Technology for High-class Lubricants

Science & Technology Management Department

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CHINA NATIONAL PETROLEUM CORPORATION

Lubricating everything in soft silence,

Kunlun Lubricant is rooted from CNPC.

Contents

China National Petroleum Corporation (CNPC) is a state-authorized investment agency and a state holding company. As an integrated oil company of cross-regions, cross-industries and cross-countries, it adopts modern enterprise system to realize the integration of upstream and downstream operations, internal and external trade and production and marketing. CNPC has 17 upstream companies, 33 downstream companies and 36 large-scale marketing companies. It is China's largest producer and supplier of oil and gas, and also one of the largest refined oil products and petrochemicals. In 2010 CNPC produced 105million tons of crude oil and 72.5 billion cubic meters of natural gas, while crude processing volume reached 135 million tons. The total revenue of RMB1,720 billion with a profit of RMB172.7 billion had been achieved the same year. Its profit is among the highest of the domestic enterprises in China.

CNPC was ranked 10th in Fortune Global 500 in 2010 and 5th among global top 50 oil companies.

CNPC strictly follows by the combined strategies of increasing resource capacity, expanding market shares and consolidating the international role, and persists in regarding technical innovation as a key framework to advance technological progress. To develop its core businesses, focuses will be placed on the solutions of key bottleneck technologies and key proprietary technologies. Thanks to continuously improving of the technical innovation system, optimizing the configuration of technological resources and strengthening the construction of strong talent teams, CNPC's technological creativity has been considerably upgraded. Consequently, a large number of technologies have been developed independently, with its own intellectual property.

The Technology for High-class Lubricants is one of representatives for major innovations of CNPC.

CLEAN ENERGY SUPPLY FOR BETTER ENVIRONMENT

1 Introduction

High-class Lubricants

Based on the predominant resources and advanced technologies, CNPC provides the customers with high-quality lubricant products and services, with the idea to care and the mission to improve the level of national lubricant oil. CNPC, which always concerns the customers' demands and technical progress of facilities, has devoted itself to the independent research and development of high-class lubricants over a long period of time and obtained a series of distinctive and innovative products with high quality and independent intellectual property rights. By now, CNPC has obtained more than 10 patents, developed nearly 100 technical secrets of product formulas, and manufactured more than 700 types of Kunlun Lubricant products. Its sales network spreads throughout China, with the distinctive products exported to overseas.

The technologies of CNPC's lubricant oil were studied in 1950s. After a decade of development, CNPC has built a professional company integrating the manufacture, research and development, marketing and service. Now a lot of distinctive technologies have been developed, among which the representative is the lubricant products containing 4 classes, 11 series and 31 specialized items. These products cover many fields such as technical development of product formulas, additives as well as lubricant analysis and appraisal.

CNPC has a large number of professional talents who are able to research, develop, manufacture and provide technical services of high-class lubricants. CNPC established the Joint Laboratory for Oil Products in cooperation with the Technical Center of China FAW Group Corporation. CNPC also has the product test station, post-doctoral research center, and so on. CNPC can provide customers with omnibearing technical support. Based on the continuous and special resources and unique insight into the Chinese market, Kunlun Lubricant can meet the demands of different customers. CNPC pursues perfection unremittingly by promoting the upgrading of lubricant products and industrial development.

Domestic sales distribution map

China

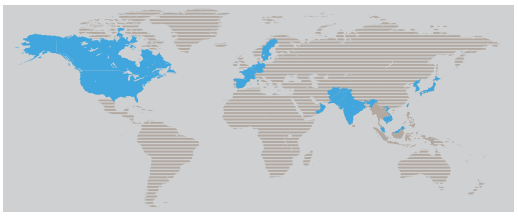
Northeast China Lubricant Marketing Company Heilongjiang, Jilin, Liaoning, Shandong	East China Lubricant Marketing Company Jiangsu, Shanghai, Zhejiang, Jiangxi, Anhui
North China Lubricant Marketing Company Beijing, Tianjin, Hebei, Shanxi, Inner Mongolia	Southwest China Lubricant Marketing Company Sichuan, Chongqing, Yunnan, Guizhou, Guangxi, Tibet
Northwest China Lubricant Marketing Company Gansu, Shanaxi, Sinkiang, Qinghai, Ningxia	Central South China Lubricant Marketing Company Henan, Hainan, Hunan, Hubei, Gaungdong, Fujian

Transformer oil, Automotive oil, Grease Sales networks in Asia

Asia

Kazakhstan
China
Mainland
Hong Kong
Taiwan
Singapore

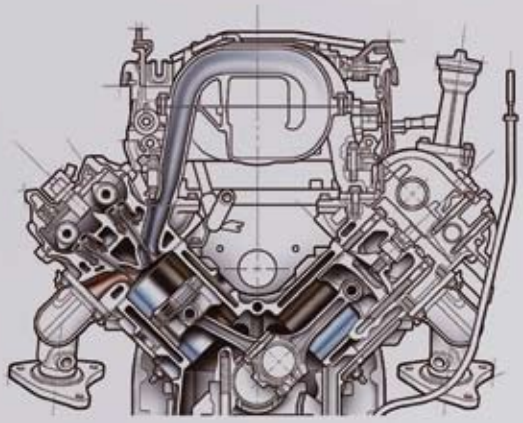
Marine engine oil support centers



World

North America	Savannah, Los Angeles, Tamarac, New York, Houston
Central America	Manzanillo, Panama
Europe	Antwerp, Rotterdam, Le Havre, Algeciras
Africa	Jebel Ali, Fujairah, Salala, Durban
Asia	Pusan, Hong Kong, Kwang Yang, Singapore, Tanjung Pelepas

2 Automotive and Ship Lubricants



Automotive and Ship Lubricants

The products of automobile oil developed by CNPC include diesel engine oil, gasoline engine oil, etc., which could meet the lubricating requirements of different engines and vehicles. The products with salicylate detergent as the main agent have excellent high temperature detergency, antioxidant and anti-wear property and soot dispersion property.

Diesel Engine Oil

The unique formula of Kunlun Diesel Engine Oil can prevent the binding of piston ring and the polishing of cylinder liner due to the use of direct injection technologies, and can keep the engine very clean. Its excellent oxidation stability and heat stability can control the increase in viscosity and the formation of piston deposits. Its excellent anti-wear property can prolong the service life of those parts.

The CF-4, CH-4, and CI-4+ Diesel Engine Oil recommended by CNPC have excellent adaptability, especially in view of heavy load and running at a high speed of commercial vehicles as well as complicated road conditions. Kunlun Diesel Engine Oil have three main viscosity grades—10W-40, 15W-40 and 20W-50. In the past few years, these products have been used extensively.

Application Cases

Oil Product	Application Cases
Kunlun CF-4 Diesel Engine Oil	It has passed the Cummins 6CTA Engine Test of Dongfeng Automobile Company, the Thermal Shock Test of CA6DL2-35 (aluminium piston) Diesel Engine of Wuxi Diesel Engine Factory and the 500h Endurance Test of 6C250 Diesel Engine of Shanghai Diesel Factory.
Kunlun CH-4 Diesel Engine Oil	It has passed the Cummins 6CTA Engine Test of Dongfeng Automobile Company.
Kunlun CI-4^{+} Diesel Engine Oil	It has passed the Ⅳ Diesel Engine Test of Wuxi Diesel Engine Factory, and it has completed 22,000km Drive Test of Beijing Xianglong Bus Co., Ltd.

Technical Certification

- Kunlun 15W/40 CI-4 Diesel Engine Oil has obtained the VDS 3 technical certification from Volvo Company of Sweden in June 2004.
- Kunlun Tianjiao 9800 (CI-4/SL 15W/40) has obtained the certification of Cummins Engine Company, and meets the requirements of CES 20078.
- Kunlun SJ/CH-4 Diesel Engine Oil has obtained the technical certification from Benz-Daimler Chrysler Automobile Company in July 2004, and it can meet the requirements of Mercedes Benz MB 228.3.

Gasoline Engine Oil

The phosphor and ash content in Kunlun Gasoline Engine Oil are low. Kunlun Gasoline Engine Oil with excellent lubricating property can avoid the abrasion of piston, cylinder liner and other components and meet the increasingly rigorous requirements of environmental protection and energy conservation.

SL/GF-3 and SJ Gasoline Engine Oil recommended by CNPC can meet the lubricating requirements of different vehicles, and Kunlun Gasoline Engine Oil has four main viscosity grades—5W-30, 10W-30, 10W-40 and 15W-40. In recent years, the products have been applied extensively.

Application Cases

- The 20,000km drive test was implemented on the Audi car with SL/GF-3 products.
- The products were applied to the Passat car (gas/gasoline dual-fuel-powered sedan), Audi car, Bluebird car and Bora car, which verified that the products had excellent oxidation stability, detergency and dispersibility, and could effectively control the formation of high-temperature deposits and meet the special requirements of CNG/LPG fuel for lubricants.
- The products have obtained the technical certification from Suzuki of Japan.

