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DOE/BETC/PPS-81/2

AVIATION TURBINE FUELS, 1980

By

Ella Mae Shelton

Date Published—March 1981

Bartlesville Energy Technology Center
U.S. Department of Energy
Bartlesville, Oklahoma

UNITED STATES DEPARTMENT OF ENERGY

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Ella Mae Shelton

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AVIATION TURBINE FUELS, 1980

By

Ella Mae Shelton¹

ABSTRACT

Properties of some aviation turbine fuels marketed in the United States during 1980 are presented in this report.

The samples represented are typical 1980 production and were analyzed in the laboratories of 17 manufacturers of aviation turbine (jet) fuels. The data were submitted for study, calculation, and compilation under a cooperative agreement between the Department of Energy (DOE), Bartlesville Energy Technology Center (BETC), Bartlesville, Oklahoma, and the American Petroleum Institute (API).

Results for the properties of 98 samples of aviation turbine fuels are included in the report for military grades JP-4 and JP-5, and commercial type Jet A.

SUMMARY

Average values of selected tests for aviation turbine fuels produced during 1980 are compared with data from the 1970-79 surveys in tables 1-3 for aviation turbine fuels for grade JP-4 military, grade JP-5 military, and Jet A commercial fuels, respectively. Table 4 includes data for each of the individual analyses. Previous Bartlesville Energy Technology Center aviation fuel survey reports are listed on page 4.

¹ Statistical Assistant

INTRODUCTION

Properties of aviation turbine fuels produced in the United States during 1980 are reported in accordance with a cooperative agreement between the American Petroleum Institute and the Bartlesville Energy Technology Center of the United States Department of Energy. By agreement with the American Petroleum Institute, identification of the contributor's data is confidential.

Analytical data are presented for 98 samples of aviation turbine fuels, representing the products of 17 companies. The data were reported by the manufacturers as typical of their 1980 production. The analyses were made in their laboratories and the results submitted to the Bartlesville Energy Technology Center for necessary calculations and for compilation.

The values reported in this survey closely reflect the average quality of materials produced by U. S. refineries. The data may not be representative of the spread of values experienced at the point of use.

INSPECTION DATA FOR AVIATION TURBINE FUELS

The data for the properties of 98 samples of aviation turbine fuels shown in table 4 were compiled from analyses submitted by 17 companies. The aviation turbine fuel data are divided into three groups: grade JP-4 military, grade JP-5 military, and Jet A commercial. This arrangement allows direct comparison of the data for 67 samples of Jet A fuel with the data for five samples of grade JP-5 fuel.

The tests were made in company laboratories by procedures approved by the American Society for Testing and Materials,² and in accordance with military specification MIL-T-5624L³ and ASTM specification D1655.⁴ ASTM test methods used also are shown in table 4.

Each item number in table 4 designates a separate sample. Each sample analysis includes data from the following 18 fuel property tests for JP-4 and JP-5 military turbine fuels: API gravity, distillation, Reid vapor pressure, freezing point, Saybolt color, aniline point, water tolerance, total acidity, total sulfur, mercaptan sulfur, copper-strip corrosion, aromatic content, olefin content, smoke point, existent gum by steam-jet at 450° F, net heat of combustion, thermal stability, and water separator index. Twenty fuel

² American Society for Testing and Materials, 1979 Annual Book of ASTM Standards, Part 23, Petroleum Products and Lubricants (1), Philadelphia, Pa., 1979, 970 pp.

³ Military Specification, Turbine Fuel, Aviation, Grades JP-4 and JP-5 MIL-T-5624L, 18 May 1979.

⁴ American Society for Testing and Materials, Standard Specification for Aviation Turbine Fuels (D1655), 1979 Annual Book of ASTM Standards Part 23, pp. 843-852.

property tests were made for Jet A commercial jet fuels, including all of the above tests except Reid vapor pressure, and also includes Tag closed-cup flash point, kinematic viscosity at -30°F, and naphthalenes. Each sample analysis also includes computed values for aniline-gravity constants. The data for net heat of combustion for each sample were computed from equations in ASTM D1405⁵ unless the data were determined as indicated by a footnote.

The average, minimum, and maximum values for JP-4, JP-5, and Jet A are given following the tabulations for each grade. The average for the distillation data recovered at 400°F is obtained by plotting the average distillation data for IBP, 10%, 20%, 50%, 90%, and end point. Data shown in the average line in table 4 for aniline-gravity constant were calculated from the average gravity and aniline point for items for which data for both properties are shown. Other averages are arithmetic means of the data shown for each property. Averages are not reported for flash point, color, corrosion, and tube deposit rating of the thermal stability test.

⁵ American Society for Testing and Materials, Standard Method of Test for Estimation of Net Heat of Combustion of Aviation Fuels (D1405); 1979 Annual Book of ASTM Standards, Part 23, pp. 753-761.

