Handbook of Products

Air BP

HANDBOOK OF PRODUCTS

Contents

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Foreword

The British Petroleum Company plc is the parent company of one of the world's largest oil resource groups. Air BP is the specialist organisation within the BP Group which markets on a world-wide basis, a comprehensive range of high quality Aviation Fuels, Aviation Engine Oils and Hydraulic Fluid. This handbook is designed to provide an easy reference to these products, their applications, properties and specifications.

A section devoted to a Health and Safety Guide to Air BP Products is included; this was compiled by the BP Group Product Stewardship Group. The products listed, when sensibly used for their intended purposes with good standards of personal and industrial hygiene, are not hazardous to health. However, in the event of accident or gross misuse, various health hazards could arise. This section illustrates the potential hazards and gives guidance on remedial action that should be taken to deal with medical emergencies that might arise.

Commercial and military specifications for aviation products are subject to regular review and changes are frequent. Where there are questions on compliance of products with recently revised, amended and new specifications, it is advisable to consult the local Air BP Representative, who will not only offer advice on any aspect of the information contained in this Handbook but will also be pleased to answer any other enquiries.

Aviation Fuels

Air BP markets a full range of aviation fuels. Each product is produced to closely defined manufacturing specifications which encompass the most stringent requirements of international civil and all widely known military specifications. During manufacture and throughout distribution in the international Air BP network the strictest attention is paid to the Air BP Fuelling and Quality Control Regulations. These require that at every stage between refinery and aircraft tank, fuel quality is checked by sampling and laboratory analysis to ensure that when delivered to the aircraft the fuel conforms to all the requirements specified for the grade.

Aviation fuels are classified into two groups; aviation gasolines for reciprocating piston engines, and aviation turbine fuels for use in turbo-propeller and turbo-jet engines. The various grades of each type available, together with relevant specifications are shown in the Index and Specification Reference Chart on page 7.

The most important property of aviation gasolines for aircraft piston engines is the anti-knock rating but the distillation range and volatility are also important because of their influence on mixture distribution and cold starting. Other specification requirements ensure that the fuel has good storage stability, will not corrode fuel system and engine parts, and can be satisfactorily supplied to the engine under all operating conditions.

The requirements of aircraft gas turbine engines stress a different combination of properties and tests than those required for aviation gasolines. Anti-knock value is of no importance and is replaced by tests directly and indirectly controlling energy content, thermal stability and combustion characteristics. However, the same basic controls are needed for properties such as storage stability and corrosivity.

There is now only one basic type of jet fuel in civil use world-wide; the kerosine type. It is a development of the illuminating kerosine originally used in gas turbine engines. The wide-cut gasoline type of jet fuel has not been used by civil aircraft for many years and, once the fuel for many military organisations, its military use has rapidly decreased over the last few years as military forces, including USA, NATO and SEATO, have changed to the kerosine type. The wide-cut fuel is a wider boiling-range material containing some gasoline fractions and was developed to increase fuel availability from crude oil.

Despite efforts to standardise jet fuels, there are still a number of differences in minimum quality standards even among major internationally used specifications. When purchasing jet fuel in other countries, international airlines are faced with a confusing array of names, definitions and specifications for jet fuels. As a partial solution, airlines quote their requirements against either the British Ministry of Defence or ASTM specifications or the IATA Guidance Material. Even with these specifications as guidelines some aspects, such as allowable additive contents, frequently are poorly defined.

There are now five basic grades of kerosine type jet fuel in civil use world-wide which are supported by actively maintained specifications. These are:

Jet A – is the grade supplied at civil airports throughout USA and in parts of Canada.

Jet A-1 – used world-wide outside of North America, Former Soviet Union and mainland China, this grade was developed by major international oil companies to alleviate problems experienced by international air carriers when purchasing fuel in other countries. The specification for Jet A-1 incorporates the most stringent requirements of the two main international specifications, namely the British Ministry of Defence and the ASTM. These “Check List” requirements are published under the title of Aviation Fuel Quality Requirements for Jointly Operated Systems, and ensure a uniform standard quality for civil jet fuel throughout most of the world.

Jet TS-1 – is supplied at all airports within the Former Soviet Union and in some Eastern European countries.

Aviation Fuels (cont.)

Jet TH – is the grade normally supplied at all civil airports in Romania.

Jet Fuel No 3 (formerly known as Grade RP-3) – is similar to Jet A-1 and is the grade supplied at all civil airports in mainland China.

Many military organisations, including USA, NATO and SEATO, now use fuels which are virtually identical to Jet A-1 in basic properties, differing mainly in the types of additives permitted. In areas where the same basic grade is used by both military and commercial, only one grade need be manufactured, stored and distributed as the additives required by the military can be injected as the fuel is supplied to the military.

The wide-cut gasoline type of jet fuel is used by the military in Former Soviet Union and mainland China.

Aviation Fuel Additives

Aviation fuel additives are compounds which are added to fuels in very small quantities to impart special or improved characteristics. Their use is rigorously controlled and only those listed in the relevant specifications may be used.

Those in common use are as follows:

1. Tetraethyl Lead (TEL) is added to aviation gasolines to improve knock value in order to avoid detonation or knock occurring in the combustion chambers of piston engines.

2. Static Dissipator Additive increases the electrical conductivity of the fuel and hence speeds up the dissipation of static electricity generated by fuel movements through fuelling systems.

3. Anti-oxidants are added to prevent oxidation of the fuel during storage. Such oxidation would result in the formation of peroxides which could attack fuel system rubber components and also form gum deposits.

4. Fuel System Icing Inhibitors prevent freezing of water precipitated out of fuel due to cooling at high altitude. The approved additives are also biostats and can be used on a continuous doping basis to inhibit microbiological growth in aircraft fuel systems.

5. Corrosion Inhibitors protect ferrous metals in fuel pipelines and equipment. They are also used to improve the lubricating properties of turbine fuels.

6. Metal De-activators depress the catalytic effect which some metals, particularly copper, have on fuel oxidation.

Methanol/Water Mixture

The maximum power output of aviation engines reduces as the atmospheric pressure decreases with altitude, and/or the ambient air temperature increases. The power output can be restored or, in some instances, boosted for take off, by injection of demineralised water or methanol/water mixture into the engine. Air BP supplies Methanol/Water Mixture 45/55 which is identified by the volumetric proportions of the constituents. The specifications met by this product are given in the Index and Specification Reference Chart on page 5.

Index and Specification Reference Chart

AVIATION FUEL		DESCRIPTION	PAGE NO.	EQUIVALENT SPECIFICATION AND REFERENCE NUMBERS						
				UK	USA	IATA	NATO	CHINA	FSU	ROMANIA
AVIATION GASOLINES	BP AVGAS 80	GASOLINE WITH MAXIMUM 0.14 g Pb/l. DYED RED	7	DEF STAN 91 – 90	ASTM D910	—	—	—	—	—
	BP AVGAS 100	GASOLINE WITH MAXIMUM 0.85 g Pb/l. DYED GREEN	8	DEF STAN 91 – 90	ASTM D910	—	—	—	—	—
	BP AVGAS 100LL	GASOLINE WITH MAXIMUM 0.56 g Pb/l. DYED BLUE	9	DEF STAN 91 – 90	ASTM D910	—	—	—	—	—
KEROSINE TYPE AVIATION TURBINE FUELS	BP JET A	FREEZING POINT BELOW -40ºC. FLASH POINT ABOVE 38ºC.	11	—	ASTM D1655 (TYPE A)	—	—	—	—	—
	BP JET A-1	FREEZING POINT BELOW -47ºC. FLASH POINT ABOVE 38ºC.	12	DEF STAN 91 – 91	ASTM D1655 (TYPE A-1)	KEROSINE TYPE FUEL	F–35	—	—	—
	BP JET A-1 FOR MILITARY	AS JET A-1 ABOVE WITH FSII AND COROSSION INHIBITOR	12	DEF STAN 91 – 87	MIL-T-83133 (JP-8)	—	F–34	—	—	—
	BP JET TS-1 AND RT-1	FREEZING POINT BELOW -50ºC. FLASH POINT ABOVE 28ºC.	14	—	—	—	—	—	GOST 10227	—
	BP JET TH	FREEZING POINT BELOW -50ºC. FLASH POINT ABOVE 28ºC.	15	—	—	—	—	—	—	STAS 5639
	BP JET FUEL NO.3	FREEZING POINT BELOW -47ºC. FLASH POINT ABOVE 38ºC.	16	—	—	—	—	GB 6537	—	—
METHANOL/WATER MIXTURE		METHANOL/WATER MIXTURE 45/55 FOR ENGINE POWER RESTORATION	18	DEF STAN 68 – 253	—	—	S-1744	—	—	—

Aviation Gasoline

General

Aviation gasoline is a complex mixture of relatively volatile hydrocarbons. The higher performance grades are produced by blending specially manufactured high octane petroleum fractions consisting of isoparaffins and light aromatic compounds.