Patents

Patent No.	Title of patent for invention
03104811.0	High-quality composition of gasoline engine oil
200610164861.9 (Application number)	Composition of gasoline engine oil
200910080627.1(Application number)	An energy-saving additive composition of engine oil

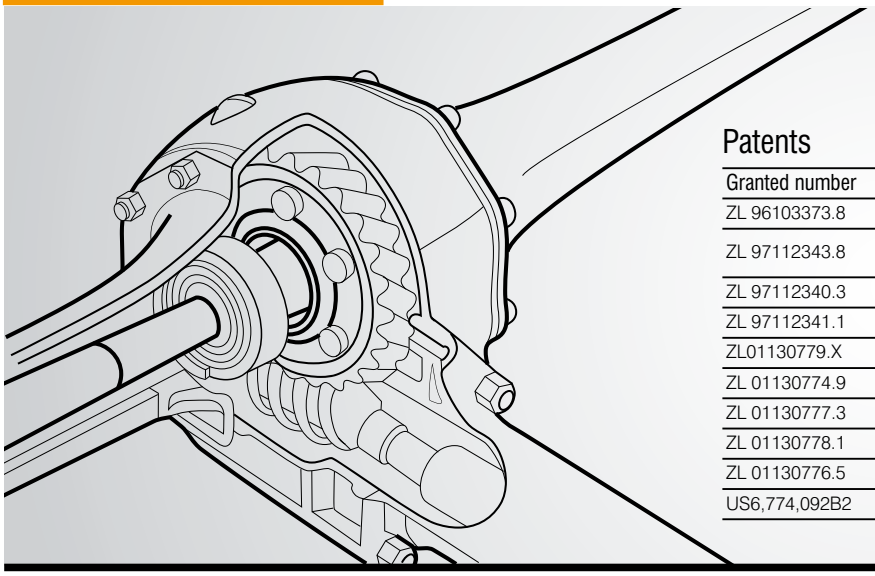
Stationary Gas Engine Oil

Kunlun Stationary Gas Engine Oil has suitable sulfate and ash content, which can effectively control the formation of deposits caused by high ash content and the valving abrasion caused by low ash content. The product also has excellent detergency and dispersibility, antioxidant and antinitration property, anti-wear property and corrosion resistance, which can effectively prolong the oil-draining period of facilities.

According to the lubricating requirements, CNPC recommends the Ashless Stationary Gas Engine Oil, Low-ash Stationary Gas Engine Oil and Medium-ash Stationary Gas Engine Oil, and it provides two viscosity grades—SAE30 and SAE40. In the past few years, the products have been used widely.

Application Cases

- "Kunlun 7701" ashless stationary gas engine oil has been tested on the stationary gas engine.
- For "Kunlun 7705" low-ash stationary gas engine oil, the 4,000h test has been performed on the ZTY265 unit of Chongqing Dingfa Industrial Co., Ltd.
- For "Kunlun 7805" low-ash stationary gas engine oil, 4,800h test has been performed on ZTY470 unit of Southwest Oil & Gas Field Company.
- For "Kunlun 7810" medium-ash stationary gas engine oil, the 5,000h test has been performed on D12V190 gas electric generators of Qinghai Oilfield Company.



Patents

Granted number	Title of patent
ZL 96103373.8	A preparation method of lubricant oil additive
ZL 97112343.8	A composition of complexing agent of multi-purpose gear oil
ZL 97112340.3	Gear lubricant oil composition
ZL 97112341.1	Gear lubricant additive composition
ZL01130779.X	A composition of mannual transmission fluid additive
ZL 01130774.9	A lubricant additive
ZL 01130777.3	A composition of gear lubricant additive
ZL 01130778.1	A lubricant additive
ZL 01130776.5	A lubricant additive and its preparation method
US6,774,092B2	A combination of manual transmission fluid additive

Automatic Transmission Fluid

PetroChina Lubricant Company chooses mineral oil, hydrogenated oil, semisynthetic oil or synthetic oil as the base oil and adds many kinds of additives into the base oil to develop the automatic transmission fluid (ATF) successfully. The product has excellent oxidation stability, frictional behavior and abrasion resistance, which reaches the advanced technological level in the world.

Application Cases

Since 2003, PetroChina Lubricant Company has provided Harbin Aircraft Manufacturing Company, Baotou Beifangbenchi Heavy-duty Truck CO., LTD, China National Heavy Duty Truck Group CO., LTD and Hangzhou Forklift Plant with the products of automatic transmission fluid.

Automotive Gear Oil

In order to meet the lubricating requirements of the manual transmission with synchronizer and the tear axle of heavy duty truck, CNPC developed the long-life heavy-duty multi-purpose gear oil, manual transmission fluid MTF10 for vehicles, manual transmission fluid MTF18 for commercial vehicles, long-life heavy-duty overloaded gear oil GL-5^{+}, which could meet the lubricating requirements of different users for different vehicles. The development of products is based on unique additives, formulas and technological platform of bench test.

Application Cases

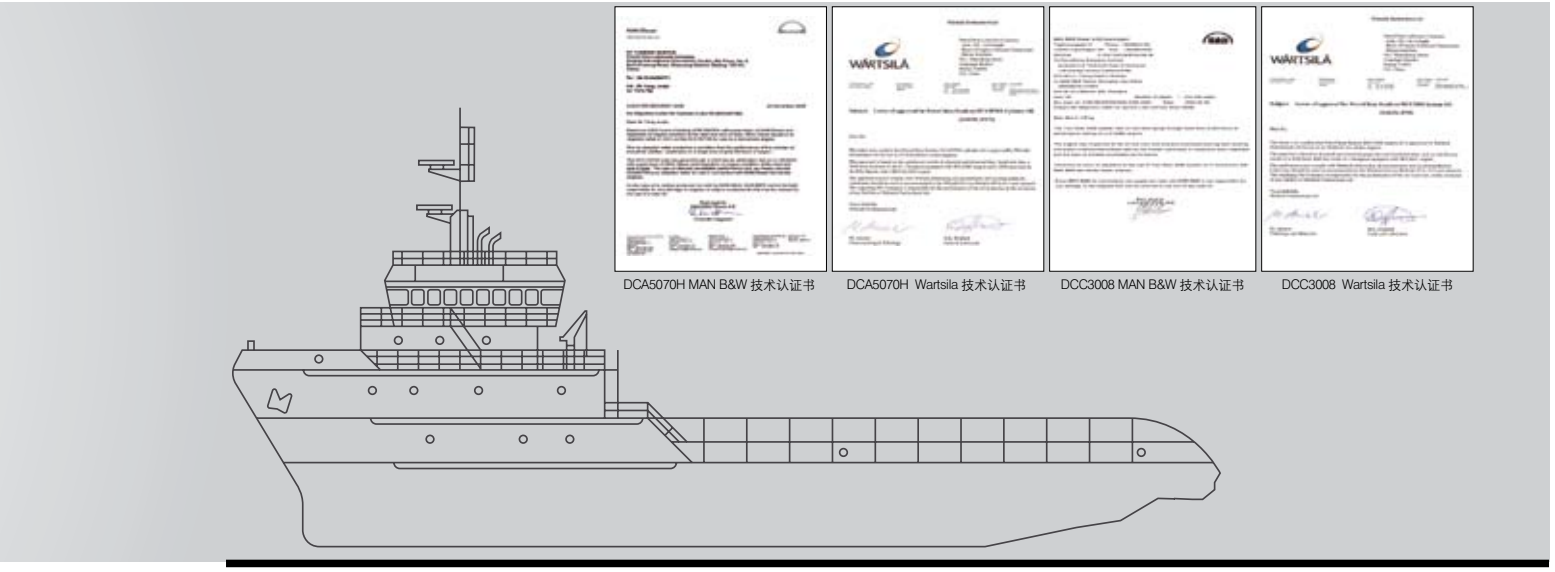
1. Multi-purpose gear oil KDL16 has become the appointed oil of the relevant equipment used in the National Day Parade in 2009.

2. Long-life heavy-duty overloaded gear oil GL-5^{+} has passed the load assessment of Dongfeng commercial vehicle in which the oil was not changed for 100,000 kilometers.

3. Manual transmission fluid MTF18 for commercial vehicles has been used in the transmission produced by Qijiang Gear Transmission Co., Ltd.

4. The long-life heavy-duty multi-purpose gear oil was given a performance test in new wheel panzer and the mileage were 240,000 kilometers. The result showed that the product performance could meet the service requirements of new wheel panzer MT and AMT transmission and actuating system.

5. Manual transmission fluid MTF18 for commercial vehicles was given a performance test in Baoshan in Yunnan Province, which involved 10 vehicles. The mileage was 1,100,000 kilometers and the maximal single mileage could amount to 141,000 kilometers. The transmission kept as bright as a new one.