LIST OF NATIONAL AVIATION FUEL SURVEY REPORTS

Report No.	Author	Production Date	Date Published	Pages
RI 4789	Blade, O. C.	Oct. 1950	Mar. 1951	11
RI 4889	Do.	Oct. 1951	May 1952	13
RI 4982	Do.	1952	May 1953	15
RI 5036	Do.	1953	Feb. 1954	15
RI 5132	Do.	1954	Apr. 1955	15
IC 7747	Do.	1955	Mar. 1956	15
IC 7782	Do.	1956	Mar. 1957	16
PPS No. 4	Do.	1957	Mar. 1958	17
PPS No. 9	Do.	1958	Mar. 1959	17
PPS No. 14	Do.	1959	Mar. 1960	16
PPS No. 19	Do.	1960	Mar. 1961	16
PPS No. 24	Do.	1961	June 1962	18
PPS No. 29	Do.	1962	June 1963	17
PPS No. 34	Do.	1963	Apr. 1964	17
PPS No. 39	Do.	1964	May 1965	18
¹ PPS No. 44	Do.	1965	Apr. 1966	13
¹ PPS No. 49	Do.	1966	Mar. 1967	13
¹ PPS No. 54	Do.	1967	Feb. 1968	13
¹ PPS No. 59	Do.	1968	Feb. 1969	13
PPS No. 64	McKinney, C. M., O. C. Blade, and Ella Mae Shelton	1969	Mar. 1970	17
¹ PPS No. 69	Shelton, Ella Mae	1970	Feb. 1971	13
¹ PPS No. 74	Do.	1971	Mar. 1972	13
¹ PPS No. 79	Do.	1972	Mar. 1973	13
¹ PPS No. 84	Do.	1973	Mar. 1974	13
¹ PPS No. 89	Do.	1974	Mar. 1975	13
¹ BERC/PPS-76/2	Do.	1975	Mar. 1976	13
¹ BERC/PPS-77/2	Do.	1976	Apr. 1977	13
¹ BERC/PPS-78/2	Do.	1977	May 1978	13
¹ (109) BETC/PPS-79/2	Do.	1978	May 1979	11
¹ (114) BETC/PPS-80/2	Do.	1979	May 1980	11
¹ This report	Do.	1980		

¹Data for aviation turbine fuels only.

TABLE 1. - SUMMARIZED DATA FOR GRADE JP-4 MILITARY AVIATION TURBINE FUELS

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
Number of fuels	33	32	35	30	33	30	33	28	23	26	26
Gravity, °API	53.8	54.5	54.6	54.1	54.3	54.0	54.1	53.9	53.9	53.5	53.7
Distillation 1/ Temperature:											
10% recovered, °F	212	211	215	216	214	211	215	211	209	208	211
50% do., °F	290	288	285	289	291	287	292	299	289	293	287
90% do., °F	389	393	394	402	397	390	399	395	400	388	387
Recovered at 400 F, %	89.5	89.4	87.5	84.0	85.9	86.0	85.6	85.7	86.2	86.2	92.5
Reid vapor pressure, lb	2.6	2.6	2.5	2.5	2.5	2.5	2.6	2.6	2.6	2.5	2.6
Freezing point, °F	<-76	<-76	-84	-80	-81	-84	-84	-79	-79	-79	-80
Viscosity, kinematic, -30 F, cs	2.80	2.94	3.01	2.83	2.68	2.20	2/ 2.4	4/ 2.4	-	-	-
Aniline point, °F	129.4	130.4	130.7	132.0	132.8	129.9	131.3	130.8	130.3	128.7	128.9
Aniline-gravity constant, No.	6,961	7,107	7,136	7,141	7,211	7,028	7,103	7,061	7,049	6,891	6,948
Water tolerance, ml	0.1	0.2	0.4	0.6	0.5	0.5	0.6	0.3	0.6	0.7	0.7
Sulfur:											
Total, wt %	0.032	0.034	0.032	0.033	0.035	0.036	0.042	0.044	0.035	0.030	0.029
Mercaptan, wt %	0.0005	0.0006	0.0005	0.0005	0.0012	0.0006	0.0005	0.0004	0.0004	0.0004	0.0005
Naphthalenes, wt %	1.45	0.88	0.74	0.9	1.3	0.20	2/0.51	4/ 0.2	-	-	-
Aromatic content, vol %	11.5	10.8	10.7	11.8	10.6	11.2	11.2	12.2	12.3	13.0	13.2
Olefin content, vol %	0.9	0.8	0.9	1.0	0.9	1.0	0.9	0.8	0.8	1.0	1.0
Smoke point, mm	27.6	27.4	28.0	28.2	28.1	27.2	27.7	27.7	27.5	26.0	25.7
Gum, mg/100 ml:											
Existent, at 450 F	0.6	0.6	0.7	0.6	0.8	0.9	0.7	0.7	0.7	0.7	0.7
Potential, at 212 F	1.2	1.2	1.1	1.2	1.2	1.0	1.0	1.0	1.2	5/ 1.0	-
Heat of combustion, net, Btu/lb	18,708	18,721	18,725	18,727	18,733	18,714	18,721	18,715	18,716	18,702	18,707
Luminometer number	63	60	63	64	62	62	3/ 61	5/ 61	-	-	-
Thermal Stability:											
Pressure drop, in. Hg	0.17	0.12	0.06	0.22	0.15	0.26	0.30	0.5	0.2	0.4	0.0
Water separator index, No.	88	88	90	90	91	90	91	90	91	91	91

1/ Distillation data reported on evaporated basis prior to 1972.

2/ Represents two samples.

3/ Represents four samples.

4/ Represents one sample.

5/ Represents three samples.

