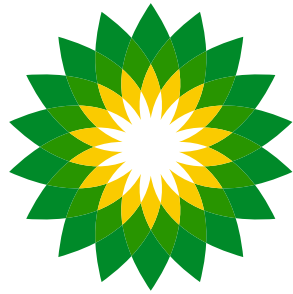


946 mL – 1 U.S. Quart



bp

TURBO OIL 2389

TURBINE ENGINE & ACCESSORY

Introduction

While the changing of our label for turbo oil is relatively new, our experience in lubricating turbine engines is not. In 1949 the Research Division, which was initially responsible for the development of our turbo oils, helped turn the vision of gas turbine powered flight into the reality we accept for granted today. By developing the first synthetic oil that could be used successfully in gas turbine engines, much wider fields to the aircraft designer were opened. This position of leadership has never been relinquished and you can depend on us just as you did in 1949.

BPTO 2389

BP Turbo Oil (BPTO) 2389 is an advanced gas turbine lubricant that has a viscosity of 3 centistokes @ 99°C (210°F) which meets or exceeds the requirements of U.S. Military Specification MIL-PRF-7808L Grade 3 and incorporates a level of technology from Type II (5cSt) commercial turbine lubricants.

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Product Description

BPTO 2389 is an advanced gas turbine lubricant that has a viscosity of 3 centistokes @99°C (210°F) manufactured from synthetic basestocks and advanced technology additives. BPTO 2389 is approved against the U.S. Military's specification MIL-PRF-7808L Grade 3. It was formulated to specifically provide the combined thermal and oxidation stability properties of commercial Type II (see Note) lubricants with the low temperature fluidity characteristics of a 3-centistoke oil. In addition, it has gear-carrying ability equal to or better than other approved MIL-PRF-7808L Grade 3 oils.

BPTO 2389 thus affords the military operator the lower viscosity advantage of MIL-PRF-7808L Grade 3 oils while providing the higher quality advantages of the Type II commercial oils, especially with respect to better thermal and oxidation stability. BPTO 2389 is fully approved against MIL-PRF-7808L Grade 3 and carries QPL reference 1M-1 or 1P-1.

BPTO 2389 commercial application is predominantly for helicopter turbo shaft engines and for certain accessories operating in extremely low environmental temperatures in conventional jet aircraft equipment.

Note: *The original specification MIL-L-7808 and subsequent modifications of it up to the present MIL-PRF-7808L have traditionally governed the characteristics and quality of aircraft turbine lubricants used in U.S. Air Force equipment. At first, this was also true of commercial equipment. In later years, however, new high-performance jet engines created the need for oils with higher viscosity (5cSt) and better thermal and oxidation stability properties than those outlined by the previous modifications of this specification. The oils developed to meet this need (MIL-PRF-23699) have come to be known as Type II lubricants and have been used for many years in U.S. Navy and commercial jet aircraft.*

VAPOR PHASE DEPOSITS: A major advantage of BPTO 2389 is its ability to limit vapor-phase deposits. With some competitive oils, heavy deposits have formed where the oil mist and vapors come in contact with hot engine surfaces resulting in migrating deposits.

LOAD CARRYING: BPTO 2389 provides load carrying ability, as measured in the Ryder Gear Test well in excess of requirements established by the engine and equipment manufacturers. Long life of bearings, gears, and other highly loaded lubricated surfaces is thus assured under normal operating conditions.

CLEANLINESS: Minimum formation of varnish or sludge deposits is one of the characteristic advantages of BPTO 2389. Long periods of severe operation are

possible without the danger of scavenge pump screen plugging or the corrosion that often accompanies excessive deposits.

BULK STABILITY (resistance to physical or chemical change resulting from oxidation): The high degree of oxidation resistance of BPTO 2389 permits long periods of severe operation without significant increase in viscosity or total acidity, the two principal indicators of product oxidation.

SHELF LIFE: The shelf life of BPTO 2389 can extend beyond ten years when stored in original, unopened quart cans under acceptable conditions, such as away from extreme heat and moisture. Likewise, drummed product (includes 55 gallon drum and 5 gallon pails) has an expected shelf life of three years minimum. For all package styles, shelf life can be increased significantly beyond those stated above, depending upon storage conditions. Please contact your bp representative if you have any questions about product usability.