Aviation gasoline grades are identified in specifications by their minimum anti-knock engine ratings. Two numbers are used, eg. 100/130, the first referring to the 'lean mixture rating' and the second to the 'rich mixture rating'. Numbers below 100 are octane numbers, while those above 100 are performance numbers. The suffix LL denotes a grade with a lower TEL content i.e. Low Lead.

The use of an incorrect grade can have disastrous results in terms of engine performance and aircraft safety. In order to differentiate between grades, dyes are added to the fuels in accordance with an internationally agreed colour code to impart a distinctive colour.

Applications

In general, each type of engine is certified to operate on a specific grade of fuel and at one time several grades covering a range of anti-knock ratings were produced to meet the requirements of all the different types of engine. In recent years the diminishing demand for aviation gasoline has led to a reduction in the number of grades available. With fewer fuel grades, manufacturing, storage and handling costs were reduced with subsequent benefits to consumers. At present, three grades – 80, 100 and 100LL are covered in the most widely recognised international specifications.

Avgas 80 is suitable only for small, low compression, low power output aero engines, whereas Avgas 100 is required for higher power output engines especially those fitted with either a supercharger or a turbocharger. Avgas 100LL is now the most widely available grade having replaced Avgas 80 and Avgas 100 in most areas of the world. It has the same anti-knock performance as the 100/130 grade but it is produced with a lower TEL content. It is approved for use in all piston engines previously operated on 80/87 and 100/130 grades.

Approvals

Approvals are not given for fuels against military or civil specifications but the BP Aviation Gasolines meet all the requirements of the appropriate grades of the specifications listed on page 5.

Aviation Gasoline (cont.)

BP AVGAS 80

Specifications

British	Def Stan 91-90
USA	ASTM D910

Typical Properties

Knock rating	
Lean mixture, aviation rating	87
Rich mixture, supercharge method	91
Tetraethyl lead, gPb/l	0.09
Colour	Red
Specific energy, net, MJ/kg	44.5
Density at 15ºC, kg/m^3	690
Distillation	
Initial boiling point, ºC	37
10% vol. evaporated at ºC	64
40% vol. evaporated at ºC	80
50% vol. evaporated at ºC	84
90% vol. evaporated at ºC	108
Final boiling point, ºC	119
Sum of 10% and 50% evaporated temperatures, ºC	154
Recovery, % vol	99.0
Residue, % vol	0.4
Loss, % vol	0.6
Vapour pressure, kPa	43.4
Freezing point, ºC	below -80
Sulphur, % mass	0.01
Copper strip corrosion (2h at 100ºC)	1
Oxidation stability (5h)	
Potential gum, mg/100ml	0.5
Lead precipitate, mg/100ml	0.1
Water reaction, volume change, ml	Nil

Aviation gasoline (cont.)

BP AVGAS 100

Specifications

British	Def Stan 91-90
USA	ASTM D910

Typical Properties

Knock rating	
Lean mixture, aviation rating	115.2
Rich mixture, supercharge method	131.7
Tetraethyl lead, gPb/l	0.77
Colour	Green
Specific energy, net, MJ/kg	44.35
Density at 15ºC, kg/m^3	695
Distillation	
Initial boiling point, ºC	40.5
10% vol. evaporated at ºC	71
40% vol. evaporated at ºC	95
50% vol. evaporated at ºC	99
90% vol. evaporated at ºC	107.5
Final boiling point, ºC	124
Sum of 10% and 50% evaporated temperatures, ºC	170
Recovery, % vol	98.5
Residue, % vol	1.0
Loss, % vol	0.5
Vapour pressure, kPa	45.5
Freezing point, ºC	below -65
Sulphur, % mass	0.008
Copper strip corrosion (2h at 100ºC)	1
Existent gum, mg/100ml	below 1
Oxidation stability	
Potential gum, mg/100ml	2
Lead precipitate, mg/100ml	below 1
Water reaction	
Volume change, ml	Nil
Interface rating	1

Aviation gasoline (cont.)

BP AVGAS 100LL

Specifications

British	Def Stan 91-90
USA	ASTM D910

Typical Properties

Knock rating	
Lean mixture, aviation rating	105
Rich mixture, supercharge method	133
Tetraethyl lead, gPb/l	0.52
Colour	Blue
Specific energy, net, MJ/kg	43.73
Density at 15ºC, kg/m^3	715
Distillation	
Initial boiling point, ºC	41
10% vol. evaporated at ºC	58
40% vol. evaporated at ºC	92
50% vol. evaporated at ºC	101
90% vol. evaporated at ºC	128
Final boiling point, ºC	156
Sum of 10% and 50% evaporated temperatures, ºC	164
Recovery, % vol	98
Residue, % vol	1
Loss, % vol	1
Vapour pressure, kPa	41.6
Freezing point, ºC	below -60
Sulphur, % mass	0.0003
Copper strip corrosion (2h at 100ºC)	1
Existent gum, mg/100ml	1
Oxidation stability	
Potential gum, mg/100ml	0.5
Lead precipitate, mg/100ml	1.0
Water reaction	
Volume change, ml	Nil
Interface rating	1

Aviation Turbine Fuels

General

Aviation turbine fuels (jet fuels) are manufactured predominantly from straight run kerosines which normally require further treatment to meet the specification requirements. At some refineries there is an increasing tendency to incorporate proportions of product produced by hydrocracking processes.

Specifications for jet fuels are prepared by a number of internationally recognised bodies. With the exception of the Former Soviet Union, certain East European countries, Romania and the People's Republic of China, commercial jet fuel world-wide is defined by specifications issued by the American Society for Testing and Materials (ASTM), the British Ministry of Defence, and the International Air Transport Association (IATA).

At many major civil airports, jet fuel supply arrangements have become rather complex involving co-mingling of product in jointly owned storage and distribution systems. As a result, fuel suppliers developed a common fuel quality standard covering the requirements of the main international specifications in common use. This standard is known as the Aviation Fuel Quality Requirements for Jointly Operated Systems, or AFQRJOS Check List.

The Check List for Jet A-1, a kerosine fuel having a maximum freezing point of –47ºC, forms the basis of international supply of virtually all commercial aviation world-wide outside of North America, Former Soviet Union, some East European countries and the People's Republic of China.

Jet A-1 produced and delivered to the Check List embodies the most stringent requirements of the following specifications: British Def Stan 91-91, ASTM D1655 Kerosine Type Jet A-1, and IATA Guidance Material – Kerosine Type.

In the USA and parts of Canada, Jet A is the fuel supplied at civil airports. This kerosine type fuel has a maximum freezing point of –40ºC.

In Former Soviet Union and some East European countries, Grade TS-1 is the jet fuel normally supplied at civil airports. Grade TS-1, meeting the requirements of the specification GOST 10227, is a kerosine type fuel with a lower flash point limit than Jet A-1. Grade RT, also to specification GOST 10227, is only occasionally available.

In the People's Republic of China, Jet Fuel No 3 (formally known as Grade RP-3) meeting the requirements of specification GB 6537 is the jet fuel supplied at all civil airports. Jet Fuel No 3 is a kerosine fuel which appears to be identical in composition to Jet A-1.

Most military organisations, including USA, NATO and SEATO, now use kerosine type fuels which are virtually identical to Jet A-1 in basic properties, differing mainly in the types of additives required. In areas where the same basic grade is used by both military and commercial, only one grade need be manufactured, stored and distributed as the additives required by the military can be injected as the fuel is supplied to the military.

The wide-cut gasoline type of jet fuel is used by the military in the Former Soviet Union, some East European countries and the People's Republic of China.

Aviation turbine fuels (cont.)