TABLE 2. - SUMMARIZED DATA FOR GRADE JP-5 MILITARY AVIATION TURBINE FUELS

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
Number of fuels	10	10	12	8	7	8	8	7	7	7	5
Gravity, °API	41.0	42.0	41.6	41.7	41.6	41.5	41.5	41.4	41.7	41.2	40.9
Distillation 1/ Temperature:											
10% recovered, °F	383	380	388	387	389	388	390	385	390	387	381
50% do., °F	416	414	419	422	419	418	422	420	419	423	422
90% do., °F	461	459	460	469	462	462	470	470	465	470	476
Recovered at 400 F, %	31.5	36.2	25.0	23.4	23.2	25.9	21.6	24.1	23.6	24.1	24.1
Reid vapor pressure, lb	-	-	-	-	-	-	-	-	-	-	-
Freezing point, °F	-58	-57	-59	-56	-58	-56	-54	-56	-55	-57	-58
Viscosity, kinematic, -30 F, cs	10.2	10.2	10.1	10.5	10.5	9.0	10.2	9.7	7.1	10.4	-
Aniline point, °F	140.0	140.8	139.7	144.6	144.0	142.1	143.3	143.0	142.9	142.5	141.9
Aniline-gravity constant, No.	5,740	5,914	5,714	6,059	5,990	5,840	5,971	5,920	5,959	5,869	5,804
Water tolerance, ml	0.2	0.03	-	-	0.1	0.1	0.3	3/ 0.0	0.5	0.7	2/ 1.0
Sulfur:											
Total, wt %	0.045	0.053	0.037	0.096	0.065	0.061	0.059	0.068	0.057	0.044	0.020
Mercaptan, wt %	0.0004	0.0003	0.0009	0.0007	0.0015	0.0006	0.0004	0.0006	0.0004	0.0003	0.0004
Naphthalenes, wt %	-	-	1.21	-	-	-	-	2/ 1.0	-	2/ 1.0	-
Aromatic content, vol %	15.9	16.4	15.7	16.0	16.0	15.2	16.9	16.0	15.3	16.4	17.4
Olefin content, vol %	1.0	1.1	0.6	0.8	1.0	1.2	0.8	0.9	1.4	0.8	0.6
Smoke point, mm	22.4	22.2	21.7	22.2	22.3	22.9	22.3	22.6	21.8	21.9	20.9
Gum, mg/100 ml:											
Existent, at 450 F	0.5	0.9	1.3	1.3	0.6	1.0	0.8	1.1	1.0	0.7	0.8
Potential, at 212 F	2.2	2.7	2.2	2.6	-	-	2/ 1.0	2/ 1.0	-	-	-
Heat of combustion, net, Btu/lb	18,514	18,534	18,515	18,526	18,539	18,522	18,538	18,533	18,535	18,530	18,525
Luminometer number	44	-	-	-	-	-	2/ 48	2/ 48	-	-	-
Thermal Stability:											
Pressure drop, in. Hg	0.01	0.08	0.14	0.5	0.2	0.16	0.16	0.4	0.3	0.2	0.2
Water separator index, No.	95	97	96	94	95	94	92	96	95	94	84

1/ Distillation data reported on evaporated basis prior to 1972.

2/ Represents one sample.

3/ Represents two samples.

TABLE 3. - SUMMARIZED DATA FOR GRADE JET A COMMERCIAL JET FUELS

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
Number of fuels	57	57	64	65	63	66	65	65	60	60	67
Gravity, °API	42.7	42.8	43.0	42.9	42.9	42.9	43.1	43.2	42.9	42.7	42.6
Distillation 1/ Temperature:											
10% recovered, °F	371	371	372	369	369	370	371	370	374	375	375
50% do., °F	417	416	415	415	413	414	415	414	416	416	417
90% do., °F	477	473	474	473	472	472	474	472	473	473	473
Recovered at 400 F, %	34.2	35.6	35.7	36.3	37.2	36.8	35.3	37.6	33.9	34.5	32.3
Reid vapor pressure, lb	0.3	0.2	0.2	0.1	-	0.2	0.2	0.2	-	-	-
Freezing point, °F	-50	-50	-50	-51	-51	-50	-51	-50	-49	-49	-48
Viscosity, kinematic, -30 F, cs	9.45	9.45	9.38	9.12	9.21	9.22	9.32	9.4	9.2	8.8	8.78
Aniline point, °F	144.4	144.1	144.8	143.2	142.6	143.4	144.2	143.6	143.6	142.4	142.1
Aniline-gravity constant, No.	6,166	6,182	6,241	6,143	6,118	6,152	6,244	6,204	6,160	6,072	6,025
Water tolerance, ml	0.2	0.2	0.3	0.5	0.5	0.4	0.5	0.3	0.4	0.6	0.5
Sulfur:											
Total, wt %	0.049	0.045	0.048	0.045	0.054	0.054	0.060	0.061	0.053	0.050	0.053
Mercaptan, wt %	0.0005	0.0006	0.0004	0.0006	0.0009	0.0008	0.0009	0.0008	0.0007	0.0008	0.0008
Naphthalenes, wt %	1.91	1.85	1.79	1.80	1.82	1.67	1.70	1.70	1.78	1.80	1.99
Aromatic content, vol %	16.4	16.1	16.1	16.3	16.7	16.9	17.0	17.2	17.4	17.9	17.5
Olefin content, vol %	1.1	1.0	1.1	1.2	1.2	1.0	1.1	1.2	1.0	0.9	1.2
Smoke point, mm	23.3	23.4	23.2	23.3	22.9	22.9	23.1	23.1	22.7	22.6	22.5
Gum, mg/100 ml:											
Existent, at 450 F	0.6	0.7	0.8	0.7	0.8	0.9	0.8	0.9	0.8	1.0	1.0
Potential, at 212 F	1.5	1.4	1.6	1.6	1.9	1.9	2.2	1.5	2.3	2.5	-
Heat of combustion, net, Btu/lb	18,586	18,584	18,589	18,583	18,582	18,622	18,609	18,589	18,584	18,598	18,574
Luminometer number	48.9	49	50	49	50	50	50	50	49	49	-
Thermal Stability:											
Pressure drop, in. Hg	0.18	0.21	0.23	0.35	0.33	0.26	0.29	0.3	0.4	0.3	0.2
Water separator index, No.	95	96	96	95	95	95	96	94	95	95	94

1/ Distillation data reported on evaporated basis prior to 1972.