Approvals

BPTO 2389, in addition to its MIL-PRF-7808L Grade 3 approval, is approved for the following engines in military service by the engine manufacturer on a brand name basis. Oil for accessories are approved by military specification and/or by brand name. The approvals listed below are current as of the time of printing; however, the respective manufacturer's manuals and service bulletins or technical orders should be consulted.

ENGINES

CFM International: BPTO 2389, by meeting MIL-PRF-7808L Grade 3, is approved for use in CFM56-2A, CFM56-3, CFM56-5 engine models.

General Electric Company: BPTO 2389 conforms to General Electric Specification D50TF1, Class A, and is approved for use in CJ610 and CF700 engines (CJ610 and CF700 Maintenance Manuals 79-00). BPTO 2389 is also approved for F404, F110, J79, J85, T58, T64 and TF34-series engines because it meets MIL-PRF-7808L Grade 3 (see applicable military technical orders).

Honeywell/AlliedSignal Aerospace: BPTO 2389 is approved for use in TPE331 and TSE331 engines (AiResearch Service Information Letter P331-20).

BPTO 2389 is also approved for use in T53 engines (Service Bulletin No. 36) and for the ALF 502 (ALF 502 Maintenance Manual Section 72-00-00). MIL-PRF-7808L Grade 3 approval permits use of BPTO 2389 in the T55-series engines (see applicable military Technical Orders).

Klimov: BPTO 2389 is approved for use in the RD-33 engine (see applicable pages of the maintenance manual).

MTU/Turbomeca/Rolls-Royce: BPTO 2389 is approved as a substitute (with restrictions) for use on the MTR 390. See maintenance manual before using.

Pratt & Whitney: BPTO 2389 is approved for F100, J52, J57, TF30 and TF33-series engines since it meets MIL-PRF-7808L Grade 3 (see applicable military technical orders). It is also approved, with restrictions, on the F117 and PW2000. See maintenance manual before using.

Pratt & Whitney Canada: BPTO 2389 is approved for use in PT6T-3, -3B and ST6T-75, -76 engines (Service Bulletin No. 5001).

Rolls-Royce Ltd.: BPTO 2389 is approved for use in the following engines:

- Gnome H1000 Mk 101, 501, 501*
- Gnome H1200 Mk 100, 600*, 2000* series
- Gnome H1400 Mk 120, 3000* series
- Gnome H1500-1 Mk 120, 3000* series
- Gem 42 Mk 100, 200, 1000 series

* Conditional on Mod compliance.

BPTO 2389 is also approved for all Spey (S.B. 5986) and Tay engine models (R-R letter dated 24 May 1990).

Rolls-Royce/Allison Engine Company: BPTO 2389 is approved for use in 250-series engines according to Section 72-00-00 of the respective operations and maintenance manual for each engine model. It is also approved for the TF41-series engines since BPTO 2389 meets MIL-PRF-7808L Grade 3 (see applicable military technical orders).

Turbomeca: BPTO 2389 is approved (Turbomeca letter to ESAF 10/94) for the following engines:

Artouste	Marbore	Arbizon	Turmo
Astazou*	Aubisque	Adour	Bastan

In addition to the above engines, BPTO 2389 is approved as substitute (with restrictions) on the Arriel 1, the Makila, the Arrius 1, and the TM 333. See applicable maintenance manual before using.

* For the Astazou XVI, 5 cSt oils are to be used under normal operation. BPTO 2389 is approved as a substitute (with restrictions). See maintenance manual before using.

ACCESSORIES

Boeing/Douglas (McDonnell Douglas Corp.): DC-8 turbo-compressor (cabin air) requires 3 cSt lubricant and BPTO 2389 is approved (McDonnell Douglas letter dated February 3, 1977).

Godfrey Precision Products: BPTO 2389 is approved for Type 210 Mk.1/GB.80Mk.1 and Type 211 Mk.1/GB.90Mk.1 compressor and gearbox assemblies (Godfrey Precision Products letter of 4 July 1977).

Hamilton Sundstrand: BPTO 2389 is approved for use in all IDG and CSD models (see appropriate pages of the overhaul manual).

BPTO 2389 is approved for all military and commercial APU applications via the MIL-PRF-7808L Grade 3 approval.