BP Jet A

BP Jet A is a petroleum distillate blended from kerosine fractions having a freezing point below –40ºC and a flash point above 38ºC. It is available only in the USA and parts of Canada. In USA Jet A is the fuel normally supplied at all civil airports. It does not usually contain a static dissipator additive.

Applications

BP Jet A is widely approved by engine and airframe manufacturers', particularly for European/American aircraft. The flight manuals, however, should be checked because the freezing point of –40ºC maximum may impose aircraft altitude restrictions or other operational limitations on certain very long range flights.

Approvals

The specification authority for Jet A to ASTM D1655 (Jet A) does not give approvals to individual suppliers but BP Jet A fully meets all the requirements of this specification.

Specifications

USA	ASTM D1655 (Jet A)

Typical Properties

Composition	
Total acidity, mg KOH/g	below 0.010
Aromatics, % vol	23.4
Total sulphur, % mass	0.07
Mercaptan, % mass	0.0005
Volatility	
Distillation	
Fuel recovered	
10% vol at ºC	185
50% vol at ºC	211
90% vol at ºC	245
Final boiling point, ºC	280
Residue, % vol	1.0
Loss, % vol	0
Flash point, ºC	51.1
Density at 15ºC, kg/m^3	820
Fluidity	
Freezing point, ºC	-51
Viscosity at -20ºC, mm^2/s	5.2
Combustion	
Specific energy, net, MJ/kg	43.02
Smoke point, mm	19.5
Naphthalenes, % vol	2.9
Corrosion	
Copper strip, 2h at 100ºC	1A
Stability	
Thermal stability (JFTOT), control temperature 260ºC	
Filter pressure differential, mm Hg	1
Tube deposit rating (visual)	1
Contaminants	
Existent gum, mg/100ml	0.5
Water reaction	
Interface rating	1

Aviation turbine fuels (cont.)

BP Jet A-1

BP Jet A-1 is a petroleum distillate blended from kerosine fractions having a freezing point below -47ºC and a flash point above 38ºC. It meets the requirements of the latest versions of UK Specification Def Stan 91-91, ASTM Specification D1655 (Jet A-1), and the IATA Guidance Material (Kerosine Type). BP Jet A-1 is the fuel supplied and used outside USA, the Former Soviet Union, the People's Republic of China and some Eastern European Countries. It normally contains a static dissipator additive.

For military use, BP Jet A-1 additionally conforms to the UK Specification Def Stan 91-87 and US Specification MIL-T-83133 (JP-8) and contains static dissipator additive, corrosion inhibitor and fuel system icing inhibitor.

Applications

BP Jet A-1 kerosine fuel is suitable for all gas turbine engines.

Approvals

The specification authorities for Jet A-1, both civil and military, do not give approvals to individual suppliers but BP Jet A-1 fully meets all the requirements of these specifications.

Specifications

	BP Jet A-1 (Civil)	BP Jet A-1 (FSII) (Military)
NATO Code No	F-35	F-34
UK Joint Services Designation	AVTUR	AVTUR/FSII
British	Def Stan 91-91	Def Stan 91-87
US Military	–	Mil-T-83133 (JP-8)
ASTM	D1655 (Jet A-1)	–
IATA Guidance Material	Kerosine Type	–

Aviation turbine fuels (cont.)

BP Jet A-1

Typical Properties

Composition	
Total acidity, mg KOH/g	0.003
Aromatics, % vol	19.5
Total sulphur, % mass	0.02
Mercaptan sulphur, % mass	0.0003
Volatility	
Distillation	
Initial boiling point, ºC	156
Fuel recovered	
10% vol at ºC	167
20% vol at ºC	172
50% vol at ºC	188
90% vol at ºC	234
End point, ºC	258
Residue, % vol	1.0
Loss, % vol	Nil
Flash point, ºC	42
Density at 15ºC, kg/m^3	804
Fluidity	
Freezing point, ºC	-50
Viscosity at -20ºC, mm^2/s	3.5
Combustion	
Specific energy, net, MJ/kg	43.15
Smoke point, mm	25
Naphthalenes, % vol	1.5
Corrosion	
Copper strip (2h at 100ºC)	1A
Silver strip (4h at 50ºC)	0
Stability	
Thermal stability (JFTOT), control temperature 260ºC	
Filter pressure differential, mm Hg	0.1
Tube deposit rating (visual)	1
Contaminants	
Existent gum, mg/100ml	1.0
Water reaction	
Interface rating	1
Conductivity	
Electrical conductivity, pS/m	180

Aviation turbine fuels (cont.)

BP Jet TS-1 and BP Jet RT-1

BP Jet TS-1 and BP Jet RT-1 are petroleum distillates blended from kerosine fractions. Grade TS-1 is the fuel normally supplied at civil airports in Russia, the Former Soviet Union and some East European countries. Grade RT-1 is not often available. Both grades are manufactured and supplied against the requirements of the latest version of the Specification GOST 10227. These requirements are specified by GOST test methods, which are not equivalent to those used in Jet A-1 specifications, making direct comparison with Jet A-1 difficult. It is clear, however, that compared to Jet A-1, BP Jet TS-1 and BP Jet RT-1 have better low temperature properties but lower flash points, and BP Jet TS-1 has higher mercaptan sulphur levels. They do not normally contain a static dissipator additive.

Specification

GOST 10227

Approvals

The specification authority for Grades TS-1 and RT-1 to GOST 10227 does not give approvals to individual suppliers but BP Jet TS-1 and BP Jet RT-1 fully meet all the requirements of this specification.

Applications

BP Jet TS-1 and BP Jet RT-1 kerosine type fuels are suitable for almost all gas turbine engines but there may still be aircraft/engines whose certification does not cover Grade TS-1 and Grade RT-1. In all such situations the aircraft/engine manufacturers' should be consulted prior to using the fuel.

Typical Properties

	BP Jet BP Jet TS-1	BP Jet RT-1
Composition		
Total acidity, mg KOH/g	0.008	0.002
Aromatics, % vol	15.2	19.5
Total sulphur, % mass	0.04	0.02
Mercaptan sulphur, % mass	0.0026	0.0003
Volatility		
Distillation		
Initial boiling point, ºC	138	140
Fuel recovered		
10% vol at ºC	160	154
50% vol at ºC	183	182
90% vol at ºC	216	211
Final boiling point, ºC	246	238
Flash point, ºC	31.0	35.0
Density at 15ºC, kg/m^3	787	793
Fluidity		
Freezing point, ºC	-64	-68
Viscosity at -40ºC, mm^2/s	2.95	3.8
Combustion		
Specific energy, net, MJ/kg	43.2	–
Smoke point, mm	28	26
Corrosion		
Copper strip (3h at 100ºC)	1A	1A
Stability		
Thermal stability, static test (5h at 150ºC), mg/100ml		
Contaminants		
Existent gum, mg/100ml	1	3
Water reaction		
Interface rating	1B	1B
Separation rating	2	2
Ash content, % mass	–	–

Aviation turbine fuels (cont.)

BP Jet TH

BP Jet TH is a petroleum distillate blended from kerosine fractions that have been processed by treatment with hydrogen. Jet TH is the fuel supplied at civil airports in Romania. It is manufactured and supplied against the requirements of the Romanian Specification STAS 5639/88. These requirements are specified by STAS test methods, which are similar to those used in Jet A-1 specifications. Apart from a lower flash point limit, the requirements of the STAS specification are similar to those for Jet A-1. Jet TH normally contains a static dissipator additive.

Specification

Romanian	STAS 5639/88

Approvals

The specification authority for Jet TH to Romanian Specification STAS 5639/88 does not give approvals to individual suppliers but BP Jet TH fully meets all the requirements of this specification.

Applications

BP Jet TH kerosine type fuel is suitable for all gas turbine engines but there may still be aircraft/engines whose certification does not cover Jet TH. In all such situations the aircraft/engine manufacturers' should be consulted prior to using the fuel.