TABLE 4. - INSPECTION DATA FOR AVIATION TURBINE FUELS, 1980

ITEM	GRAV., ASTM D287, API	DISTILLATION, ASTM D86								RVP, ASTM D323, LB	FREEZE., POINT, ASTM D2386, F	COLOR ASTM D156, NO.	ANIL. POINT, D611, F	ANILINE GRAVITY CONSTANT, NO.	WATER TOL. ASTM D1094, ML	ACIDITY ASTM D974, KOH, MG/G	
		TEMPERATURE, F (CORRECTED TO 760 MM HG)						RECOV. AT 400									
		PERCENT RECOVERED						F %	RES, %								LOSS, %
		TBP	10	20	50	90	EP										
MILITARY TURBINE FUELS GRADE JP-4 (MIL-T-5624L)																	
1	55.5	149	236	245	272	335	410	95.0	1.0	1.0	2.9	-112	+30	134.0	7,437	0.5	0.003
2	52.0	115	239	275	320	363	400	100.0	1.0	1.0	2.6	-81	+29	126.0	6,552	0.5	0.010
3	56.1	147	174	185	244	433	478	82.6	1.0	1.0	2.7	-74	+17	131.0	7,349	0.0	0.010
4	54.3	136	180	205	280	428	486	85.2	1.0	1.0	2.8	-83	+21	126.3	6,858	1.0	0.004
5	52.4	122	192	216	283	396	437	91.0	1.0	1.0	2.7	-85	+30	134.0	7,022	0.0	-
6	53.9	137	202	226	293	434	496	83.0	0.5	1.5	2.6	-76	+28	129.0	6,953	(1B)	0.003
7	53.1	144	232	270	313	363	396	-	-	-	2.9	-85	+25	126.0	6,691	1.0	0.012
8	55.5	144	245	250	261	290	328	97.5	1.0	0.5	2.6	< -81	-	125.0	6,938	1.0	0.008
9	53.0	-	199	210	234	320	426	98.1	1.0	1.0	2.5	< -90	+19	99.0	5,247	1.0	0.003
10	51.7	126	198	223	295	442	494	81.0	1.1	0.9	3.0	-76	+13	130.8	6,762	-	0.008
11	55.9	165	193	202	236	373	475	93.1	0.5	0.5	2.5	< -74	+12	125.0	6,988	(1B)	0.008
12	53.4	151	231	244	260	368	414	97.2	1.0	1.0	2.4	-89	+18	125.8	6,718	1.0	0.010
13	56.0	153	198	214	241	447	483	79.1	0.1	0.9	-	-78	+30	136.0	7,616	1.0	0.009
14	55.0	124	239	259	300	446	509	78.0	1.0	1.0	2.6	-74	+20	139.0	7,645	1.0	0.007
15	54.6	149	217	243	262	316	374	-	1.0	1.0	2.8	-76	+20	121.0	6,607	(1B)	-
16	48.7	138	232	267	340	420	491	86.3	1.0	0.5	2.6	-80	-	-	-	1.0	0.007
17	52.6	131	203	254	313	351	410	98.7	1.0	1.0	2.6	-103	+20	120.0	6,312	(1B)	0.003
18	53.9	145	219	235	270	340	431	98.0	1.0	0.2	2.5	-78	-	-	-	1.0	0.008
19	53.4	133	220	262	311	355	398	-	0.8	0.7	2.8	-80	+29	127.0	6,782	0.2	0.005
20	55.1	133	171	195	257	430	493	76.8	1.0	0.9	2.7	-84	-	131.7	7,257	1.0	0.004
21	53.0	133	207	237	309	384	442	93.2	1.0	1.0	2.5	-72	-	135.8	7,197	1.0	0.004
22	56.5	162	204	224	290	436	484	81.8	1.0	1.0	2.6	-	+26	144.0	8,136	1.0	0.006
23	53.3	136	169	190	367	439	484	59.1	1.0	1.0	2.8	-75	-	138.0	7,355	(1B)	0.003
24	50.5	152	220	238	300	450	518	81.6	1.2	1.3	2.7	< -81	+16	124.0	6,262	0.0	0.003
25	51.5	136	243	273	320	381	430	96.0	0.5	1.0	2.4	< -72	+30	136.0	7,004	0.0	0.001
26	54.4	140	228	243	279	329	403	99.7	0.5	0.5	2.4	< -72	+30	130.0	7,072	0.1	0.000
AVG	53.7	140	211	234	287	387	446	92.5	0.9	0.9	2.6	-81	-	128.9	6,948	0.7	0.006
MIN	48.7	115	169	185	234	290	328	59.1	0.1	0.2	2.4	-112	+12	99.0	5,247	0.0	0.000
MAX	56.5	165	245	275	367	450	518	100.0	1.2	1.5	3.0	-72	+30	144.0	8,136	1.0	0.012

26 SAMPLES

MILITARY TURBINE FUELS
GRADE JP-5 (MIL-T-5624L)

27	41.7	239	338	376	426	498	550	25.3	-	-	-	-57	+20	146.5	6,109	-	0.004
28	42.3	349	388	392	415	483	515	33.4	1.0	1.0	-	-68	-	145.0	6,134	1.0	0.004
29	42.6	372	396	404	424	460	494	14.9	1.0	1.0	-	-53	+25	148.0	6,305	-	0.006
30	41.3	370	388	396	412	451	496	23.6	1.0	1.0	-	-54	-	137.5	5,679	-	0.003
31	36.8	360	396	406	434	486	524	14.0	1.0	1.0	-	-60	-	132.5	4,876	-	0.003
AVG	40.9	338	381	395	422	476	516	24.1	1.0	1.0	-	-58	-	141.9	5,804	-	0.004
MIN	36.8	239	338	376	412	451	494	14.0	1.0	1.0	-	-68	+20	132.5	4,876	1.0	0.003
MAX	42.6	372	396	406	434	498	550	33.4	1.0	1.0	-	-53	+25	148.0	6,305	1.0	0.006

5 SAMPLES

- 1/ DOES NOT MEET THE REQUIREMENT FOR THIS FUEL.
2/ DETERMINED DATA FOR NET HEAT OF COMBUSTION.