Honeywell/AlliedSignal Aerospace: BPTO 2389 is approved for all commercial APUs except the TSCP700 series. (See applicable pages of maintenance manual.) Since BPTO 2389 is approved against MIL-PRF-7808L Grade 3, it is approved for military APUs requiring that oil (see applicable technical orders).

Microturbo: Use of MIL-PRF-7808L Grade 3 or AIR 3513 oils is recommended for Saphir I thru IV APUs. BPTO 2389 is approved against MIL-PRF-7808L Grade 3 and meets the requirements of Air 3513 and is therefore cleared for use in SAPHIR APUs (Service Bulletin 49-10-07).

MTU: BPTO 2389 is approved for use on the AST 950 APU. BPTO 2389 is approved as substitute (with restrictions) on the AST 600 APU. See maintenance manual before using.

Pratt & Whitney Canada: BPTO 2389 is approved for the PW901A APU (see appropriate pages of the overhaul manual).

Solar: BPTO 2389 is approved for APU models T-62T-25, -29, -39, -40 via its MIL-PRF-7808L Grade 3 approval.

Technical Service

BP provides technical service in support of its products and their performance. The two vital elements of this service consist of a highly qualified Technical Staff and a complex of Sales Service Laboratories. As the name implies, the Technical Staff maintains contact with customers, engine and airframe manufacturers, and accessory equipment manufacturers. The Sales Service Laboratories provide laboratory services to assist in used oil analyses.

TECHNICAL STAFF

The Technical Staff consists of aviation career specialists to provide service to customers and to work with major airframe and engine builders. These specialists have at their disposal the full facilities of Sales Service Laboratories and BP product research facilities. This system ensures that each individual is well informed on equipment developments, industry problems and product performance. Thus, while only one member of the Technical Staff will be the principal contact with a customer, that member will reflect the experience and knowledge of the entire organization and will have ready access to all facilities of the corporation for assistance as required on behalf of his assigned accounts. The fact that the Technical Staff is part of the headquarters of their respective organizations assures that the staff members have headquarters authority to assist in effective handling of their assignments.

BP provides worldwide technical service in support of turbo oil customers. Service is coordinated by Air BP Lubricants from its office in Parsippany, New Jersey.

SALES SERVICE LABORATORIES

The Sales Service Laboratories are located throughout the world at BP's major refineries and blending plants. These laboratories in turn are backed up by the full facilities of BP research facilities in Naperville, Illinois.

PRODUCT SAMPLE PROCEDURES AND HANDLING

The base purpose of analyzing product samples is to assist in solving or defining a problem that may be related to the performance of the lubricant. Thus, the sample size and handling procedures may vary with the nature of the suspected problem and with the analytical techniques required for definition and solution. Experience has provided standardized procedures applicable in many instances. Details are available from a member of the Technical Staff.

Quality Control

BPTO 2389 is blended in batches with each batch composed of the identical chemicals, in the same proportions, used in all previous batches. Approximately 22 tests are performed on each batch to evaluate the physical, chemical and performance characteristics of the product. Historically, the batch-to-batch variations are within the limits of test repeatability.

As each batch is prepared, a quantity of product is set aside in sealed containers. Periodically, a container is opened and tested to ensure that no change has occurred in the physical or chemical properties as a result of time. Customers can enhance the product storage stability life by using first-in, first-out inventory procedures and maintaining the oil under normal storage conditions (indoors protected from excessive heat). Within these parameters, experience has shown BPTO 2389 shelf life has no effect on its performance. It is suggested that oil that has been exposed to extremes of high temperature and humidity in storage be retested.

Most important in monitoring product quality is the frequent observation of airline engines and accessories. A specialized rating system has been developed by the Technical Staff in cooperation with the product research facilities. This system provides for numerical descriptions of engine mechanical condition and lubricant performance for all critical lubricated components. By this means, the conditions of two or more engines can be compared even though they may be inspected at different times. The system thus provides a yardstick for measuring the uniformity of performance in operating engines. This method of documentation also permits an appraisal of engine mechanical condition, an evaluation of the effectiveness of mechanical modifications and a comparison of the performance of different lubricants.

Future Outlook

While the outlook for continuing excellent performance from BPTO 2389 is bright, our research continues to develop and evaluate new oils aimed at providing even greater value to the world's airlines and military agencies.

