIR INTO VACUUM EQUIPMENT, MAY RESULT IN IGNITIONS WITHOUT THE PRESENCE OF OBVIOUS IGNITION SOURCES. PUBLISHED "AUTOIGNITION" OR "IGNITION" TEMPERATURE VALUES CANNOT BE TREATED AS SAFE OPERATING TEMPERATURES IN CHEMICAL PROCESSES WITHOUT ANALYSIS OF THE ACTUAL PROCESS CONDITIONS. ANY USE OF THIS PRODUCT IN ELEVATED TEMPERATURE PROCESSES SHOULD BE THOROUGHLY EVALUATED TO ESTABLISH AND MAINTAIN SAFE OPERATING CONDITIONS.

HYDROCARBON SOLVENTS ARE BASICALLY NON-CONDUCTORS OF ELECTRICITY AND CAN BECOME ELECTROSTATICALLY CHARGED DURING MIXING, FILTERING OR PUMPING AT HIGH FLOW RATES. IF THIS CHARGE REACHES A SUFFICIENTLY HIGH LEVEL, SPARKS CAN FORM THAT MAY IGNITE THE VAPORS OF FLAMMABLE LIQUIDS.

THE INFORMATION ACCUMULATED HEREIN IS BELIEVED TO BE ACCURATE BUT IS NOT WARRANTED TO BE WHETHER ORIGINATING WITH THE COMPANY OR NOT. RECIPIENTS ARE ADVISED TO CONFIRM IN ADVANCE OF NEED THAT THE INFORMATION IS CURRENT, APPLICABLE, AND SUITABLE TO THEIR CIRCUMSTANCES.

SECTION X-LABEL INFORMATION

CAUTION!

MAY CAUSE EYE, SKIN AND RESPIRATORY IRRITATION
MAY BE HARMFUL IF INHALED OR SWALLOWED.
MAY CAUSE CENTRAL NERVOUS SYSTEM DEPRESSION

HANDLING & STORAGE:

KEEP AWAY FROM HEAT AND OPEN FLAME. CONTAINER SHOULD BE GROUNDED AND BONDED WHEN TRANSFERRING LIQUID CONTENTS. AVOID BREATHING VAPOR OR MIST. AVOID CONTACT WITH EYES, SKIN AND CLOTHING. WEAR CHEMICAL SPLASH GOGGLES, IMPERVIOUS GLOVES AND OTHER NECESSARY PROTECTIVE EQUIPMENT. WASH THOROUGHLY AFTER HANDLING. USE OR STORE ONLY WITH ADEQUATE VENTILATION. REFER TO APPLICABLE OSHA REGULATIONS. KEEP WORKPLACE AIRBORNE CONCENTRATIONS BELOW LEGAL AND RECOMMENDED LIMITS. CIRCUMSTANCES COULD REQUIRE USE OF RESPIRATORY PROTECTION. DO NOT TRANSFER TO UNLABELED CONTAINER. KEEP CONTAINER CLOSED WHEN NOT IN USE. NEVER USE PRESSURE TO EMPTY. EMPTY CONTAINERS MAY CONTAIN HAZARDOUS PRODUCT RESIDUES. KEEP CLOSURE END UP. LOOSEN CLOSURE CAREFULLY. BEFORE USE, REVIEW MATERIAL SAFETY DATA SHEET FOR MORE DETAILED INFORMATION, INCLUDING CHRONIC HEALTH EFFECTS. DO NOT USE CUTTING OR WELDING TORCH ON THIS CONTAINER (EVEN EMPTY). 24-HOUR EMERGENCY NUMBER 1-800-274-5263

FIRST AID:

CONTINUED ON PAGE: 6

SECTION X-LABEL INFORMATION (CONTINUED)

EYES: IMMEDIATELY FLUSH WITH WATER FOR AT LEAST 15 MINUTES WHILE LIFTING UPPER AND LOWER EYELIDS. DO NOT USE CHEMICAL ANTIDOTE. IF REDNESS OR IRRITATION PERSISTS, GET MEDICAL ATTENTION.

SKIN: THOROUGHLY FLUSH WITH WATER. IF REDNESS OR IRRITATION PERSISTS, GET MEDICAL ATTENTION. REMOVE CONTAMINATED CLOTHING AND WASH BEFORE REUSE. DISCARD CONTAMINATED SHOES.

INHALATION: IF AFFECTED, REMOVE TO FRESH AIR. IF NOT BREATHING, GIVE ARTIFICIAL RESPIRATION AND GET MEDICAL ATTENTION IMMEDIATELY. IF BREATHING IS DIFFICULT, GET MEDICAL ATTENTION.

INGESTION: DO NOT INDUCE VOMITING. GIVE TWO GLASSES OF WATER AND GET MEDICAL ATTENTION IMMEDIATELY. NEVER GIVE ANYTHING BY MOUTH TO AN UNCONSCIOUS PERSON.

CHRONIC INFORMATION:

NOTICE: OVEREXPOSURE TO SOLVENT VAPORS CAN IRRITATE THE RESPIRATORY TRACT AND CAUSE HEADACHE, DIZZINESS, DROWSINESS OR OTHER NERVOUS SYSTEM EFFECTS.

*** COMPONENTS APPEAR IN SECTION II ***

LAST PAGE----------------------------------LAST PAGE

INCH-POUND

MIL-PRF-7024E
1 Oct 1997
Superseding
MIL-C-7024D
30 August 1990

PERFORMANCE SPECIFICATION
CALIBRATING FLUIDS, AIRCRAFT FUEL SYSTEM COMPONENTS

This specification has been approved for all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers the requirements for three types of calibrating fluid used in the calibration of aircraft fuel system components.

1.2 Classification. The fluids will be of the following types as specified (6.2):

Type I - Normal Heptane
Type II - Special Run Stoddard Solvent
Type III - High Flash Point Fluid

2. APPLICABLE DOCUMENTS.

2.1 General. The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents cited in other sections of this specification or those identified as recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all the requirements of the specified documents cited in sections 3 and 4 of this specification, whether or not they are listed.

2.2 Government Documents.

2.2.1 Specifications, Standards, and Handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DoDISS) and supplement thereto, cited in the solicitation (see 6.2).

SPECIFICATIONS

DEPARTMENT OF DEFENSE

MIL-I-25017 Inhibitor, Corrosion/Lubricity Improver, Fuel Soluble

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to SA-ALC/SFSP, 1014 Billy Mitchell Blvd./Ste 1, Kelly AFB TX 78241-5603, by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A FSC 6850

DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited.

2.3 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DOD adopted are those listed in the issue of the DoDISS cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DoDISS are the issues of the non-Government documents which are current on the date of the solicitation.

American Society for Testing and Materials (ASTM)

ASTM D 56 - Test Method for Flash Point by Tag Closed Tester (DoD adopted)

ASTM D 86 - Method for Distillation of Petroleum Products (DoD adopted)

ASTM D 130 - Methods for Detection of Copper Corrosion from Petroleum Products by the Copper Strip Tarnish Test (DoD adopted)

ASTM D 156 - Test Method for Saybolt Color of Petroleum products (Saybolt Chronometer Method) (DoD adopted)

ASTM D 323 - Test Method for Vapor Pressure of Petroleum Products (Reid Method) (DoD adopted)

ASTM D 381 - Test Method for Existent Gum in Fuels by Jet Evaporation (DoD adopted)

ASTM D 445 - Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (and the Calculation of Dynamic Viscosity) (DoD adopted)

ASTM D 873 - Test Method for Oxidation Stability of Aviation Fuel (Potential Residue Method) (DoD adopted)

ASTM D 1093 - Test Method for Acidity of Distillation Residues or Hydrocarbon Liquids (DoD adopted)

ASTM D 1298 - Test Method for Density, Relative Density, (Specific Gravity), or API Gravity of Crude Petroleum Petroleum Products by Hydrometer Method (DoD adopted)

ASTM D 1319 - Test Method for Hydrocarbon Types in Liquid Petroleum Products by Fluorescent Indicator Adsorption (DoD Adopted)

ASTM D 2276 - Test Method for Particulate Contaminant in Aviation Turbine Fuels (DoD adopted)

ASTM D 2386 - Test Method for Freezing Point of Aviation Fuels (DoD adopted)

ASTM D 3227 - Test Method for Mercaptan Sulfur in Gasoline, Kerosene, Aviation Turbine, and Distillate Fuels (Potentiometric Method) (DoD adopted)

ASTM D 3242 - Test Method for Total Acidity in Aviation Turbine Fuel (DoD adopted)

ASTM D 3606 - Test Method for Determination of Benzene and Toluene in Finished Motor and Aviation Gasoline by Gas Chromatography

ASTM D 4052 - Test Method for Density and Relative Density of Liquids by Digital Density Meter (DoD adopted)

ASTM D 4057 - Practice for Manual Sampling of Petroleum and Petroleum Products (DoD adopted)

ASTM D 4952 - Test Method for Quantitative Analysis for Active Sulfur Species in Fuels and Solvents (Doctor Test)

ASTM D 5972 - Test Method for Freezing Point of Aviation Fuels (Automatic Phase Transition Method)

ASTM E 29 - Recommended Practice for Indicating Which Places of Figures are to be Considered Significant in Specified Limiting Values (DoD adopted)

(Application for copies of ASTM documents should be addressed to the American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959).

(Non-Government standards and other publications are normally available from the organizations that prepare or distribute the documents. These documents also may be available in or through libraries or other informational services.)

2.4 Order of precedence. In the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

TABLE I. Chemical and Physical Requirements and Test Methods.

REQUIREMENTS	Type I	Type II	Type III	ASTM Test Method
Specific Gravity, 15.6°C/15.6°C (60°F/60°F)	0.699 ±0.002	0.770 ±0.005	0.780 ±0.005	D 1298 D 4052
Color, Saybolt, Lighter Than	+25		+25	D 156
Viscosity, Centistokes at 0°C (32°F)	0.785 ±0.01			D 445
25°C (77°F)		1.17 ±0.05		
37.8°C (100°F)	0.54 ±0.01		2.47 ±0.10	
Vapor Pressure at 37.8°C (100°F), kPa (psi) Max	13.8 (2.0)			D 323
Existent Gum, mg/100ml Max	2.0	5.0		D 381 1/
Potential Gum, mg/100ml Max	5.0			D 873 2/
Distillation: Initial BP °C (°F) Min		149(300)	216(420)	D 86
Recovered 10% °C (°F)			3/	
Recovered 50% °C (°F)			221-232 (430-450)	
Recovered 90% °C (°F)			3/	

TABLE I. Chemical and Physical Requirements and Test Methods(cont).

Final Boiling Point °C (°F)		210 (410) Max	232-246 (450-475)	
Recovery, Percent Min		98.5		
Range, 5 to 95% points °C (°F)	1.7 (3) 4/			
Residue, Volume %, Max			1.5	
Loss, Volume %, Max			1.5	
Flash Point,°C(°F),Min		38 (100)	79 (175)	D 56
Aromatics, Vol %, Max		20.0		D 1319
Benzene, Vol %, Max	0.01	0.01	0.01	D 3606
Olefins, Vol %, Max		5.0		D 1319
Particulate Matter, mg/l, Max		2.0		D 2276
Mercaptan Sulfur, %Wt, Max or Doctor Test		0.001 Sweet		D 3227 D 4952
Copper Corrosion, Max	No. 1	No. 1	No. 1	D 130
Total Acid Number, mg/l, Max		0.015		D 3242
Freezing Point,°C(°F), Max			-54 (-65)	D 2386 D 5972
Acidity, Distillation Residue, Max			Neutral	D 1093

1/ Air Jet Method
2/ 5-Hour Aging Period
3/ To Be Reported-Not Limited
4/ Must Include Temperature of 98°C(208°F)

3. REQUIREMENTS

3.1 Materials. The fluids shall consist completely of hydrocarbon compounds, except as otherwise specified herein.

3.2 Chemical and Physical Requirements. The product shall conform to the requirements as specified in Table I. Requirements in Table I are absolute and not subject to correction for tolerance of test methods. The finished calibrating fluid shall be homogenous, visually free from water, sediment, or suspended matter and shall be clear and bright at the ambient temperature or at 21 degrees Centigrade (70 degrees Fahrenheit), whichever is higher.

3.3 Additives - Corrosion Inhibitor. If so specified by the procuring activity, a corrosion inhibitor conforming to MIL-I-25017 shall be blended into the calibration fluid by the contractor. The amount added shall be equal to or greater than the minimum effective concentration listed in the latest revision of QPL-25017. The supplier may add any one of the corrosion inhibitors listed on the latest revision of QPL-25017. The supplier shall maintain documentation that the corrosion inhibitor used is an approved QPL-25017 product.

3.4 Additives-Antioxidants. If so specified by the procuring activity, an anti-oxidant additive shall be blended into the type II calibrating fluid in total concentration not less than 4.2 pounds of inhibitor (not including weight of solvents) per 1000 barrels of fluid nor more than 8.4 pounds per 1000 barrels, in order to prevent the formation of gums and peroxides. The following additives or additive blends are approved for use:

a. 2,6-di-tert-butyl-4-methylphenol

b. 6-tert-butyl-2,4-dimethylphenol

c. 2,6-di-tert-butylphenol

d. 75 percent min 2,6-di-tert-butylphenol
25 percent max tert-butylphenols and tri-tert-butylphenols

e. 72 percent min 6-tert-butyl-2,4-dimethylphenol
28 percent max tert-butyl-methylphenols and tert-butyl-dimethylphenols

f. 55 percent min 6-tert-butyl-2,4-dimethylphenol
45 percent max mixture of tert-butylphenols and di-tert-butylphenols

g. 60 to 80 percent 2,6-dialkylphenols
20 to 40 percent mixture of 2,3,6-trialkylphenols and 2,4,6-trialkylphenols

h. 35 percent min 2,6-di-tert-butyl-4-methylphenol
65 percent max mixture of methyl-, ethyl-, and dimethyl-tert-butylphenols

i. 60 percent min 2,4-di-tert-butylphenol
40 percent max mixture of tert-butylphenols

j. 30 percent min mixture of 2,3,6-trimethylphenol and 2,4,6-trimethylphenol
70 percent max mixture of dimethylphenols

k. 65 percent min mixture of 2,4,5-triisopropylphenol and 2,4,6 triisopropylphenol
   35 percent max mixture of other isopropylphenols and biphenols

l. 55 percent min butylated ethyl phenols
   45 percent max butylated methyl and dimethyl phenols

3.5 Workmanship. The finished calibrating fluid shall be homogenous, visually free from undissolved water, sediment, or suspended matter and shall be clear and bright at the ambient temperature or at 21°C (70°F), whichever is higher.

3.6 Toxicity. The finished calibrating fluid shall have no adverse effect on the health of personnel when used for its intended purpose. The fluid shall contain no components which produce noxious vapors in such concentrations that would cause physical irritation to personnel during use or formulation under conditions of adequate ventilation. Percent composition of benzene shall be less than 0.01% of the total volume of the calibrating fluid due to benzene's toxic properties.

3.7 Limiting Values. The following applies to all specified limits in this performance specification: For the purposes of determining conformance with these requirements, an observed value or a calculated value shall be rounded off "to the nearest unit" in the last right-hand digit used in expressing the specification limit according to the rounding-off method of ASTM Practice E 29 for using Significant Digits in Test Data to Determine Conformance with Specifications.

4. VERIFICATION

4.1 Classification of Inspection. The inspections shall be classified as quality conformance inspections.

4.2 Quality Conformance Inspection. Inspections of individual lots shall serve as a basis for acceptance and shall consist of all the examinations and tests specified in section 3. Use the chemical and physical requirements and applicable test methods as specified in Table I for conformance testing.

4.3 Lot Definitions.

a. Bulk Lot of Material. An indefinite quantity of a homogeneous mixture of material contained in one isolated tank or kettle which is greater than 55 gallons in size, or a quantity manufactured by a single plant run through the same processing equipment during one continuous operation not exceeding a 24-hour period.

b. Packaged Lot of Material. A container lot of material shall be defined as an indefinite number of 55-gallon drums or smaller unit containers of identical size and type, filled with a homogeneous mixture of material manufactured by a single plant run through the same processing equipment during one continuous operation not exceeding a 24 hour period.

4.4 Sample. Each sample shall be of sufficient size to conduct all the quality conformance tests as specified herein. Unless otherwise specified, the quality conformance tests shall be performed on each required sample.

4.5 Sampling. Sampling shall be in accordance with ASTM D 4057.

4.5.1 Drums. The number of drums selected for sampling from each lot shall be according to Table II. The calibrating fluid from each container sampled shall constitute a separate sample.

TABLE II. Sampling for test.

Number of containers in lot	Number of containers to be sampled
2-25	2
26-150	3
151-1200	5
1201-7000	8

4.2.2.1.4 Portable tanks, cargo tanks, and tank cars. Each portable tank, cargo tank, or tank car shall constitute a lot. Unless otherwise specified, the sample shall be composited into one sample when one-third portions are withdrawn from the bottom, center, and top thirds of the tank.

4.2.2.1.5 Other containers. Unless otherwise specified, other containers of 100 gallons or less water capacity shall be sampled according to 4.2.2.1.3. Containers greater than 100 gallons water capacity shall be sampled according to 4.2.2.1.4.

4.6 Government Requested Sample. When requested, a 1-gallon sample shall be forwarded to the laboratory designated by the procuring activity for testing as specified herein.

4.7 Rejection. Failure of any calibrating fluid sample to conform to any of the specification requirements shall be cause for rejection of the lot represented.

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When actual packaging of materiel is to be performed by DoD personnel, they will contact the responsible packaging activity to ascertain requisite packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activity within the Military Department or Defense Agency, or within the Military Department's System Command. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful but is not mandatory.)

6.1 Intended Use. The fluids covered by this specification are intended for use in the calibration of aircraft fuel system components. Exercise caution to avoid prolonged contact with the skin and observe Occupational Safety and Health Administration (OSHA) guidelines.

Questions pertaining to the toxic effects should be referred to the appropriate departmental medical service.

6.2 Acquisition Requirements. Acquisition documents should specify the following:

a. Title, number, and date of this specification
b. Type
c. Issue of DoDISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.2.1 and 2.3)
d. Facility where Government requested test sample should be sent
e. Quantity required, and size and type of containers required
f. Packaging requirements (see 5.1)
g. Addition of corrosion inhibitor to the calibrating fluid
h. Addition of anti-oxidant additive to the calibrating fluid

6.3 Part or Identifying Number (PIN). The PIN number is created as shown below. It serves to identify a product during procurement and also in the Federal Supply System.

```
M   7024
|    |
|    |_______Specification number.
|
|____________Prefix for military specification.
```

6.4 Changes from Previous Issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extent of the changes.

6.5 Subject Term (key word) Listing.

High Flash Point
Corrosion Inhibitor
Antioxidant

Custodians:
Army - AV
Navy - AS
Air Force - 68

Review Activities:
Army - EA, MD
Air Force - 11
DLA - GS

Preparing activity:
Air Force - 68

(Project 6850-1205)

32106624

ASHLAND PETROLEUM COMPANY
DIVISION OF ASHLAND OIL, INC.
P.O. BOX 391, ASHLAND, KENTUCKY 41101
(606) 329-3333

JP 4 JET FUEL

THIS MSDS COMPLIES WITH 29 CFR 1910.1200 (THE HAZARD COMMUNICATION STANDARD)

24-HOUR EMERGENCY TELEPHONE: 1-800-ASHLAND OR 1-800-274-5263

****

PRODUCT NAME: JP 4 JET FUEL
CAS NUMBER: RPT SUP - -

DATA SHEET NO: 0013941-003.000
PREPARED: 02/12/91
SUPERSEDES: 11/04/85

SECTION I-PRODUCT IDENTIFICATION

GENERAL OR GENERIC ID: PETROLEUM DISTILLATE
DOT HAZARD CLASSIFICATION: FLAMMABLE LIQUID (173.115)

SECTION II-COMPONENTS

IF PRESENT, IARC, NTP AND OSHA CARCINOGENS AND CHEMICALS SUBJECT TO THE REPORTING REQUIREMENTS OF SARA TITLE III SECTION 313 ARE IDENTIFIED IN THIS SECTION. SEE DEFINITION PAGE FOR CLARIFICATION

INGREDIENT	% (BY VOL)	NOTE
PETROLEUM DISTILLATE PEL: 400 PPM	>95	(1)
BENZENE CAS #: 71-43-2 PEL: 1 PPM TLV: 10 PPM IDENTIFIED AS A CARCINOGEN BY NTP, IARC, OSHA	0.01-0.2	(2)
CYCLOHEXANE CAS #: 110-82-7 PEL: 300 PPM TLV: 300 PPM	0.2-2.2	(3)

(1): NIOSH RECOMMENDS A LIMIT OF 100 MG/CUM - 10 HOUR TIME WEIGHTED AVERAGE.