TABLE 4. - INSPECTION DATA FOR AVIATION TURBINE FUELS, 1980 - - CONTINUED

TOTAL SULFUR, ASTM D1266, WT %	MERCAPTAN SULFUR, ASTM D1323, WT %	CORROSION, ASTM D130, RATING		HYDROCARBON ANALYSIS ASTM D1319, VOL %		SMOKE POINT, ASTM D1322 MM	GUM MG/100 ML EXISTENT, AT 450 F, ASTM D381	HEAT OF COMBUSTION, NET ASTM D1405, BTU/LB	THERMAL STABILITY, ASTM D1660		WATER SEPAROMETER INDEX, ASTM D2550, NO.	ITEM
		3 HR, 122 F	2 HR, 212 F	AROM., VOL %	OLEF., VOL %				PRESS. DROP, IN. HG	TURE RATING CODE		
		MILITARY TURBINE FUELS GRADE JP-4 (MIL-T-56241.)										
0.020	0.0010	1	1	8.0	<1.0	32.0	1.0	18,759	0.0	1	90	1
0.030	0.0010	1	1	13.0	<1.0	25.5	1.0	18,665	0.0	0	80	2
0.020	0.0009	1	1	12.0	0.9	26.0	1.8	18,750	0.0	1	95	3
<0.010	0.0002	-	1	17.0	2.0	25.0	0.5	18,700	0.0	1	90	4
0.010	-	-	1B	14.3	1.2	25.0	0.8	18,717	0.0	<1	94	5
0.010	-	-	1A	14.0	1.0	26.4	0.5	18,710	0.0	1	99	6
0.030	0.0010	-	1A	12.8	0.3	25.0	0.2	2/18,684	0.0	1	-	7
0.004	-	-	1A	9.3	2.2	35.2	0.2	18,709	0.0	1	98	8
0.050	-	-	1A	22.9	1.1	22.0	0.4	18,524	0.0	1	99	9
0.070	0.0003	-	1	10.2	1.0	27.0	1.0	2/18,681	0.0	<1	97	10
0.040	0.0001	-	1A	9.9	0.3	28.5	0.6	18,709	0.1	1	96	11
0.020	<0.0010	-	1	12.0	1.0	26.0	1.0	18,684	0.0	1	82	12
0.040	-	-	1A	8.7	0.6	32.2	0.0	18,775	0.0	0	85	13
0.020	0.0010	-	1A	10.3	1.0	28.8	0.3	18,781	0.0	1	86	14
0.020	0.0006	-	1A	12.0	0.5	21.0	0.8	18,672	0.0	1	97	15
0.050	0.0004	1A	-	16.6	<0.5	21.0	1.0	-	0.0	0	83	16
0.030	0.0004	-	1A	19.7	0.8	23.0	0.2	18,639	0.0	1	95	17
0.008	0.0003	-	1A	20.0	2.4	24.0	0.9	-	0.0	1	96	18
0.008	0.0003	-	1A	13.7	0.6	-	0.3	18,692	0.0	0	97	19
0.100	-	-	1A	11.2	0.8	26.0	1.0	18,729	0.0	<1	90	20
0.050	-	-	1A	10.3	0.7	22.0	0.3	18,730	0.0	<1	89	21
0.010	-	-	1B	12.9	1.3	27.4	-	18,835	0.0	1	100	22
0.010	0.0006	-	1A	12.0	0.5	22.0	1.0	18,752	1.0	0	90	23
0.020	0.0002	-	1	12.4	0.4	23.0	0.8	18,635	0.0	0	89	24
0.050	0.0000	-	1A	17.2	0.4	22.0	0.2	18,709	0.0	1	90	25
0.000	0.0000	-	1A	10.9	0.5	-	0.9	18,724	0.0	1	75	26
0.029	0.0005	-	-	13.2	1.0	25.7	0.7	18,707	0.0	-	91	
0.000	0.0000	-	-	8.0	0.3	21.0	0.0	18,524	0.0	0	75	
0.100	0.0010	-	-	22.9	2.4	35.2	1.8	18,835	1.0	1	100	

MILITARY TURBINE FUELS
GRADE JP-5 (MIL-T-56241)

0.040	0.0010	-	1A	16.1	0.5	22.0	0.6	18,553	0.0	1	-	27
<0.030	0.0001	1B	-	15.7	<0.5	22.0	1.0	18,557	0.0	0	75	28
0.010	-	-	1B	16.3	0.8	22.3	-	18,578	0.0	1	90	29
0.010	0.0002	-	1A	19.5	0.5	19.0	1.0	18,512	1.0	0	90	30
0.020	0.0002	-	1	19.3	0.7	19.0	0.6	18,426	0.1	1	79	31
0.020	0.0004	-	-	17.4	0.6	20.9	0.8	18,525	0.2	-	84	
0.010	0.0001	-	-	15.7	0.5	19.0	0.6	18,426	0.0	0	75	
0.040	0.0010	-	-	19.5	0.8	22.3	1.0	18,578	1.0	1	90	