DCA5070H MAN B&W 技术认证书 DCA5070H Wartsila 技术认证书 DCC3008 MAN B&W 技术认证书 DCC3008 Wartsila 技术认证书

Marine Engine Oil

CNPC's Cylinder Oil DCA5070H and System Oil DCC3008 have obtained the technical certification from Wartsila and MAN B&W, two large OEM of marine engines in the world. Kunlun Lubricants are recommended to be used in low-speed crosshead marine engines with high power and long stroke and produced by Wartsila and MAN B&W. CNPC is the unique one which has obtained the technical certification from Wartsila and MAN B&W in China. The Marine Medium Speed Engine Oil DCB4030 has been used by shipping companies for many years, and it is steady when used in four-cycle engines, and the high performance formula is undergoing the technical certification at the moment.

CNPC has provided COSCO, China Shipping Transport Company and other shipping companies with marine engine oil for a long period of time, and 35% of the domestic market share for marine engine oil is held by CNPC. In order to follow the international current, CNPC is trying hard to expand its market to overseas by signing a long-term oil servicing agreement with MAERSK Shipping Co., Ltd.—the international shipping magnate.

Technical Certification

- CNPC's Kunlun DCA5070H Marine Cylinder Oil obtained the technical certification from MAN B&W on December 26, 2006.
- CNPC's Kunlun DCA5070H Marine Cylinder Oil obtained the technical certification from Wartsila on October 9, 2008.
- CNPC's Special Complexing Agent RHY3532 of cylinder oil for BOB system obtained the technical certification from MAN B&W on January 6, 2010.
- CNPC's Kunlun DCC3008 Marine System Oil obtained the technical certification from MAN B&W on February 6, 2002.
- CNPC's Kunlun DCC3008 Marine System Oil obtained the technical certification from Wartsila on June 24, 2008.

Application Cases

- CNPC has provided COSCO Shipping Co., Ltd. with Cylinder Oil DCA5070H since 2003.
- CNPC has provided MAERSK Shipping Co., Ltd. with Cylinder Oil DCA5070H since 2006.
- CNPC has provided China Shipping Transport Company with System Oil DCC3008 since 2002.
- CNPC has provided MAERSK Shipping Co., Ltd. with System Oil DCC3008 since 2008.
- CNPC has provided the different types of engines of Yang River Shipping Company with Medium Speed Oil DCB4012, 4030 and 4040 since 2000.
- Since 2005, CNPC has provided Shandong Bohai Ferry Co., Ltd. with Marine Medium Speed Engine Oil DCB4012, 4030 and 4040 produced with the high-performance formula.

3 Industrial Oil

Industrial Oil

Industrial Gear Oil

In order to meet the lubricating requirements of the industrial equipment's gears, CNPC developed KG-Series heavy-load industrial gear oil, L-CKD and L-CKC. The KG-Series heavy-load industrial gear oil can not only meet the requirements of GB5903 L-CKD industrial gear oil, but also meet the performance requirements of AGMA, DIN51517 and US STEEL 224, especially suitable for the lubrication of mechanical equipment which is heavy-loaded and easy to be invaded by water. The development of Kunlun Industrial Gear Oil is based on CNPC's unique formula, which has been applied in Baotou Iron and Steel (Group) Company, Guangzhou Liuxi Iron and Steel (Group) Company, and so on.

Typical Cases

Kunlun KG220 Heavy-duty Industrial Oil obtained the certification from Guangzhou Liuxi Iron and Steel (Group) Company in February 2006.

Patents

Patent No.	Title of patent for invention
1130775.7	A composition of industrial gear oil additive

Steam Turbine Oil

The steam turbine oil developed independently by CNPC encompasses three series of products, namely, KTL Long-life Steam Turbine Oil, KTL /S Long-life and Highly Clean Steam Turbine Oil and KTL/EP Long-life and Anti-wear Steam Turbine Oil. The products can meet the lubricating requirements of different facilities.

Application Cases

- 130,000 kW unit (HTC) of Gezhouba hydropower station of China Yangtze Power Co., Ltd.
- 600,000 kW unit (GE) of Huaneng Nantong Electric Power Plant
- 300,000 kW unit (Mitsubishi) of Henan Xiaolangdi Hydropower Station
- 300,000 kW unit (GE) of Baogang Steel Work's Power Plant
- 600,000 kW unit (SAIC) of Henan Zhengzhou Electric Power Plant
- 600,000 kW unit (Dongfeng Automobile) of Guangxi Laibin Electric Power Plant
- 1mn kW unit (Siemens) of Zhejiang Yuhua Huaneng Electric Power Plant
- 600,000 kW unit (Dongfeng Automobile) of Guangzhou Henyun Electric Power Plant
- 600,000 kW unit (Dongfeng Automobile) of Chongqing Hechuan Electric Power Plant
- 300,000 kW unit (Dongfeng Automobile) of Henan Nanyang Tianyi Gas Fuel Electric Power Plant
- 1mn kW unit of Ling'ao second period (Dongfeng Automobile) of Shenzhen Dayawan Nuclear Power Plant
- The first-fill lubricant of Shanghai Turbine Works
- The first-fill lubricant of Dongfang Turbine Works
- The first-fill lubricant of Harbin Turbine Works





Technical Certification

- Kunlun Steam Turbine Oil KTL32, KTL46 and EP Turbine Oil KTL/EP46 obtained the certification from Alstom Company on November 4, 2005.
- Kunlun Steam Turbine Oil KTL32, KTL46 and EP Turbine Oil KTL/EP46 obtained the certification from Siemens Company on November 18, 2005.
- Kunlun Steam Turbine Oil TSA32, TSA 46, KTL32 and KTL46 obtained the technical certification from Harbin Turbine Works in July 2005.
- Kunlun Steam Turbine Oil KTL32, KTL46 and KTL/EP46 obtained the technical certification from Dongfang Turbine Works in December 2005.
- Kunlun Steam Turbine Oil KTL32, KTL46, KTL/EP32 and KTL/EP46 obtained the technical certification from Shanghai Turbine Works in December 2005.
- Kunlun Steam Turbine Oil KTL32 and KTL46 have obtained the technical certification from Beijing Beizhong Steam Turbine Generator Co. Ltd. on August 21, 2006.

Hydraulic Oil

Kunlun Hydraulic Oil Products include HL Oxidation-resistant & Rust-resistant Hydraulic Oil, HM Anti-wear Hydraulic Oil, HV Low-temperature Hydraulic Oil, HS Synthetic & Low-temperature Hydraulic Oil, HG Hydraulic Rail Oil, HMP High-pressure & Anti-wear Hydraulic Oil, HMC Clean Hydraulic Oil, HML Long-life Hydraulic Oil, High efficiency & Energy-saving Hydraulic Oil, etc. HL, HM, HV, HS, HG meet the technical requirements of GB 11118.1-94 and the other products are the special ones developed independently by CNPC. Besides meeting the requirements of GB 11118.1-94, the products are also improved in their performance indexes.

Application Cases

- Shanghai Electric
  HMP high-pressure and anti-wear hydraulic oil is used in the 10,000 ton oil press of Shanghai Electric. The oil press is mainly used to produce ship bearing (the system pressure 34MPa), plunger pump (the system contains a dozen of servo-valve) and filter (with the accuracy 3~5μm). CNPC provides Shanghai Electric with HMP 46 of NAS 5 grade, with good effects.
- Beifangbenchi Company
  Beifangbenchi Company mainly produces trucks, dumpers, semi-trailer towing vehicles and other heavy-duty trucks. The products, which are applied extensively to road, petroleum, chemical industry, fire protection, etc., are marketed to Iraq, Ethiopia and other countries. CNPC's hydraulic oil products are the vehicles' first-fill lubricant, with good effects.
- Dalian Harbor Bureau
  HML Long-life Hydraulic Oil is used in the gantry crane and fork-lift of Dalian Harbor Bureau, with good effects.
- Daqing Chemical Engineering & Construction Company
- Pingsu Antaibao Coal Mine

Technical Certification

The products obtained the technical certification from Parker Denison in May 2005.	DENISON Hydraulics Parker
The products obtained the technical certification from Eaton in February 2007.	EATON
The products obtained the technical certification from Cincinnati Milacron in October 2006.	MAG CINCINNATI

4 Special Lubricants






Special Lubricants

Transformer Oil

CNPC is the only special company which produces naphthenic-base transformer oil in China, with forty years' production experience. CNPC, as the biggest transformer oil supplier in China, manufactures and sells the transformer oil of 14 grades and nearly 240,000 tons, which hold more than 80% share in the domestic transformer oil market.