(2): THE OSHA STEL FOR BENZENE IS 5 PPM AVERAGED OVER ANY 15 MINUTE PERIOD. THE ACTION LEVEL IS 0.5 PPM 8-HOUR TWA. REFER TO 29 CFR 1910.1028. NIOSH RECOMMENDS A 1.0 PPM 60 MINUTE CEILING.
THIS CHEMICAL IS KNOWN TO THE STATE OF CALIFORNIA TO BE A CARCINOGEN.
THIS CHEMICAL IS SUBJECT TO THE REPORTING REQUIREMENTS OF SECTION 313 OF SARA TITLE III.

CONTINUED ON PAGE: 2

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SECTION II-COMPONENTS (CONTINUED)

THIS COMPONENT IS INHERENTLY PRESENT IN THIS PRODUCT.

(3): THIS CHEMICAL IS SUBJECT TO THE REPORTING REQUIREMENTS OF SECTION 313 OF SARA TITLE III.

SECTION III-PHYSICAL DATA

PROPERTY	REFINEMENT	MEASUREMENT
BOILING POINT	FOR PRODUCT	130.00 - 160.00 DEG F (54.44 - 71.11 DEG C) @ 760.00 MMHG
VAPOR PRESSURE	FOR PRODUCT	129.00 MMHG @ 68.00 DEG F (20.00 DEG C)
SPECIFIC VAPOR DENSITY		HEAVIER THAN AIR
SPECIFIC GRAVITY		.751 - .802 @ 60.00 DEG F (15.55 DEG C)
PERCENT VOLATILES		100.00%
EVAPORATION RATE		SLOWER THAN ETHER
APPEARANCE		CLEAR
STATE		LIQUID
FORM		HOMOG SOLN

SECTION IV-FIRE AND EXPLOSION INFORMATION

FLASH POINT < 30.0 DEG F
(-1.1 DEG C)

EXPLOSIVE LIMIT (PRODUCT) LOWER - 1.3%

EXTINGUISHING MEDIA: REGULAR FOAM OR CARBON DIOXIDE OR DRY CHEMICAL

CONTINUED ON PAGE: 3

SECTION IV-FIRE AND EXPLOSION INFORMATION (CONTINUED)

HAZARDOUS DECOMPOSITION PRODUCTS: MAY FORM TOXIC MATERIALS:, CARBON DIOXIDE AND CARBON MONOXIDE, VARIOUS HYDROCARBONS, ETC.

FIREFIGHTING PROCEDURES: WEAR SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE OPERATED IN THE POSITIVE PRESSURE DEMAND MODE WHEN FIGHTING FIRES.

WATER OR FOAM MAY CAUSE FROTHING WHICH CAN BE VIOLENT AND POSSIBLY ENDANGER THE LIFE OF THE FIREFIGHTER, ESPECIALLY IF SPRAYED INTO CONTAINERS OF HOT, BURNING LIQUID.

SPECIAL FIRE & EXPLOSION HAZARDS: NEVER USE WELDING OR CUTTING TORCH ON OR NEAR DRUM (EVEN EMPTY) BECAUSE PRODUCT (EVEN JUST RESIDUE) CAN IGNITE EXPLOSIVELY.

MATERIAL IS HIGHLY VOLATILE AND READILY GIVES OFF VAPORS WHICH MAY TRAVEL ALONG THE GROUND OR BE MOVED BY VENTILATION AND IGNITED BY PILOT LIGHTS, OTHER FLAMES, SPARKS, HEATERS, SMOKING, ELECTRIC MOTORS, STATIC DISCHARGE, OR OTHER IGNITION SOURCES AT LOCATIONS DISTANT FROM MATERIAL HANDLING POINT.

NFPA CODES: HEALTH- 1 FLAMMABILITY- 3 REACTIVITY- 0

SECTION V-HEALTH HAZARD DATA

EFFECTS OF ACUTE OVEREXPOSURE:

EYES - CAN CAUSE SEVERE IRRITATION, REDNESS, TEARING, BLURRED VISION.

SKIN - PROLONGED OR REPEATED CONTACT CAN CAUSE MODERATE IRRITATION, DEFATTING, DERMATITIS.

BREATHING - EXCESSIVE INHALATION OF VAPORS CAN CAUSE NASAL AND RESPIRATORY IRRITATION, CENTRAL NERVOUS SYSTEM EFFECTS INCLUDING DIZZINESS, WEAKNESS, FATIGUE, NAUSEA, HEADACHE AND POSSIBLE UNCONSCIOUSNESS, AND EVEN DEATH.

SWALLOWING - CAN CAUSE GASTROINTESTINAL IRRITATION, NAUSEA, VOMITING, AND DIARRHEA. ASPIRATION OF MATERIAL INTO THE LUNGS CAN CAUSE CHEMICAL PNEUMONITIS WHICH CAN BE FATAL.

FIRST AID:

IF ON SKIN: THOROUGHLY WASH EXPOSED AREA WITH SOAP AND WATER. REMOVE CONTAMINATED CLOTHING. LAUNDER CONTAMINATED CLOTHING BEFORE RE-USE.

IF IN EYES: FLUSH WITH LARGE AMOUNTS OF WATER, LIFTING UPPER AND LOWER LIDS OCCASIONALLY, GET MEDICAL ATTENTION.

IF SWALLOWED: DO NOT INDUCE VOMITING, KEEP PERSON WARM, QUIET, AND GET MEDICAL ATTENTION. ASPIRATION OF MATERIAL INTO THE LUNGS DUE TO VOMITING CAN CAUSE CHEMICAL PNEUMONITIS WHICH CAN BE FATAL.

IF BREATHED: IF AFFECTED, REMOVE INDIVIDUAL TO FRESH AIR. IF BREATHING IS DIFFICULT, ADMINISTER OXYGEN. IF BREATHING HAS STOPPED GIVE ARTIFICIAL RESPIRATION. KEEP PERSON WARM, QUIET AND GET MEDICAL ATTENTION.

CONTINUED ON PAGE: 4

SECTION V-HEALTH HAZARD DATA (CONTINUED)

PRIMARY ROUTE(S) OF ENTRY:

SKIN CONTACT, INHALATION

EFFECTS OF CHRONIC OVEREXPOSURE:

THIS SUBSTANCE CONTAINS MATERIAL(S) SIMILAR TO MATERIAL(S) WHICH HAS(HAVE) BEEN SHOWN TO PRODUCE SKIN CANCER IN LABORATORY ANIMALS FOLLOWING REPEATED SKIN EXPOSURE WITHOUT WASHING OR REMOVAL.

REPEATED OR PROLONGED EXPOSURE TO BENZENE, EVEN AT RELATIVELY LOW CONCENTRATIONS, MAY RESULT IN VARIOUS BLOOD DISORDERS RANGING FROM ANEMIA TO LEUKEMIA. FOR ADDITIONAL INFORMATION ON EMPLOYEE MONITORING, INFORMATION AND TRAINING, MEDICAL SURVEILLANCE, METHODS OF COMPLIANCE, ETC., REFER TO THE OSHA BENZENE STANDARD, 29 CFR 1910.1028

SECTION VI-REACTIVITY DATA

HAZARDOUS POLYMERIZATION: CANNOT OCCUR
STABILITY: STABLE
INCOMPATIBILITY: AVOID CONTACT WITH:, STRONG OXIDIZING AGENTS

SECTION VII-SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED:

SMALL SPILL: ELIMINATE ALL SOURCES OF IGNITION SUCH AS FLARES, FLAMES (INCLUDING PILOT LIGHTS), AND ELECTRICAL SPARKS.
ABSORB ONTO SAND OR OTHER ABSORBENT MATERIAL.
LARGE SPILL: ELIMINATE ALL IGNITION SOURCES (FLARES, FLAMES INCLUDING PILOT LIGHTS, ELECTRICAL SPARKS). PERSONS NOT WEARING PROTECTIVE EQUIPMENT SHOULD BE EXCLUDED FROM AREA OF SPILL UNTIL CLEAN-UP HAS BEEN COMPLETED. STOP SPILL AT SOURCE. PREVENT FROM ENTERING DRAINS, SEWERS, STREAMS OR OTHER BODIES OF WATER.PREVENT FROM SPREADING. IF RUNOFF OCCURS, NOTIFY AUTHORITIES AS REQUIRED. PUMP OR VACUUM TRANSFER SPILLED PRODUCT TO CLEAN CONTAINERS FOR RECOVERY. ABSORB UNRECOVERABLE PRODUCT.TRANSFER CONTAMINATED ABSORBENT, SOIL AND OTHER MATERIALS TO CONTAINERS FOR DISPOSAL.
PREVENT RUN-OFF TO SEWERS, STREAMS OR OTHER BODIES OF WATER. IF RUN-OFF OCCURS, NOTIFY PROPER AUTHORITIES AS REQUIRED, THAT A SPILL HAS OCCURED.

CONTINUED ON PAGE: 5

SECTION VII-SPILL OR LEAK PROCEDURES (CONTINUED)

WASTE DISPOSAL METHOD:

SMALL SPILL: DISPOSE OF USED MATERIAL AND ABSORBANT IN ACCORDANCE WITH APPLICABLE LOCAL, STATE AND FEDERAL REGUATIONS.
LARGE SPILL: RECOVER AS MUCH OF THE PRODUCT AS POSSIBLE BY SUCH METHODS AS VACUUMING, FOLLOWED BY RECOVERING RESIDUAL FLUIDS BY USING ABSORBENT MATERIALS. NONRECOVERABLE PRODUCT, CONTAMINATED SOIL, DEBRIS AND OTHER MATERIALS SHOULD BE PLACED IN PROPER CONTAINERS AND DISPOSED OF IN ACCORDANCE WITH APPLICABLE LOCAL, STATE AND FEDERAL REGULATIONS. AVOID DIRECTING MATERIAL TO STORM OR SANITARY SEWERS.

SECTION VIII-PROTECTIVE EQUIPMENT TO BE USED

RESPIRATORY PROTECTION: IF WORKPLACE EXPOSURE LIMIT(S) OF PRODUCT OR ANY COMPONENT IS EXCEEDED (SEE SECTION II), A NIOSH/MSHA APPROVED AIR SUPPLIED RESPIRATOR IS ADVISED IN ABSENCE OF PROPER ENVIRONMENTAL CONTROL. OSHA REGULATIONS ALSO PERMIT OTHER NIOSH/MSHA RESPIRATORS (NEGATIVE PRESSURE TYPE) UNDER SPECIFIED CONDITIONS (SEE YOUR SAFETY EQUIPMENT SUPPLIER). ENGINEERING OR ADMINISTRATIVE CONTROLS SHOULD BE IMPLEMENTED TO REDUCE EXPOSURE.
VENTILATION: PROVIDE SUFFICIENT MECHANICAL (GENERAL AND/OR LOCAL EXHAUST) VENTILATION TO MAINTAIN EXPOSURE BELOW TLV(S).
PROTECTIVE GLOVES: WEAR RESISTANT GLOVES SUCH AS:, NEOPRENE, NITRILE RUBBER
EYE PROTECTION: CHEMICAL SPLASH GOGGLES IN COMPLIANCE WITH OSHA REGULATIONS ARE ADVISED; HOWEVER, OSHA REGULATIONS ALSO PERMIT OTHER TYPE SAFETY GLASSES. (CONSULT YOUR SAFETY EQUIPMENT SUPPLIER)
OTHER PROTECTIVE EQUIPMENT: TO PREVENT REPEATED OR PROLONGED SKIN CONTACT, WEAR IMPERVIOUS CLOTHING AND BOOTS.

SECTION IX-SPECIAL PRECAUTIONS OR OTHER COMMENTS

CONTAINERS OF THIS MATERIAL MAY BE HAZARDOUS WHEN EMPTIED. SINCE EMPTIED CONTAINERS RETAIN PRODUCT RESIDUES (VAPOR, LIQUID, AND/OR SOLID), ALL HAZARD PRECAUTIONS GIVEN IN THIS DATASHEET MUST BE OBSERVED.
THE INFORMATION ACCUMULATED HEREIN IS BELIEVED TO BE ACCURATE BUT IS NOT WARRANTED TO BE WHETHER ORIGINATING WITH THE COMPANY OR NOT. RECIPIENTS ARE ADVISED TO CONFIRM IN ADVANCE OF NEED THAT THE INFORMATION IS CURRENT, APPLICABLE, AND SUITABLE TO THEIR CIRCUMSTANCES.

LAST PAGE--------------------------------LAST PAGE

METRIC

MIL-DTL-5624T
18 September 1998
SUPERSEDING
MIL-PRF-5624S
22 November 1996

DETAIL SPECIFICATION

TURBINE FUEL, AVIATION, GRADES JP-4, JP-5, AND JP-5/JP-8 ST

This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers three grades of aviation turbine fuel NATO F-40 (JP-4), NATO F-44 (JP-5), and JP-5/JP-8 ST (see *6.1*). This specification was thoroughly reviewed as a part of acquisition reform. While most of the requirements were converted to performance terms, due to the military-unique nature of the product (see *6.1*) and the need for compatibility with deployed systems, it was determined that not all requirements could be converted. The issuance of this specification as "detail" is not intended to constrain technology advances in future systems.

1.2 Classification. Aviation turbine fuel will be of the following grades, as specified (see *6.2*).

Grade	NATO Code No.	Description
JP-4	F-40	Wide cut, gasoline type
JP-5	F-44	High flashpoint, kerosene type
JP-5/JP-8 ST		Special test fuel, high flashpoint, kerosene type, for engine development and qualification testing (see *6.1*).

1.3 References. Turbine fuels in accordance with this specification and generally referenced in other documents with grade not specified will be interpreted to also include turbine fuels in accordance with *MIL-T-83133*.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: ASC/ENSI, Bldg 560, 2530 Loop Rd, West, Wright-Patterson AFB OH 45433-7101, by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document, or by letter.

AMSC N/A

FSC 9130

DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in *sections 3* and *4* of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements documents cited in *section 3* and *4* of this specification, whether or not they are listed.

2.2 Government documents.

2.2.1 Specifications and standards. The following specifications and standards form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the *Department of Defense Index of Specifications and Standards* (*DoDISS*) and supplement thereto, cited in the solicitation (see *6.2*).

SPECIFICATIONS

DEPARTMENT OF DEFENSE

MIL-PRF-25017	Inhibitor, Corrosion/Lubricity Improver, Fuel Soluble (Metric)
MIL-I-85470	Inhibitor, Icing, Fuel System, High Flash, NATO Code Number S-1745 (Metric)

STANDARDS

DEPARTMENT OF DEFENSE

MIL-STD-290	Packaging of Petroleum and Related Products

QUALIFIED PRODUCTS LIST

QPL-25017	Inhibitor, Corrosion/Lubricity Improver, Fuel Soluble (Metric)

(Unless otherwise indicated, copies of federal and military specifications, standards, and handbooks are available from the Department of Defense Single Stock Point, Building 4D, 700 Robbins Avenue, Philadelphia PA 19111-5098.)

2.3 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents that are DoD adopted are those listed in the issue of the *DoDISS* cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the *DoDISS* are the issues of the documents cited in the solicitation (see *6.2*).

AMERICAN SOCIETY FOR TESTING AND MATERIALS STANDARDS

ASTM D56	Standard Test Method for Flash Point by Tag Closed Tester (DoD Adopted)
ASTM D86	Standard Test Method for Distillation of Petroleum Products (DoD Adopted)
ASTM D93	Standard Test Methods for Flash Point by Pensky-Martens Closed Cup Tester (DoD Adopted)
ASTM D130	Standard Test Method for Detection of Copper Corrosion from Petroleum Products by the Copper Strip Tarnish Test (DoD Adopted)
ASTM D156	Standard Test Method for Saybolt Color of Petroleum Products (Saybolt Chromometer Method) (DoD Adopted)
ASTM D323	Standard Test Method for Vapor Pressure of Petroleum Products (Reid Method) (DoD Adopted)

ASTM D381	Standard Test Method for Existent Gum in Fuels by Jet Evaporation (DoD Adopted)
ASTM D445	Standard Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (the Calculation of Dynamic Viscosity) (DoD Adopted)
ASTM D976	Standard Test Methods for Calculated Cetane Index of Distillate Fuels (DoD Adopted)
ASTM D1094	Standard Test Method for Water Reaction of Aviation Fuels (DoD Adopted)
ASTM D1266	Standard Test Method for Sulfur in Petroleum Products (Lamp Method) (DoD Adopted)
ASTM D1298	Standard Practice for Density, Relative Density (Specific Gravity), or API Gravity of Crude Petroleum and Liquid Petroleum Products by Hydrometer Method (DoD Adopted)
ASTM D1319	Standard Test Method for Hydrocarbon Types in Liquid Petroleum Products by Fluorescent Indicator Adsorption (DoD Adopted)
ASTM D1322	Standard Test Method for Smoke Point of Kerosene Aviation Turbine Fuels (DoD Adopted)
ASTM D2276	Standard Test Method for Particulate Contaminant in Aviation Fuel by Line Sampling (DoD Adopted)
ASTM D2386	Standard Test Method for Freezing Point of Aviation Fuels (DoD Adopted)
ASTM D2622	Standard Test Method for Sulfur in Petroleum Products by X-Ray Spectrometry (DoD Adopted)
ASTM D2624	Standard Test Methods for Electrical Conductivity of Aviation and Distillate Fuels Containing a Static Dissipator Additive
ASTM D2887	Standard Test Method for Boiling Range Distribution of Petroleum Fractions by Gas Chromatography (DoD Adopted)
ASTM D3120	Standard Test Method for Trace Quantities of Sulfur in Light Liquid Petroleum Hydrocarbons by Oxidative Microcoulometry (DoD Adopted)
ASTM D3227	Standard Test Method for Mercaptan Sulfur in Gasoline, Kerosene, Aviation Turbine, and Distillate Fuels (Potentiometric Method) (DoD Adopted)
ASTM D3241	Standard Test Method for Thermal Oxidation Stability of Aviation Turbine Fuels (JFTOT Procedure) (DoD Adopted)
ASTM D3242	Standard Test Method for Acidity in Aviation Turbine Fuel (DoD Adopted)
ASTM D3338	Standard Test Method for Estimation of Net Heat of Combustion of Aviation Fuels (DoD Adopted)
ASTM D3343	Standard Test Method for Estimation of Hydrogen Content of Aviation Fuels (DoD Adopted)
ASTM D3701	Standard Test Method for Hydrogen Content of Aviation Turbine Fuels by Low Resolution Nuclear Magnetic Resonance Spectrometry (DoD Adopted)
ASTM D3828	Standard Test Methods for Flash Point by Small Scale Closed Tester (DoD Adopted)
ASTM D3948	Standard Test Methods for Determining Water Separation Characteristics of Aviation Turbine Fuels by Portable Separometer (DoD Adopted)

ASTM D4052	Standard Test Method for Density and Relative Density of Liquids by Digital Density Meter (DoD Adopted)
ASTM D4057	Standard Practice for Manual Sampling of Petroleum and Petroleum Products (DoD Adopted)
ASTM D4177	Standard Practice for Automatic Sampling of Petroleum and Petroleum Products (DoD Adopted)
ASTM D4294	Standard Test Method for Sulfur in Petroleum Products by Energy-Dispersive X-Ray Fluorescence Spectroscopy (DoD Adopted)
ASTM D4306	Standard Practice for Aviation Fuel Sample Containers for Tests Affected by Trace Contamination
ASTM D4529	Standard Test Method for Estimation of Net Heat of Combustion of Aviation Fuels
ASTM D4809	Standard Test Method for Heat of Combustion of Liquid Hydrocarbon Fuels by Bomb Calorimeter (Precision Method) (DoD Adopted)
ASTM D4952	Standard Test Method for Qualitative Analysis for Active Sulfur Species in Fuels and Solvents (Doctor Test) (DoD Adopted)
ASTM D4953	Standard Test Method for Vapor Pressure of Gasoline and Gasoline-Oxygenate Blends (Dry Method)
ASTM D5006	Standard Test Method for Measurement of Fuel System Icing Inhibitors (Ether Type) in Aviation Fuels (DoD Adopted)
ASTM D5190	Standard Test Method for Vapor Pressure of Petroleum Products (Automatic Method)
ASTM D5191	Vapor Pressure of Petroleum Products (Mini Method) (DoD Adopted)
ASTM D5452	Standard Test Method for Particulate Contamination in Aviation Fuels by Laboratory Filtration
ASTM D5453	Standard Test Method for Determination of Total Sulfur in Light Hydrocarbons, Motor Fuels and Oils by Ultraviolet Fluorescence
ASTM D5901	Standard Test Method for Freezing Point of Aviation Fuels (Automatic Optical Method)
ASTM D5972	Standard Test Method for the Freezing Point of Aviation Fuels (Automated Phase Transition Method)
ASTM D6045	Standard Test Method for Color of Petroleum Products by the Automatic Tristimulus Method
ASTM E29	Standard Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications (DoD Adopted)

(Application for copies should be addressed to the American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken PA 19428-2959; (610) 832-9500.)