TABLE 4. - INSPECTION DATA FOR AVIATION TURBINE FUELS, 1980 - - CONTINUED

ITEM	GRAV., ASTM D287, API	DISTILLATION, ASTM D86,										FLASH POINT, ASTM D56 F	FREEZ., POINT, ASTM D2386, F	COLOR ASTM D156, NO.	VIS. AT -30 F, ASTM D445, CS	ANIL. POINT, D611, F	ANILINE GRAVITY CONSTANT, NO.	WATER TOL. ASTM D1094, ML	ACIDITY ASTM D974, KOH, MG/G
		TEMPERATURE, F (CORRECTED TO 760 MM HG)					REC'D, AT 400 F %	RES., %	LOSS, %										
		TBP	PERCENT RECOVERED							EP									
			10	20	50	90													
COMMERCIAL JET FUELS (ASTM D1655)																			
JET A																			
32	42.7	344	378	391	421	483	518	30.0	1.0	1.0	138	-44	+21	-	146.5	6,256	0.5	<0.010	
33	41.4	353	394	406	433	477	509	16.0	1.0	1.0	146	-50	+30	-	140.0	5,796	0.5	0.010	
34	43.7	311	362	378	414	483	538	38.0	1.0	1.0	106	-40	+22	-	146.0	6,380	0.0	0.010	
35	42.3	364	391	400	417	458	498	20.0	1.0	1.0	146	-87	+30	-	147.0	6,218	0.5	0.010	
36	40.7	346	385	396	424	476	521	21.0	1.0	0.0	136	-50	+30	-	137.2	5,584	0.0	0.040	
37	40.2	353	383	390	416	465	480	32.6	1.4	0.6	132	-70	+28	8.50	131.0	5,266	0.5	0.007	
38	43.2	360	389	404	433	484	534	17.1	1.0	1.0	134	-41	+30	12.70	151.0	6,523	1.0	-	
39	42.7	368	388	394	422	460	512	28.0	1.0	0.0	148	-46	+30	10.40	143.0	6,106	0.0	0.010	
40	42.7	347	372	386	419	481	524	31.6	0.5	0.5	132	-46	+28	9.80	141.5	6,042	0.0	0.004	
41	41.8	365	384	394	416	460	499	25.9	0.5	0.5	146	-53	+28	12.80	142.0	5,936	(1R)	0.003	
42	42.6	310	362	381	426	475	509	35.0	1.0	1.0	116	-50	+26	9.80	-	-	-	0.004	
43	43.8	338	374	384	415	486	518	37.2	1.0	0.5	126	-48	+30	8.84	142.0	6,220	1.0	0.005	
44	41.7	372	390	399	412	447	467	20.0	1.0	1.0	138	-49	+30	9.50	141.5	5,901	0.0	0.003	
45	42.0	330	375	390	425	485	528	27.0	1.0	1.0	124	-48	+23	9.90	140.0	5,880	-	0.000	
46	43.4	-	332	349	401	482	516	49.9	1.0	1.0	102	-42	+24	6.70	134.0	5,816	1.0	0.003	
47	40.5	296	367	384	426	485	540	30.4	1.0	1.0	116	-44	+16	10.10	135.4	5,484	-	0.030	
48	42.5	316	354	374	410	481	529	44.2	1.0	1.0	-	-48	+16	-	139.3	5,920	1.0	0.010	
49	41.5	320	350	365	395	460	504	53.9	1.0	1.0	-	-65	+14	-	131.4	5,453	1.0	0.010	
50	42.0	366	399	409	432	480	511	10.9	1.0	0.0	146	-42	+25	10.40	146.5	6,153	1.0	0.013	
51	43.0	316	361	370	416	501	538	38.0	1.0	1.0	120	-42	+27	9.00	143.7	6,179	1.0	0.017	
52	42.0	-	362	381	423	485	542	32.5	0.5	0.5	172	< -48	+28	11.00	-	-	1.0	0.001	
53	42.8	331	360	372	406	465	498	45.2	1.0	0.0	122	-54	+20	4.40	136.9	5,859	1.0	0.016	
54	41.0	349	386	396	435	487	530	23.7	1.0	1.0	136	-52	+28	9.90	146.0	5,986	0.0	0.020	
55	43.0	363	386	396	419	462	500	24.4	0.5	0.5	140	-42	+30	9.70	145.0	6,235	0.0	0.010	
56	41.4	358	382	395	422	482	522	24.4	1.0	1.0	142	-44	+30	10.80	140.0	5,796	0.0	0.020	
57	42.5	350	378	392	415	477	535	29.0	1.0	1.0	132	-44	+25	10.20	143.0	6,078	0.0	0.020	
58	42.5	345	378	392	422	476	515	25.7	1.0	1.0	140	-47	+30	11.20	145.0	6,163	0.0	0.010	
59	42.6	-	385	395	424	470	513	25.0	1.0	1.0	140	-45	+30	13.12	-	-	-	0.015	
60	41.9	338	370	385	424	476	512	30.8	1.0	1.0	124	-48	+20	6.20	136.0	5,698	(1R)	0.008	