Typical Properties

Composition	
Total acidity, mg KOH/g	0.002
Aromatics, % vol	16.5
Total sulphur, % mass	0.01
Mercaptan sulphur, % mass	0.0004
Volatility	
Distillation	
Initial boiling point, ºC	142
Fuel recovered	
10% vol at ºC	155
50% vol at ºC	189
90% vol at ºC	229
End point, ºC	259
Residue, % vol	1.5
Loss, % vol	1.5
Flash point, ºC	40
Density at 20ºC, kg/m^3	800
Fluidity	
Freezing point, ºC	–53
Viscosity at -20ºC, mm^2/s	4.3
Combustion	
Specific energy, net, MJ/kg	43.24
Smoke point, mm	22
Corrosion	
Copper strip (2h at 100ºC)	1
Silver strip (4h at 50ºC)	0
Stability	
Thermal stability (Coker),	
Filter pressure differential, mm Hg	5
Tube deposit rating	1
Contaminants	
Existent gum, mg/100ml	3.2
Water reaction	
Interface rating	1b
Conductivity	
Electrical conductivity, pS/m	120

Aviation turbine fuels (cont.)

BP Jet Fuel No 3

In the People's Republic of China, Jet Fuel No 3 (formally known as Grade RP-3) meeting the requirements of Specification GB 6537 is the jet fuel supplied at all civil airports. Jet Fuel No 3 is a kerosine fuel which appears to be identical in composition to Jet A-1. It normally contains a static dissipator additive.

Applications

BP Jet Fuel No 3 kerosine type fuel is suitable for all gas turbine engines but there may still be aircraft/engines whose certification does not cover Jet Fuel No 3. In all such situations the aircraft/engine manufacturers' should be consulted prior to using the fuel.

Approvals

The specification authority for Jet Fuel No 3 to Specification GB 6537 does not give approvals to individual suppliers but BP Jet Fuel No 3 fully meets all the requirements of this specification.

Specifications

Chinese GB 6537

Typical Properties

Composition	
Total acidity, mg KOH/g	0.003
Aromatics, % vol	16.0
Total sulphur, % mass	0.20
Mercaptan sulphur, % mass	0.0018
Volatility	
Distillation	
Initial boiling point, ºC	153
Fuel recovered	
10% vol at ºC	168
50% vol at ºC	194
90% vol at ºC	237
End point, ºC	261
Residue, % vol	0.5
Loss, % vol	0.5
Flash point, ºC	39
Density at 15ºC, kg/m^3	799
Fluidity	
Freezing point, ºC	-52
Viscosity at -20ºC, mm^2/s	3.5
Combustion	
Specific energy, net, MJ/kg	43.35
Smoke point, mm	25
Corrosion	
Copper strip (2h at 100ºC)	1A
Silver strip (4h at 50ºC)	0
Stability	
Thermal stability (JFTOT), control temperature 260ºC	
Filter pressure differential, mm Hg	0.1
Tube deposit rating (visual)	1
Contaminants	
Existent gum, mg/100ml	1.2
Water reaction	
Interface rating	1
Conductivity	
Electrical conductivity, pS/m	180

Methanol/Water Mixture 45/55

The power output of an engine is directly related to the mass or weight of the airflow passing through the engine, and thus, when operating under high temperature and/or high altitude conditions where air density is low, power is reduced. Under these conditions, the power output can be restored by the injection into the airflow of special power boost fluids, which are also known as thrust augmentation fluids.

These fluids have a high latent heat of vaporisation and act by cooling the airflow to raise its density and thereby increase the weight of the airflow through the engine. This technique can also be used to augment take off power under normal atmospheric conditions. The effect can be obtained using water alone but methanol can be added to the water to prevent freezing and also to provide an additional source of fuel.

The use of these fluids is steadily diminishing and, presently, Air BP supplies only one grade, namely Methanol/Water Mixture 45/55.

The methanol and water used must be of very high purity to prevent the formation of deposits in the engines. Methanol conforms to Specification BS 506 and the water, either demineralized or distilled, meets the UK Defence Standard and the Rolls Royce Specification. Details of the components and the Methanol/Water Mixture 45/55 are shown on the following table.

Applications

Modern gas turbine engines do not require the use of either water or water/methanol mixture. For certain older designs of engine, water alone is usually used but there are some engines which use methanol/water mixture, the most significant being the Rolls-Royce Dart turboprop engine.

Methanol/water mixture

	METHANOL	GRADE 45/55	WATER
UK Joint Services Designation	AL-14	AL-28	WTA
NATO Code No	S-747	S-1744	S-1739
SPECIFICATIONS			
British Military	–	Def Stan 68-253	Def Stan 68-253
Rolls-Royce	–	MSRR.9359	MSRR.9359
COMPOSITION			
Methanol	100% by vol	43.8% by vol	–
Demineralised Water	–	56.2% by vol	100% by vol
PROPERTIES			
Density at 20ºC, kg/m^3	791-794	–	–
Density at 15ºC, kg/m^3	–	941-945	–
Dissolved Solids, mg/l	10 max	10 max	10 max
Acidity as Formic Acid, % m/m	30 max	0.0015 max	–
pH Value	–	–	5.0-7.5
Electrical Conductivity, µS/m	–	1100 max	1100 max
Silica Content (as SiO_2), mg/l	–	3 max	–
PRINCIPAL APPLICATION	Component of methanol/water mixtures	Turbine engines (particularly R-R Dart)	Turbine engines

Aviation Engine Oils

Air BP markets mineral oils for aviation piston engines. These products are blended from carefully selected, highly refined, base stocks. By paying scrupulous attention to stringent quality control requirements and procedures during manufacture and distribution, Air BP ensures that the product is of the highest quality when delivered to the customer.

Two types of piston engine oils are marketed: straight mineral and ashless dispersant mineral. The suffix for each grade of oil corresponds to the viscosity in Saybolt Universal Seconds (SUS) at 100ºC. The additive mineral grades are identified by the letter 'D' immediately prior to the suffix.

For many years military specifications and their related approval systems, especially the US military specifications, Mil-L-6082 and Mil-L-22851, have had the greatest influence on the quality of these mineral oils. The US military have not required these oils for many years and are, therefore, unwilling to continue to support the specifications. Commercial specifications equivalent to the US military specifications have been developed under the auspices of the Society of Automotive Engineers (SAE) and now these are fully operational, the US military specifications have been cancelled. For similar reasons the UK specifications for aviation piston engines have been declared obsolete.The SUS commercial grade designations are gradually being replaced by the SAE Grade classifications. Air BP's ashless dispersant multigrades have therefore been given SAE classification suffixes.

The range of piston engine oils marketed by Air BP is shown in the Index and Specification Reference Chart on page 20 and the characteristics of the two types ie. straight mineral and additive mineral, are discussed in more detail on pages 21 and 23 respectively.

Index and Specification Reference Chart

PRODUCT		DESCRIPTION	PAGE NO.	SAE GRADE	SPECIFICATIONS AND REFERENCE NUMBERS			
					USA	FRENCH	NATO	AIRCRAFT ENGINE MANUFACTURERS
STRAIGHT MINERAL OILS	BP AVIATION OIL 80	OIL MEETS CIVIL AND MILITARY SPECIFICATIONS	22	40	SAE J1966 MIL-L-6082E	—	—	REFER TO PRODUCT DESCRIPTION PAGES FOR DETAILS OF AIRCRAFT AND ENGINE MANUFACTURERS' SPECIFICATIONS AND APPROVAL STATUS OF BP OILS FOR AVIATION PISTON ENGINES AND HYDRAULIC FLUID.
	BP AVIATION OIL 100	OIL MEETS CIVIL AND MILITARY SPECIFICATIONS	22	50	SAE J1966 MIL-L-6082E	AIR 3560D	0-117	
	BP AVIATION OIL 120	OIL MEETS CIVIL AND MILITARY SPECIFICATIONS	22	60	SAE J1966 MIL-L-6082E	—	—	
ASHLESS DISPERSANT ADDITIVE MINERAL OILS	BP AERO OIL D80	OIL MEETS PISTON ENGINE MANUFACTURERS' REQUIREMENTS AND CIVIL AND MILITARY SPECIFICATIONS	25	40	SAE J1899 MIL-L-22851D	AIR 3570	0-123	
	BP AERO OIL D100	OIL MEETS PISTON ENGINE MANUFACTURERS' REQUIREMENTS AND CIVIL AND MILITARY SPECIFICATIONS	25	50	SAE J1899 MIL-L-22851D	—	—	
	BP AERO OIL D120	OIL MEETS PISTON ENGINE MANUFACTURERS' REQUIREMENTS AND CIVIL AND MILITARY SPECIFICATIONS	25	60	SAE J1899 MIL-L-22851D	—	0-128	
	BP MULTIGRADE AERO OIL D SAE 20W/50	MULTIGRADE OIL MEETS PISTON ENGINE MANUFACTURERS' REQUIREMENTS AND CIVIL AND MILITARY SPECIFICATIONS	25	20W/50	SAE J1899 MIL-L-22851D	—	—	
	BP MULTIGRADE AERO OIL D SAE 25W/60	MULTIGRADE OIL MEETS PISTON ENGINE MANUFACTURERS' REQUIREMENTS AND CIVIL AND MILITARY SPECIFICATIONS	25	25W/60	SAE J1899 MIL-L-22851D	—	—	
HYDRAULIC FLUID	BP AERO HYDRAULIC IF	PETROLEUM BASED OIL WITH LOW POUR POINT AND LOW VISCOSITY	26	—	MIL-H-5606G	AIR 3520 B	H-515	

Straight Mineral Piston Engine Oils

The Air BP straight mineral grades are available for those users requiring high quality oils of proven performance without ashless dispersant additives. They are produced from highly refined petroleum basestocks selected from North American crude oils. The only additive present is a pour point depressant to impart improved fluidity at low temperatures.