2.4 Order of precedence. In the event of a conflict between the text of this document and the references cited herein (except for related associated detail specifications, specification sheets, or MS standards), the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Materials. The fuels supplied under this specification shall be refined hydrocarbon distillate fuel oils which contain additives in accordance with *3.3*. The feed stock from which the fuel is refined shall be crude oils derived from petroleum, tar sands, oil shale, or mixtures thereof.

3.2 Chemical and physical requirements. The chemical and physical requirements of the finished fuel shall conform to the requirements listed in *section 3* and *tables I and II*, as applicable, when tested in accordance with the applicable test methods.

3.3 Additives. Information concerning the type and amount of each additive used shall be made available when requested by procuring activity or user.

3.3.1 Antioxidants. Immediately after processing (i.e., during the rundown into feed/batch tank) and before the fuel is exposed to the atmosphere, an approved antioxidant shall be added to all JP-5 and JP-5/JP-8 ST fuels; and to JP-4 fuels that contain blending stocks that have been hydrogen treated to prevent the formation of gums and peroxides after manufacture. JP-4 fuels that do not contain hydrogen-treated blending stocks may have the antioxidant added. The concentration of antioxidant to be added shall be as follows:

a. For JP-5, JP-5/JP-8 ST, and hydrogen treated JP-4: Not less than 17.2 mg, nor more than 24.0 mg of active ingredient per liter of fuel (6.0 to 8.4 lb/1000 barrels).

b. For those JP-4 fuels not hydrogen treated, the supplier may add not more than 24.0 mg of active ingredient per liter of fuel (8.4 lb/1000 barrels).

3.3.1.1 Formulations. The following antioxidant formulations are approved:

a. 2,6-di-tert-butyl-4-methylphenol

b. 6-tert-butyl-2,4-dimethylphenol

c. 2,6-di-tert-butylphenol

d. 75 percent min 2,6-di-tert-butylphenol
25 percent max tert-butylphenols and tri-tert-butylphenols

e. 72 percent min 6-tert-butyl-2,4-dimethyphenol
28 percent max tert-butyl-methylphenols and tert-butyl-dimethylphenols.

f. 55 percent min 2,4-dimethyl-6-tert-butylphenol and
15 percent min 2,6-di-tert-butyl-4-methylphenol and
30 percent max mixed methyl and dimethyl tert-butylphenols

3.3.2 Metal deactivator. A metal deactivator, N,N'-disalicylidene-1,2-propanediamine, may be blended into the fuel. The concentration of active material used on initial batching of the fuel at the refinery shall not exceed 2.0 mg/L. Cumulative addition of metal deactivator when redoping the fuel, shall not exceed 5.7 mg/L. Metal deactivator additive shall not be used in JP-4 or JP-5 unless the supplier has obtained written consent from the Procuring Activity and user. If JP-5 is to be used by the Navy, written consent for the use of metal deactivator shall also be obtained from NAVAIR (4.4.5).

3.3.3 Corrosion inhibitor. A corrosion inhibitor that conforms to *MIL-PRF-25017* shall be blended into the JP-4, JP-5, and JP-5/JP-8 ST fuel by the supplier. The amount added shall be equal to or greater than the minimum effective concentration and shall not exceed the maximum allowable concentration listed in the latest revision of *QPL-25017*.

3.3.4 Fuel system icing inhibitor. The use of a fuel system icing inhibitor shall be mandatory. The icing inhibitor shall be in accordance with *MIL-I-85470*. The point of injection of the additive for JP-4, JP-5, and JP-5/JP-8 ST shall be determined by agreement between the Purchasing Authority and the supplier.

3.3.5 Static dissipator additive. A static dissipator additive shall be blended into JP-4 fuel in sufficient concentration to increase the conductivity of the fuel to within the range specified in table I, at the point of injection. The point of injection shall be determined by agreement between the Purchasing Authority and the supplier. The following static dissipator additive is approved: Stadis 450®, marketed by Octel America, Newark, DE 19702. Static dissipator additive is not permitted in JP-5 to be used by the Navy unless the supplier or Procuring Activity has obtained written consent from NAVAIR (4.4.5)

3.3.6 Premixing of additives. Additives shall not be premixed with other additives before injection into the fuel so as to prevent possible reactions among the concentrated forms of different additives.

3.4 Workmanship. At the time of Government acceptance, the finished fuel shall be clear and bright and visually free from undissolved water, sediment, or suspended matter. In case of dispute, the fuel shall be clear and bright at 21°C (70°F) and shall contain no more than 1.0 mg/L of particulate matter as required in *Table I*.

TABLE I. Chemical and physical requirements and test methods.

Requirements	Grade JP-4	Grade JP-5	*Test Method ASTM Standards*
Color, Saybolt	Report	Report	*D156*[11] *or D6045*
Total acid number, mg KOH/g, max	0.015	0.015	*D3242*
Aromatics, vol percent, max	25.0	25.0	*D1319*
Sulfur, Mercaptan, mass percent, max OR	0.002	0.002	*D3227*
Doctor test	Negative	Negative	*D4952*
Sulfur, total, mass percent, max	0.40	0.40	*D1266, D2622, D3120, D4294*[11] *or D5453*
Distillation temperature, °C			*D86*[1,11] *or D2887*
(*D2887* tests in parentheses)[15]			
Initial boiling point	Report	Report	
10 percent recovered, temp	Report	206 (185)°C, max	
20 percent recovered, temp	100°C, min	Report	
50 percent recovered, temp	125°C, min	Report	
90 percent recovered, temp	Report	Report	
End point, max temp	270°C, max	300 (330)°C, max	
Residue, vol %, max (for *D86*)	1.5	1.5	
Loss, vol %, max (for *D86*)	1.5	1.5	
Flash point, °C, min		60[14]	*D56, D93*[11]*, or D3828*
Density, at 15°C			*D1298 or D4052*[11]
kg/L, min (API max)	0.751 (57.0)	0.788 (48.0)	
kg/L, max (API min)	0.802 (45.0)	0.845 (36.0)	
Vapor pressure, at 37.8°C (100°F), kPa			*D323, D4953, D5190, or D5191*[11,12]
minimum	14		
maximum	21		
Freezing point, °C, max	-58	-46	*D2386*[11]*, D5901, or D5972*[2]
Viscosity, at -20°C, max, mm^2/s		8.5	*D445*
Heating value,			
Heat of combustion, MJ/kg,	42.8	42.6	*D3338, D4809*[11]*, or D4529*

TABLE I. Chemical and physical requirements and test methods (continued)

Requirements	Grade JP-4	Grade JP-5	Test Method ASTM Standards
Calculated Cetane Index		Report	*D976*[3]
Hydrogen content, mass percent, min	13.5	13.4	*D3701*[4]
Smoke point, mm, min	20.0	19.0	*D1322*
Copper strip corrosion, 2 hr at 100°C (212°F), max	1	1	*D130*
Thermal stability:			
Change in pres. drop, mm of Hg, max	25	25	*D3241*[5]
Tube deposit code, less than	3	3	
Existent gum, mg/100 mL, max	7.0	7.0	*D381*[13]
Particulate matter, mg/L, max	1.0	1.0	*D2276 or D5452*[6, 11]
Filtration time, minutes, max	10	15[7]	[6]
Water reaction			
Interface rating, max	1b	1b	*D1094*[6]
Microseparometer rating, min	[8]	[8]	*D3948*
Fuel system icing inhibitor			*D5006*
volume percent min	0.10	0.15	[9]
volume percent max	0.15	0.20	[9]
Fuel electrical conductivity, pS/m allowable range	150 to 600[10]		*D2624*

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[1] A condenser temperature of 0° to 4°C (32° to 40°F) shall be used for the distillation of JP-5 and JP-5/JP-8 ST fuels. For JP-4, group 3 test conditions shall be used.

[2] *ASTM D5972* may be used for freeze point determination of JP-5 only.

[3] Mid-boiling temperatures may be obtained by either D86 or D2887 to perform the Cetane Indexcalculation. If D86 values are used, they should be corrected to standard barometric pressure.

[4] ASTM D3343 or ASTM D3701 may be used to measure hydrogen content of JP-4, but when measuringhydrogen content of JP-5 and JP-5/JP-8 ST fuel, only ASTM D3701 shall be used.

[5] See 4.4.2.1 for ASTM D3241 test conditions and test limits.

[6] A minimum sample size of 3.79 liters (1 gallon) shall be filtered. Filtration time will be determined inaccordance with the procedure in appendix A. The procedure in appendix A may also be used for the determination of particulate matter as an alternate to ASTM D2276 or ASTM D5452.

[7] The flow reducer ring of appendix A, A.4.c, is not required for JP-5 and JP-5/JP-8 ST fuel.

8 The minimum microseparometer rating using a Micro-Separometer (MSEP) shall be as follows:

Product	Additives	MSEP Rating, min
JP-4, JP5, and JP-5/JP-8 ST	Antioxidant (AO)*, Metal Deactivator (MDA)*	90
JP-4, JP-5, and JP-5/JP-8 ST	AO*, MDA*, and Fuel System Icing Inhibitor (FSII)*	85
JP-4, JP-5, and JP-5/JP-8 ST	AO*, MDA*, and Corrosion Inhibitor/Lubricity Improver (CI/LI)	80
JP-4, JP-5, and JP-5/JP-8 ST	AO*, MDA*, CI/LI, and FSII	70

* Even though the presence or absence of this additive does not change these limits, samples submitted for specification conformance testing shall contain the same additives present in the refinery batch.

Regardless of which minimum the refiner elects to meet, the refiner shall report the MSEP rating on a laboratory hand blend of the fuel with all additives required by the specification.

9 Tests shall be performed with ASTM D5006 using the DiEGME scale of the refractometer.

10 The conductivity must be in the range of 150 to 600 pS/m at ambient fuel temperature or 29.4°C (85°F), whichever is lower.

11 Referee Test Method.

12 When using ASTM D5191 for vapor pressure determinace of JP-4, the quality control checks, section 10, must be performed each day using two control samples as the reference pure materials. The first control sample must have a vapor pressure between 7 and 14 kPa and the second control sample must have a vapor pressure between 21 and 23 kPa.

13 If air is used instead of steam while performing ASTM D381, it must be reported. In case of a failure with air, the sample must be retested using steam.

14 ASTM D3828 may give results up to 1.7°C (3°F) below the ASTM D93 results. ASTM D56 may give results up to 1°C (2°F) below the ASTM D93 results.

15 ASTM D2887 may be used for JP-5 fuel only.

TABLE II. Chemical and physical requirements for JP-5/JP-8 ST.

Requirements	Minimum	Maximum	Test Method ASTM Standards
Aromatics, vol percent	23.0	27.0	*D1319*
Flash point, °C	60		*D56, D93, or D3828*
Density, at 15°C, kg/L (API)	0.815 (42.1)	0.845 (36.0)	*D1298* or *D4052*
Viscosity, @ -40°C, mm²/s	12		*D445*
Hydrogen content, wt percent	13.3	13.5	*D3701*
Smoke point, mm	18.0	21.0	*D1322*
NOTE: All other requirements of *table I* for grade JP-5 apply.			

4. VERIFICATION

4.1 Classification of inspections. The inspection requirements specified herein are classified as quality conformance inspection (see *4.2*).

4.2 Conformance inspection. Test for the acceptance of individual lots shall consist of tests for all requirements specified in *section 3*. Quality conformance inspection shall include the test requirement herein.

4.2.1 Inspection lot. For acceptance purposes, individual lots shall be examined as specified herein and subjected to tests for all requirements cited in *section 3*.

4.2.2 Sampling plans.

4.2.2.1 Sampling for verification of product quality. Each bulk or packaged lot (see *6.6*) of material shall be sampled for verification of product quality in accordance with *ASTM D4057* and/or *ASTM D4177*, except where individual test procedures contain specific sampling instructions.

4.2.2.1.1 Sample containers. A number of jet fuel properties are very sensitive to trace contamination that can originate from sample containers. For recommended sample containers refer to *ASTM D4306*.

4.2.2.2 Sampling for examination of filled containers for delivery. A random sample of filled containers shall be selected from each lot. The samples shall be examined in accordance with *4.4.1.3*.

4.3 Inspection conditions. The Fuel shall comply with the specified limiting values in *Table I* and *Table II*, using the cited test methods. The specified limiting values must not be changed. This precludes any allowance for test method precision and adding or subtracting digits. For purposes of determining conformance with the specified limiting values, an observed value or a calculated value shall be rounded off "to the nearest unit" in the last right-hand place of digits used in expressing the specified limiting value, in accordance with the Rounding-Off Method of *ASTM E29*.

4.4 Methods of inspection.

4.4.1 Examination of product.

4.4.1.1 Visual inspection. Samples selected in accordance with *4.2.1* shall be visually examined for compliance with *3.4*.

4.4.1.2 Examination of empty containers. Prior to filling, each empty unit container shall be visually inspected for cleanliness and suitability in accordance with *ASTM D4057*.

4.4.1.3 Examination of filled containers. Samples, taken as specified in *4.2.2* shall be examined for conformance to *MIL-STD-290* with regard to fill, closure, sealing, leakage, packaging, packing, and markings. Any container having one or more defects under the required fill shall be rejected.

4.4.2 Chemical and physical tests. Tests to determine conformance to chemical and physical requirements (see *3.2*) shall be conducted in accordance with the applicable test methods listed in *tables I* and *II*, except for those specified herein.

4.4.2.1 Thermal stability. The thermal stability test shall be conducted using *ASTM D3241* (JFTOT). The heater tube shall be rated visually (see Annex A1 of ASTM D3241).

4.4.2.1.1 Test conditions.

a. Heater tube temperature at maximum point: 260 °C (500 °F)

b. Fuel system pressure: 3.45 MPa (500 pounds/square inch of gravity)

c. Fuel flow rate: 3.0 milliliter/minute

d. Test duration: 150 minutes

4.4.2.1.2 Acceptability criteria. The fuel sample is acceptable if all the following criteria are met:

a. The maximum visual rating of the heater tube deposits is less than a code 3 (Annex A1 of ASTM D3241).

b. The visual rating of the heater tube shows neither peacock-type deposit (code P) nor abnormal-type deposits (code A).

c. The maximum differential pressure across the test filter does not exceed 25 mm of mercury.

d. Remove the reservoir cover and pour into a measuring cylinder the fuel found above the piston only. If this measured fuel is less than 405 mls, reject the test because insufficient fuel has been pumped for a normal 150-minute test. It is suggested the cause of the insufficient flow be located before another test is run.

4.4.2.1.3 *ASTM D3241* reported data.

a. Report the differential pressure in millimeters of mercury at 150 minutes, or time to differential pressure of 25 mm of mercury, whichever comes first.

b. Report the heater tube deposit code rating at the end of the test.

c. If a Mark 8A Tube deposit rater is available, the maximum SPUN TDR rating shall be reported for information purposes.

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see *6.2*). When actual packaging of material is to be performed by DoD personnel, these personnel need to contact the responsible packaging activity to ascertain requisite packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activity within the Military Department or Defense Agency, or within the Military Department's System Command. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. The JP-4 and JP-5 fuels covered by this specification are intended for use in aircraft turbine engines. These fuels require military unique additives that are necessary in military weapon systems. This requirement is unique to military aircraft, engine designs, and missions. Additionally, JP-5 is a military unique fuel because it must have a flash point substantially higher than commercial aviation turbine fuels. It is stored in large quantities on aircraft carriers and other vessels. The flash point is for safety in these military unique applications. The JP-5/JP-8 ST (special test) fuel is a worst-case kerosene-type aviation turbine fuel in terms of fuel effects on engine starting, altitude relight, combustor durability, and exhaust smoke emissions. This fuel is intended for use in the development, testing, and qualification of engine components, engines, and aircraft. When authorized, the JP-5/JP-8 ST fuel may also be used for qualification testing of ground-based turbine engines.

6.2 Acquisition requirements. Acquisition documents should specify the following:

a. Title, number, and date of this specification

b. Issue of *DoDISS* to be cited in the solicitation and, if required, the specific issue of individual documents referenced (see *2*)

c. Grade of fuel required (see *1.2*)

d. Quantity required and size containers desired

e. Level of packaging and packing required

f. Location and injection method for addition of fuel system icing inhibitor (JP-4, JP-5, and JP-5/JP-8 ST and electrical conductivity additive (JP-4 only)).

6.3 Conversion of metric units. Units of measure have been converted to the International System of Units (SI) (Metric) in accordance with *ASTM SI 10*. If test results are obtained in units other than Metric or there is a requirement to report dual units, *ASTM SI 10* should be used to convert the units.

6.4 Inspection. Inspection should be performed in accordance with *method 9601* of *FED-STD-791*.

6.5 Material Safety Data Sheets. Contracting officers will identify those activities requiring copies of completed Material Safety Data Sheets prepared in accordance with *FED-STD-313*. The pertinent Government mailing addresses for submission of data are listed in *FED-STD-313*.

6.6 Definitions.

6.6.1 Bulk lot. A bulk lot consists of an indefinite quantity of a homogeneous mixture of material offered for acceptance in a single isolated container or manufactured in a single plant run through the same processing equipment, with no change in ingredient material.

6.6.2 Packaged lot. A packaged lot consists of an indefinite number of 208-liter (55-gallon) drums or smaller unit packages of identical size and type, offered for acceptance, and filled from the isolated tank containing a homogeneous mixture of material, or filled with a homogeneous mixture of material run through the same processing equipment, with no change in ingredient material.