61	41.0	326	382	396	428	468	502	25.0	1.0	1.0	128	-44	+29	9.00	142.5	5,843	0.5	-	
62	41.8	349	376	385	406	447	502	43.1	1.0	-	130	-65	-	3.70	133.5	5,580	1.0	<0.001	
63	43.5	342	378	392	416	460	498	29.0	1.0	0.0	128	-52	+30	-	149.0	6,482	-	0.113	
64	44.6	-	351	368	407	478	530	44.0	1.0	0.0	116	-41	+23	-	-	-	0.5	0.050	
65	45.1	326	358	374	412	486	524	42.1	1.2	0.8	120	-43	+29	-	-	-	0.0	0.000	
66	41.6	341	390	403	425	466	505	17.4	-	-	142	-48	+18	9.52	142.9	5,945	0.0	0.001	
67	42.6	309	389	404	430	482	516	17.0	1.0	1.0	126	-44	+27	-	147.0	6,262	1.0	0.000	
68	43.0	335	378	392	429	492	517	37.0	1.0	1.0	128	-40	+30	9.20	146.8	6,312	1.0	0.013	
69	41.3	362	396	411	437	487	520	12.4	1.0	-	148	-48	+28	1.90	-	-	0.0	0.002	
70	40.2	329	376	394	434	488	520	23.7	1.0	1.0	124	-43	+30	5.70	139.0	5,588	1.0	0.003	
71	38.3	325	363	388	440	503	530	24.9	1.1	1.1	122	-53	+30	7.00	137.0	5,247	1.0	0.020	
72	43.2	350	379	384	428	487	510	34.6	1.0	1.0	138	-42	+30	5.50	144.0	6,221	0.1	0.001	
73	43.0	367	384	390	410	460	496	37.2	1.0	1.0	146	-55	+23	4.40	138.0	5,934	1.0	0.010	
74	40.9	317	375	392	431	496	530	24.6	1.0	0.0	126	-45	+20	7.00	-	-	1.0	0.010	
75	43.0	364	388	400	420	472	514	20.0	1.0	1.0	144	-49	+30	5.76	-	-	1.0	0.006	
76	44.6	346	366	376	402	458	508	48.1	1.3	0.7	128	-58	-	9.60	-	-	0.0	0.000	
77	43.6	388	396	403	424	467	493	15.7	1.0	1.0	148	-48	-	10.20	-	-	-	0.003	
78	43.2	336	383	400	420	468	511	20.0	1.0	-	134	-41	-	10.10	149.0	6,437	1.0	0.020	
79	42.5	338	365	374	387	432	487	64.9	1.0	0.0	138	-69	-	7.20	130.0	5,525	(1R)	0.030	
80	47.3	324	340	350	387	464	523	60.0	1.0	1.0	116	-51	-	11.20	145.0	6,859	1.0	0.010	
81	37.5	368	389	400	422	467	498	20.0	1.3	1.2	144	-67	-	14.60	132.0	4,950	0.0	0.002	
82	45.4	366	378	388	392	414	476	68.4	0.5	0.5	136	< -40	-	-	145.0	6,583	1.0	0.004	
83	43.5	351	372	382	417	489	527	36.9	0.5	0.5	128	-42	+30	8.60	150.0	6,525	0.0	0.015	
84	43.1	358	383	391	416	463	504	31.1	1.0	0.0	148	-46	+26	10.50	148.0	6,379	0.5	0.005	
85	41.9	363	381	390	410	470	521	33.0	-	-	136	-58	+28	7.20	140.0	5,866	0.0	-	
86	43.4	300	354	371	403	470	508	47.7	1.0	1.0	126	-43	+20	8.85	-	-	1.0	0.010	
87	44.5	320	355	371	396	478	520	52.9	1.0	1.0	120	-49	+21	8.93	-	-	1.0	-	
88	45.1	345	366	379	392	445	490	53.0	0.5	0.5	126	-56	+14	8.10	143.8	6,485	0.0	0.005	
89	41.9	324	358	371	410	479	532	43.0	0.8	0.7	120	-53	+21	8.24	146.0	6,117	1.0	0.002	
90	42.7	348	367	376	405	472	519	46.0	1.0	0.5	128	-58	+30	8.24	143.0	6,106	1.0	0.002	
91	42.0	357	380	391	416	468	505	29.0	0.5	0.5	142	-53	+21	-	138.0	5,796	0.0	0.000	
92	46.6	352	375	381	405	459	502	42.0	1.2	0.0	126	-45	+30	7.30	150.1	6,995	0.0	0.001	
93	41.8	326	379	397	440	504	542	22.0	1.0	1.0	126	-40	+30	9.98	144.1	6,023	1.0	0.030	
94	42.3	343	383	390	426	491	526	24.0	1.5	1.0	136	-45	+25	9.60	144.0	6,091	(1R)	0.003	
95	44.4	320	356	371	412	462	500	80.0	1.0	0.8	116	-44	+26	4.80	135.0	5,994	0.0	0.000	
96	43.0	348	377	386	415	498	536	47.0	1.0	1.0	130	-43	+26	-	146.5	6,300	0.1	0.001	
97	42.5	329	380	392	417	473	532	29.5	1.0	1.0	134	-49	+26	9.90	146.0	6,205	0.0	0.003	