Through continuing monitoring of product performance and technological developments, BP affiliates anticipate being able to provide synthetic turbo oils that will satisfy the most critical needs of the aviation industry.

Health and Safety

Precautions

Health studies have shown that under normal conditions of use, turbo oil presents a low risk to human health. The major health risk from exposure to turbo oil is temporary irritation of the eyes, skin, and respiratory tract. Temporary irritation is a common hazard of most petroleum hydrocarbons and synthetic lubricants, like turbo oil. Irritation occurs when product is applied directly to the eyes, repeatedly to the skin, or when high levels of vapors or mist are inhaled. Because sensitivity to irritation can vary from person to person, direct contact with the eyes and skin, and inhalation of vapors or mist should be minimized. Prolonged and repeated skin contact with turbo oil can also cause temporary dermatitis.

Because the vapor pressure of turbo oil is very low, generation of vapor under ambient temperature conditions is unlikely. At elevated temperatures, however, product vapor may be generated at concentration levels sufficient to cause irritation, particularly in poorly ventilated areas or in confined spaces. If this occurs, or if a mist of turbo oil is generated, precautions should be taken to avoid inhaling vapor or mist at concentrations above the exposure guidelines specified on the product Material Safety Data Sheet (MSDS). Prolonged over-exposure to vapors or mist could cause headache, light-headedness, dizziness, and potentially unconsciousness, but normal conditions of use will not produce these effects.

You can protect yourself from routine turbo oil-related hazards by using appropriate engineering controls and work practices, and by wearing proper eye protection, gloves and clothing. Additional important health and safety information for this product is provided on the MSDS, which is available from your BP representative. The exposure guidelines found on the MSDS should always be followed.

Turbo oil should never be siphoned by mouth. However, if the oil is swallowed, DO NOT induce vomiting, but seek medical advice immediately to guard against the hazard of aspirating oil into the lungs. While the oil is not highly toxic when swallowed, lung aspiration can result in chemical pneumonia that may not occur for some time.

In the event of fire or leakage of product onto an extremely hot surface which causes turbo oil to burn, emission of fumes and combustion products that are potentially irritating, noxious, and toxic may occur, such as aldehydes and carbon monoxide. Take precautions to avoid and/or minimize exposure under these conditions. Use supplied oxygen if necessary.

Additional health and safety information may be obtained by writing to: Air BP Lubricants, Air BP, Maple Plaza II-1N, Six Campus Drive, Parsippany, NJ 07054.

BPTO 2389 Typical Inspections vs. MIL-PRF-7808L Grade 3 Specification

The values shown here are representative of current production. Some are controlled by manufacturing specifications, while others are not. All of them may vary within modest ranges.

MILITARY SPECIFICATION TESTS	BPTO 2389	MIL-PRF-7808L GRADE 3		ASTM STANDARD	FED. TEST METHOD STD. NO. 791
		MIN.	MAX.		
Particulate contamination, contaminant mg/litre.....	2.0	—	5.0		Appendix A of 7808 Spec
Filtering time, min/qt	14	—	30		
Total acid number, mg KOH/g	0.23	—	0.30	D664*	
Viscosity at 100°C, cSt	3.19	3.0	—	D445	
Viscosity at 40°C, cSt	12.46	12.0		D445	
Viscosity at -51°C, cSt				D2532	
at 35 minutes	7800	—	17,000		
at 3 hours	7837	—	17,000		
at 72 hours.....	7900	—	17,000		
Viscosity stability, %, 3 hr. vs. 35-minute determination	0.47	—	6		
Flash point (C.O.C.), °C.....	220	210	—	D92	
Evaporation loss, 6½ hrs., @ 205°C, wt. %	20.0	—	30	D972*	
Foaming characteristics (static)					3213
Foam volume, ml.....	30	—	100		
Foam collapse time, sec.	0	—	60		
Foaming characteristics (dynamic)					3214
Foam volume, ml/collapse time, sec.					
80°C @ 1000 cc/min.	15/8	—	100/60		
80°C @ 1500 cc/min.	45/8	—	150/60		
80°C @ 2000 cc/min.	105/15	—	200 /60		
110°C @ 1000 cc/min.	20/8	—	100/60		
110°C @ 1500 cc/min.	55/8	—	150/60		
110°C @ 2000 cc/min.	170/18	—	200/60		
Deposition test, average deposition rating	0.59	—	1.5		5003
Acid no. change, mg KOH/g	11.2		20		
Viscosity @ 40°C, % change.....	96		100		
Oil consumption, ml.....	100		100		
SOD Pb corrosion, wt. change, g/m ²	+0.64	—	9.3		5321
Bronze corrosion @ 232°C, wt. change, g/m ²	0.0	—	±4.5		5305
Ag corrosion @ 232°C, wt. change, g/m ²	0.0	—	±4.5		5305
Ryder gear load, avg. % relative rating x 508 kN/m (avg. of 2 det)	462	420	—	D1947	
Oxidation & corrosion stability @ 200°C for 96 hrs.					5307
Al, wt. change, mg/cm ²	0.00	—	±0.2		
Ag, wt. change, mg/cm ²	-0.02	—	±0.2		
Bronze, wt. change, mg/cm ²	+0.04	—	±0.4		
Fe, wt. change, mg/cm ²	+0.02	—	±0.2		
M-50, wt. change, mg/cm ²	-0.02	—	±0.2		
Mg, wt. change, mg/cm ²	-0.02	—	±0.4		
Ti, wt. change, mg/cm ²	0.00	—	±0.2		
Viscosity change, % @ 40°C.....	+9.5	-5	+25		
Neut. no., change	0.96	—	4.0		