6.6.3 Homogeneous product. A homogeneous product is defined as a product where samples taken at various levels of the batch tank are tested for the defining homogeneous characteristics and all values obtained meet the repeatability precision requirements for that test method.

6.7 Subject term (key word) listing.

antioxidant
corrosion inhibitor

icing inhibitor
jet fuel
special test fuel
static dissipater additive

6.8 International standardization agreements. Certain provisions of this specification are the subject of international standardization agreements *ASCC Air Std 15/6*, *ASCC Air Std 15/9*, NATO *STANAG 1135*, and NATO *STANAG 3747*. When amendment, revision, or cancellation of this specification is proposed which affects or violates the international agreement concerned, the Preparing Activity will take appropriate reconciliation action through international standardization channels including the departmental standardization office, if required.

6.9 Changes from previous issue. Marginal notations are used in this revision to identify changes with respect to the previous issue.

Custodians:
Army - AT
Navy - AS
Air Force - 11
DLA - PS

Review activities:
Army - AV, AR
Air Force - 68
Navy – SH

Preparing activity:
Air Force - 11

(Project 9130-1068)

International Interest:
(See *6.8*)

MIL-DTL-5624T
APPENDIX A

METHODS FOR DETERMINATION OF FILTRATION TIME AND TOTAL SOLIDS (PARTICULATE)

A.1 SCOPE

A.1.1 Scope. This method describes a procedure to determine singularly or simultaneously the filterability characteristics and solids contamination of jet fuel. The purpose is to detect and prevent contaminants in jet fuel which can plug and cause rupture of ground filtration equipment, thereby affecting flight reliability/safety of aircraft. This appendix is a mandatory part of the specification. The information contained herein is intended for compliance.

A.2 APPLICABLE DOCUMENTS

AMERICAN SOCIETY FOR TESTING AND MATERIALS STANDARDS

ASTM D4057	Standard Practice for Manual Sampling of Petroleum and Petroleum Products (DoD Adopted)
ASTM D4177	Standard Practice for Automatic Sampling of Petroleum and Petroleum Products (DoD Adopted)
ASTM D5452	Standard Test Method for Particulate Contamination in Aviation Fuels by Laboratory Filtration

A.3 METHODS

A.3.1 Summery of methods. 3.79 liters (1 gallon) of jet fuel is filtered through a membrane filter in the laboratory. The time required to filter this volume is measured in minutes and solids content is determined gravimetrically.

A.4 APPARATUS

a. Membrane filter: White, plain 47-mm diameter, nominal pore size 0.8 micron. The membrane must be approved by ASTM for use with *ASTM D5452*.

b. Filtration apparatus: Of the types shown in *ASTM D5452, figure 2*. It consists of a funnel and funnel base with a filter support such that a membrane filter can be securely locked or clamped between the sealing surfaces of the funnel and its base. The funnel and funnel base shall be of stainless steel or glass construction.

c. Insert ring. The insert ring shall only be used with JP-4 fuel. A 47-mm diameter paper flow reducer ring with dimensions to give a filtering area of 4.8 cm^2. (Millipore Corporation Part No. XX10 04710.)

d. Vacuum flask: A minimum of 4 liters.

e. Vacuum system: That develops in excess of 67.5 kPa (20 in. of mercury) vacuum.

f. Oven: Of the static type (without fan assisted circulation) controlling to 90° ± 5°C (194° ± 9°F).

g. Forceps: Flat-bladed with unserrated, nonpointed tips.

h. Solvent filtering dispenser: Containing a 0.45 micron maximum pore size filter in the delivery line.

i. Glass Petri dish: Approximately 125 mm in diameter with removable cover.

j. Analytical balance: Single or double pan, the precision standard deviation of which must be 0.07 mg or better.

A.5 PREPARATION

A.5.1 Preparation of apparatus and sample containers. All components of the filtration apparatus (except the vacuum flask), sample containers, and their caps must be cleaned as described in *Paragraph 8* of *ASTM D5452.* All metal parts of the filtration apparatus are to be electrically bonded and grounded, including the fuel sample container and the metal insert ring, if used. See *ASTM D5452* for other safety precautions.

A.6 SAMPLING

A.6.1 Sample. Obtain a representative 3.79 liters (1 gallon) sample as directed in *Paragraph 9* of *ASTM D5452.* When sampling from a flowing stream is not possible, an all level sample or an average sample in accordance with *ASTM D4057* and/or *ASTM D4177* shall be permitted. The 3.79-liters (1-gallon) sample container shall be an interior epoxy-coated metal can, a brown glass bottle, or a clear glass bottle protected by suitable means from exposure to light.

A.7 PROCEDURE

A.7.1 Test procedure.

a. Membrane filters shall be removed from the package and placed in an oven for a minimum of 15 minutes at 90°C. After preheating, but prior to weighing, the membrane filters shall be stored in a desiccator.

b. Each membrane filter shall be weighed. A filter weighing in excess of 90 mg will not be used in the test.

c. The insert ring shall be centered on the filter base. One membrane filter shall be placed directly over the insert ring. The top funnel shall be locked into place.

d. Immediately prior to filtering the fuel, shake the sample to obtain a homogenous mix and assure that fuel temperature does not exceed 30°C (86°F). Clean the exterior or top portion of the sample container to insure no contaminants are introduced. Any free water present in the fuel sample will invalidate the filtration time results by giving an excessive filtration time rating.

e. With the vacuum off, pour approximately 200 mL of fuel into the funnel.

f. Turn vacuum on and record starting time. Continue filtration of the 3.79 liters (1 gallon) sample, periodically shaking the sample container to maintain a homogenous mix. Record the vacuum in kPa (in. of mercury) 1 minute after start and again immediately prior to completion of filtration. Throughout filtration, maintain a sufficient quantity of fuel in the funnel so the membrane filter is always covered.

g. Report the filtration time in minutes expressed to the nearest whole number. If filtration of the 3.79 liters (1 gallon) is not completed within 30 minutes, the test will be stopped and the volume of the fuel filtered will be measured. In these cases, report filtration time as ">30 minutes" and the total volume of fuel filtered.

h. Report the vacuum in kPa (in. of mercury) as determined from the average of the two readings taken in *A.7.1.f.*

i. After recording the filtration time, shut off the vacuum and rinse the sample container with approximately 100 mL of filtered petroleum ether and dispense into the filtration funnel. Turn on the vacuum and filter the 100 mL rinse. Turn off the vacuum and wash the inside of the funnel with approximately 50 mL of filtered petroleum ether. Turn on vacuum and filter. Repeat the funnel rinse with another 50 mL of petroleum ether but allow the rinse to soak the filter for approximately 30 seconds before turning on the vacuum to filter the rinse. With the vacuum on, carefully remove the top funnel and rinse the periphery of the membrane filter by directing a gentle stream of petroleum ether from the solvent dispenser from the edge of the membrane toward the center, taking care not to wash contaminants off the filter. Maintain vacuum after final rinse for a few seconds to remove the excess petroleum ether from the filter.

CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

9000000426

TRADE NAME: JET FUEL, JP-8
CAS NUMBER: 8008-20-6
SYNONYM(S): MIDDLE DISTILLATE
MSDS NUMBER: 4872
PRODUCT CODE: NA
HIERARCHY: NA
MANUFACTURER/SUPPLIER: BP Oil Company

ADDRESS: 200 Public Square, Cleveland, OH 44114-2375
TELEPHONE NUMBERS - 24 HOUR EMERGENCY ASSISTANCE:
BP America (In Ohio): 800-362-8059
BP America (Outside Ohio): 800-321-8642
CHEMTREC ASSISTANCE: 800-424-9300
TELEPHONE NUMBERS - GENERAL ASSISTANCE: (Normal Office Hours):
(8:00-4:30 M-F, EST):
Technical: 216-441-8106
MSDS Contact: 216-586-8023

COMPOSITION/INFORMATION ON INGREDIENTS

COMPONENT: Kerosine
CAS NO.: 8008-20-6
% BY WT.: 99.9 - 100
EXPOSURE LIMITS:
100 mg/m3 REL NIOSH

HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW:

Colorless/Straw/Colored Clear Liquid With a Hydrocarbon Odor.
Danger!
Harmful or Fatal If Swallowed.
Aspiration Hazard If Swallowed--Can Enter Lungs and Cause Damage.
May Be Harmful If Inhaled.
May Be Irritating To the Skin, Eyes and Respiratory Tract.
Skin Cancer Hazard Based on Tests With Laboratory Animals.
Combustible Liquid & Vapor.

POTENTIAL HEALTH EFFECTS:

SKIN:

Repeated or prolonged contact may result in defatting, redness, itching, inflammation, cracking and possible secondary infection.

High pressure skin injections are Serious Medical Emergencies. Injury may not appear serious at first; within a few hours, tissue will become swollen, discolored and extremely painful (see Notes to Physician section). Contact with heated material may cause thermal burns.

EYE:

Exposure to vapors, fumes or mists may cause irritation. Contact with heated material may cause thermal burns.

INHALATION:

May cause respiratory tract irritation. Exposure may cause central nervous system symptoms similar to those listed under "Ingestion" (see Ingestion section). Degenerative changes in the liver, kidneys and bone marrow may occur with prolonged, high concentrations. Repeated or prolonged exposures may cause behavioral changes.

INGESTION:

Aspiration into lungs may cause pneumonitis. May cause gastrointestinal disturbances. Symptoms may include irritation, nausea, vomiting and diarrhea. May cause harmful central nervous system effects. Effects may include excitation, euphoria, headache, dizziness, drowsiness, blurred vision, fatigue, tremors, convulsions, loss of consciousness, coma, respiratory arrest and death.

SPECIAL TOXIC EFFECTS:

IARC has determined that Jet Fuel is not classifiable as to its carcinogenicity to humans (Group 3). IARC has determined that occupational exposures in petroleum refining are probably carcinogenic to humans.

Warning: The use of any hydrocarbon fuel in an area without adequate ventilation may result in hazardous levels of combustion products and inadequate oxygen levels.

See Section FIRST AID MEASURES - for Medical Conditions Aggravated By Exposure.

======================= FIRST AID MEASURES =============================

SKIN:

Remove contaminated clothing immediately. Wash area of contact thoroughly with soap and water. Get medical attention if irritation persists. High pressure skin injections are serious medical emergencies. Get immediate medical attention. Thermal burns require immediate medical attention.

EYE:

Flush immediately with large amounts of water for at least 15 minutes. Eyelids should be held away from the eyeball to ensure thorough rinsing. Get medical attention if irritation results. Thermal burns require immediate medical attention.

INHALATION:

Remove affected person from source of exposure. If not breathing, ensure clear airway and institute cardiopulmonary resuscitation (CPR). If breathing is difficult, administer oxygen if available. After administration of oxygen, continue to monitor closely. Get medical attention.

INGESTION:

Do not induce vomiting because of danger of aspirating liquid into lungs. Get immediate medical attention. If spontaneous vomiting occurs, monitor for breathing difficulty.

NOTES TO PHYSICIAN:

In case of ingestion, gastric lavage with activated charcoal can be used promptly to prevent absorption. Consideration should be given to the use of an endotracheal tube, to prevent aspiration. Individuals intoxicated by middle distillates should be hospitalized immediately, with acute and continuing attention to neurologic and cardiopulmonary function. Positive pressure ventilation may be necessary. After the initial episode, individuals should be followed for changes in blood variables and the delayed appearance of pulmonary edema and chemical pneumonitis. Such patients should be followed for several days or weeks for delayed effects, including bone marrow toxicity, hepatic and renal impairment. Individuals with chronic pulmonary disease will be more seriously impaired, and recovery from inhalation exposure may be complicated. Avoid emesis unless a large amount has been ingested or it contains a toxic additive. Gastric lavage after endotracheal intubation should be reserved for a patient who requires GI decontamination and is lethargic or obtunded. Safe use of activated charcoal and cathartic should be considered if ingested. Mineral oil cathartics should not be given to patients. Saline cathartics or sorbitol is preferable. In case of skin injection, prompt debridement of the wound is necessary to minimize necrosis and tissue loss.

====================== FIREFIGHTING MEASURES ============================

FLASH POINT: > 37.7778 C (100 F) TCC

AUTOIGNITION TEMPERATURE: 210 C (410 F)
FLAMMABILITY LIMITS IN AIR (% BY VOL.) LOWER: > 0.7
FLAMMABILITY LIMITS IN AIR (% BY VOL.) UPPER: < 5

HAZARDOUS COMBUSTION PRODUCTS:

Combustion may produce CO, CO2 and reactive hydrocarbons.

BASIC FIRE FIGHTING PROCEDURES:

Use water spray, dry chemical, foam or carbon dioxide to extinguish fire. Use water spray to cool fire-exposed containers, structures and to protect personnel. If leak or spill has not ignited, ventilate area and use water spray to disperse gas or vapor and to protect personnel attempting to stop leak. Use water to flush spills away from sources of ignition. Do not flush down public sewers or other drainage systems. Exposed firefighters must wear MSHA/NIOSH approved positive pressure self-contained breathing apparatus with full face mask and full protective clothing.

UNUSUAL FIRE & EXPLOSION HAZARDS:

Dangerous when exposed to heat or flame. Containers may explode in heat of fire. Runoff to sewer may cause fire or explosion hazard. Irritating and/or toxic substances may be emitted upon thermal decomposition.

ACCIDENTAL RELEASE MEASURES

If your facility or operation has an "Oil or Hazardous Substance Contingency Plan", activate its procedures. Take immediate steps to stop and contain the spill. Caution should be exercised regarding personnel safety and exposure to the spilled material. For technical advice and assistance related to chemicals, contact CHEMTREC (800/424-9300) and your local fire department. Notify the National Response Center, if required. Also notify appropriate state and local regulatory agencies, the LEPC and the SERC. Contact the local Coast Guard if the release is into a waterway.

Keep unnecessary people away; isolate hazard area and deny entry. Stay upwind; keep out of low areas. (Also see Personal Protection Information section.) Isolate for 1/2 mile in all directions if tank, rail car or tank truck is involved in fire.
Shut off ignition sources; no flares, smoking or flames in hazard area. Stop leak if you can do it without risk. Water spray may reduce vapor; but it may not prevent ignition in closed spaces. Small Spills: Take up with sand or other noncombustible absorbent material and place into containers for later disposal. Large Spills: Dike far ahead of liquid spill for later disposal.

When reporting a spill to the National Response Center or the Coast Guard, you may need to supply the Coast Guard Chemical Hazard Response Information System (CHRIS) code:

Group Number: 33
CHRIS Code: JPE

Additional spill related information may be found in the U.S. Coast Guard Chemical Hazard Response Information System (CHRIS) Manual.

During an accidental release, personal protection equipment may be required (see Section EXPOSURE CONTROLS/PERSONAL PROTECTION). Additional regulatory requirements may apply (see Section REGULATORY INFORMATION).

====================== HANDLING AND STORAGE ============================

HANDLING:

Use non-sparking tools. Ground lines and equipment used during transfer to reduce the possibility of static spark-initiated fire or explosion. Use good personal hygiene practices. Wash hands before eating, drinking, smoking, or using toilet facilities. Remove contaminated clothing and clean before reuse. Wash thoroughly after work using soap and water.

Empty containers may contain toxic, flammable/combustible or explosive residue or vapors. Do not cut, grind, drill, weld, reuse or dispose containers unless adequate precautions are taken against these hazards.

STORAGE:

Store in tightly closed containers in cool, dry, isolated, well-ventilated area away from heat, sources of ignition and incompatibles.

============== EXPOSURE CONTROLS / PERSONAL PROTECTION ===================

ENGINEERING CONTROLS:

Ventilation and other forms of engineering controls are often the preferred means for controlling chemical exposures.

PERSONAL PROTECTION EQUIPMENT (PPE):

EYE PROTECTION:

Avoid eye contact with this material. Wear chemical safety goggles. Provide an eyewash station immediately accessible to the work area.

Do not wear contact lenses when working with this substance.

SKIN PROTECTION:

Avoid skin contact. When working with this substance, wear appropriate chemical protective gloves. Depending upon conditions of use, additional protection may be necessary such as face shield, apron, armcovers, etc.

RESPIRATORY PROTECTION:

If exposure limits are exceeded or if irritation is experienced, NIOSH approved respiratory protection should be worn. Respiratory protection may be needed for non-routine or emergency situations.

See Section COMPOSITION/INFORMATION ON INGREDIENTS For Exposure Guidelines.

PHYSICAL AND CHEMICAL PROPERTIES

BOILING POINT:	148.9 C (300.02 F)
SP. GRAVITY (Water=1):	0.825 @ 15.56 C (60.008 F)
MELTING POINT:	NA
% VOLATILE:	100
VAPOR PRESSURE:	0.4 MM HG @ 20 C (68 F)
EVAPORATION RATE:	Slower
VAPOR DENSITY (Air=1):	4.7
VISCOSITY:	1.3 - 2.2 CST @ 37.8 C (100.04 F)
% SOLUBILITY IN WATER:	Negligible
POUR POINT:	-34.4 C (-29.92 F)
pH:	ND
BULK DENSITY:	ND
MOLECULAR WEIGHT:	NA
MOLECULAR FORMULA:	Mixture

ODOR/APPEARANCE:
Colorless/Straw/Colored Clear Liquid With a Hydrocarbon Odor.

STABILITY AND REACTIVITY

STABILITY/INCOMPATIBILITY:

Stable. Avoid contact with strong oxidizers.

TOXICOLOGICAL INFORMATION

EYE EFFECTS:

Slightly Irritating. Rabbit Draize = 2.0/110.

SKIN EFFECTS:

Practically Non-Toxic (Acute Exposure). Rabbit dermal LD50 = >5 ml/kg. Moderately To Severely Irritating. Rabbit dermal PSI = 5.5.

ACUTE ORAL EFFECTS:

Moderately Toxic (Acute Exposure). Human oral LDLo = @10 mls. Rat oral LD50 = > 5 g/kg.

ACUTE INHALATION EFFECTS:

Practically Non-Toxic (Acute Exposure). Rat 4-hour LC50 = > 5 mg/L.

SENSITIZATION:

Based on the results obtained in a guinea pig dermal sensitization test, this product is not considered to be a skin sensitizer.

CHRONIC EFFECTS / CARCINOGENCITY:

Results from a lifetime chronic skin painting study indicate that skin tumors may be formed with repeated and prolonged skin contact.

MUTAGENICITY:

This component was tested in a variety of mutagenicity assays and the results were generally negative. However, this product was positive in a Mouse Lymphoma Assay. This material has been shown to induce a genetic change in a bacterial test system (Modified Ames).

DISPOSAL CONSIDERATIONS

WASTE DISPOSAL (Resource Conservation & Recovery Act - RCRA):

This material, when discarded or disposed of, is a characteristic hazardous waste according to Federal regulations (40 CFR 261). This material exhibits the characteristic of ignitable and is assigned the EPA Hazardous Waste Number of D001. The discarding or disposal of this material must be done at a properly permitted facility in accordance with the regulations of 40 CFR 262, 263, 264, and 268. Additionally, the discarding or disposal of this material may be further regulated by state, regional, or local regulations. Chemical additions, processing or otherwise altering this material may make the waste management information presented in this MSDS incomplete, inaccurate, or otherwise inappropriate. The transportation, storage, treatment and disposal of this waste material must be conducted in compliance with all applicable Federal, state, and local regulations.