Depending on the advantageous naphthenic-base crude oil resources, advanced processes & technologies and strict specialized management, the transformer oil was developed, which stands as the authorized and the most excellent insulating liquid of electrical equipment nowadays. Moreover, it has outstanding electric insulation performance, rapid heat transfer, excellent oxidation stability and other features. The products are produced as per the strict quality control program,


with stable resources and steady and dependable performance. The transformer oil products meet all the requirements of national standards, such as GB2536, BS148. They also meet all the requirements of international standards, such as IEC60296, ASTMD3487. In addition, the products meet the special requirements of many famous transformer manufacturers such as ABB, SIEMENS, and gain the general admiration of the electric power industry and broad users. They are applied extensively in main transformer plants and great engineering construction projects at home and abroad. In recent years, the products are also used in ±500kV and ±800kV high-voltage direct current transformer (HVDC) and 500kV and 1000kV extra high-voltage alternating current (HVAC) at home.

Application Cases

- The First HVDC Transmission Project in China
  Lingbao Back-to-Back HVDC Converter Station, which is subordinated to the Northwest-Central China Grid Project, is a completely domestic large HVDC converter station. The HVDC converter station has two sets of converter transformers (the core equipment) which are composed by a 330kV circuit and a 220kV circuit. The 330kV additional transformer manufactured by Xi´ an Transformer Company uses Kunlun KI50X DC Transformer Oil. The 220kV additional transformer manufactured by Shenyang Transformer Company uses the Transformer Oil KI50GX DC. The HVDC converter station was put into test operation in April 2005 and formally operated on July 3, 2005. The HVDC converter station has run in industry for four years till now with sound operation.

- 750 kV Power Transmission and Transformation Demonstration Project
  The 750kV Power Transmission and Transformation Demonstrate Project (750 Project), as the first one to be designed, constructed, manufactured, operated and managed in China, has operated for one year till September 26, 2006. That is the splendid accomplishment achieved by the State Grid through implementing the strategy of the transformation of grid development patterns. The central reactors, which are developed and manufactured by TBEA Hengyang Transformer Co., Ltd, use Kunlun KI50AX Transformer Oil.

- 1000kV Southeastern Shanxi-Nanyang-Jingmen UHVAC Pilot Demonstration Project
  The project starts from Changzhi Transforming Station of southeastern Shanxi, and passes through Nanyang Switch Station in Henan Province and ends at Jingmen Transforming Station in Hubei Province. The whole line is erected in single-loop, with the full length of 640 km and the transformer capacity of 6 million kVA. The system´ s voltage rating is 1,000 kV, and the highest operating voltage is 1,100 kV. The project was finished completely in December, 2008, and then it was put into test operation after the system debugging. The 168-hour test operation ended in January 2009 and it is in sound condition all the time after being put into commercial operation. This represents a historic breakthrough in the development of equipment localization. The main transformers, which are developed and manufactured by TBEA Shenyang Transformer Group Co., Ltd., apply Kunlun Transformer Oil KI25X and KI45X.



Technical Certification

- Kunlun KI50X Hyperbaric AC/DC Transformer Oil obtained the technical certification from German ABB Company in November 2002.
- Kunlun KI45AX Hyperbaric Transformer Oil obtained the global certification from German SIEMENS Company in September 2002.
- The products have passed the quality certifications of American DOBLE Company, German ABB Company and SIEMENS Company.

ABB SIEMENS doble ALSTOM TBEA

Advanced Product Quality Evaluation Facilities

Assembly Line of Refrigeration Oil Products

Refrigeration Oil

Refrigeration oil, as the special lubricant for refrigeration compressors, is the cardinal component that decides and affects the refrigeration function and the efficiency of refrigeration compressors. In the refrigeration system, the refrigeration oil mainly plays such vital roles as lubrication, sealing, heat dissipation and energy adjustment.

CNPC has more than forty years' experience in the development and manufacture of asphalt-base refrigeration oil, which is also in charge of drafting the national standard GB/T16630-1996 for refrigeration oil products. At present, Kunlun Refrigeration Oil products produced by CNPC hold 60% share of the national market of refrigeration oil. The quality of products is generally confirmed in the industry for their outstanding performances. The refrigeration oil products 22 , 32 , 46 , 68 obtained the National Silver Medal, the title of "Premium Product" of Ministry of Petroleum Industry and the title of "Premium Product" of Sinkiang from 1979 to 1983. From 2003 to 2004, CNPC has successfully developed the lubricant oil for the refrigeration system (containing the hydrocarbon refrigerant with hydrogen, fluorine and chlorine, e.g. R22)—L-DRC-Series Refrigeration Oil that can meet the requirements for lubricant oil of the refrigeration system with R22 as its refrigerant. The Refrigeration Oil ATMOS NM56 produced in cooperation with the New PetroJapan has been used by many air conditioning compressor manufactures at home. From 2004 to 2006, CNPC has successfully developed the lubricant oil for refrigeration system with the hydrocarbon refrigerant (e.g. R600a)—KRD-Series Refrigeration Oil. KRD-Series Refrigeration Oil has obtained the technical certification of many refrigeration compressor manufacturers, such as Sichuan Danpu, Shanghai Kena.

Kunlun Refrigeration Oil is produced by PetroChina Lubricant Branch Company which adopts the domestic resources of asphalt-base crude oil and advanced technologies. The products are produced as per the strict quality control program, with stable resources and steady and dependable performances. At present, CNPC has the production capacity to produce the Refrigeration Oil products L-DRA/A, DRA/B, DRC/A, DRC/B and KRD, with the total production capacity exceeding 50,000t/y. (See Fig.33-37)

Rubber Oil

In the process of compounding, processing and aggregation of rubber, the rubber oil is the third assist agent next to soot and green rubber. The rubber oil is used extensively in the production and processing of synthetic rubber, for example, butyl rubber (IIR), ethylene propylene rubber (EPM), isoprene rubber (IR), natural rubber (NR), butadiene rubber (BR), styrene-butadiene rubber (SBR), chloroprene rubber (CR), nitrile rubber (NBR), thermoplastic elastomer (SBS).

CNPC is the second largest manufacturer of the asphalt-base lubricant in the world, which has the abundant resources of asphalt-base heavy oil with low condensation point. The kind of crude oil, with features such as high density, high viscosity, low wax content, low flow point, high cycloalkane content, low bitumen content, is generally acknowledged as the good raw material and precious resource for producing the rubber oil, transformer oil and refrigeration oil. The products meet the special requirements of domestic industries such as rubber, filling paste of cable and optical cable, petrolatum, lubricant grease, etc., and are commended by the synthetic rubber manufacturers and broad users.

Application Cases

KN-Series High-quality Asphalt-base Rubber Oil is used to produce the SBS oil extended rubber and is applied in shoemaking and hot melt adhesive industry where the raw material is SBS oil extended rubber. The main SBS manufacturers in China are Synthetic Rubber Plant of Yueyang Baling Petrochemical Complex Company in Hunan Province (Baling Petrochemical), Synthetic Rubber Plant of Beijing Yanshan Petrochemical Corporation (Yanshan Petrochemical) and Maoming Petrochemical Ethylene Industrial Company in Guangdong Province (Maoming Petrochemical), with the total production capacity of 260,000 t/y. Kunlun KN4010 High-quality Asphalt-base Rubber Oil has been used in these three synthetic rubber plants for nine years.

Fuller Company is one of the biggest transnational corporations which produce and market adhesive, sealant, coating, paint and other special chemical products professionally. The company uses High-quality Asphalt-base Rubber Oil KN 4010 to produce hot melt adhesive products.

Bostik is one of the biggest international manufacturers of adhesive and sealant. The company uses High-quality Asphalt-base Rubber Oil KN 4010 to produce hot melt adhesive products. KP-Series High-quality Paraffin-base Rubber Oil is used to produce the oil-extended rubber for the ethylene propylene rubber and is applied in the manufacturing industry, such as automobile sealings, high-quality sealing materials. The raw materials are ethylene propylene rubber and ternary oil-extended rubber of ethylene propylene rubber. PetroChina Jilin Petrochemical Company uses KP-Series High-quality Paraffin-base Rubber Oil to produce the ternary oil-extended rubber.

yansan 燕山石化 H.B. Fuller Bostik 波士胶

Kunlun Rubber Oil

KN-Series High-quality Asphalt-base Rubber Oil

KN-Series High-quality Asphalt-base Rubber Oil is used to produce SBS thermoplastic elastomer as well as high-quality shoes and adhesives with SBS as the main raw material. It is the ideal rubber oil to produce the high-quality rubber used in daily life and health industry, and is used widely for producing white or colored rubber goods, e.g. NR (natural rubber), SBR (styrene-butadiene rubber), BR (butadiene rubber), EPM (ethylene propylene rubber). In addition, it is applied in the rubber goods of high-quality shoe materials and adhesives in daily life and health industry where the product quality is required highly.

