附件三

出國報告書封面（出國類別：國際會議）

ICAMCME 2017 國際研討會

服務機關：國立虎尾科技大學車輛工程系

姓名職稱：翁豐在 教授

派赴國家： 荷蘭(阿姆斯特丹)

出國期間：106.01.20~106.02.10

報告日期：106.03.30

摘要

ICAMCME 2017 國際研討會包含台灣及國際多所知名大學學者參與，會議於 2017 年 2 月 7 日至 2 月 8 日，在荷蘭阿姆斯特丹，舉辦 19th International Conference on Advanced Motion Control and Mechanical Engineering 國際研討會。此次會議有來自許多其他國家之各類不同領域研究者發表近期創作，目前節能議題以及車輛新技術普遍受到國際重視，荷蘭風車村(桑斯安斯) Zaanse Schans 更是風力發電的傳統風機示範區，桑斯安斯風車村更發展成為荷蘭重要觀光地區，帶來觀光收益。荷蘭政府有計畫的推展綠能發電，鼓勵民間電廠設置以及電力自由買賣，許多措施值得借鏡。智慧及節能汽車也是各國汽車產業發展重要科技方向，節約燃油的消耗，進而減少地球環境汙染是普世價值。參與研討會除發表論文之外，積極與其他領域研究者交流新知，並進行阿姆斯特丹地區附近綠能景點參訪，接觸並了解當地文化；研討會接受之論文，除刊登於研討會論文集之外，並且將獲推薦轉投 EI 期刊。

目次

本文

（一）目的:

參加本次研討會目標主要進行論文發表交流與綠能科技參訪，論文主題在汽車節能與引擎潤滑技術發方面，藉由參與新能源與科技技術方面交流，能誘發新的研發方向。

緣起：節能及智慧車輛科技已是本世紀各國政府及產業追求及發展的新目標，新能源、智慧車及傳統引擎技術已有許多新科技應用案例，本研究參與國際研討會動機主要在於了解新能源與智慧車輛相關技術發展。

預期效益： 研討會除發表論文之外，積極聽取相關領域技術報告，並進行阿姆斯特丹地區附近綠能景點參訪，接觸並了解當地文化及吸收風力有關綠能資訊；研討會接受之論文，除刊登於研討會論文集之外，可獲推薦國際期刊之機會。

（二）過程:

研討會經過情形如下:一月二十一日早班機桃園出發，當日晚間到達目的地阿姆斯特丹稍作休息，進行旅遊觀光活動。二月六日搭車前往會場偉斯普(weesp) NH 旅館熟悉環境。二月七日早上前往會場報到，並領取研討會文件(圖一)，參加研討會發表論文(圖二)，並且主持研討會議(圖三 a b)。午餐前大合照(圖四)，下午繼續參與研討會。二月八日進行參訪 WEESP 當地有名的風車(圖五)，其為水平軸式風力發電設施，夏日季節，河道及風車觀光，也為當地帶來可觀收入。二月九日白天走訪阿姆斯特丹市區(圖六 a,b)。於二月九日晚班機回程。