Applications

The majority of engine manufacturers' recommend ashless dispersant additive oils for general use in preference to straight oils because of their enhanced oxidation and thermal stability properties, and their dispersancy characteristics enable deposit formation in the engine oil system to be minimised. However, straight oils are recommended for approximately the first 50 hours running-in period for new and newly overhauled engines as they allow faster piston ring bedding-in and oil loss control. The engine manufacturer's specific requirements for running-in practices should be strictly adhered to.

The applications of the Air BP Aviation Oils are similar to those recommended for the same viscosity Air BP Aero D ashless dispersant grades.

Straight Mineral Piston Engine Oils (cont.)

Approvals

	BP Aviation Oil 80	BP Aviation Oil 100	BP Aviation Oil 120
Military			
US Mil-L-6082F:	Cancelled	Cancelled	Cancelled
UK Specification:	Now Obsolete	Now Obsolete	Now Obsolete
Commercial			
Approved against SAE:	J1966 (SAE 40)	J1966 (SAE 50)	J1966 (SAE 60)
Meets requirements of:			
AVCO Lycoming Specification:	301F (Grade 1080)	301F (Grade 1100)	301F (Grade 1120)
Teledyne Continental Motors Specification MHS 24B for straight mineral grades:	SAE 40	SAE 50	SAE 60

Specifications

NATO Code No.	None	O-117	None
UK Joint Services Designation	OM-170	OM-270	None

Typical Properties

Viscosity, cSt			
at 100ºC	15.6	18.2	24.6
at 40ºC	166	205	321
Flash point, ºC	264	261	280
Sulphur, % mass	0.5	0.5	0.7
Pour point, ºC	-27	-18	-18
Total acid number, mg KOH/g	0.02	0.02	0.02
Density, kg/m^3	891	891	894
Ash content, % mass	0.001	0.001	0.001
Trace sediment, ml/100ml oil	<0.005	<0.005	<0.005
Copper corrosion, (3h at 100ºC)	1b	1b	1b

Ashless Dispersant Additive Mineral Piston Engine Oils

Air BP markets a range of five ashless dispersant additive mineral oils: three single viscosity grades and two multi-viscosity grades. All the grades are blended from high quality, high viscosity, solvent refined, de-waxed paraffinic North American lubricating base stocks. They contain an ashless dispersant additive which leaves no metallic ash residues which could cause combustion chamber deposits and a tendency towards pre-ignition. BP Multigrade Aero Oils D SAE 20W/50 and 25W/60 contain, in addition, a shear stable viscosity index improver additive which enables them to combine the viscosity levels of SAE 20W and 25W grade oils at cold temperatures, while retaining all the lubrication performance of SAE 50 and 60 grade oils at normal engine operating temperatures.

Applications

BP ashless dispersant mineral oils are suitable for use in all aviation piston engines operating in the general aviation market. They should be used only in accordance with the engine manufacture's recommended lubrication procedures including oil change schedules. The break-in of new or newly overhauled engines is normally carried out using a straight grade aviation mineral oil. Again, the engine manufacture's recommended procedures for running-in period should be observed before switching to an ashless dispersant grade oil.

The choice between the single viscosity BP Aero Oils, D80, D100 or D120 grades will largely depend upon engine power output and ambient air temperature operating conditions. Higher power outputs and higher ambient air temperatures will generally dictate use of the more viscous D100 or D120 grades. The major drawback in using single viscosity grade oils is that a change to an alternative grade oil may have to be made seasonally or when flying between regions having significantly different ambient temperatures.

These problems of choice of oil grade are overcome when using BP Multigrade Aero Oil D SAE 20W/50 or 25W/60. They provide the performance of SAE 20W or SAE 25W grade oils at cold temperatures, while retaining all the protective lubricating properties of SAE 50 or SAE 60 grade oils at normal operating temperatures. They are specifically recommended for use in engines subjected to wide variations of temperature. The wide operating temperature range of the oils provide the following benefits:

– reduced oil consumption

– reduced fuel consumption

– seasonal oil changes eliminated

– flights through wider ranges of climatic conditions permitted without the need of changing oil grade

– greatly assisted engine starting and rapid lubrication of piston rings, cylinder walls and valves during the critical warm-up period

– the above make their use highly desirable in turbocharged or supercharged engines operating at higher altitudes and lower outside air temperatures.

The highly effective additive package, which is approved against the specifications Mil-L-22851D (recently cancelled) and SAE 1899, provides excellent dispersancy, anti-wear and anti-foam properties and enhances oxidation and thermal stability whilst providing the lubricating properties of an SAE 50 or SAE 60 grade oils at normal engine operating temperatures.

Ashless Dispersant Additive Mineral Piston Engine Oils (cont.)

Change of Oil Type

It is appreciated that, particularly in the general aviation sector, operators may not always be able to top up with the appropriate grade of BP mineral oil. Oil mixing is not encouraged due to slight differences in the characteristics of the different competitors' oils, but approved aviation oils of the same viscosity grade are compatible and may be used when necessary.

BP Multigrade Aero Oil D SAE 20W/50 and SAE 25W/60 oils are compatible with other grades of oil but if full advantage is to be taken of their all-temperature performance, mixing should only be carried out in an emergency and not on a regular basis.

If, after a significant period of operation on a straight mineral oil, it is required to change to a BP ashless dispersant additive grade, the following procedure should be adopted:

1. Drain straight oil and refill with recommended grade of BP dispersant additive oil.

2. Due to the detergent action of the dispersant additive, sludge and carbonaceous material may be dislodged and the oil should be changed after five hours running.

3. Oil filters should be inspected frequently and if deposits persist, oil should be changed frequently until normal operation is achieved.

Ashless Dispersant Additive Mineral Piston Engine Oils (cont.)

Approvals

	BP Aero Oil			BP Multigrade Aero Oil	
	D80	**D100**	**D120**	**20W/50**	**25W/60**
Military:					
Mil-L-22851D (Now cancelled)	SAE 40	SAE 50	SAE 60	20W/50	25W/60
Commercial:					
Approved against SAE 1899	SAE 40	SAE 50	SAE 60	20W/50	25W/60
Meets requirements of:					
AVCO Lycoming MHS-301F	SAE 40	SAE 50	SAE 60	20W/50	25W/60
Teledyne Continental Motors MHS 24B	SAE 40	SAE 50	SAE 60	20W/50	25W/60

Specifications

NATO Code No :	O-123	None	O-128	None	None

Typical Properties

Viscosity, cSt					
at 100ºC	14.4	19.0	23.0	19.8	24
at 40ºC	121	182	241	158	240
Viscosity, cP					
at -10ºC	–	–	–	3200	–
at-5ºC	–	–	–	–	4500
Flash point, ºC	246	252	270	236	261
Sulphur content, % mass	0.5	0.5	0.5		
Viscosity index	120	118	118	140	125
Total acid no, mg KOH/g	0.03	0.03	0.03		
Density at 15ºC, kg/m^3	886	889	888	882	880
Trace sediment, ml/100ml	<0.005	<0.005	<0.005		
Pour point, ºC	-27	-24	-24	-33	-27
Ash content, % mass	0.001	0.001	0.001		
Copper corrosion	1b	1b	1b		

Hydraulic Fluid

BP Aero Hydraulic 1F

BP Aero Hydraulic 1F is a low viscosity, low pour point petroleum base oil blended with a viscosity index improver, an oxidation inhibitor and up to 0.5% of triaryl phosphate of the 'non-toxic' type as an anti-wear agent. The formulation is approved against the French Specification AIR 3520/B, the US Specification Mil-H-5606G and the British Specification Def Stan 91-48/2, and is available only in the superclean grade. During manufacture it is subjected to fine filtration in a 'clean-room' facility which guarantees the high degree of cleanliness necessary to enable it to conform to the rigid cleanliness clause of the AIR 3520/B Specification.