TABLE 4. - INSPECTION DATA FOR AVIATION TURBINE FUELS, 1980 - - CONTINUED

TOTAL SULFUR, ASTM D1266, WT %	MERCAPTAN SULFUR, ASTM D1323, WT %	NAPHTHA- LENES, ASTM D1840, WT %	CORROSTON ASTM D130, RATING		HYDROCARBON ANALYSIS ASTM D1319		SMOKE POINT, ASTM D1322, MM	GUM MG/100 ML EXISTENT, AT 450 F, ASTM D381	HEAT OF COMBUSTION NET ASTM D1405, BTU/LB	THERMAL STABILITY ASTM D1660		WATER SEPAROMETER INDEX, ASTM D2550, NO.	ITEM
			3 HR, 122 F	2 HR, 212 F	AROM., VOL %	OLEF., VOL %				PRESS. DROP, IN. HG	TUBE RATING CODE		
			COMMERCIAL JET FUELS (ASTM D1655)										
JET A													
0.060	0.0010	2.50	1	1	15.0	<1.0	23.5	1.0	18,594	0.5	1	95	32
0.050	0.0010	2.00	1	1	20.0	<1.0	22.0	1.0	18,545	1.0	1	95	33
0.010	0.0010	2.00	1	1	22.0	<1.0	26.0	1.0	18,614	0.0	1	99	34
0.010	0.0010	1.10	1	1	14.0	<1.0	27.0	1.0	18,597	0.1	1	97	35
-	0.0001	2.90	-	1A	19.1	0.6	19.0	0.2	18,529	0.0	0	98	36
<0.000	<0.0000	0.02	-	1	20.2	0.3	21.0	<0.1	18,494	0.0	0	97	37
0.030	0.0003	2.65	-	1A	14.5	-	22.0	2.1	18,627	0.6	1	93	38
0.010	-	-	1A	-	20.0	-	20.6	-	18,585	1.0	0	94	39
0.100	0.0007	-	1	1	17.2	-	26.0	0.5	18,565	0.0	3	98	40
0.030	0.0000	2.00	-	1B	19.5	1.0	21.2	0.5	18,563	0.0	1	95	41
0.090	0.0010	-	-	1	17.0	0.5	-	0.5	-	-	-	94	42
0.050	0.0024	-	-	1A	-	-	-	1.0	2/ 18,598	0.0	<1	-	43
0.010	0.0001	0.30	-	1A	13.1	0.5	23.0	0.2	18,562	0.0	<1	98	44
0.030	0.0001	1.90	-	1A	23.0	1.9	21.0	0.4	2/ 18,590	0.1	1	96	45
0.100	-	2.90	-	1A	21.1	1.0	22.0	0.6	18,540	0.0	1	98	46
0.080	0.0010	2.20	-	1	21.0	1.8	20.0	1.0	2/ 18,544	0.0	<1	93	47
-	<0.0010	1.20	-	1	15.0	1.0	21.0	1.0	18,566	0.0	1	93	48
-	<0.0010	1.70	-	1	19.0	1.0	20.0	1.0	18,515	0.0	1	93	49
0.130	-	-	-	1A	14.3	0.7	26.0	0.0	18,573	0.0	0	90	50
0.120	0.0010	2.00	-	1A	19.5	1.0	21.2	0.3	18,577	0.0	1	96	51
0.020	0.0001	2.10	-	1A	17.0	0.3	21.8	1.5	2/ 18,565	1.0	1	95	52
0.023	-	-	-	1A	16.1	2.4	22.5	0.5	18,556	0.0	1	98	53
0.020	0.0010	0.80	-	1	14.0	0.5	21.0	1.0	18,570	0.1	1	95	54
0.010	0.0030	2.50	-	1	17.0	1.0	25.0	1.0	18,599	0.0	0	95	55
0.060	0.0010	2.30	-	1	19.0	1.0	21.0	2.0	18,544	0.0	0	88	56
0.050	0.0020	2.30	-	1	20.0	2.0	20.0	1.0	18,576	0.0	1	90	57
0.010	0.0010	2.30	-	1	17.0	0.5	24.0	1.0	18,591	0.1	0	96	58
0.010	0.0010	2.80	-	1A	18.9	-	22.0	2.7	-	0.1	0	98	59
0.040	0.0006	2.10	-	1A	19.0	0.5	20.0	1.0	18,536	0.0	1	98	60
0.110	<0.0020	2.85	1A	1A	15.0	-	21.0	1.0	18,542	-	-	85	61
0.060	0.0005	1.90	1B	-	22.0	<0.5	20.5	1.0	18,520	0.0	0	98	62
0.050	0.0002	-	-	1A	16.0	-	22.0	-	18,620	-	-	-	63
0.069	0.0005	2.70	-	1A	17.3	4.2	21.0	1.9	-	0.0	1	94	64
0.040	0.0010	-	-	1A	14.2	-	26.0	1.0	-	0.0	0	97	65
0.180	0.0010	2.60	-	1A	19.2	1.2	21.0	1.2	18,543	0.5	<1	90	66
0.100	0.0010	2.70	-	1B	17.2	-	22.0	2.2	18,589	1.0	<1	93	67
0.039	0.0017	2.15	1A	1B	16.4	5.4	21.8	0.5	18,603	1.0	2	95	68
0.080	0.0010	1.70	-	1A	15.5	0.0	24.0	0.6	-	0.1	0	98	69
0.010	0.0010	1.70	-	1	22.4	0.8	19.0	1.0	18,528	0.1	0	98	70
0.001	0.0001	0.20	-	1A	17.6	0.4	19.2	2.2	18,492	0.1	<1	95	71
0.030	0.0010	2.50	-	1B	18.7	-	21.0	1.0	18,594	0.0	1	99	72
0.030	0.0010	1.80	-	1	20.8	0.9	21.0	1.0	18,563	0.0	0	99	73
0.030	0.0010	2.60	-	1A	12.9	4.3	21.0	1.0	-	0.2	1	88	74
0.030	0.0010	1.30	-	1B	18.0	-	22.3	1.0	2/ 18,612	0.0	1	99	75
0.050	-	-	-	1A	12.6	1.6	26.0	-	-	0.0	0	98	76
0.130	0.0004	2.30	-	1A	18.5	0.5	20.0	-	-	1.0	0	94	77
0.100	-	-	-	1A	19.5	-	-	0.4	18,608	0.0	1	97	78
0.060	0.0017	2.40	-	1A	21.3	-	20.0	0.2	18,514	0.1	1	89	79
0.040	0.0004	-	-	1	16.8	-	26.0	2.4	18,662	0.0	2	92	80
0.020	0.0002	0.90	-	1	18.7	-	20.0	0.6	18,457	0.0	1	86	81
0.000	0.0000	-	-	1A	11.6	-	28.0	0.6	18,638	0.0	1	80	82
0.040	<0.0010	-	-	1B	20.5	-	21.5	1.0	2/ 18,589	1.5	0	88	83
0.010	-	-	-	1B	16.4	0.2	22.0	0.4	2/ 18,630	0.0	1	93	84
0.014	<0.0005	-	-	1A	18.1	-	24.0	0.8	2/ 18,605	0.2	<1	92	85
0.100	0.0001	2.50	-	1A	14.8	-	24.5	1.9	-	0.1	1	82	86
0.050	0.0006	-	-	1A	10.9	-	25.0	3.0	-	0.6	1	95	87
0.220	-	1.50	1A	1B	16.0	2.0	26.0	2.0	18,596	0.1	1	98	88
0.030	0.0002	2.24	-	1A	18.0	0.9	20.0	1.9	18,583	0.0	1	99	89
0.040	0.0002	1.16	-	1A	18.1	1.0	20.0	2.0	18,580	0.0	1	96	90
0.260	-	3.00	-	1A	20.6	2.3	24.0	0.0	18,515	0.5	1	87	91
0.001	0.0010	1.90	1A	1B	14.4	0.8	25.0	0.0	18,683	0.5	1	100	92
0.024	0.0003	2.05	1A	1A	18.5	1.0	25.0	0.0	18,574	0.5	0	96	93
0.058	0.0002	2.70	1A	1A	17.8	1.2	24.0	1.0	18,576	0.0	2	99	94
0.003	<0.0004	-	-	1A	16.9	0.9	25.0	0.0	18,573	0.4	0	98	95
0.019	0.0009	2.10	-	1A	15.5	0.8	22.0	0.1	18,604	0.0	1	-	96
0.019	0.0001	0.90	1A	1B	18.4	0.0	26.0	0.0	18,594	0.0	0	-	97
0.060	0.0010	2.65	1A	1A	16.3	0.6	22.0	0.4	18,606	0.2	1	99	98
0.053	0.0008	1.99	-	-	17.5	1.2	22.5	1.0	18,574	0.2	-	94	
0.000	0.0000	0.02	-	-	10.9	0.0	19.0	0.0	18,457	0.0	0	80	
0.260	0.0030	3.00	-	-	23.0	5.4	28.0	3.0	18,683	1.5	3	100	