There may be specific current regulations at the local, regional, or state level that pertain to this information. Chemical additions, processing, or otherwise altering this material may make the waste

TRANSPORT INFORMATION

U.S. DEPARTMENT OF TRANSPORTATION (D.O.T.):

Proper Shipping Name (49 CFR 172.101): Fuel, Aviation, Turbine Engine
Hazard Class (49 CFR 172.101): 3
UN/NA Code (49 CFR 172.101): UN 1863
Packing Group (49 CFR 179.101): PG III
Bill Of Lading Desc. (49 CFR 172.101): Fuel, Aviation, Turbine Engine, 3, UN 1863, PG III
Labels Required (49 CFR 172.101): Flammable Liquid
Placards Required (49 CFR 172.101): Flammable

INTERNATIONAL AND DOMESTIC AIR TRANSPORTATION:

IATA Proper Shipping Name: Fuel, Aviation, Turbine Engine
Hazard Class: 3
Subsidiary Risk: None
UN Code: UN 1863
Package Specification: 309, 4309, 310
Labels Required: Flammable Liquid, Orientation Arrows

INTERNATIONAL WATER TRANSPORTATION:

IMDG Proper Shipping Name: Fuel, Aviation, Turbine Engine
Hazard Class: 3.2
UN Code: UN 1863
IMDG Page Number: 3271
Labels Required: Flammable Liquid, Orientation Arrows
Placards Required: Flammable

CANADIAN TRANSPORTATION OF DANGEROUS GOODS (T.D.G.):

Shipping Name: Fuel, Aviation, Turbine Engine
PIN (UN/NA): UN 1863
Regulated Class: 3
Division: NA
Packaging Group: PG III
Labels Required: Flammable Liquid, Orientation Arrows

Placards Required: Flammable

REGULATORY INFORMATION

NOTIFICATION:

Any spill or release, or substantial threat of release, of this material to navigable water (virtually any surface water) sufficient to cause a visible sheen upon the water must be reported immediately to the National Response Center (800/424-8802), as required by U.S. Federal Law. Failure to report may result in substantial civil and criminal penalties. Also contact the Coast Guard and appropriate state and local regulatory agencies.

US EPA TOXIC SUBSTANCE CONTROL ACT (TSCA):

All components of this product are listed on the TSCA inventory.

US EPA SUPERFUND AMENDMENTS & REAUTHORIZATION ACT (SARA) TITLE III INFORMATION:

Listed below are the hazard catagories for SARA Section 311/312 (40 CFR 370):

Immediate Hazard: X
Delayed Hazard: X
Fire Hazard: X
Pressure Hazard: -
Reactivity Hazard: -

CANADIAN ENVIRONMENTAL PROTECTION ACT (CEPA):

All components of this product are listed on the Canadian DSL Inventory.

CANADIAN WORKPLACE HAZARDOUS MATERIALS INFORMATION SYSTEM (WHMIS) CATEGORIES:

The following WHMIS categories apply to this product:

Compressed Gas:	-	Other Toxic Effects:	X
Flammable/Combustible:	X	Bio Hazardous:	-
Oxidizer:	-	Corrosive:	-
Acutely Toxic:	X	Dangerously Reactive:	-

OTHER INFORMATION

NFPA RATINGS:		HMIS RATINGS:	
Health:	0	Health:	0
Flammability:	2	Flammability:	2

Reactivity: 0   Reactivity: 0
Special Hazards: -   Personal Protective Equipment:H

REVISION DATE: 13-jun-1996
REPLACES SHEET DATED: 11-jul-1995
COMPLETED BY: BP OIL HSEQ DEPARTMENT
REVISION SUMMARY: The following section(s) have been revised since the previous issue of this MSDS:

- COMPOSITION/INFORMATION ON INGREDIENTS
- HAZARDS IDENTIFICATION
- FIRST AID MEASURES
- FIREFIGHTING MEASURES
- HANDLING AND STORAGE
- EXPOSURE CONTROLS / PERSONAL PROTECTION
- PHYSICAL AND CHEMICAL PROPERTIES
- TOXICOLOGICAL INFORMATION
- DISPOSAL CONSIDERATIONS
- TRANSPORT INFORMATION
- REGULATORY INFORMATION
- OTHER INFORMATION

ND: No Data NA: Not Applicable *See specific note or sectionVMSmail To information:
CLVX11::MRGATE::"Mci_gateway::MCIMAIL::H*CHARGE:PMPRS_MSDS,FORM:BPOIL",CLVX11::MRGATE::"Mci_gateway::MciMail::COUNTRY:USA ::CODE:46554 ::STATE:IN ::CITY:MISHAWAKA :

METRIC

MIL-DTL-83133E
1 April 1999
SUPERSEDING
MIL-T-83133D
29 January1992

DETAIL SPECIFICATION

TURBINE FUELS, AVIATION, KEROSENE TYPES, NATO F-34 (JP-8), NATO F-35, AND JP-8+100

This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 **Scope.** This specification covers three grades of kerosene type aviation turbine fuel, NATO F-34 (JP-8), NATO F-35, and JP-8+100. This specification was thoroughly reviewed as a part of acquisition reform. While most of the requirements were converted to performance terms, due to the military-unique nature of the product (see *6.1*) and the need for compatibility with deployed systems, it was determined that not all requirements could be converted. The issuance of this specification as "detail" is not intended to constrain technology advances in future systems.

1.2 **Classification.** Aviation turbine fuel will be of the following grades, as specified (see *6.2*).

NATO Code No./Grade	Description
F-35	Kerosene type turbine fuel which will contain a static dissipator additive, may contain antioxidant, corrosion inhibitor/lubricity improver, and metal deactivator but will not contain fuel system icing inhibitor.
F-34 (JP-8)	Kerosene type turbine fuel which will contain a static dissipator additive, corrosion inhibitor/lubricity improver, and fuel system icing inhibitor, and may contain antioxidant and metal deactivator.
JP-8+100	F-34 (JP-8) type kerosene turbine fuel which contains thermal stability improver additive as described in *Para 3.3.6.*

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: ASC/ENSI Bldg 560, 2530 Loop Rd., West, Wright-Patterson AFB, OH 45433-7107, by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document, or by letter.

AMSC N/A **FSC 9130**

DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited.

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in *sections 3* and *4* of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements documents cited in *sections 3* and *4* of this specification, whether or not they are listed.

2.2 Government documents

2.2.1 Specifications and standards. The following specifications and standards form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the *Department of Defense Index of Specifications and Standards (DoDISS)* and supplement thereto, cited in the solicitation (see *6.2*).

SPECIFICATIONS

DEPARTMENT OF DEFENSE

MIL-DTL-5624	- Turbine Fuel, Aviation, Grades JP-4, JP-5 and JP-5/JP-8 ST
MIL-PRF-25017	- Inhibitor, Corrosion/Lubricity Improver, Fuel Soluble (Metric)
MIL-DTL-85470	- Inhibitor, Icing, Fuel System, High Flash NATO Code Number S-1745 (Metric)

STANDARDS

DEPARTMENT OF DEFENSE

MIL-STD-290	- Packaging of Petroleum and Related Products

QUALIFIED PRODUCTS LIST

QPL-25017	- Inhibitor, Corrosion/Lubricity Improver, Fuel Soluble

(Unless otherwise indicated, copies of the above specifications, standards, and handbooks are available from the Department of Defense Single Stock Point, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5098).

2.3 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DoD adopted are those listed in the issue of DoDISS specified in the solicitation. Unless otherwise specified, the issues of documents not listed in the DoDISS are the issues of the documents cited in the solicitation (see 6.2).

AMERICAN SOCIETY FOR TESTING AND MATERIALS STANDARDS

ASTM D56	- Standard Test Method for Flash Point by Tag Closed Tester (DoD Adopted)
ASTM D86	- Standard Test Method for Distillation of Petroleum Products (DoD Adopted)
ASTM D93	- Standard Test Methods for Flash Point by Pensky-Martens Closed Cup Tester (DoD Adopted)
ASTM D129	- Standard Test Methods for Sulfur in Petroleum Products (General Bomb Method)

ASTM D130 - Standard Test Methods for Detection of Copper Corrosion from Petroleum Products by the Copper Strip Tarnish Test (DoD Adopted)

ASTM D156 - Standard Test Method for Saybolt Color of Petroleum Products (Saybolt Chromometer Method) (DoD Adopted)

ASTM D381 - Standard Test Method for Existent Gum in Fuels by Jet Evaporation (DoD Adopted)

ASTM D445 - Standard Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (the Calculation of Dynamic Viscosity) (DoD Adopted)

ASTM D976 - Standard Test Methods for Calculated Cetane Index of Distillate Fuels (DoD Adopted)

ASTM D1094 - Standard Test Method for Water Reaction of Aviation Fuels (DoD Adopted)

ASTM D1266 - Standard Test Methods for Sulfur in Petroleum Products (Lamp Method) (DoD Adopted)

ASTM D1298 - Standard Practice for Density, Relative Density (Specific Gravity), or API Gravity of Crude Petroleum and Liquid Petroleum Products by Hydrometer Method (DoD Adopted)

ASTM D1319 - Standard Test Method for Hydrocarbon Types in Liquid Petroleum Products by Florescent Indicator Adsorption (DoD Adopted)

ASTM D1322 - Standard Test Method for Smoke Point of Kerosene Aviation Turbine Fuels (DoD Adopted)

ASTM D1840 - Standard Test Method for Naphthalene Hydrocarbons in Aviation Turbine Fuels by Ultraviolet Spectrophotometry (DoD Adopted)

ASTM D2276 - Standard Test Method for Particulate Contaminant in Aviation Fuel by Line Sampling (DoD Adopted)

ASTM D2386 - Standard Test Method for Freezing Point of Aviation Fuels (DoD Adopted)

ASTM D2622 - Standard Test Method for Sulfur in Petroleum Products by X-Ray Spectrometry (DoD Adopted)

ASTM D2624 - Standard Test Method for Electrical Conductivity of Aviation and Distillate Fuels Containing a Static Dissipater Additive

ASTM D2887 - Standard Test Method for Boiling Range Distribution of Petroleum Fractions by Gas Chromatography (DoD Adopted).

ASTM D3120 - Standard Test Method for Trace Quantities of Sulfur in Light Liquid Petroleum Hydrocarbons by Oxidation Microcoulometry (DoD Adopted)

ASTM D3227 - Standard Test Method for Mercaptan Sulfur in Gasoline, Kerosene, Aviation Turbine, and Distillate Fuels (Potentiometric Method) (DoD Adopted).

ASTM D3241 - Standard Test Method for Thermal Oxidation Stability of Aviation Turbine Fuels (JFTOT Procedures) (DoD Adopted)

ASTM D3242 - Standard Test Method for Acidity in Aviation Turbine Fuel (DoD Adopted)

ASTM D3338 - Standard Test Method for Estimation of Heat of Combustion of Aviation Fuels (DoD Adopted)

ASTM D3343 - Standard Test Method for Estimation of Hydrogen Content of Aviation Fuels (DoD Adopted)

ASTM D3701 - Standard Test Method for Hydrogen Content of Aviation Turbine Fuels by Low Resolution Nuclear Magnetic Resonance Spectrometry (DoD Adopted)

ASTM D3828	- Standard Test Methods For Flash Point by Small Scale Closed Tested (DoD Adopted)
ASTM D3948	- Standard Test Methods for Determining Water Separation Characteristics of Aviation Turbine Fuels by Portable Separometer (DoD Adopted)
ASTM D4052	- Standard Test Method for Density and Relative Density of Liquids by Digital Density Meter (DoD Adopted)
ASTM D4057	- Standard Practice for Manual Sampling of Petroleum and Petroleum Products (DoD Adopted)
ASTM D4177	- Standard Practice for Automatic Sampling of Petroleum and Petroleum Products (DoD Adopted)
ASTM D4294	- Standard Test Method for Sulfur in Petroleum Products by Energy Dispersive X-Ray Fluorescence Spectroscopy (DoD Adopted)
ASTM D4306	- Standard Practice for Aviation Fuel Sample Containers for Tests Affected by Trace Contamination
ASTM D4809	- Standard Test Method for Heat of Combustion of Liquid Hydrocarbon Fuels by Bomb Calorimeter (Precision Method) (DoD Adopted)
ASTM D4952	- Standard Test Method for Qualitative Analysis for Active Sulfur Species in Fuels and Solvents (DoD Adopted)
ASTM D5006	- Standard Test Method for Measurement of Fuel System Icing Inhibitors (Ether Type) in Aviation Fuels
ASTM D5452	- Standard Test Method for Particulate Contamination in Aviation Fuels by Laboratory Filtration
ASTM D5453	- Standard Test Method for Determination of Total Sulfur in Light Hydrocarbons, Motor Fuels and Oils by Ultraviolet Fluorescence
ASTM D5901	- Standard Test Method for Freezing Point of Aviation Fuels (Automatic Optical Method)
ASTM D5972	- Standard Test Method for the Freezing Point of Aviation Fuels (Automated Phase Transition Method)
ASTM D6045	- Standard Test Method for Color of Petroleum Products by the Automatic Tristimulus Method
ASTM E29	- Standard Practice for Using Significant Digits in the Test Data to Determine Conformance with the Specifications (DoD Adopted)

(Application for copies should be addressed to the American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959; (610)-832-9500).

2.4 Order of precedence. In the event of a conflict between the text of this document and the references cited herein, (except for related associated specifications or specification sheets), the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Materials. The fuel supplied under this specification shall be refined hydrocarbon distillate fuel oils containing additives in accordance with *3.3*. The feed stock from which the fuel is refined shall be crude oils derived from petroleum, tar sands, oil shale, or mixtures thereof.

3.2 Chemical and physical requirements. The chemical and physical requirements of the finished fuel shall conform to those listed in *table I*.

3.3 Additives. The type and amount of each additive used shall be made available when requested by procurement activity or user. (see *6.2.e*).

3.3.1 Antioxidants. Immediately after processing and before the fuel is exposed to the atmosphere (i.e., during rundown into feed/batch tankage), add an approved antioxidant (see *3.3.1.1*) in order to prevent the formation of gums and peroxides after manufacture. The concentration of antioxidant to be added shall be:

a. Not less than 17.2 mg nor more than 24.0 mg of active ingredient per liter of fuel (6.0 to 8.4 lb/1000 barrels) to all JP-8 fuel that contains blending stocks that have been hydrogen treated.

b. At the option of the supplier, not more than 24.0 mg of active ingredient per liter of fuel (8.4 lb/1000 barrels) may be added to JP-8 fuels that do not contain hydrogen treated blending stocks.

3.3.1.1 Antioxidant formulations. The following antioxidant formulations are approved:

a. 2,6-di-tert-butyl-4-methylphenol

b. 6-tert-butyl-2,4-dimethylphenol

c. 2,6-di-tert-butylphenol

d. 75 percent min-2,6-di-tert-butylphenol
25 percent max tert-butylphenols and tri-tert-butylphenols

e. 72 percent min 6-tert-butyl-2,4-dimethyphenol
28 percent max tert-butyl-methylphenols and tert-butyl-dimethylphenols

f. 55 percent min 2,4-dimethyl-6-tert-butylphenol and
15 percent min 2,6-di-tert-butyl-4-methylphenol and
30 percent max mixed methyl and dimethyl tert-butylphenols

3.3.2 Metal deactivator. A metal deactivator, N,N'-disalycylidene-1,2-propanediamine, may be blended into the fuel. The concentration of active material used on initial batching of the fuel at the refinery shall not exceed 2.0 mg/L. Cumulative addition of metal deactivator when redoping the fuel, shall not exceed 5.7 mg/L. Metal deactivator additive shall not be used in JP-8 unless the supplier has obtained written consent from the Procuring Activity and user.

3.3.3 Static dissipater additive. An additive shall be blended into the fuel in sufficient concentration to increase the conductivity of the fuel to within the range specified in *table I* at the point of injection. The point of injection of the additive shall be determined by agreement between the purchasing authority and the supplier. The following electrical conductivity additive is approved: Stadis 450 marketed by Octel America, Inc., Newark, DE 19702.

3.3.4 Corrosion inhibitor. A corrosion inhibitor conforming to *MIL-PRF-25017* shall be blended into the F-34 (JP-8) grade fuel by the contractor. The corrosion inhibitor additive is optional for F-35. The amount added shall be equal to or greater than the minimum effective concentration and shall not exceed the maximum allowable concentration listed in the latest revision of *QPL-25017*. The contractor or transporting agency, or both, shall maintain and upon request shall make available to the Government evidence that the corrosion inhibitors used are equal in every respect to the qualification products listed in *QPL-25017*. The point of injection of the corrosion inhibitor shall be determined by agreement between the purchasing authority and the supplier.

TABLE I. Chemical and physical requirements and test methods.

Property	Min	Max	Test Methods ASTM Standards
Color, Saybolt Total Acid number, mg KOH/gm Aromatics, vol percent		[1/] 0.015 25.0	*D156* [2/] *or D6045* *D3242* *D1319*
Sulfur, total, mass percent		0.30	*D129, D1266, D2622, D3120, D4294* [2/] *or D5453*
Sulfur Mercaptan, mass percent OR Doctor Test		0.002 negative	*D3227* *D4952*
Distillation Temperature, °C [3/] (D2887 limits given in parentheses) Initial boiling point 10 percent recovered 20 percent recovered 50 percent recovered 90 percent recovered End point Residue, vol percent Loss, vol percent		 [1/] 205 (186) [4/] [1/] [1/] 300(330) 1.5 1.5	*D86* [2/]*, D2887*
Flash point, °C Density or Gravity Density, kg/L at 15° C OR Gravity, API at 60°F	38 0.775 37.0	[4/] 0.840 51.0	*D56, D93* [2/] *or D3828* [4/] *D1298 or D4052* [2/] *D1298*
Freezing point, °C Viscosity, at -20°C, mm²/s Net heat of combustion, MJ/kg	 42.8	-47 8.0	*D 2386* [2/]*, D 5901 or D5972* *D445* *D3338* [5/] *or D4809* [2/]
Hydrogen content, mass percent Smoke point, mm, OR Smoke point, mm, AND Naphthalene, vol percent	13.4 25.0 19.0	 3.0	*D3701* [2/]*, D3343* *D1322* *D1322* *D1840*
Calculated Cetane Index Copper strip corrosion, 2hr at 100°C (212°F) Thermal stability change in pressure drop, mm Hg heater tube deposit, visual rating		[1/] No. 1 25 <3 [12/]	*D976* [6/] *D130* *D3241* [2/]
Existent gum, mg/100 ml Particulate matter, mg/L Filtration time, minutes Water reaction interface rating Water separation index Fuel system icing inhibitor, vol % Fuel electrical conductivity, ps/m	 [9/] 0.10 [11/]	7.0 1.0 15 1 b 0.15 [11/]	*D381* *D2276* [8/] *or D5452* [2/] [8/] *D1094* *D3948* *D5006* [10/] *D2624*

1/ To be reported - not limited.

2/ Referee Test Method.

3/ A condenser temperature of 0° to 4° C (32° to 40°F) shall be used for the distillation by *ASTM D86*.

4/ *ASTM D56* may give results up to 1° C (2° F) below the *ASTM D93* results. *ASTM D3828* may give results up to 1.7° C (3° F) below the *ASTM D93* results. Method IP170 is also permitted.

5/ When the fuel distillation test is performed using *ASTM D2887*, the average distillation temperature, for use in *ASTM D3338* shall be calculated as follow:

$$V = (10\% + 50\% + 95\%)/3$$

6/ Mid-boiling temperature may be obtained by either *ASTM D86* or *ASTM D2887* to perform the cetane index calculation. *ASTM D86* values should be corrected to standard barometric pressure.

7/ See *4.5.3* for *ASTM D3241* test conditions and test limitations.

8/ A minimum sample size of 3.79 liters (1 gallon) shall be filtered. Filtration time will be determined in accordance with procedure in *appendix A*. This procedure may also be used for the determination of particulate matter as an alternate to *ASTM D2276* or *ASTM D5452*.