Applications

It is designed for use in aircraft hydraulic mechanisms operating between -54ºC and 135ºC in pressurised systems, including automatic pilots, shock absorbers, brakes, undercarriages, flap control mechanisms and servo units. It is intended for use with synthetic rubber parts and must not be used in systems incorporating natural rubber. The oil is dyed red for identification and to ease the detection of leaks.

As approved AIR 3520/B fluid, BP Aero Hydraulic 1F is recommended by many aircraft manufacturers for use in the hydraulic systems and flying controls of their military and civil aircraft. It is finding increasing use in industrial and marine hydraulic equipment and in some automotive applications.

Approvals

French Military	AIR 3520/B
US Military	Mil-H-5606G
British	Def Stan 91-48/2

Specifications

NATO Code No	H-515
UK Joint Services Designation	OM-15

Typical Properties

Density at 20ºC, kg/l	0.868
Kinematic viscosity, cSt	
at 100ºC	5.3
at 40ºC	14
at -54ºC	1800
Flash point, ºC	93
Pour Point, ºC	<-60
Total acid number, mg KOH/g	0.03

Introduction

The Air BP range of products comprises aviation fuels (gasolines and kerosines), aviation lubricants (engine oils and hydraulic fluid) and methanol/water mixtures (power boost fluids). These products are unlikely to present health, safety or environmental risks provided they are used according to the recommended handling procedures and with high standards of personal and industrial hygiene. However, if standards are not maintained, hazards could arise. This section describes the hazards associated with Air BP products, and provides guidance on how to avoid or minimise any potential risks.

It contains general advice on the handling and use of Air BP products; this is supplemented by more detailed information, which is given in the Materials Safety Data Sheets contained in the pocket at the back of the Handbook. Materials Safety Data Sheets obtained locally may contain any additional information required by National regulatory requirements.

For ease of reference the section is divided into five parts: Part 1 gives information on safety hazards, Part 2 describes the health aspects relevant to Air BP products, Part 3 gives advice on environmental considerations, Part 4 describes the purpose and content of the Materials Safety Data Sheets for Air BP products and Part 5 gives guidance on where to obtain further information.

Part 1. Safety

The main safety hazard with Air BP products relates to the risk of fire or explosion with aviation fuels and methanol/water mixtures. The information in this part is intended to act as a guide to users. It is of a very general nature and is not intended to replace any local regulations.

1.1 Flash Point Classification

To apply safeguards to the storage, transport and handling of petroleum liquids, international organisations and authorities classify these liquids according to their flammability. These classifications sometimes vary slightly from country to country but the variations are not likely to affect the classifications of Air BP products, which are classified according to their closed cup flash points in conformance with the most widely used system. The classification and guidance is as follows:-

Class I
Products with a closed cup flash point below 21ºC should be stored and handled in accordance with local regulations for highly flammable liquids and all sources of ignition excluded. Electrical equipment used must satisfy the requirements of the Institute of Petroleum Electrical Safety Code or its local equivalent.

Class II
Products with a closed cup flash point from 21ºC to 55ºC inclusive should be stored and handled in accordance with local regulations for flammable products and stored in closed containers and all sources of ignition excluded. Electrical equipment used must satisfy the requirements of the Institute of Petroleum Electrical Safety Code or its local equivalent.

Class III
Products having a closed cup flash point above 55ºC up to and including 100ºC.

Unclassified
Products having a closed cup flash point above 100ºC.

Air BP Aviation gasolines and methanol/water mixtures are Class I products. Their very low flash points mean that any spillage or leak is a severe fire and/or explosion hazard. They must be stored at ambient temperatures away from ignition sources and only in equipment or containers designed specifically for their use. Containers must be properly labelled and kept closed when not in use. Hot work, such as cutting or welding, must not be carried out on any container used for these products unless it has been made safe. Containers, such as drums, containing residues of these products must be disposed of safely according to local regulations.

Air BP Aviation turbine kerosines are Class II products, which are flammable and should be stored in closed containers and all sources of ignition excluded. Any spillage should be treated as a potential fire hazard and/or explosion hazard.

Air BP Aviation lubricants and hydraulic fluid are unclassified products which are combustible and should be stored at ambient temperature away from ignition sources.

1.2 Fire Extinguishing

In the event of fire, extinguish using dry powder, foam or, for small fires, carbon dioxide. NOTE: The use of BCF/halon extinguishers is environmentally unacceptable. Water (as a fine spray or mist) should only be used as a protective screen and/or to cool adjacent tanks.

In some instances, products which are exposed to fire may produce toxic fumes during thermal decomposition.

1.3 Specially Hazardous Circumstances

Aviation Fuel Spillages. If fuel is spilled in a confined space, dangerously high concentrations of vapour are produced; *great care must be taken to reduce fire hazard and to prevent the serious consequences of inhalation in such circumstances by wearing the appropriate respiratory protection (see also Sections 2.3 and 2.5).*

Aviation Fuel Tank Cleaning. Special precautions must be taken during cleaning or maintenance on avgas storage tanks. Special precautions are also necessary when sludge from these tanks is being removed or disposed of. The necessary precautions are described in Associated Octel Co. Ltd's booklet *'Leaded Gasoline Tank Cleaning and Disposal of Sludge'.*

Part 2. Health

2.1 General Health Aspects

Aviation fuels (gasolines and kerosines) are complex mixtures of distillate fractions of petroleum. They are manufactured to a technical specification and their hydrocarbon make-up varies considerably, depending on crude oil source, processing and intended application. They generally contain low concentrations of performance additives.

Air BP lubricants and hydraulic oil are formulated from highly refined mineral oils and special additive systems.

The following general health advice relates to all Air BP products. Individual Materials Safety Data Sheets (see pocket in the back of this handbook) should be consulted for specific details of applications, physical characteristics/composition and health advice.

2.2 Exposure

Under normal conditions of use, exposure to Air BP aviation fuels is likely to be confined to inhalation of mists or vapours generated during handling or incidental skin contact. Accidental skin contact with methanol/water mixtures may also occur during maintenance. Inhalation exposure or accidental ingestion or eye contact is also possible.

Exposure to Air BP lubricants and hydraulic oil is most likely to occur due to incidental skin contact during ‘top-up’ or routine maintenance procedures.

2.3. Effects of Exposure

Inhalation

The volatility and vapour pressure of aviation fuels and methanol/water mixtures means that inhalation exposure may occur to vapours and mists evolved during handling. Such exposure to high concentrations may cause irritation of the respiratory tract. In common with many hydrocarbons, exposure to high vapour concentrations may cause drowsiness or loss of consciousness. Aviation fuels are complex mixtures which can contain small amounts of dangerous components. Inhalation, therefore, presents a potential hazard in that this could result in absorption into the bloodstream and possibly systemic damage.

Under normal conditions of use, inhalation of aviation lubricants and hydraulic oil are unlikely. However, if the products are heated or used in situations where aerosolisation is likely then exposure to mists may occur. Apart from transient irritation of the respiratory tract, such exposure is not expected to cause any particular health effects. Overheating of the products may, however, result in hazardous decomposition products being evolved.

Skin

Frequent or prolonged skin contact with fuels and lubricants will de-fat the skin, leaving it dry and susceptible to fissuring, dermatitis and subsequent infection. Exposure to fuels may also cause chemical burns particularly if contact is prolonged or the affected area is occluded for example by clothing.

Skin exposure to used lubricants should be avoided as they may have a potential to cause serious irreversible skin disorders, such as warty growths and cancer, due to the presence of small amounts of harmful contaminants.

Simple, practical advice on the prevention of occupational skin diseases and the importance of preventing contamination of the skin is given in Part 2.5 on page 33.