K-Series Asphalt-base Rubber Oil

K-Series Asphalt-base Rubber Oil can be used as the extended oil for compounding in the synthetic rubber factories and as the process oil and emollient for rubber goods. K-Series Asphalt-base Rubber Oil is used widely in SBS (thermoplastic elastomer), NR (natural rubber), SBR (styrene-butadiene rubber), BR (butadiene rubber), EPM (ethylene propylene rubber) and EPDM (ethylene propylene diene rubber) and other light or colored rubber goods. Also, it is used in the production of TPR shoe materials, hot melt adhesives and auto sealings.

KP-Series High-quality Paraffin-base Rubber Oil

KP-Series High-quality Paraffin-base Rubber Oil is mainly used to produce oil-extended EPDM (ethylene propylene diene rubber), and is also used extensively to produce IIR (butyl rubber), EPM (ethylene propylene rubber), IR (isoprene rubber), NR (natural rubber) and some thermoplastic rubber. It is particularly recommended to produce rubber goods which are required to have light smell, light color, good heat-resistance and illumination performance. In the production of butyl rubber and ethylene propylene rubber, KP-Series High-quality Paraffin-base Rubber Oil is the donor of low unsaturation. In the production of the automobile rubber accessories, attachments of home appliances, wires and cables and other products restricted by environmental regulations, KP-Series High-quality Paraffin-base Rubber Oil also shows very nice performance.



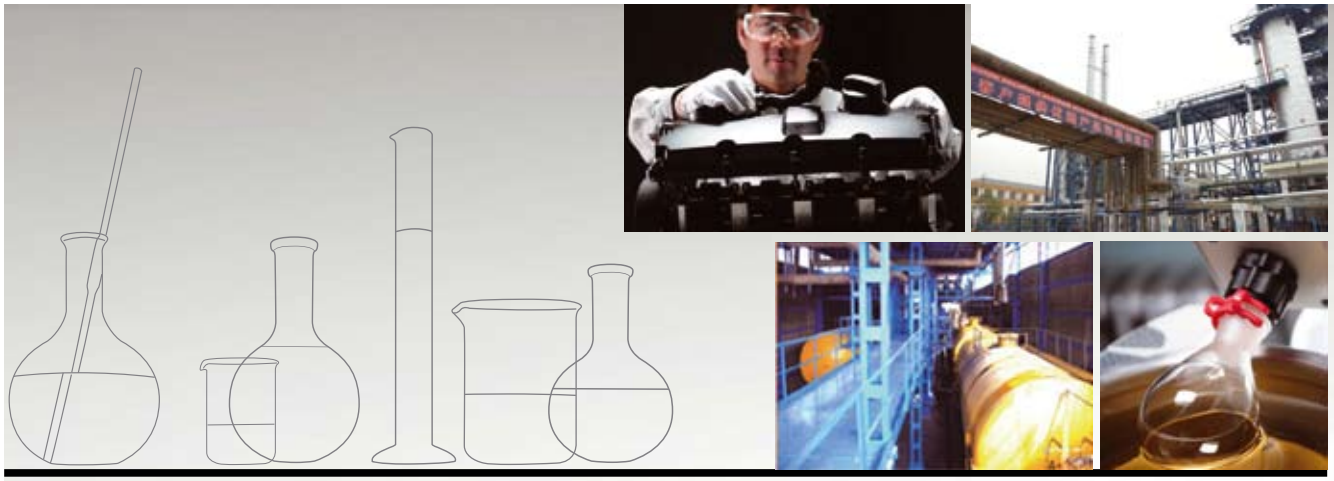






Technical Certification

5 Lubricant Additives



The lubricant additive products developed independently by CNPC include many series of products such as calcium alkyl salicylate, S-P type EP antiwear additives, which meet the R&D requirements for Kunlun Lubricants. The products can be used extensively in the industrial oil such as internal combustion engine oil, gear oil, bearing oil, circulating oil of paper machine. Also, the products meet the operating requirements for oil products.

CNPC has the entire system of research, development and production of additives, integrates production, marketing and research, and has applied for ten patents of unique technologies.

Calcium Alkyl Salicylate

During the processes such as neutralization and calcification, the alkyl salicylic acid with proper olefin fraction can be transformed into the series products of Kunlun Calcium Alkyl Salicylate. The products have excellent high-temperature detergency property, good acid neutralizing ability, preferable heat stability, anti-oxidant property as well as certain-degree dispersing ability at low temperatures. The products are applied widely in the lubrication for internal combustion engines, industrial oil, lubricant grease, etc. Now, only a few companies (e.g. SHELL, CNPC) own the proprietary industrialized technologies.

As per the basicity, the products of Kunlun Calcium Alkyl Salicylate are divided into medium-basicity calcium alkyl salicylate T109 and high-basicity calcium alkyl salicylate T109B.

Application Cases

The products are used extensively in high-quality Kunlun gasoline engine oil, diesel engine oil and stationary gas engine oil.

Patents

Patent number	Title of patent for invention
ZL00122002	A preparation method of synthetic metallic detergent with ultrahigh basicity
ZL00130608.1	Process for preparing ultrahigh basicity alkyl salicylate
ZL97116375.8	A preparation method of calcium alkyl salicylate with ultra-high basicity
ZL95115487.7	A preparation method of lubricant additive
ZL95117936.5	A preparation method of lubricant additive
ZL94106384.4	A preparation method of alkyl salicylate additive

S-P Type EP Anti-wear Additives

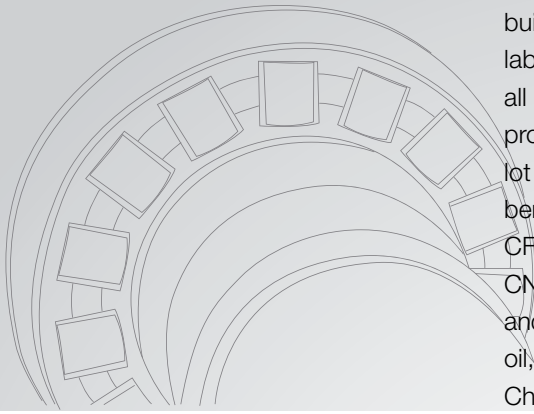
Aiming at the improvement of EP anti-wear property and the hold capacity of phosphorus, S-P Type EP Anti-wear Additives are based on CNPC's proprietary technologies and design platform specifically for the development of additives with sulfurous and phosphoric content. The products are used extensively in gear oil, bearing oil, circulating oil of paper machine and other industrial oil.

Kunlun EP Anti-wear Additives mainly include the ashless anti-wear agents RHY310A, RHY311, RHY313 and RHY314.

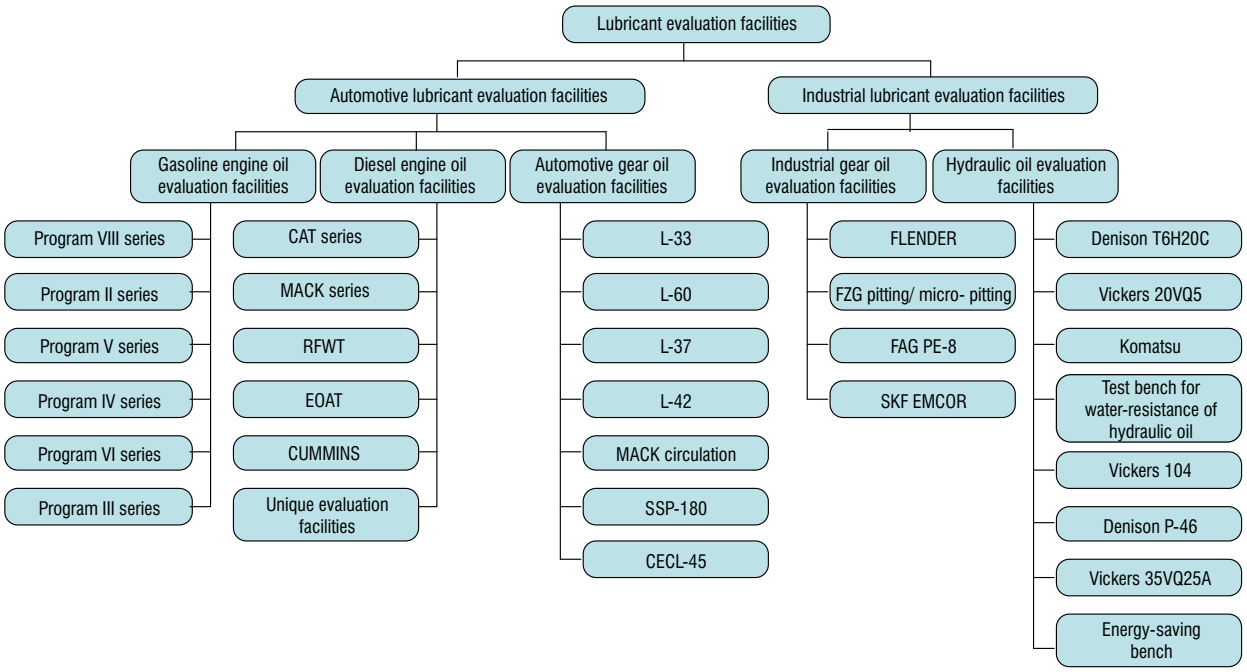
Application Cases

- RHY310A is used successfully in GL-5^{+} Kunlun Vehicle Gear Oil.
- RHY311 is used successfully in Kunlun MTF18 Manual Transformer Oil for commercial vehicles.
- RHY313 is used successfully in the ashless hydraulic oil and vibration damper oil for motorcycles.
- RHY314 is used successfully in the gear oil for aerogenerators and vibration damper oil for vehicles.