9/ The minimum microseparometer rating using a Micro-Separometer (MSEP) shall be as follows:

JP-8 Additives	MSEP Rating, min.
Antioxidant (AO)*, Metal Deactivator (MDA)*	90
AO*, MDA*, and Fuel System Icing Inhibitor (FSII)	85
AO*, MDA*, and Corrosion Inhibitor/Lubricity Improver (CI/LI)	80
AO*, MDA*, FSII and CI/LI	70

*Even though the presence or absence does not change these limits, samples submitted for specification conformance testing shall contain the same additives present in the refinery batch. Regardless of which minimum the refiner elects to meet, the refiner shall report the MSEP rating on a laboratory band blend of the fuel with all additives required by the specification.

10/ Test shall be performed in accordance with *ASTM D5006* using the DiEGME scale of the refractometer.

11/ The conductivity must be between 150 and 450 pS/m for F-34 (JP-8) and between 50 and 450 pS/m for F-35, at ambient temperature or 29.4°C (85°F), whichever is lower, unless otherwise directed by the procuring activity. In the case of JP-8+100, JP-8 with the thermal stability improver additive (see *3.3.6*), the conductivity limit must be between 150 to 700 pS/m at ambient temperature or 29.4°C (85°F), whichever is lower, unless otherwise directed by the procuring activity.

12/ Peacock or Abnormal color deposits result in a failure.

3.3.5 Fuel system icing inhibitor. The use of a fuel system icing inhibitor shall be mandatory for NATO F-34 (JP-8) and shall conform to *MIL-DTL-85470*. The point of injection of the additive for NATO F-34 (JP-8) shall be determined by agreement between the Purchasing Authority and the supplier. The fuel system icing inhibitor is not to be added to NATO F-35 unless so directed by the Purchasing Authority.

3.3.6 Thermal stability improver additive. Due to logistical concern, personnel at the operating location shall request written approval from the cognizant activity to add a thermal stability improver additive to the fuel. If approval is given, the concentration of the additive and location of injection shall be specified by the cognizant service activity listed below. JP-8 fuel with an approved thermal stability improver additive at the required concentration shall be designated as JP-8+100. Thermal stability improver additive shall not be used in JP-8 without approval, in writing, from:

Cognizant Activity for the Navy and Marine Corps: Naval Air Systems Command, AIR-4.4.5, Bldg 2360 PSEF, 22229 Elmer Road, Patuxent River, MD 20670-1534.

Cognizant Activity for the Air Force and all other DoD agencies: AFRL/PRSF, Bldg 490, 1790 Loop Road N, WPAFB, OH 45433-7103.

Cognizant Activity for the Army: US Army Tank-automotive and Armaments Command, AMSTA-TR/210, Warren, MI 48397-5000.

3.3.6.1 **Qualified additives.** Qualified thermal stability improver additives are listed in *table II.*

TABLE II Qualified Thermal Stability Improver Additives

Additive Name	Qualification Reference	Manufacturer
SPEC AID 8Q462	AFRL/PRSF Ltr, 9 Dec 97	BetzDearborn 9669 Grogan Mill Road P.O. Box 4300 The Woodlands TX 77387
AeroShell Performance Additive 101	AFRL/PRSF Ltr, 13 Jan 98	Shell Aviation Ltd. Shell-Mex House Strand London WC2R 0ZA

3.3.7 **Premixing of additives.** Additives shall not be premixed with other additives before injection into the fuel so as to prevent possible reactions among the concentrated forms of different additives.

3.4 **Workmanship.** At the time of Government acceptance, the finished fuel shall be visually free from undissolved water, sediment, or suspended matter and shall be clear and bright. In case of dispute, the fuel shall be clear and bright at 21°C (70°F) and shall contain no more than 1.0 mg/L of particulate matter as required in *table I.*

4. VERIFICATION

4.1 **Classification of inspections.** The inspection requirements specified herein are classified as quality conformance inspections (see *4.2*).

4.2 **Conformance inspection.** Test for acceptance of individual lots shall consist of tests for all requirements specified in *section 3.* Quality conformance inspection shall include the test requirement herein.

4.2.1 **Inspection lot.** For acceptance purposes, individual lots shall be examined as specified herein and subjected to tests for all requirements cited in *section 3.*

4.3 Inspection.

4.3.1 **Inspection conditions.** The fuel shall comply with the specified limiting values in *table I*, using the cited test methods. The specified limiting values must not be changed. This precludes any allowance for test method precision and adding or subtracting digits. For the purposes of determining conformance with the specified limiting values, an observed value or a calculated value shall be rounded off "to the nearest unit" in the last right-hand place of digits used in expressing the specified limiting value, in accordance with the Rounding-Off Method of *ASTM E29.*

4.4 Sampling plans.

4.4.1 **Sampling.** Each bulk or packaged lot of material shall be sampled for verification of product quality in accordance with *ASTM D4057* or *ASTM D4177*, except where individuals test procedures contain specific sampling instructions.

4.4.2 Sampling for inspection of filled containers. A random sample of filled containers shall be selected from each lot and shall be subjected to the examination of filled containers as specified in *4.5.1.3*.

4.5 Methods of inspection.

4.5.1 Examination of product.

4.5.1.1 Visual inspection. Samples selected in accordance with *4.4.1* shall be visually examined for compliance with *3.4*.

4.5.1.2 Examination of empty containers. Before filled, each unit container shall be visually inspected for cleanliness and suitability in accordance with *ASTM D4057*.

4.5.1.3 Examination of filled containers. Samples taken as specified in *4.4.2* shall be examined for conformance to *MIL-STD-290* with regard to fill, closure, sealing, leakage, packaging, packing, and markings. Any container with one or more defects under the required fill shall be rejected.

4.5.2 Chemical and physical tests. Tests to determine conformance to chemical and physical requirements shall be conducted in accordance with *table I*. The fuel shall pass all tests listed in *table I*. No additional testing shall be required. Requirements contained herein are not subject to corrections for test tolerances. If multiple determinations are made, results falling within any specified repeatability and reproducibility tolerances may be averaged. For rounding off of significant figures, *ASTM E29* shall apply to all tests required by this specification.

4.5.3 Thermal stability tests. The thermal stability test shall be conducted using *ASTM D3241*. The heater tube shall be rated visually (*see Annex A1 of ASTM D3241*).

4.5.3.1 *ASTM D3241* test conditions

a. Heater tube temperature at maximum point: 260°C (500°F).

b. Fuel system pressure: 3.45 MPa (500 psig).

c. Fuel flow rate: 3.0 mL/min.

d. Test duration: 150 minutes.

4.5.3.2 Acceptability criteria. The fuel sample is acceptable if all the following criteria are met:

a. The maximum differential pressure across the test filter does not exceed 25 millimeters of mercury.

b. The maximum visual rating of the heater tube deposits are less than a code 3, and visual rating of the heater tube shows neither peacock type deposits (code P) nor abnormal type deposits (code A).

c. Remove the reservoir cover and pour into a measuring cylinder the fuel found above the piston only. If this measured fuel is less than 405 mls, reject the test because insufficient fuel has been pumped for a normal 150 minute test. It is suggested to locate the cause of the insufficient flow before running another test.

4.5.3.3 *ASTM D3241* reported data. The following data shall be reported:

a. Differential pressure in millimeter of mercury at 150 minutes, or time to differential pressure of 25 millimeters of mercury, whichever comes first.

b. Heater tube deposit visual code rating at the end of the test.

c. If a Mark 8A tube deposit rater (TDR) is available, the maximum SPUN TDR rating shall be reported.

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see *6.2*). When actual packaging of materiel is to be performed by DoD personnel, these personnel need to contact the responsible packaging activity to ascertain requisite packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activity within the Military Department or Defense Agency, or within the Military Department's System Command. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products or by contacting the responsible packaging activity.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory).

6.1 Intended use. The fuels covered by this specification are intended for use in aircraft turbine engines. JP-8 contains military unique additives that are required by military weapon systems. This requirement is unique to military aircraft and engine designs. When authorized, NATO F-34 (JP -8) may be used in ground - based turbine and diesel engines. NATO F-35 is intended for commercial aviation, but can be converted to NATO F-34 (JP-8) by the addition of the appropriate additives. A JP-5/JP-8 ST (special test) fuel, included in *MIL-DTL -5624*, is intended for use in the development and qualification testing of engines and aircraft designed to operate with JP-5 and JP-8.

6.2 Acquisition requirements. Acquisition documents must specify the following:

a. Title, number, date of this specification, and grade (type) of fuel.

b. Issue of DoDISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see *2*).

c. Quantity required and size containers desired.

d. Level of packaging and packing required (see *5.1*).

c. Location and injection method for addition of electrical conductivity additive, fuel system icing inhibitor and corrosion inhibitor, as required.

6.3 Conversion of metric units. Units of measure have been converted to the International System of Units (SI) (Metric) in accordance with *ASTM SI 10*. If test results are obtained in units other than metric or there is a requirement to report dual units, *ASTM SI 10*, should be used to convert the units.

6.4 Definitions.

6.4.1 Bulk lot. A bulk lot consists of an indefinite quantity of a homogeneous mixture of material offered for acceptance in a single isolated container or manufactured in a single plant run through the same processing equipment, with no change in ingredient material.

6.4.2 Packaged lot. A packaged lot consists of an indefinite number of 208-liter (55-gallon) drums, or smaller unit packages of identical size and type, offered for acceptance and filled from an isolated tank containing a homogeneous mixture of material; or filled with a homogeneous mixture of material run through the same processing equipment with no change in ingredient material.

6.4.3 Homogeneous product. A homogeneous product is defined as a product where samples taken at various levels of the batch tank are tested for the defining homogeneous characteristics and all values obtained meet the repeatability precision requirements for that test method.

6.5 Subject term (key word) listing

Antioxidants
Aviation fuel
Corrosion inhibitor
Fuel
F-34
F-35
Flash point
Freezing point
Hydrocarbon distillate fuel
Hydrogen content
Icing inhibitor
JP-8
JP-8+100
Jet A-1
Kerosene
Lubricity improver
Static dissipator
Thermal stability improver
Turbine

6.6 International agreements. Certain provisions of this specification are the subject of international standardization agreement *ASCC Air Std 15/6*, *ASCC Air Std 15/9*, *NATO STANAG 1135*, and *NATO STANAG 3747*. When amendment, revision, or cancellation of this specification is proposed which will modify the international agreement concerned, the preparing activity will take appropriate action through international standardization channels including departmental standardization offices, to change the agreement or make other appropriate accommodations.

6.7 Material Safety Data Sheet. Contracting officers will identify those activities requiring copies of completed Material Safety Data Sheets prepared in accordance with *FED-STD-313*. The pertinent Government mailing addresses for submission of data are listed in *FED-STD-313*.

6.8 Test report. Test data required by *4.5* should be available for the procurement activity and user in the same order as listed in *table* I. The Inspection Data on Aviation Turbine Fuels form published in *ASTM D1655* should be used as a guide. Also, the type and amount of additives used should be reported

6.9 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

Custodian:
Army - MR
Navy - AS
Air Force - 11
DLA – PS

Review Activities:
Army - AV, AR
Air Force – 68

Preparing Activity:
Air Force - 11

Project 9130-1067

International Interest:
(See *6.6*)

MIL-DTL-83133E
APPENDIX A

METHODS FOR DETERMINATION OF FILTRATION TIME AND TOTAL SOLIDS (PARTICULATE)

A.1 GENERAL

A.1.1 Scope. This method describes a procedure for determining singularly or simultaneously the filterability characteristics and solids contamination of jet fuel. The purpose is to detect and prevent contaminants in jet fuel that can plug and cause rupture of ground filtration equipment, thereby affecting flight reliability of aircraft.

A.2 APPLICABLE DOCUMENTS

AMERICAN SOCIETY FOR TESTING AND MATERIALS STANDARDS

ASTM D4057	Standard Practice for Manual Sampling of Petroleum and Petroleum Products
ASTM D4177	Standard Method for Automatic Sampling of Petroleum and Petroleum Products
ASTM D5452	Standard Test Method for Particulate Contamination in Aviation Fuels by Laboratory Filtration

A.3 METHODS

A.3.1 Summary of methods. 3.79 liters (1 gallon) of jet fuel is filtered through a membrane filter in the laboratory. The time required to filter this volume is measured in minutes and solids content is determined gravimetrically.

A.4 APPARATUS

a. Membrane filter: White, plain 47 mm diameter, nominal pore size 0.8 micron. The membrane must be approved by ASTM for use with *ASTM D5452*

b. Filtration apparatus: Of the types shown in *ASTM D5452 figure 2*. It consists of a funnel and funnel base with a filter support such that a membrane filter can be securely locked or clamped between the sealing of the funnel and its base. The funnel and funnel base shall be of stainless steel or glass construction.

c. Inset ring: A 47-mm diameter paper flow reducer ring with dimensions to give filtering area of 4.8 cm^2. (Millipore Corporation Part No. XX10 04710.)

d. Vacuum flask: A minimum of 4 liters.

e. Vacuum system: That develops in excess of 67.5 kPa (20 inches of mercury) vacuum.

f. Oven: Of the static type (without fan assisted circulation) controlling to 90° ± 5° C (194° ± 9° F).

g. Forceps: Flat-bladed with unserrated nonpointed tips.

h. Solvent filtering dispenser: Containing a 1.2 micron maximum pore size filter in the delivery line.

i. Glass petri dish: Approximately 125 mm in diameter with removable cover.

j. Analytical balance: Single or double pan, the precision standard deviation of which must be 0.07 mg or better.

A.5 PREPARATION

A.5.1 Preparation of apparatus and sample containers. All components of the filtration apparatus (except the vacuum flask), sample containers and their caps must be cleaned as described in *paragraph 8* of *ASTM D5452*. All metal parts of the filtration apparatus are to be electrically bonded and grounded, including the fuel sample container and the metal insert ring, if used. See *ASTM D5452* for other safety precautions.

A.6 SAMPLING

A.6.1 Sampling. Obtain a representative 3.79 L (1 gallon) sample as directed in *paragraph 9* of *ASTM D5452*. When sampling from a flowing stream is not possible, an all level sample or an average sample, in accordance with *ASTM D4057* and/or *ASTM D4177* shall be permitted. The 3.79 L (1 gallon) sample container shall be an interior epoxy-coated metal can, a brown glass bottle, or a clear glass bottle protected by suitable means from exposure to light.

A.7 PROCEDURE

A.7.1 Test procedure.

a. Membrane filters shall be removed from the package and placed in an oven for a minimum of 15 minutes to 90° C. After preheating, but prior to weighing, the membrane filters shall be stored in a desiccator.

b. Each membrane filter shall be weighed. A filter weighing in excess of 90 mg will not be used in the test.

c. The membrane filter shall be placed directly over the insert ring. The top funnel shall be locked into place.

d. Immediately prior to filtering the fuel, shake the sample to obtain a homogeneous mix and assure that fuel temperature does not exceed 30° C (86° F). Clean the exterior or top portion of the sample container to ensure that no contaminants are introduced. Any free water present in the fuel sample will invalidate the filtration time results by giving an excessive filtration time rating.

e. With the vacuum off, pour approximately 200 ml of fuel into the funnel.

f. Turn vacuum on and record starting time. Continue filtration of the 3.79 liters (1 gallon) sample, periodically shaking the sample container to maintain a homogenous mix. Record the vacuum in kPa (inches of mercury) 1 minute after start and again immediately prior to completion of filtration. Throughout filtration, maintain a sufficient quantity of fuel in the funnel so that the membrane filter is always covered.

g. Report the filtration time in minutes expressed to the nearest whole number. If filtration of the 3.79 liters (1 gallon) is not completed within 30 minutes, the test will be stopped and the volume of the fuel filtered will be measured. In these cases, report filtration time as ">30 minutes" and the total volume of fuel filtered.

h. Report the vacuum in kPa (inches of mercury) as determined from the average of the two readings taken in *A.7.f.*

i. After recording the filtration time, shut off the vacuum and rinse the sample container with approximately 100 ml of filtered petroleum ether and dispense into the filtration funnel. Turn the vacuum on and filter the 100 ml. Rinse. Turn vacuum off and wash the inside of the funnel with approximately 50 ml of filtered petroleum ether. Turn vacuum on and filter. Repeat the funnel rinse with another 50 ml of petroleum ether but allow the rinse to soak the filter for approximately 30 seconds before turning the vacuum on to filter the rinse. With vacuum on, carefully remove the top funnel and rinse the periphery of the membrane filter by directing a gentle stream of petroleum ether from the solvent dispenser from the edge of the membrane toward the center, taking care not to wash contaminants off the filter. Maintain vacuum after final rinse for a few seconds to remove the excess petroleum ether from the filter.

j. Using forceps, carefully remove the membrane filter from the filter and place in a clean petri dish. Dry in the oven at 90° C (194° F) for 15 minutes with the cover on the petri dish slightly ajar. Place dish in a desiccator and allow to cool for a minimum of 15 minutes. If more than one sample is processed, cooling time will have to be increased. Reweigh the filter.

k. Report the total solids content in mg/liter by using the following formula:

$$\frac{\text{Weight gain of filter in mgs}}{3.785} = \text{mg/liter}$$

l. Should the sample exceed the 30-minute filtration time and a portion of the fuel is not filtered, the solids content in mg/liter will be figured as follows: Determine the volume of fuel filtered by subtracting the ml of fuel remaining from 3.785.

$$\frac{\text{Weight gain of filter in mgs}}{\text{ml of fuel filtered X 0.001}} = \text{mg/liter}$$

A.8 LIMITS

A.8.1 Test limits.

a. Filtration time:

(1) The maximum allowable filtration time shall be 15 minutes for Grade JP-8.

(2) The vacuum should exceed 67.5 kPa (20 inches of mercury) throughout the test (i.e., the differential pressure across the filter should exceed 67.5 kPa (20 inches of mercury)).

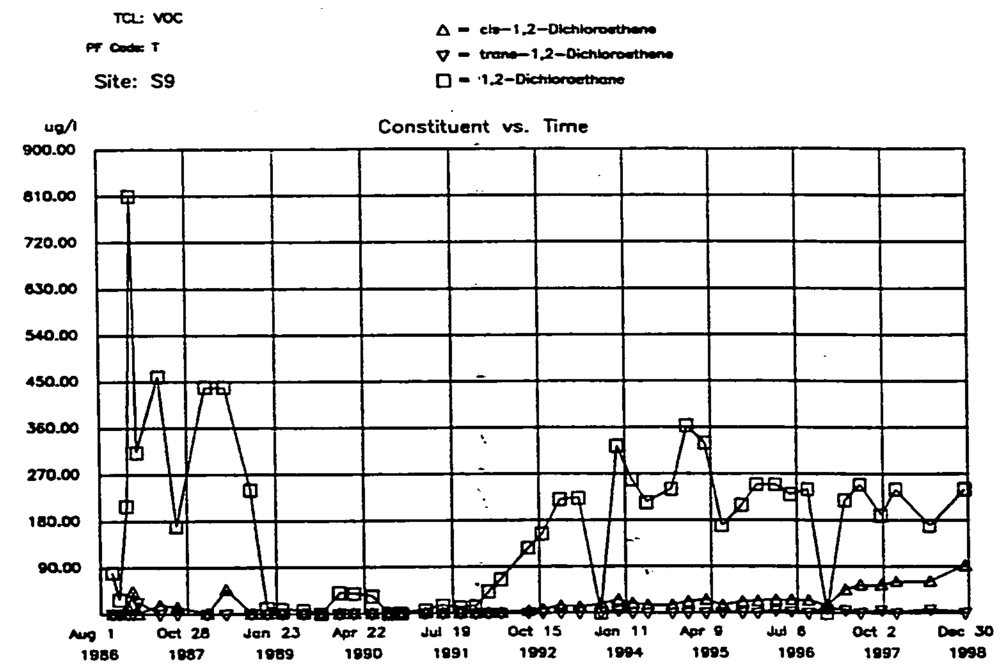
(3) The fuel temperature shall be between 18° and 30° C (64° and 86° F). If artificial heat (i.e., a hot water bath) is used to heat the sample, erroneously high filtration times may occur, but this approach is allowed.