Injections through the skin arising from contact with high pressure/velocity sprays are **SERIOUS MEDICAL EMERGENCIES.** Injuries may not appear serious at first but within a few hours tissue becomes swollen, discoloured and extremely painful with extensive subcutaneous necrosis. Emergency surgical exploration and thorough cleansing of the wound and underlying tissue is necessary to minimise necrosis and tissue loss. **NOTE:** high pressure may force material considerable distances along tissue planes.

Eyes

Eye contact with liquid products and their vapours may cause transient irritation but no lasting effects. Irritant effects are likely to be more pronounced with products of low viscosity and high aromatic content, such as some aviation gasolines.

Part 2.
Health (cont.)

Ingestion
Under normal conditions of use, ingestion of Air BP products is unlikely. If it does occur they may produce local irritation of the mouth and gastrointestinal tract. Ingestion of low viscosity products also presents a risk of aspiration into the lung (see Aspiration).

Aspiration
Aspiration means the introduction of liquid into the lungs. Products such as aviation gasolines and kerosines can enter the lung causing rapidly developing inflammation (chemical pneumonitis) which may prove fatal.

Aspiration can occur after ingestion of a liquid particularly if vomiting occurs, or if the patient is unconscious or semi-conscious.

2.4 Occupational Exposure Limits

Occupational Exposure Limits (OELs) – of which the Threshold Limit Values (TLVs), adopted annually by the American Conference of Governmental Industrial Hygienists, are probably the most widely known – recommend the airborne concentrations of substances in the working environment to which it is believed that nearly all workers may be exposed repeatedly, day after day, without adverse effects. The purpose of such limits is to act as a guide to the establishment of an acceptable working environment. They do not indicate an index of toxicity or even a relative degree of risk or hazard. The limits are based on the best available information although in some cases this may be limited. The best practice is to maintain airborne concentrations of substances as far below the appropriate OEL as is practicable.

For most substances, OELs are expressed as time weighted average (TWA) concentrations for an 8 hour working day, but for some an absolute ceiling concentration – not to be exceeded at any time – or additional short-term (15 minutes) exposure limits, annotated as C and STEL respectively, may be assigned. Some OELs may also be annotated – skin – which indicates that dermal adsorption is an important route of exposure to the material.

OELs are usually quoted as parts of vapour or gas per million parts of contaminated air by volume (ppm) at 25ºC and 760 mm of Hg pressure or milligrams of substance per cubic meter of air (mg/m^3).

2.5 Preventive Measures

Inhalation
Inhalation of mists and vapours should be avoided as far as possible, and where applicable, OELs should be observed and exposures reduced to the lowest practicable level. Good local and general ventilation should be provided.

Appropriate personal protective equipment should be available. If operations are such that exposure to vapour, mist or fume may be anticipated, then suitable approved respiratory equipment should be worn. The use of respiratory equipment must be strictly in accordance with the manufacturer's instructions and any statutory requirements governing its selection and use.

Skin Contact
Skin contact with fuels and lubricating oils of various types is a common route of industrial exposure. Adverse effects can be prevented by the use of good industrial and personal hygiene measures such as:

– the wearing of adequate protective clothing and the frequent laundering of overalls;

– the provision of disposable 'wipes' (oily rags or tools should never be kept in overall pockets);

– good washing facilities should be available with hot and cold water, proprietary hand-cleansers and clean towels (barrier creams and reconditioning creams may be beneficial).

Detailed advice on how to care for skin when using petroleum products is given in Part 2.6.

Part 2.
Health (cont.)

2.6 Skin Care When Using Petroleum Products

To minimise the possibility of skin problems arising during handling of Air BP products, it is important that good hygiene (industrial and personal) practices are followed. This section provides general advice on the prevention of occupational skin diseases when using petroleum products. The appropriate BP Materials Safety Data Sheet should be consulted for specific advice on safe handling precautions and emergency procedures for particular Air BP products.

Healthy Skin

The skin is the main barrier protecting the body from harmful substances in the environment and comprises a thin outer layer (the epidermis) and a thicker inner layer (the dermis which contains sweat glands, hair follicles and blood vessels). The epidermis consists of a layer of dead cells (cells being the basic structural and functional building blocks of the body) bound together by natural oils to form an impervious barrier. The natural oils present are important in retaining water and their loss (known as defatting) can lead to dehydration of the skin which becomes stiff and cracks open exposing the underlying living cells to harmful substances or infection.

Effects of Petroleum Products on the Skin

Frequent or prolonged contact with mineral oil products can cause various skin conditions which may occur singly or in combination:

Irritant Contact Dermatitis is inflammation of the skin resulting from contact with an irritant material. The response of individuals to irritant materials may vary. Petroleum products, particularly those of low viscosity, may defat the skin leaving it dry and susceptible to dermatitis and infection. Irritant dermatitis is the most common skin condition caused by frequent or prolonged skin contact with petroleum products.

Allergic Contact Dermatitis occurs only in individuals who have become allergic (sensitised) to particular materials as a result of previous exposure. The inflammation of the skin in such cases is the same as in irritant contact dermatitis except that severe inflammation may be caused by even trivial contact with small amounts of the material.

In both irritant and allergic contact dermatitis, inflammation causes the skin to become red and itchy. Small watery blisters may develop and burst, leaving the skin surface dry and flaky which may result in cracking and in some cases bleeding. Dermatitis developing over a long period may result in skin which is thickened and scaly. Occupational contact dermatitis commonly affects forearms, backs of hands and between fingers, but may affect any exposed areas of skin. Although it may occur at any age it arises most often in middle age, sometimes after exposure to the same material for twenty years or more. Once contact dermatitis has developed, the skin does not always return to a normal healthy condition even if all contact with the offending material(s) is avoided. Prevention of contact dermatitis developing must, therefore, be the primary consideration.

Oil Folliculitis (blocking of hair follicles) and/or **Oil Acne** (blocking of sebaceous and/or sweat glands) may develop as a result of prolonged skin contact with mineral oil products (particularly where oil-soaked clothing has been allowed to remain in prolonged contact with the skin). The first sign is normally the appearance of ‘blackheads’ but more susceptible individuals may suffer from boils or even carbuncles.

Frequent and prolonged skin contact with some lubricants and fuels, especially if accompanied by poor standards of personal hygiene, may lead to localised thickening of the skin (keratosis) or to warty growths.

Part 2.
Health (cont.)

Rarely, a warty growth may become malignant (cancer). In addition, small growths or malignant ulcers may develop on otherwise normal skin. These occur most frequently on exposed areas (hands, forearms) but may also appear on other areas where the skin is habitually chafed by oil-impregnated clothing. The scrotum is particularly susceptible and therefore oily rags or tools should never be put into trouser pockets. Work clothes should be cleaned regularly and changed promptly if they become contaminated. It is essential to maintain high standards of personal hygiene.

Skin cancers may not appear for many years (usually more than twenty) after exposure. Early medical treatment is essential. Personnel with prolonged occupational exposure to petroleum products should be advised by management to examine themselves regularly, for example when bathing. Handling instructions for materials suspected of being able to cause skin cancer should be followed carefully at all times. Anyone who develops a skin sore or ulcer which does not heal quickly (even though they have not handled petroleum products for many years) should consult a physician.

Prevention of Skin Contamination
The best way to protect the skin from any harmful effects of petroleum products is to prevent skin contamination. Personal protection is less effective than properly engineered containment. Work practices must be adopted to minimise contact and prevent the accumulation of material on the skin. Only disposable 'wipes' should be used – workers should never put oily rags or tools in pockets.

Protective clothing: cotton or polyester/cotton overalls normally provide adequate protection where only intermittent or occasional contact is likely. Where a higher degree of contact is possible additional impermeable protective clothing, such as gloves, aprons, oil-resistant footwear, should be worn as appropriate. Clothes should be changed regularly (immediately if impregnated) and laundered before re-use. Saturated clothing should not be allowed to chafe against the skin.

Barrier Creams may help to prevent grime becoming ingrained into the skin but offer little or no protection against harmful substances. Petroleum products should be washed off the skin using soap or proprietary skin cleansers and warm water. Fuels, such as gasoline or kerosine, or solvents, such as white spirit, should never be used as they themselves may cause dermatitis if used repeatedly. Workers should be encouraged to wash regularly, particularly before eating. Skin cleansers (moisturising creams) may be used, for example at the end of each shift, as they can help replace natural oils and prevent defatting.