6 Lubricant Evaluation Technologies

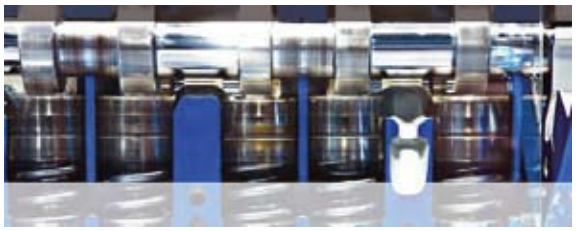


CNPC has the most advanced lubricant evaluation facilities with the building area of 4,200m^2, the necessary evaluation methods ranging from laboratory model tests to bench tests, and splendid technical personnel, all of which ensure the continuous improvement of the quality of lubricant products. With over 60 sets of test benches and facilities for evaluation, a lot of researches (e.g. laboratory research, analysis and examination and bench evaluation) can be conducted for lubricant oil and additives of SL, CF, CF-4, CI-4, GL-5 and MT-1 conforming to API standard. Meanwhile, CNPC has initiated the technological cooperation with the domestic OEMs and developed the unique technologies for the evaluation of diesel engine oil, hydraulic oil, etc. CNPC's Lubricant Evaluation Technologies, leading in China, is the reliable basis of lubricant R&D.










CNPC's Engine Oil Evaluation Technologies involves Gasoline Engine Oil Evaluation Technology, Diesel Engine Oil Evaluation Technology and Vehicle Gear Oil Evaluation Technology, and the evaluation results are used to define the quality grade of engine oil.

Gasoline Engine Oil Evaluation Technology

The Gasoline Engine Oil Evaluation Technology is the basis for identifying the quality grade of engine oil, which is developed as per the distinctive features of gasoline engines with operating conditions of high rotational speed, low/moderate duty, deposit of engine sludge, corrosion and abrasion of engine and valve system that are caused by frequent starts and stops.

The Gasoline Engine Oil Evaluation Technology involves the bench test facilities and evaluation methods for gasoline engines, including the bench test of gasoline engines with Program III Series, Program V Series, Program VI Series, Program IV Series and Program VIII Series as well as the BRT Test.

Technical Features

- BRT Test: It is designed to evaluate the anti-corrosion performances of different kinds of lubricant oil towards the valve system in the engine under the conditions of low temperature and short-distance driving.
- Program III Series Engine Test: It is designed to evaluate the properties of engine lubricant oil, such as oxidation at the high temperature, thickening, deposits of sludge and paint film, abrasion towards engine, etc.
- Program V Series Engine Test: It is designed to evaluate the properties of engine lubricant oil, such as the resistance to the deposits of sludge and paint film, anti-abrasion of valve system, etc.
- Program VI Series Engine Test: It is used to evaluate the influence of lubricant upon the fuel economy of engine.
- Program IV Series Engine Test: For protecting the three-way catalytic converter of the vehicle, the phosphor content in the gasoline engine oil of superior quality is limited more harshly, which causes the salient problem of abrasion of the gasoline engine's valve system. Therefore, the test with Program IVA is introduced to evaluate the abrasion of slide valve system.
- L-38/Program VIII Series Engine Test: It is designed to evaluate the engine oil's anti-oxidation at high temperature and corrosion protection for axle bush .

Scope of Application

The Gasoline Engine Oil Evaluation Technology can be used to evaluate the performance of the gasoline engine oil of different specifications from SG to SL/GF-3.





Diesel Engine Oil Evaluation Technology

The Diesel Engine Oil Evaluation Technology is developed according to the distinctive features of the diesel engine that uses post treating technologies (e.g. high-pressure common-rail, fuel injection delay, EGR) and the problems (e.g. engine abrasion, carbon deposit, abrasion of valve system, filter clogging) caused by running continuously under heavy load.

The Diesel Engine Oil Evaluation Technology involves bench test facilities and evaluation methods for gasoline engines, i.e. Single-cylinder Diesel Engine Cat Test, Mack-series Engine Test, Cat C13 Engine Test, Cummins ISB Engine Test, Roller Follower Wear Test (RFWT), Program IIIF Engine Test, L-38/Program VIII Engine Test, and so on.

Scope of Application

The Diesel Engine Oil Evaluation Technology can be used to evaluate the performance of diesel engine oil from CF-4 to CJ-4.

Technical Features

- Single-cylinder Diesel Engine Cat Test: It is designed to evaluate the impact of lubricants on such problems as piston ring bonding, abrasion of piston ring and cylinder and formation of piston deposits. So far, this evaluation method has evolved from 1G2, 1K and 1N to 1P and 1R.
- Mack-series Engine Test: It is mainly divided into two types.
- Mack T-8 is used to evaluate the tendency to increase the viscosity of lubricants due to the increase of soot content in engine oil, thus evaluating API CF-4 and diesel engine oil of higher grade.
- Mack T-11/T-12 is used to evaluate the abrasion protection of diesel engine oil towards piston ring cylinder liner as well as axle bush.
- Cummins ISB Engine Test: It is designed to evaluate the anti-abrasion property of diesel engine oil towards camshaft and valve system under the condition of high soot content.
- Cummins ISM Engine Test: It is the substitute of Cummins ISM EGR test demanded in CI-4 specification. The purpose of this test is to evaluate the abrasion of the valve actuating mechanism caused by the increase of soot content and sludge as well as the engine oil filter clogging.
- Roller Follower Wear Test (RFWT): It is designed to evaluate the performance of diesel engine oil (i.e. CG-4, CH-4, CI-4, and CJ-4) towards the abrasion of roller lifter and valve system caused by the increase of soot content.
- Cat C13 Engine Test: It is designed to evaluate the performance of diesel engine oil in cleaning the high-temperature piston and controlling the consumption of engine oil.

Unique Evaluation Technology for Diesel Engine Oil

With the 6DL engine produced by FAW Jiefang Automotive Co., Ltd.—Wuxi Diesel Engine Works as the test platform, the 6DL engine test bench and test method are established. The test is used to evaluate the high-temperature detergency property and soot dispersing property of diesel engine oil. At present, the test method has become the company standard of China FAW Group Corporation.

Technical Features

- 6DL 1-30 Engine Test (standard number: Q/CAM-146-2005): It is designed to evaluate the performance of the engine for piston cleaning, abrasion of piston ring and cylinder, tendency to form piston deposits as well as engine oil consumption.
- 6DL 2-35 Engine Test: It is designed to evaluate the trend of the increase in lubricant viscosity caused by the rise of soot content.

Unique Technology

The bench test and test method for 6DL engine are developed with the 6DL engine manufactured by FAW Jiefang Automotive Co, Ltd.—Wuxi Diesel Engine Works as the test platform and in consideration of the home-made diesel-powered vehicles being often in heavy load, overload and running at a high speed over a long period of time. The unique technologies can be applied to better evaluate the properties of lubricant such as the detergency of high-temperature substances (i.e. piston deposits) and resistance to abrasion (e.g. cam abrasion, barrel wear, weight loss of piston ring) and evaluate the increase in lubricant viscosity caused by the increased soot content, engine oil consumption, etc.

Scope of Application

- 6DL 1-306 Engine Test is applied to evaluate the performance of the API CF-4 diesel engine oil.
- 6DL 2-35 Engine Test is applied to evaluate the performance of CF-4, CH-4 and CI-4 diesel engine oil.

Automotive Gear Oil Evaluation Technology

The Automotive Gear Oil Evaluation Technology mainly evaluates the impact of the automotive gear oil on gear abrasion under the simulated driving conditions (i.e. acceleration, climbing, running at high speed, complex weather situations), as well as the gear oil's anti-oxidation and resistance to sludge deposits. The results of bench tests are used to determine the quality grade of the automotive gear oil.