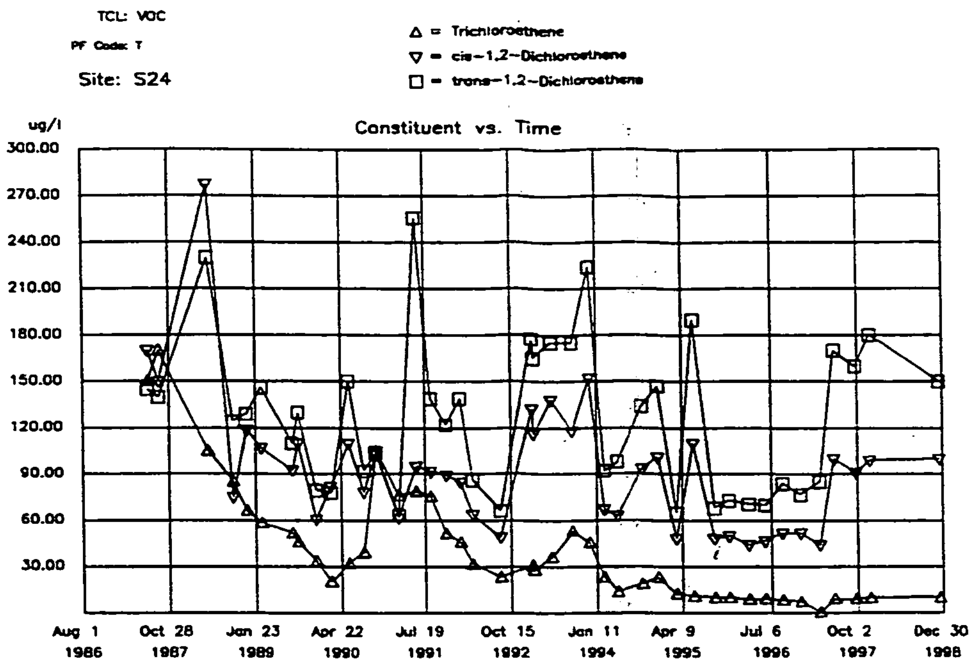
b. Total solids: Maximum allowable particulate matter is 1.0 mg/liter.

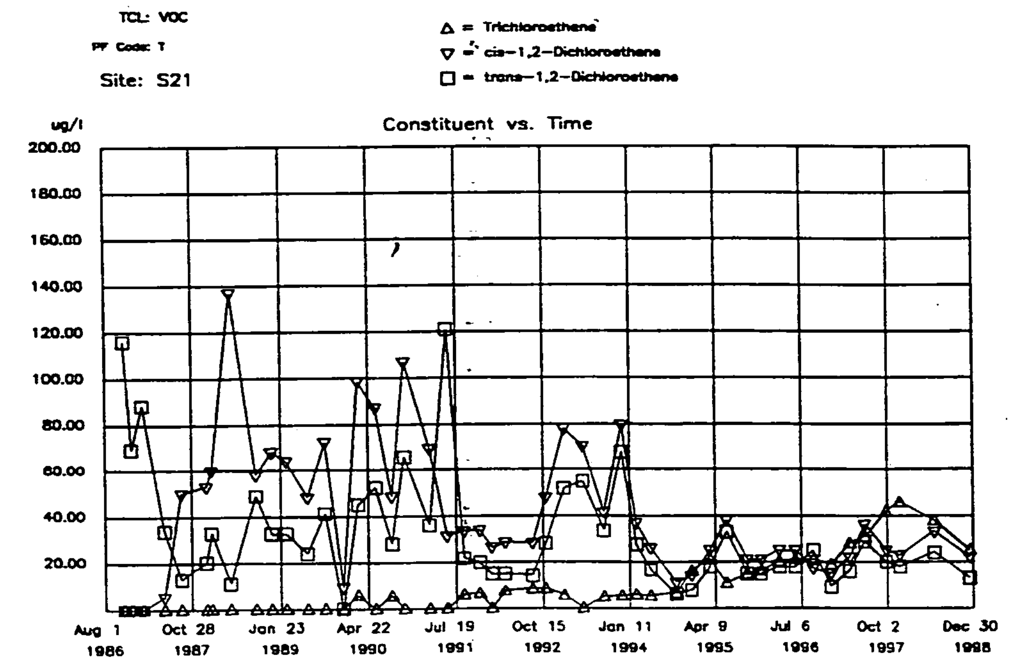
A.9 NOTES

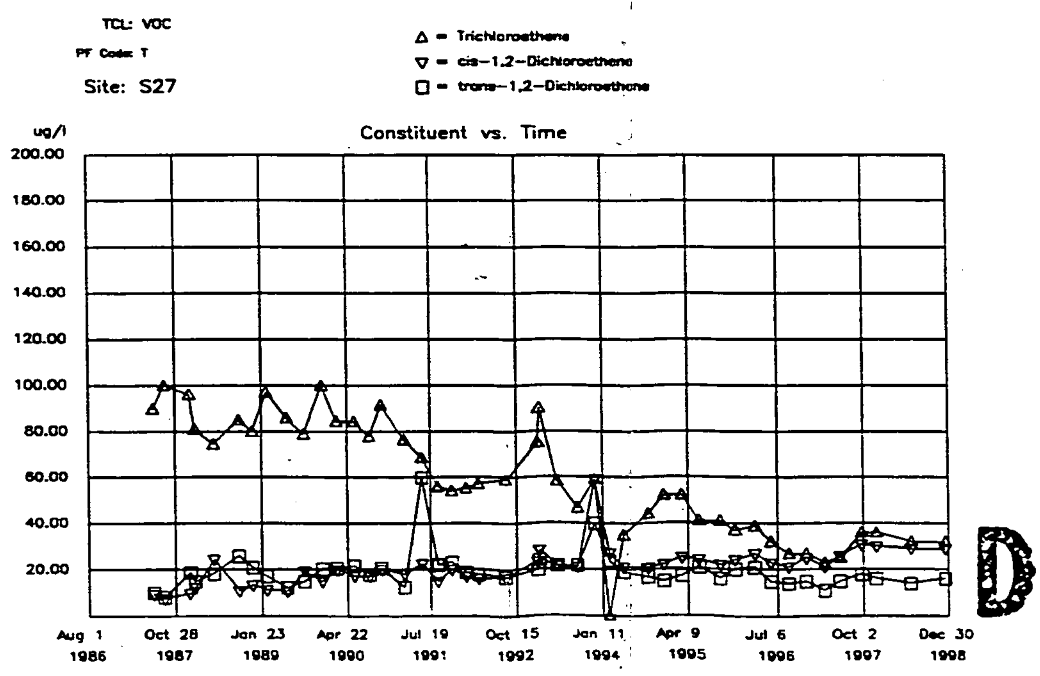
A.9.1 If it is desired to determine the filtration time and not the total solids content, perform the test by omitting steps *A.6.i*, *A.6.j*, *A.6.k*, and *A.6.l*.

A.9.2 If it is desired to determine the total solids content and not the filtration time, use of the insert ring may be omitted. It is also permissible, but not required, to use a control filter for a specific analysis or a series of analyses. When this is accomplished, the procedures specified in *ASTM D5452* apply.









DRAFT

0 400 800
Scale in feet

CHEMICAL TREND LINE PLOTS, OFF-SITE GROUNDWATER PLUME

ALLIEDSIGNAL INDUSTRIAL COMPLEX
SOUTH BEND, INDIANA

Harding Lawson Associates

\9822-13\98221002.DWG 5/5/99 EJL

1996 Tier II Cleanup Goals, Indiana Voluntary Remediation Program

Constituent		On-Site Soil 1996 Tier II Industrial	On-Site Groudwater 1996 Tier II Industrial	Off-Site Groundwater 1996 Tier II Residential
VOLATILE ORGANIC COMPOUNDS (VOC)		(mg/kg)	(mg/L)	(mg/L)
Gasoline/ Painting Solvents	Benzene	4.77	0.0986	0.005
	Ethylbenzene	1,000	10.22	0.7
	Toluene	1,000	20.44	1
	Xylene	1,000	204.4	10
	Acetone	136.29	10.22	3.04
Stoddard/ Naphthas	Isopropylbenzene	NL	NL	NL
	2-Methylnaphthalene	NL	NL	NL
	Naphthalene	10,000	4.088	1.216
	n-Propylbenzene	NL	NL	NL
	1,2,4-Trimethylbenzene	NL	NL	NL
	1,3,5-Trimethylbenzene	NL	NL	NL
Chlorinated Solvents	Chlorobenzene	NL	NL	NL
	1,1-Dichloroethane	1,000	10.22	0.64
	1,1-Dichloroethene	0.08	0.007	0.007
	1,2-Dichloroethane	0.37	0.0314	0.005
	cis-1,2-Dichloroethene	102.49	1.022	0.07
	trans-1,2-Dichloroethene	NL	NL	NL
	Methylene Chloride	NL	NL	NL
	Methyl Ethyl Ketone	146.24	5.11	0.91772
	Tetrachloroethene	8.01	0.0561	0.005
	Trichloroethene	25.73	0.26	0.005
	1,1,1-Trichloroethane	1,000	9.198	0.2
	Vinyl Chloride	0.13	0.01	0.002
	Chloroethane	1,000	NL	23.16075
TOTAL PETROLEUM HYDROCARBONS (TPH)				
	JP-4	1,000	Analyze for individual constituents	Analyze for individual constituents
	JP-5 or Jet A	1,000		
	Lube oil or Waste Oil	10,000		
SEMI-VOLATILE ORGANIC COMPOUNDS/POLYCHLORINATED BIPHENYLS (SVOC)				
Polynuclear Aromatic Hydrocarbons	Benzo (b) Fluoranthene	354.98	0.01	0.0002
	Benzo (k) Fluoranthene	3,759.12	0.0392	0.0002
	Fluoranthene	10,000	0.8176	0.2432
	Naphthalene	10,000	4.088	1.216
	Phenanthrene	NL	NL	NL
	Pyrene	10,000	3.066	0.912
Phenols	2-Methylphenol	375.93	5.11	1.52
	2,4-Dimethylphenol	NL	NL	NL
	4-Methylphenol	427.24	5.11	1.52
	Total Phenols	658.78	12.264	3.648
PCBs	PCBs, total	4.23	0.0007	0.0005
INORGANICS				
Metals	Arsenic	438	0.05	0.05
	Cadmium	730	0.0511	0.005
	Chromium VI	7,300	0.511	0.1
	Chromium III	10,000	102.2	0.1
	Total Chromium	NL	NL	NL
	Cyanide	10,000	2.044	0.2
	Lead	NL	NL	NL
	Mercury	87.6	0.0061	0.002
	Nickel	10,000	2.044	0.1
	Selenium	7,300	0.511	0.05
	Zinc	10,000	30.66	9.12

Note: NL = not listed; a cleanup objective was not published in the 1996 VRP Guidance Document

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June 14, 1999

Mr. Ray White
AlliedSignal Inc.
Aerospace Equipment Systems
717 North Bendix Drive
South Bend, IN 46620

FILE COPY

Re: Phase II Review
AlliedSignal Inc.
VRP #:6980601

AlliedSignal Inc.
717 North Bendix Drive
South Bend, IN

Dear Mr. White:

This letter presents the findings of the Voluntary Remediation Program and its consultant's review of the April 1998 Voluntary Site Investigation (VSI) report for the AlliedSignal Industrial Complex located in South Bend, Indiana. These comments cover the Voluntary Site Investigation document, its appendices, and the following supporting documentation:

Preliminary Assessment Visual Site Inspection, August 12, 1991
Semi-Annual Groundwater Monitoring Report, July 1998
Design and Installation Report - VOC Recovery System Rehabilitation, September 1998
Soil Management Report, November 1998

The VSI was reviewed as a stand alone document with respect to the IDEM VRP Phase Investigation Report outline, as established in the July 1996 *VRP Resource Guide*. The purpose of the review was to determine if the VSI satisfied all specific reporting requirements and to assess the technical merit and completeness of the site investigation. Attempts to review the VSI with respect to the *Risk-Integrated System of Cleanups* Public Draft document dated October 21, 1997 were difficult due to the existence of a February 1999 update.

Based on our review, we make the following comments and recommendations regarding the AlliedSignal VSI:

1. The last paragraph in Section 1.0 (p 1-2) states, "The VSI was executed in accordance with the Work Plan, Quality Assurance Project Plan, Health and Safety Plan and associated amendments prepared by ABB. However, no Work Plan, Quality Assurance Project Plan, or Health and Safety Plan were submitted for review.

2. Section 2.1 describes the property around the AlliedSignal Complex as including mixed residential and Figure 2-1 depicts most of the land surrounding the complex as residential in nature. As such, unless AlliedSignal has control of the property, residential cleanup goals and residential exposure scenarios apply to off-site media and site-related contamination.

3. No prepared laboratory analytical or quality control reports were provided with this document. Rather, summary tables of the analytical data are included as Appendix K.

4. Section 2.3 discusses the occurrence of naptha/Stoddard solvent with the following highlights:

   - Naptha/Stoddard solvent was reported seeping through the floor of the Plant 2 basement;

   - One recovery well (EW-3) reportedly recovered 1,500 gallons of product daily; and

   - In 1981, Geraghty & Miller concluded that a 1- to- 10- foot-thick layer of naptha/Stoddard solvent was floating on the water table in an area that covered 40 acres within the complex.

It was then further reported that the naptha recovery system was effective, the free-product plume was stable, and in some areas the free-product plume was shrinking. Please provide a greater level of detail associated with the naptha recovery system. The success of the recovery system has not been supported with data.

5. The VRP performance standard requires that all free product be removed or a system be in pace to remove free product. Has this been accomplished?

6. Please provide material safety data sheets for the naptha/Stoddard solvent used at the site.

7. What was the cumulative volume of the naptha/Stoddard solvent recovered?

8. Was a specific source or release attributable for this volume of free product? Please clarify.

9. Section 5.1.2 (bottom of page 5-4) indicates that sediment samples collected from the pond contained no constituents "at levels of concern." Please define 'level of concern.' It is not apparent that a site-specific ecological assessment was prepared for purposes of evaluating ecological concerns associated with the site. As such, which screening criteria were used to make the claim that no constituents were present at levels of concern?

10. Under Riparian Areas (p 5-5), the statement is made that the ground water quality data indicate that the plume is stable. How was plume stability evaluated? How was the plume defined? Please clarify.

11. How was the leading edge of the plume defined: with respect to RBSLs or estimated quantitation limits (EQLs)?

12. How were wastes generated while advancing soil boring, monitoring well development, and well sampling activities (*i.e.*, soil cuttings, well development water, and purge water) disposed? Were waste characterization analyses performed? If so, where are the resulting data?

13. Section 4.1.6 (p 4-7) that monitoring well MW-6 was sampled for volatiles using a peristaltic pump. The use of a peristaltic pump is known to induce volatile loss. As such, an

alternative sampling technique is recommended.

14. Figure 4-1, which depicts sample locations, is illegible. A larger scale map would be very useful.

- Please provide maps that clearly identify cone penetrometer test locations, sample locations, and monitoring and recovery wells.

15. Section 4.2 indicates that level 3 data quality objectives (DQOs) were used to provide data for possible evaluation of site-specific risks and remedial alternatives. The IDEM guidance requires the use of level 4 DQOs for site-specific risk evaluations Please differentiate between the data quality levels (field data versus engineering analysis) and identify the components included in the deliverable packages.

16. Section 4.2.2 discusses data "usability" and indicates that ABB reviewed each data package to evaluate its usability. "The data were flagged with qualifiers as necessary to indicate its usability." Did ABB flag the data? Typically, the laboratory would flag the data. Please clarify, as no laboratory sheets were included with the submittal.

17. Section 4.4 defines risk-based screening levels (RBSLs). As no single source contained "...a complete set of RBSLs appropriate for screening the site, the RBSLs used during the VSI were selected from the following..." Please clearly and define 'appropriate' in terms of site-applicability. Why were criteria "selected?" One alternative for constituents with no VRP criteria is to use the EQL.

18. It is not apparent that the RBSLs (Section 4.4), which include MCLs, Michigan Department of Environmental Quality Generic Cleanup Criteria, and VRP goals, are appropriate for this project. As the site has entered into the IDEM VRP, the most applicable goals would be the IDEM VRP or the IDEM RISC values.

19. The RISC (1997) values were used in the AlliedSignal risk assessment as Tier I values. However, the RISC sampling methodologies and associated protocols were not explicitly followed. In addition, a revised RISC (1999) document has been released.

20. Please provide a reference for using "20 times the groundwater" (Section 4.4.1) as a conservative measure of evaluating the leaching to ground water pathway. Why weren't the VRP Tier II subsurface soil values used? Page 111 of the VRP guidance document states that the Tier II subsurface soil values *do* account for a leaching-to-ground water pathway.

21. Page 4-13 indicates that VRP Tier II non-residential goals were used for constituents with no MCLs. Why weren't the VRP Tier II *residential* goals used? They are likely to be more closely related to the MCLs than the non-residential goals. See also Comment 3.

22. The third paragraph on page 5-10 references Figure 5-4 as illustrating the effectiveness of the Plant 1 and Plant 9 VOC recovery system to "inhibit" off-site migration of ground water from the this area. Please provide additional clarification and supporting information that the recovery system is acting to inhibit the off-site migration of ground water.

- As shown on Figure 5-4, ground water in the vicinity of Plant 9 appears to flow to the north-northeast and north-northwest. Ground water in the vicinity of Plant 1, Areas 14 and 15, appears to flow off-site to the south and southwest. Based on the potentiometric surface maps provided, it is not apparent that the current system is inhibiting the off-site migration of ground water.

- Figures 3 and 4 (Semi-Annual Ground Water Monitoring Report, 1998) show cones of depression surrounding four and two, respectively, VOC recovery wells. However, there is no indication that recovery well interference is occurring. Recovery well interference is desirable to limit the off-site migration of contamination. Ideally, the cones of depression associated with the recovery wells would influence or overlap one another so as to limit off-site migration of contamination.

- Given the current distribution of monitoring and recovery wells and water level data from these wells, it is not apparent that an effective capture zone exists. Please provide additional supporting information.

23. Section 5.1.4 discusses chemical distribution in ground water. Please clearly identify constituents and their relationship in terms of the naptha/Stoddard solvent, the chlorinated solvents, and the volatile fuel compounds. Are the chlorinated VOCs in ground water associated with the naptha/Stoddard solvent? What constituents are associated with the volatile fuel compounds? Please clarify.

24. Page 5-13 (5th paragraph) states, 'These impacts are likely residual constituents from the former free-product plume which once covered this area." Which free-product plume is being discussed? Is this the naptha/Stoddard solvent, volatile fuel compound, the chlorinated VOCs, or are they one in the same?

25. Section 5.1.4.1, second paragraph, indicates that the low levels of VOCs detected in ground water at well S-1 are *not* attributed to site-related activities. Please support this assertion. What is the source of VOC contamination at well S-1?

26. The DNR (1987; Figure 24) identifies four significant ground water facilities located to the north and northwest of the AlliedSignal complex. Three of these sites are identified as containing several facilities. Three are also likely to be located within one mile of the AlliedSignal Complex. Why weren't these facilities discussed as part of the baseline hydrogeologic assessment (Section 5.1.1)? A minimum, these facilities should be identified and discussed in the Remediation Work Plan (RWP). (*Reference*: DNR, 1987, Water resource availability in the St. Joseph River basin, Indiana: Department of Natural Resources Division of Water, Water Resource Assessment 87-1, 139 p.)

27. Sections 5.13.1, 5.13.2 and 5.13.5 indicate that the extent of soil and ground water contamination associated with degreasing Areas 1, 2, and 5 has not been defined with respect to RBSLs. Are further soil and/or ground water investigations planned for the painting and degreasing Area 1, Area 2, and Area 5 to determine the extent of contamination? Of note is that the RISC (1997) document requires delineation of contamination to estimated quantitation limits (EQLs) (p 81).