Part 3. Environment

If Air BP products are released accidentally into the environment through spillage, leakage from fixed installations or following incorrect disposal of waste product, they may cause adverse effects. Should such environmental contamination occur, the prime concern must be to avoid fire and explosion. Consistent with this objective, the spillage should be contained and isolated from all sources of ignition and from personnel. Spilled material should be recovered by the use of absorbents, such as sand, sawdust or other proprietary absorbent, and stored in suitable containers in a safe and well ventilated area prior to disposal under conditions approved by the local authorities.

Aviation fuels in particular can be harmful to aquatic organisms and may persist in the environment. Aviation fuels may also find their way into water courses and possibly drinking water supplies. Contamination of water courses and drainage systems must at all times be prevented.

Apart from their well recognised effects due to physical fouling, lubricant products are unlikely to be particularly harmful to aquatic organisms, although they persist in the environment (water/soil) for some time. Heavily contaminated soil may need to be removed and disposed of according to local regulations.

New and used lubricants and waste fuels must be disposed of in accordance with local regulations ensuring that they do not contaminate water courses and drainage systems.

Part 4.
Materials Safety Data Sheets

Materials Safety Data Sheets (MSDS) for the generic product types supplied by Air BP are enclosed in the back of this brochure. This section provides some guidance on the purpose and content of these sheets.

4.1. Purpose

Knowing how and where to obtain basic Health, Safety and Environmental information is often the first step in preventing problems during use of products. Similarly, the availability of information on the effects of product spillage, or the disposal of used products, can help to protect health and the environment.

The Air BP MSDS provide a useful summary of all health, safety and environmental information for Air BP products. It is intended as an aid to safe use, an indicator of any potential hazards and a guide to the necessary response to any problems arising. It contains first aid advice and procedures for emergency situations such as fire and spillage. Information is also provided on environmental effects and safe disposal. The MSDS are intended for all persons using or handling the product.

In most cases the products present little or no health, safety or environmental hazard if handled according to the instructions given in the MSDS.

4.2. Contents

Air BP MSDS are divided into sections which provide in a concise form all relevant health, safety and environmental information on the product. These data are largely self-explanatory but further information on the content of a number of sections may be helpful to understand the type of information they contain. These are listed below:

Application
A short description is given of the primary intended use of the product. The product should not be used for any other purpose or application unless specifically recommended or advised by Air BP.

Composition and Hazards Identification
These sections provide a description of the composition of the product and identify particular components which are identified as hazardous by regulatory authorities. Components may be identified by their assigned Chemical Abstracts Service (CAS) number or European Inventory of Existing Commercial Chemical Substances (EINECS) number. It should be noted that the presence of any such ‘hazardous’ components does not necessarily indicate that a finished product will present any hazard. Whether or not it does will depend on the concentration of the hazardous component in the product.

Where a product is considered to present a significant flammability, health or environmental hazard, the nature of the hazard is described in this section.

First Aid Measures and Medical Advice
This section provides advice on immediate action to take in the event of accidental exposure to the product, or if adverse health effects are experienced. A separate section may be included to provide advice to medical practitioners when they are involved in the treatment of a casualty.

Exposure Controls and Personal Protection
Workplace exposure limits, sometimes called Occupational Exposure Limits (OEL) or Threshold Limit Values (TLV), are provided if they have been established or recommended by a regulatory authority or professional body. These limits are not dividing lines between ‘safe’ and ‘unsafe’ levels of exposure, but are airborne concentrations that should not cause significant adverse health effects. Concentrations may be expressed either in terms of short term exposure (typically 15 minutes for the Short Term Exposure Limit or STEL) or longer-term exposure (8 hour OEL or TLV). In either case the aim should be to reduce the airborne concentrations of the product in the workplace below the limit as far as is reasonably practical. Exposure should be calculated as Time Weighted Average (TWA) values over the defined period.

Where appropriate, this section will also provide advice on appropriate personal protective equipment (clothing, goggles, etc) to reduce the risk of accidental contamination with the product.

Part 4.
Materials Safety Data Sheets (cont.)

Physical Characteristics
Typical physical characteristics are given which are relevant to health, safety and environmental assessment.

Stability and Reactivity Information
The chemical and physical stability of the product at ambient temperature is indicated together with conditions and incompatible materials to be avoided to prevent explosions or reactions that might produce toxic products. A common concern with oil products is the generation of carbon monoxide and/or smoke from incomplete combustion.

Toxicological Information
The potential hazards to health arising from short and long-term exposure to the product by various routes are indicated, for example by splashing on the skin or in the eyes, by inhalation of mist or vapour, or by ingestion.

Eye Contact: An indication of whether the product will be irritant, or damaging if splashed into the eye.

Skin Contact: An indication of the effect of the product on the skin from short term exposure, for example irritation, or from repeated or prolonged exposure, which may result in allergic sensitisation or more severe skin disorders. In addition, if there is a possibility that some product may be absorbed through the skin to produce injury to parts of the body remote from where contact occurs, this would also be indicated. This is known as a systemic toxic effect.

Ingestion: An indication of whether the product is likely to produce any harmful or toxic effects if swallowed. In addition for liquids of low viscosity a warning will be given regarding possible hazards from aspiration into the lungs.

Inhalation: an indication of the effect of breathing mist, vapour, gas or fumes produced during use.

Ecological Information
Advice is provided in this section on any adverse effects of the product if accidentally released into the environment. In particular, information is included on the toxicity of the product to organisms in the aquatic environment, the likely fate and persistence of spilled product, and an indication of the ability of the product to be degraded biologically.

Transport and Regulatory Information
These sections provide details of labelling requirements for transport and supply of the product. Most frequently the supply labelling relates to the European Union (EU) Directives for the labelling of dangerous substances and preparations. Other national regulations may be included as appropriate.

The product label indicates the main hazards of the product, for example ‘Highly Flammable’ or ‘Toxic’, and includes a description of any hazard along with advice on safety. In certain circumstances, where it may be helpful to customers, BP will voluntarily include additional information on the warning label even when this is not required by law.

Part 4.
Materials Safety Data Sheets (cont.)

4.3. Glossary of Terms

Acute – effects that rapidly follow exposure (seconds to hours)

Aspiration – introduction of liquid into the lungs

Biodegradability – the ability of a material to break down in the environment

Carcinogen – any cancer-producing substance

Chronic – effects from repeated or prolonged exposure (days to years)

Dermatitis – non-infective inflammation of the skin

Ecotoxicity – the ability of a material to cause adverse effects in the environment

Ingestion – taking by mouth

Inhalation – breathing vapour, gas or fumes into the lungs

Irritation – inflammation caused by immediate, prolonged or repeated contact by a material with skin, eye or mucous membrane

Local – effects occurring at point of contact with material

Mucous membrane – lining of cells of the respiratory system, eyes, nose and mouth

Respiratory tract – air passageways including nose, throat, windpipe and lungs

Sensitisation – development of an allergic state: a sensitised individual will react on subsequent exposure to even very small amounts of the sensitiser

Systemic – effects occurring in parts of body remote from site of contact

Toxicity – the inherent ability of a material to produce injury when it has reached a susceptible site on or within the body

Part 5.
Further Information

Further copies of this Handbook, and any more detailed advice, may be obtained from your normal Air BP contact, or from

Air BP
Breakspear Park
Breakspear Way
Hemel Hempstead
Herts HP2 4UL
United Kingdom

Switchboard: 44 1442 225711
Central Fax: 44 1442) 224861
Telex: 825380

A number of more detailed publications on the subject of health and safety have been prepared by the oil industry body CONCAWE (Oil Companies European Organisation for Environment and Health Protection). These not only provide useful background information, but also list further reference material. The relevant reports are:

– CONCAWE Report No 1/97 “Petroleum products – first aid, emergency and medical advice”.

– CONCAWE Report No 2/85 “Health aspects of petroleum fuels – general principles”.

– CONCAWE Report No 85/81 “Health aspects of petroleum fuels – potential hazards and precautions for individual classes of fuels”.

– CONCAWE Report No 5/87 “health aspects of lubricants”.

– CONCAWE Report No 7/87 “Health aspects of toluene and xylene exposures associated with motor gasoline”.

– CONCAWE Report No 95/59 “The classification and labelling of petroleum substances according to the EU dangerous substances directive”.

Copies of these reports can be obtained from the CONCAWE office at:

Madouplein 1
B- 1030
Brussels
Belgium