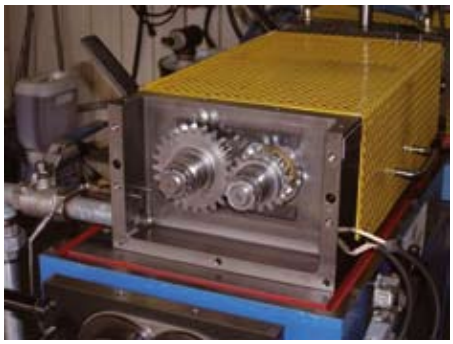
The Automotive Gear Oil Evaluation Technology covers the bench test facilities and evaluation methods for automotive gear oil, including the test benches such as CRC L-33, L-60, L-37, L-42, MACK circulation, SSP-180.

Technical Features

- CRC L-37 High-torque Test: It is designed to evaluate the carrying capacity, anti-abrasion and extreme-pressure properties of the automotive gear oil, and is used to evaluate the performance of the API GL-5 automotive gear oil.
- CRC L-42 High Speed Impact Test: It is designed to evaluate the anti-abrasion property of automotive gear oil, and is used to evaluate the performance of the API GL-5 automotive gear oil.
- CRC L-33 Corrosion Test: It is designed to evaluate the corrosion protection of the moisture-bearing automotive gear oil towards metal parts, and is used to evaluate the performance of the API GL-5 automotive gear oil.
- CRC L-60 and CRC L-60-1 Thermal Oxidative Stability Test: It is designed to evaluate the thermal oxidative stability and detergency property of automotive gear oil.
- MACK Cycle Test: It is designed to evaluate the thermal stability of manual transmission fluid, and is used to evaluate the performance of the API MT-1 manual transmission fluid.
- SSP-180 Test: It is designed to evaluate the manual transmission fluid's endurance to gear-shift in order to determine the relationship between the gear-shift quality and frequency of lubricant.
- CEC L-45 test: Using the tapered roller bearing, it is mainly designed to evaluate the reduction of kinematical viscosity of the sheared gear oil to determine its shearing-resistance.
- TE92M Test: It is designed to evaluate the frictional behavior and friction durability of the automatic transmission fluid.

Scope of Application

The Automotive Gear Oil Evaluation Technology can be used to evaluate the performances of gear oil, e.g. GL-5, MT-1, PM-1.


Industrial Gear Oil Evaluation Technology

According to the evaluation requirements of OEMs and in view of the typical application of the industrial gear oil, CNPC developed the Industrial Gear Oil Evaluation Technology including FLENDER Foam Test, FZG Pitting/Micro-pitting Test, FAG FE-8 Test and SKF EMCOR Test. And the results of the tests represent a significant basis for evaluating the quality of the industrial gear oil.


Technical Features

- FLENDER Foam Test: In the test, a pair of standard gears is used to simulate the actual application situation of gear oil, and the antifoam property of the gear oil is decided by the relationship between the volume of oil bubble and the time.
- FZG Pitting/Micro-pitting Test: It is designed to evaluate the gear oil´ s restraining effect on the occurrence of pitting and micro-pitting on the surface of gear pairs under extreme pressure.
- FAG FE-8 Test: It is designed to evaluate the anti-wear property of different kinds of gear oil in the bearing test.
- SKF EMCOR Rust Test: It is designed to evaluate the anti-rust property of lubricants and lubricant greases for the bearings under wet conditions.

Hydraulic Oil Evaluation Technology

The Hydraulic Oil Evaluation Technology involves the bench test facilities and evaluation methods, e.g. test bench and methods for high-pressure & anti-abrasion, anti-moisture, oxidation-resistance and energy-saving performance of hydraulic oil (fluid). The results of bench tests represent a significant basis for evaluating the quality of hydraulic oil, and provide technical support for the development of a higher-performance formula of hydraulic oil.

Technical Features

- Denison T6H20C Test Bench: It uses duplex mixing pumps to ensure the simultaneous evaluation of both vane pump test and plunger pump test, thus fulfilling the evaluation of the hydraulic oil HF-0. The fluctuating pressure load test is carried out under extremely harsh test conditions, with the test temperature of dry phase reaching 110℃ , the highest in all the evaluation tests of hydraulic oil.
- Vickers 20VQ5 Oxidation Durability Test Bench: It uses Vickers 20VQ5 vane pump. The air-entrainment test is carried out under high temperature and high pressure in order to observe the acid number increase, viscosity change and sludge generation of lubricant oil.
- Komatsu HPV35+ 35 Twin-piston Pump Bench: A Komatsu plunger pump, as the test pump, runs under relatively severe conditions for 500 hours at the pressure of 34.5MPa and temperature of 95 ℃ . The test conditions are relatively harsh. The oil products that have passed the test can be applied to the hydraulic system with the pressure over 34.3MPa and oil temperature of 100℃ .
- Energy-saving Test Bench: It facilitates the development of highly-efficient and energy-saving hydraulic oil, and plays an important role in the exploration and research of standard test methods. The energy-saving test bench was applied for one national patent for utility model.

- Water-resistance Simulation Bench: According to the pump similarity theory and hydrodynamic similarity criteria, it explores a reliable testing method in the evaluation of test bench simulation for hydraulic oil, which makes the evaluation test simple, dependable, oil-saving and time-saving. The bench test is suitable for the investigation and evaluation of the wet phase performance of hydraulic oil, i.e. wearability and filterability.

- Vickers 104 Vane Pump Bench: It is used to evaluate the erformance of anti-wear hydraulic oil. The hydraulic oil goes through the motor-driven 104-C vane pump for 100h. The weight losses of the leaf blade and stator of vane pump before and after the test are compared, and the weight loss decides the performance of the oil product. This bench method was drafted by CNPC and has been established as a petrochemical industry standard.

- Denison P-46 Plunger Pump Bench: It is designed to evaluate the wear conditions after the use of hydraulic oil on Denison 46 plunger pump. The test duration is 100 hours and the pump pressure is 34.5MPa. The method is divided into two stages: in the first stage the pump runs for 60h at 71℃ , which is followed by a stage with pump running for 40h at 99 ℃ . This bench method was drafted by CNPC and has been established as a petrochemical industry standard.

- Vickers 35VQ25A Vane Pump Bench: It is designed to evaluate the performance of the anti-wear hydraulic oil as per the weight loss of the leaf blade and stator of the 35VQ25A vane pump. The test duration is 50 hours, with the pump outlet pressure of 21MPa and pump inlet temperature of 93.3℃ . In this test, three pumps are used—if one of them fails, the other two should both pass the test. This bench method was drafted by CNPC and has been established as a petrochemical industry standard.

Patents:

Bench of simulation and evaluation for dry/wet phase wearability of hydraulic oil Authorization Number: ZL2006 2 0092702.8
Energy-saving test bench for hydraulic oil Authorization Number: 200920107873.7

No.	Patent No.	Title of patent for invention	Granted date
1	3104811	A combination of premium gasoline engine oil	2006.01.18
2	200610164861.99 (Application number)	Combination of gasoline engine oil	2006.12.07 (Application)
3	200910080627.1 (Application number)	A combination of energy-saving engine oil additive	2009.03.20 (Application)
4	1130774.9	A lubricant additive	2005.5.25
5	1130776.5	A lubricant additive and its preparation method	2006.1.18
6	US 6,774,092	Additive composition for gearbox oil	2004.8.10
7	200710098945.1	A Combination of manual transmission fluid for sedans	2008.11.5
8	CN00122002	A preparation method of synthetic metallic detergent with ultrahigh basicity	2003.11.05
9	CN00130608.1	A preparation method of alkyl salicylate with ultrahigh basicity	2003.07.23
10	CN97116375.8	The preparation method of calcium alkyl salicylate with ultrahigh basicity	2001.04.04
11	CN95115487.7	A preparation method of lubricant additive	1999.06.23
12	CN95117936.5	A preparation method of lubricant additive	1999.03.31
13	CN94106384.4	A preparation method of alkyl salicylate additive	1997.02.05
14	ZL2006 20092702.8	Test bench for simulation and evaluation of dry/wet-phase wearability of hydraulic oil	2007.08.15
15	15 200920107873.7	Energy-saving test bench for hydraulic oil	2010.02.03

6 R&D and Production Equipment

Support of Scientific Research & Technologies

The formulas of lubricants and additives are the core technologies in the lubricant industry. CNPC has always been devoting itself to improving the technical level and quality of products through the incessant modification and innovation, in order to provide the wide users with the first-rate technologies and products.

- CNPC has built a professional company integrating the manufacture, research and development, marketing and service.
- CNPC is a large comprehensive scientific research entity with strong capability of scientific and technological innovation and development. CNPC integrates the R&D, analysis, research of technical information and market services on lubrication, lubricant additives, fuel additives and technologies of crude oil.
- CNPC has the most advanced facilities for analysis and evaluation in the world—more than 1,578 sets. Many researches of oil products and additives (incl. SL, CF, CF-4, GL-5, MT-1, MIL-PRF-2105E and DENISON HF-0) which meet the API standard can be carried out. The research contains bench test, analysis and detection, simulated test, bench evaluation, middle-sized scale-up test, performance test, and so on.