* Modified

BPTO 2389 Typical Inspections vs. MIL-PRF-7808L Grade 3 Specification

(Cont'd)

MILITARY SPECIFICATION TESTS	BPTO 2389	MIL-PRF-7808L GRADE 3		ASTM STANDARD	FED. TEST METHOD STD. NO. 791
		MIN.	MAX.		
NBR-H rubber swell, % (168 hrs. @ 70°C)	27.9	12	35		3604
FKM rubber swell, % (72 hrs. @ 175°C).....	14.6	2	25		3432
Tensile strength, % change	+6.7	—	50		
Elongation, % change	+13.0	—	50		
Hardness, change	0	—	20		
FVMQ rubber swell, % (72 hrs. @ 150°C).....	5.5	2	25		3432
Tensile strength, % change	-3.9	—	50		
Elongation, % change	+1.1	—	50		
Hardness, change	0.0	—	20		
QV I rubber swell, % (72 hrs. @ 150°C).....	20.4	2	30		3432
Tensile strength, % change	-39	—	50		
Elongation, % change	-3	—	50		
Hardness, change	-10	—	20		
Bearing deposition					3450
Average deposit rating (3 determinations).....	49	—	60		
Filter deposit, gm	1.7	—	2.0		
Oil consumption, ml.	864	—	1440		
Viscosity change, %.....	+7	-5	25		
Neutralization number change (avg. of 3 determinations)		0.2	—	1.0	
Metal specimen weight change, mg/cm ²	Pass	—	±0.2		
Compatibility, turbidity, ml sediment/200 ml of oil.....	Nil	—	0.005		3403*
Compatibility, intermixing	Pass	Pass		Sec. 3.4.1.4 of 7808 Spec.	
Storage stability, Pb corrosion after 2 days @ 110°C, g/m ² .	+0.2	—	40	Sec. 4.6.6 of 7808 Spec.	
after 7 days @ 110°C, g/m ² ...	-24.6	—	230		
Trace element content, ppm				Sec. 4.6.2 of 7808 Spec.	
Al	0	—	2		
Fe	1	—	2		
Cr.....	0	—	2		
Ag	0	—	1		
Cu	0	—	1		
Sn	9	—	11		
Mg.....	1	—	2		
Ni	0	—	2		
Ti	1	—	1		
Si	1	—	2		
OTHER TESTS					
Coefficient of expansion (avg: -40° to 300°F)	0.00045	—	—	BP Test Method	
Specific heat, Btu/lb/°F				D2766	
at 100°F.....	0.444	—	—		
at 200°F.....	0.493	—	—		
at 300°F.....	0.533	—	—		
at 400°F.....	0.565	—	—		
Thermal conductivity, Btu/(hr)(ft ²)(°F/ft)				D2717	
at 100°F.....	0.087	—	—		
at 400°F.....	0.083	—	—		

*Modified



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