28. Were detection limits sufficiently conservative for purposes of achieving cleanup goals?

29. The site conceptual model should, at minimum, include ecological receptors. Because surface soil was identified as a source, volatilization and particulate emission should be identified as a release mechanism. As well, surface soil should be included as a potentially

contaminated medium.

30. Section 6.1.2 states that COCs are those constituents that exceeded RBSLs "where the frequency of detection, maximum concentration, and persistence/toxicity were significant enough to warrant further evaluation." Please explain 'significance' in this context and provide clarification regarding how a constituent, although it's concentration exceeded a RBSL, could be eliminated as warranting further evaluation.

31. The first bulleted item on page 6-6 indicates that PCBs in Area 3/11 will be evaluated separately. Will a separate evaluation be submitted to the VRP for evaluation?

32. Section 6.1.3 (2nd paragraph) states, "When calculating the arithmetic mean of reported concentrations, one-half the analytical quantitation limit was used as the reported concentration for results reported as not-detected (i.e., results assigned a "U" or "<" qualifier). Conversely, the arithmetic mean of detected concentrations was calculated using only results reported as detected." Does this mean that if a result were <0.1, the value used in the risk evaluation as the reported value is 0.05? Or, was the result eliminated from the evaluation because it wasn't a detected concentration? Please clarify.

33. The IDEM VRP guidance (1996) identifies surface soil as the upper two feet of soil rather than the first 12 inches, as is identified on page 6-6 of the VSI.

34. The statement, "The presence of pavement and/or release history at other AOCs precludes the need to collect surface soil at those AOCs (see Section 5)." The presence of pavement may be considered a barrier to limit exposure; however, it does not explicitly preclude the necessity to conduct sampling. The potential for either construction or utility activities to take place (digging through surface soils) has not been eliminated. Thus, a potentially complete exposure scenario exists. Table 6-3 identifies the commercial/industrial worker exposure via inhalation of volatiles and particulates to site soil as a complete pathway.

- Surface soil samples were *only* collected from Area 3/11 (p 6-16). As such, the statement (p 6-16), "Therefore, there are no industrial surface soil HPL exceedances under the present site conditions" is very misleading and implies that surface soil samples were collected site-wide.

35. Section 6.2.1 identifies sources consulted for information regarding future and current land use of the Complex and surrounding area. Potential references should also include the following, as available:

- Town Comprehensive Land Use or Zoning Plan;
- Town or subdivision zoning ordinance;
- Planning department; and
- Water department;

36. Page 6-9 (1st paragraph) indicates that two on-site water supply wells are not presently in use. Have these wells been properly abandoned? If not, will they be abandoned to fully eliminate this as a potential exposure pathway?

37. The second paragraph of page 6-9 addresses off-site ground water users. The statement is made that because residents have access to municipal water, "...there is no off-site use of

groundwater in the area of the groundwater plume." However, sufficient justification has not been provided for eliminating residential exposure to off-site residential populations as available water well records indicate that the nearest residential well may be 1,000 feet downgradient from the facility. The fact that municipal water is available does not preclude the potential for residential exposure to site-related contamination via consumption of ground water.

38. In describing future land use (p 6-9), AlliedSignal states, "...each AOC is assumed to be occupied, and occupational workers and construction workers are assumed to be present at each AOC." Will it be assumed that a worker may enter any or all of the AOCs over a given time period? This possibility seems feasible. As such, the risks associated with each AOC exposure scenario should be summed.

39. Under the current land use scenario, off-site ground water is assumed to not be used. However, under the future land use scenario, off-site ground water is assumed to have future uses as a source of potable and/or non-potable water (p 6-10). If ground water may serve as a future source, logic dictates that ground water be protected as though it serves as a current source.

40. Section 6.3 identifies the RISC (1997) values as Tier I values that will be compared to AOC data. Why was a second screening evaluation conducted? The RBSLs appear to serve the same purpose as the Tier I values.

41. It is not evident that the RISC (1997) sampling protocols and methodologies were applied. As such, these criteria may not be valid for use as screening criteria.

42. The first paragraph of page 6-15 identifies constituent and "appropriate" surrogate constituents. No references or toxicological discussion are presented to support the use of these surrogate compounds. Please provide both reference material and discussion s of toxicological similarities for the compounds and the proposed surrogates.

43. Page 6-14 (1st paragraph) of the VSI identifies four IDEM (RISC) threshold concentrations:

- Soil saturation limit;
- 1,000 mg/Kg in soil;
- Ground water solubility limit; and
- 1,000 mg/L in ground water.

44. Page 6-16 then erroneously identifies a threshold value as 10,000 mg/Kg. Please correct. See also the comments associated with Appendix I, which outlines the development of risk-based values for jet fuel, JP5 and JP4.

45. The proposed concentration for jet fuel (14,300 mg/Kg) exceeds the previously identified 1,000 mg/Kg threshold.

46. The VRP performance standard requires that all free product be removed or a system be in pace to remove free product. Is this achievable in light of a 14,300 mg/Kg goal?

47. Combinations of many of the proposed cleanup goals exceed the VRP guidance maximum upper limit for chemical classes in surface and subsurface soil. The upper limits are as follows:

- Total semi-volatile compounds not to exceed 10,000 mg/Kg and
- Total volatile compounds, total cyanide, and total mercury concentrations *each* not to exceed 1,000 mg/Kg.

48. Section 6.4.1 (bottom of page 6-18) discusses the Tier II evaluation and indicates that off-site ground water at the "...leading edge monitoring wells..." was evaluated for possible future use as a potable water source. Does AlliedSignal have control of the off-site ground water? If not, a residential exposure scenario including consumption of ground water is appropriate for purposes of the risk evaluation.

49. The discussion of health protective level (HPLs) for leaching to ground water (p 6-19) indicates that a model was used to calculate a soil concentration that would result in an acceptable ground water concentration "...at a distant downgradient compliance point." The VRP guidance document states (p 97), "The point of compliance for ground water contamination is the downgradient limit of the site..." Unless AlliedSignal has control of the off-site property, residential goals typically must be achieved outside the property boundary.

50. Page 6-20 (2nd paragraph) indicates that the area of cracks in the building foundation was adjusted from 1% to 0.01% based on empirical measurements cited in the literature and confirmatory engineering calculations cited in MDEQ's user manual. Please provide additional justification and supporting documentation for this two order of magnitude adjustment.

51. Page 6-24 states, "...the soil leaching model appears to overestimate the impact to groundwater, suggesting that AOCs where average COC concentrations only slightly exceed Tier II criteria are unlikely to pose a substantial threat to groundwater quality at the point of compliance."

- Why wasn't the leaching model calibrated to more accurately reflect actual conditions?
- Please define "substantial" threat.
- RAGS Part A (p 6-19) (EPA, 1989) indicates that, because of the uncertainty associated with estimating an exposure concentration, the upper confidence limit (*i.e.*, 95 percent upper confidence limit) on the arithmetic average should be used. The 95% upper confidence limit rather than the average concentration should serve as the exposure concentration and be compared to the cleanup goals. Please adjust accordingly.

52. Page 6-24 "It is noted, however, that groundwater approximately 600 feet upgradient of the eastern-most leading edge wells...is not in compliance with residential groundwater criteria." "...because groundwater is not used as a potable water source with a two-block radius of the leading plume edge, there are no risks under present land use conditions." The VRP does not concur. See Comment 39.

53. The risk evaluation did not include an uncertainty analysis or a toxicity assessment.

54. Section 7 (p 7-20) indicates that metals were of concern in ground water when samples were not field filtered. The IDEM VRP requires that ground water confirmation samples be unfiltered (p 89). As such, please adjust the evaluation accordingly to include metals in ground water.

The subject of the following comments concern the April 1998 Voluntary Site Investigation Report **Appendices** for AlliedSignal Industrial Complex in South Bend, Indiana, IN Site (VRP Site No. 6980601). These technical comments represent our review of selected appendices. Based on our review, we make the following comments and recommendations regarding the AlliedSignal VSI appendices:

Appendix I

1. Appendix I of the AlliedSignal VSI outlines the development of risk-based values for jet fuel, JP5, and JP4. The proposed values for the three identified compounds range from 14,300 mg/Kg to 6,000 mg/Kg.

2. These values exceed IDEM RISC threshold value of 1,000 mg/Kg in soils.

3. What is the rationale for use of these three compounds? Do they have site-specific applicability?

4. Why was an exposure duration of only one year used? One year does not appear to be sufficiently conservative for purposes of evaluating site risk. Typically, a 25 year exposure duration is used for an industrial worker scenario. Please clarify.

5. It is not apparent that the entire TPH mixture was evaluated. For example, no polyaromatic hydrocarbons (*i.e.*, benzo(a)pyrene) were included in the TPH risk evaluation.

Appendix O-1

1. Appendix O-1 presents the results of the Tier I evaluation. The footer to most of the tables indicates "Mean of detects is used as the mean concentration for comparison of Tier I values." For screening purposes, use of the mean is not sufficiently conservative. The exposure concentration, as per RAGS Part A (p 6-19), is typically the upper confidence limit (*i.e.*, 95% upper confidence limit) on the arithmetic average.

2. Note Table O-1-7. The maximum detected concentration of trichloroethylene (TCE) is 1,500 mg/Kg while the 'mean of detects' is 67 mg/Kg. Accordingly, the 'mean of the detect' did not exceed either the industrial surface soil or construction soil criteria.

3. Table O-1-2 indicates that the residential subsurface soil value for TCE is 5.05 mg/Kg. Table O-1-3 indicates that the residential subsurface soil value for TCE is 0.057 mg/Kg. Why is this the case?

4. Why do the Tier II values vary so significantly with AOC? For example, the residential subsurface soil value for cis-1,2-dichloroethylene in Area 14 (Table O-2-3) is 2.35E+09 mg/Kg while the value for the same chemical in Area 15 (Table O-2-5) is 1.24 mg/Kg?

5. Please provide exposure parameter variables and assumptions associated with the calculation of the site-specific Tier II values.

6. Table O-1-2 indicates that 'NA' means that the maximum concentration did not exceed the Tier I criterion. How was this comparison made? If the maximum detected concentration of a constituent exceeded a Tier I, was it retained for further evaluation? Or, was the comparison to

the arithmetic average (or mean) the determining comparison. Please clarify.

7. Table O-1-17 provides the results for ground water. The maximum sample quantitation limits (SQL) are orders of magnitude greater than the minimum SQL. How did the elevated quantitation limits affect the data quality? Were the limits sufficiently conservative to meet cleanup goals? Was free-phase product observed? Please provide additional discussions.

8. Rather than 'NA,' the Tier II values should be provided in the summary tables.

9. Many of the values presented simple fail the sensibility rule. See Table O-2-6 for an extreme example (3.16E+40 mg/Kg for toluene). The values provided on Table O-2-2 are 7.99E+11 mg/Kg for tetrachloroethylene and 1.33E+11 mg/Kg for TCE. Values of this magnitude raise suspicion and grossly exceed previously identified threshold values.

Appendix O-3

1. Table footers should define column heading abbreviations.

2. Page 3 states that vapor migration from ground water was calculated for a residential scenario and that documentation is provided in Table O-3-4a. However, units are lacking from Table O-3-4a and there is no definition for column heading abbreviations, making the information presented difficult to understand.

3. Table O-3-4c does not identify both a residential and industrial/commercial value associated with the indoor vapor migration pathway. Why is this the case? Was the more conservative of the two values used? Please clarify.

4. Ground water modifications were described on page 2. As written, the discussion is very unclear. Please provide additional justification and the rationale for the modifications.

5. Why was the Csource value for soil substituted with a Csource value for ground water?

6. What is the rationale for Cr soil to be 1 g/g?

7. Why are the average contaminant levels in soil and ground water, as listed on Table O-3-4a, not site-specific values? The same question applies to area of basement and area of cracks.

Appendix O-5

1. Appendix O-5 provides the results of a vadose zone soil leaching model. Please correct the appendix heading and the subject line to read 'vadose' rather than 'valdose.'

2. The introduction identified the "selected point of compliance" at the downgradient limits of Kennedy Park. Is this location within the property boundary?

3. Under the model inputs, fraction organic carbon (0.0006) is listed as a site-specific value. Are test results available to support this value?

4. The first sentence of page 6 states, "The fraction organic carbon varies from a high in the source area to a low in relatively uncontaminated areas (i.e., downgradient aquifer). The average value seems appropriate..." Rather than using the average value, why wasn't a sensitivity analysis conducted over the range of site-specific values?

5. The third paragraph of page 6 states that the mixing zone thickness and mixing dilution

factors were evaluated using the site-specific equations. How were these equations obtained? Please clarify.

6. Page 8 indicates that the model results "...generally over predict impacts to groundwater when compared with the observed results." Is it feasible to calibrate this model such that the calculated and observed values agree? If so, the model could potentially be used to predict future concentrations. If not, the value of the modeling effort is limited.

Appendix O-6

1. The well survey (Appendix O-6; p 2) indicates, "Residents were asked if a private well exists at the residence (or business) or if the water is obtained from the municipal supply." However, the results only provide the outcome (yes or no) to whether or not a resident is connected to water. Please provide the additional information regarding the existence of private well on site. The availability of municipal water does not preclude a complete exposure pathway if a private well exists on site.

The **In-Situ Remediation Pilot Test Work Plan** was reviewed as a stand alone document. The purpose of the review was to determine if the Work Plan provides a sound foundation to conduct in-situ pilot testing activities at AlliedSignal's South Bend facility. Based on our review, we provide the following comments and recommendations:

1. Overall, the work plan is quite good. It appears as though the May 1992 Air Force Center for Environmental Excellence "Test Plan and Technical Protocol for a Field Treatibility Test for Bioventing" was followed.

2. How was it ascertained that the size of the blower is sufficient? The blower selected for the study: 60 scfm at 25 inches of water vacuum, is at the lower end of blowers typically used for sandy soils (20 to 90 scfm at 20" to 100" water, respectively). During extraction testing, the blower must be large enough to discharge through carbon. Depending on the permeability of the soils, it appears that the potential exists that the blower may not be large enough.

3. How will permeability be calculated based on pilot test data? How will this information be used?

4. A goal of respiration testing is determining oxygen utilization rates for contaminant degradation. Total oxygen utilization rates are comprised of the following:

- oxygen use of naturally occurring organics:
- oxygen use of contaminants; and
- oxygen that simply leaves the area via advection.

5. To determine the oxygen use of contaminants, the oxygen use of naturally occurring organics is ascertained by installing a background probe in clean soils. Any oxygen used is assumed to be from the oxidation of naturally occurring organics.

13. Please revise Section 7 of the QAPP Amendment to include a specific reference to Attachment 1.

14. The cover page of Attachment 1 incorrectly identifies the method as TO-1. Please revise.

References

EPA, 1989. *Risk Assessment Guidance for Superfund Volume 1: Human Health Evaluation Manual (Part A).* Office of Emergency Response and Remedial Response. EPA/540/1-89/002. December.
RISC, 1997. *Draft Risk Integrated System of Cleanups*. Indiana Department of Environmental Management, October 21.
VRP, 1996. *Voluntary Remediation Program Resource Guide.* Indiana Department of Environmental Management. Office of Environmental Response, July1996.

If you have any questions, please contact me at (317)308-3126.

Sincerely,

Ed Joniska

Ed Joniskan, Project Manager
Voluntary Remediation Program
Office of Environmental Response

cc: Margie Veitch, EarthTech

6. To ascertain the oxygen that is leaving the area via advection, helium may be added to the injection air at a precise concentration and then measured in the probes using a helium meter. If the helium concentrations in the probes match the injection concentration, then it may be deduced that no oxygen is leaving via advection. Otherwise, if the concentration of helium being measured by the probes is less that the concentrations injected into the system, oxygen use rates must be corrected.

7. How will the oxygen used by naturally occurring organics and the oxygen leaving the area via advection be evaluated? Please clarify.

A **Site Safety Plan** amendment was reviewed with respect to the IDEM VRP model Health and Safety Plan (HASP) guidelines as established in the July 1996 *VRP Resource Guide* and relevant Occupational Health and Safety Administration (OSHA) guidelines for Health and Safety during the proposed In-situ remediation pilot test. Based on our review, we make the following comments and recommendations regarding the Site Safety Plan Amendment #2:

1. No site HASP was provided for review.

2. This document can not be considered a stand-alone HASP as it does not address the requirements set forth in the IDEM VRP model HASP guidelines. Earth Tech recommends that a site specific HASP be provided for review.

A **Quality Assurance Project Plan** (QAPP) Amendment was included as Appendix B of the April 1999 Work Plan for In-Situ Remediation Pilot Test at the AlliedSignal Industrial Complex located in South Bend, Indiana. Based on our review, we make the following comments and recommendations regarding the AlliedSignal QAPP Amendment:

1. The first paragraph in Section 1.0 (pg. 1) refers to a Remediation Work Plan, and a Quality Assurance Project Plan dated September 1996. However, no 1996 Work Plan or Quality Assurance Project Plan were submitted for review.

2. Please revise Section 1 of the QAPP Amendment to include, or provide specific references to appropriate sections of the QAPP and/or RWP for the following:

   a. Description of site, facility, process, or operating parameters to be studied (including
   b. appropriate maps);
   c. A list of all measurements to be performed;
   d. A project schedule, indicating when samples are expected to be submitted to the laboratory;
   e. A summary table covering the following for each sampling location:
      -Type of sample
      -All measurements planned for each sample
      -A list of measurements to be performed, differentiating, where applicable, the

critical measurements (those necessary to achieve project objectives), from the non-critical measurements.

3. Please provide a detailed organization chart, and descriptions of the roles and responsibilities of key project personnel, as per Section 2.0 of the VRP guidance document model QAPP.

4. What are the objectives of the air monitoring proposed for the bioventing test? Because the specific objectives of this activity are not clearly stated, it cannot be demonstrated that the sampling and analysis methods described herein will satisfy the objectives.

5. Do the sampling ports on the bioventing monitoring points provide access the atmosphere immediately beneath the sealed cap, or at the depth of the screen? If the port provides access immediately beneath the cap, the sample collected may not be representative of the atmosphere within the monitoring point, particularly if dense contaminant vapors are present. Please describe the sampling mechanisms more completely, and define the relationship between the sample to be collected and the atmosphere within the monitoring point.

6. If the 'wells' that constitute the bioventing monitoring points are maintained with a sealed cap, the pressure within the devices may be expected to vary over time, relative to ambient atmospheric pressure. Please describe how such changes may affect the representativeness of air monitoring data collected from these monitoring points.

7. The Landtech GA-90 instrument is described in Section 4 of the QAPP Amendment. Does this instrument respond to carbon *monoxide* or carbon *dioxide*, as is indicated in the QAPP Amendment?

8. Please identify which volatile organic (VOCs) compounds are anticipated to be present in samples obtained from the bioventing monitoring points and compare the ionization potentials for constituents of concern to the energy produced by the flame ionization detector (FID) flame.

9. The FID will report a single value representing the total concentration of organic compounds ionized by the hydrogen flame within the atmosphere sampled – specific compounds cannot be identified or quantified. How will data generated by the FID during bioventing and soil vapor extraction (SVE) tests be used to satisfy the project objectives?

10. For the samples collected in the SUMMA containers during the SVE tests, please describe associated quality control samples (type of sample, method of collection, frequency of collection, etc.)

11. Will the polyethylene tubing used to connect the SUMMA canister to the sampling port be evacuated prior to sample transfer? Also, please address the effects of adsorption of VOCs onto the polyethylene.

12. The reference document for EPA Method TO-14, as provided in Attachment 1, appears to be incomplete. Page TO14-5 was the last page received.