- CNPC has the domestic first-class and perfect simulation test apparatus and nationally authorized qualification of lab analysis and detection.
- CNPC has the test base with advanced facilities, and various pilot-scale studies can be carried out.
- CNPC has the Joint Laboratory for Oil Products in cooperation with the Technical Center of China FAW Group Corporation, National Engineering Research Center for Fine Petrochemical Intermediates in cooperation with Lanzhou Institute of Chemical Physics as well as the enterprise post-doctoral scientific research station and key laboratory for lubricants.
- CNPC has the joint laboratory in cooperation with the Oil Institute of General Logistics Department of PLA and the joint laboratory in cooperation with the Technical Equipment Institute of Naval Logistics, and established the evaluation system which meets the specifications of global hydraulic oil OEMs.
- By the end of 2009, CNPC has obtained more than 836 scientific research achievements in the lubrication field, 2 national prizes for scientific and technological invention, 36 national prizes for scientific and technological progress and 201 provincial and ministerial-level prizes for scientific and technological achievement, as well as over 85% conversion rate in the industry. CNPC has applied for 131 national patents and one foreign patent, and obtained 74 authorized patents. 105 patents applied for and 67 patents authorized are related to the lubrication field. That lays a good technical foundation for the further development of lubrication products.
- CNPC has a highly qualified team and an entire technical system ranging from the research of products to market technical services.
- Lanzhou Research and Development Center has a $4m^3$ batch reaction unit, two 500L reaction units, one 200L reaction unit and one 500L pressure reaction unit, which can achieve the amplification research of the pilot plant test for additives.
- Lanzhou Lubrizol Lanlian Additive Plant has the advanced production equipment of single agent and complexing agent of additives, which can fulfill the industrial scale-up test and make the production capacity amount to 40,000t/y.

Lubricant Production Plants:

PetroChina Lanzhou Blending Plant	PetroChina Liaohe Blending Plant
PetroChina Dalian Blending Plant	PetroChina Fushun Blending Plant
PetroChina East China Blending Plant	PetroChina Yumen Blending Plant
PetroChina Karamay Blending Plant	PetroChina Chengdu Blending Plant
PetroChina Daqing No.1 Lubricating Oil Blending Plant	PetroChina Lanzhou Lubricating Grease Plant
PetroChina Daqing No.2 Lubricating Oil Blending Plant	PetroChina Beijing Kunlun Blending Plant
PetroChina Dushanzi Blending Plant	Wuxi PetroChina Lubricating Grease Co., Ltd.

Production Equipment

CNPC has 14 lubricating oil blending plants and lubricating grease plants, and its resource extent of the base oil and production capacity account for 60% and 67% separately in China. The process technologies of every lubrication production plant are complete, and they have the most advanced blending technologies and equipment in the world. Every lubricant production plant has perfect monitoring devices and means, and CNPC has the most perfect and advanced analysis and test center in China, able to produce many lubricant (grease, agent) products of 28 types and over 700 shop signs. With the annual sales volume of 2 million tons, CNPC has very strong ability to supply and guarantee.

CNPC actively introduces the latest and advanced processes and technologies. Coupled with the application and promotion of the recent Metering Technology and Computer Control Technology, the pulse blending system, automatic pipeline pigging system, simultaneous metering blending (SMB), ABB automatic batch blending (ABB), DDU automatic bailing tube system, batch multi-directional pneumatic vortex mixing system and many other systems are put into use more and more widely. The newly-built plants are in the DCS control in the whole course, and the technical level is first-class in the world and is leading in China. In those plants, the production loss is decreased, the production effect raised and the product quality improved.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昆仑天润
GL-5

7 Qualification and Standard






认证证书

认证证书

中国石油天然气集团公司自主创新重要产品
证书

CERTIFICATE
环境管理体系认证证书

国家技术发明奖
证书

8 Expert Team

CNPC has more than 40 years' experience in the research and development of lubricants and boasts a team of academic talents in various fields.

Fu Xisheng

(Expert in the research and development of gear oil and manual transmission fluid, petrochemical professor, senior engineer, doctor of science)

He is engaged in the research and development of gear oil and additives. He has published more than 50 papers and monographs in journals and academic conferences at home and abroad. He has applied for 18 patents at home and abroad, including 13 granted patents and one US patent (patent number USP 6,774,092) which obtained the Award for "Ten Excellent Patents" and the Award for "Chinese Excellent Patents of CNPC" in 2005. He has obtained one prize of technology invention award at the provincial and ministerial level, one prize of technology innovation award of the provincial and ministerial level and one second-prize of National Technology Invention Award.

Phone: 0931-7932973

E-mail: fuxisheng_rhy@petrochina.com.cn

Wang Ze'en

(Senior engineer)

He is now the director of PetroChina Dalian Blending Plant and was once the chief of PetroChina Dalian Lubricant Oil R&D Center. He is engaged in the research on the formulas of the internal combustion engine oil and relevant additives. He has made many scientific research achievements, among which one was awarded the second prize of CNPC Technology Innovation Award, several awarded the first prize or second prize of Technology Innovation Award of PetroChina Lubricant Company. He has issued more than 10 papers.

Phone: 0411-86788701

E-mail: wangzeen_rhy@petrochina.com.cn

Li Shaohui

(Senior engineer, first-grade technical professor of PetroChina Lubricant Company)

He is mainly engaged in the research on the formulas of automatic transmission fluid and relevant additives. He has made many scientific research achievements, among which one was awarded the third prize of CNPC Technology Progress Award, one awarded the first prize and two awarded the second prize of Technology Innovation Award of PetroChina Lubricant Company. He has issued 15 papers. Now he is undertaking a project named "Development of Automatic Transmission Fluid" of PetroChina Lubricant Company.

Phone: 0411-86774288

E-mail: lishaohui_rhy@petrochina.com.cn

Sun Dingwei

(Expert in research and development of internal combustion engine oil, senior engineer)

He has been engaged in the research on lubricants for 18 years. He has made 20 scientific research achievements, among which two are respectively awarded the second prize and third prize of CNPC Science and Technology Achievement Award, four awarded the first prize of Science and Technology Achievement Award of PetroChina Lubricant Company, two awarded the second prize of Science and Technology Achievement Award of PetroChina Lubricant Company, one awarded the third prize of Science and Technology Achievement Award of Gansu Province, three awarded the first prize and two awarded the second prize of Science and Technology Achievement Award of Lanzhou Petroleum Processing & Chemical Complex. He has applied for 6 patents containing 4 granted patents. He has issued 17 papers in journals and academic conferences at home and abroad.

Phone: 0931-7932977

E-mail: sundingwei_rhy@petrochina.com.cn

Zhai Yuekui

(Senior engineer, technical professor of CNPC, Chief of PetroChina Dalian Lubricant R&D Center)

He is mainly engaged in the research on the formula of the internal combustion engine oil and relevant additives. He has made many scientific research achievements, among which three were awarded the second prize of CNPC Technology Progress Award, three awarded the first prize of Technology Innovation Award of PetroChina Lubricant Company. He has issued more than 20 papers. Now he is undertaking two projects named ″Study on Lubricant Evaluation Method and Standard″ of CNPC and ″Development and OEM Certification of Low-speed Marine Engine Oil″ of PetroChina Market Company.

Phone: 0411-86774288

E-mail: zhaiyuekui_rhy@petrochina.com.cn

Ma Shujie

He has been engaged in the research and development of transformer oil since 1987. He has more than 20 years´ technical experience. He has issued over 30 papers and has 2 patents for invention. He is the technical expert of China Insulating Material Committee as well as in the lubricant industry.

Phone: 0990-6834578

E-mail: mashujie_rhy@petrochina.com.cn

Zhou Xuguang

(Expert in research and development of lubricant additives, senior engineer, Master of Science)

Now she is engaged in the research on additives in PetroChina Lanzhou Lubricating Oil R&D Institute. She has developed many kinds of lubricant additives and fuel oil additives. She has issued more than 10 papers in journals and academic conferences at home and abroad. She has made more than 10 scientific research achievements and obtained one second-prize of CNPC Technology Progress Award.

Phone: 0931-7932972

E-mail: zhouxuguang_rhy@petrochina.com.cn

Xie Jingchun

(Senior engineer)

He is mainly engaged in the research of bench evaluation of lubricants. He has obtained one second-prize for CNPC Technology Innovation and one first-prize of Science and Technology Innovation Award of PetroChina Lubricant Company. He is in charge of introducing 6 set benches and has made predominant contribution to the bench test evaluation of lubricants.

Phone: 0931-7933713

E-mail: xiejingchun_rhy@petrochina.com.cn

CNPC
中国石油

联系人：刁顺 先生
电　话：59986059
Email: sdiao@cnpc.com.cn

Contact: Mr. Diao Shun
Tel: 59986059
Email: sdiao@cnpc.com.cn