圖一研討會報到領取文件

圖二　論文發表

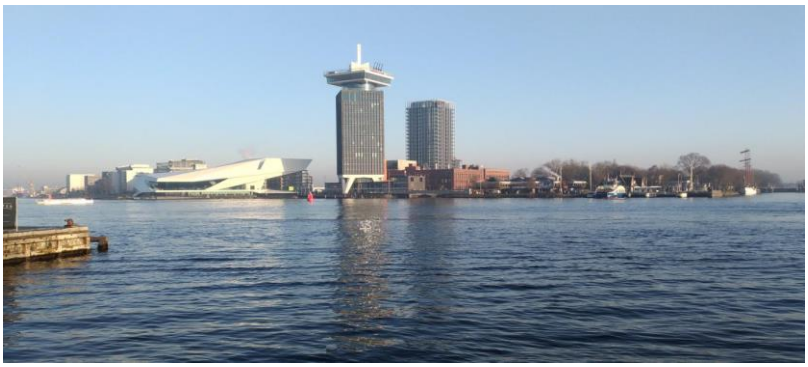
(圖三 a) 主持會議

(圖三 b) 主持會議

(圖四) 會議大合照

(圖五) **參訪偉斯普(weesp)風車**

(圖六 a) 阿姆斯特丹市區參訪



(圖六 b) 阿姆斯特丹市區參訪

（三） 心得及建議事項：

本次研討會行程中，除發表論文之外，與國外研究者討論車輛科技與綠能技術，從而獲益良多，對於荷蘭文化，也有了些粗淺層面認識，期望能多藉由國際研討會場合的交流與學習，增廣見聞與教學新知，擴充知識文化視野，增進教學之能。參訪偉斯普(weesp)當地有名的復古風車設施，此不同於風力發電機，夏日季節，河道及風車觀光，可為當地帶來可觀收入，台灣海島西岸具有可觀風力資源，建議政府可仿效此方式發展地方觀光，應可收到不錯效果。

(附件)研討會議程　　CONFERENCE VENUE　NH Naarden Hotel, IJsselmeerweg
31411 AA Naarden.　The Netherlands

CONFERENCE REGISTRATION
February 7, 2017 from 08:40 to 11:00

February 7, 2017 Ijsselmeer Room
Session I: 08:55-10:00

Chair: Hassan Albishri

Sustainability Assessment of Municipal Wastewater Treatment	Yousra Zakaria Ahmed, Ahmed El Gendy, Salah El Haggar American University in Cairo, Egypt	
Overview of Constructed Wetlands System for Greywater Treatment: Challenges, Advantages, and Sustainable Analysis	Iga Maliga Padjadjaran University, Indonesia	
Genetic Polymorphism of Milk Protein Gene and Association with Milk Production Traits in Local Latvian Brown Breed Cows	Daina Jonkus, Solvita Petrovska, Dace Smiltina, Lasma Cielava University of Agriculture, Latvia	e-Poster
PRKAG3 and RYR1 Gene in Latvian White Pigs	Daina Jonkus, Liga Paura, Tatjana Sjakste, Kristina Dokane Latvia University of Agriculture, Latvia	e-Poster
Radiation Usage Impact of on Anti-Nutritional Compounds (Antitrypsin and Phytic Acid) of Livestock and Poultry Foods	Mohammad Khosravi, Ali Kiani, Behroz Dastar, Parvin Showrang Gorgan University, Iran, Islamic Republic Of	e-Poster
Comparison of Selected Behavioural Patterns of German Shepherd Puppies in Open-Field Test by Practical Assessment Report	Igor Miňo, Lenka Lešková University of Veterinary Medicine in Kosice, Slovakia	e-Poster
Antistress Effects of Hydrangeae Dulcis Folium on Net Handing Stress-Induced Anxiety-Like Behavior in Zebrafish: Possible Mechanism of Action of Adrenocorticotropin Hormone (ACTH) Receptor	Lee Seungheon, Kim Ba-Ro Jeju National University, Korea, Republic Of	e-Poster
Impact of pH Control on Peptide Profile and Antigenicity of Whey Hydrolysates	Natalia Caldeira De Carvalho, Tassia Batista Pessato, Luis Gustavo R. Fernandes, Ricardo L. Zollner, Flavia Maria Netto University of Campinas, Brazil	e-Poster
Effect of Whey Proteins and Caffeic Acid Interactions on Antioxidant Activity and Protein Structure	Tassia Batista Pessato, Francielli Pires Ribeiro Morais, Fernanda Guimaraes Drummond Silva, Flavia Maria Netto University of Campinas, Brazil	e-Poster
Development of Ecofriendly Ionic Liquid Modified Reverse Phase Liquid Chromatography Method for Simultaneous Determination of Anti-Hyperlipidemic Drugs	Hassan M. Albishri, Fatimah Al-Shehri, Deia Abd El-Hady King Abdulaziz University, Saudi Arabia	e-Poster

February 7, 2017 Ijsselmeer Room
Session IV: 12:20-13:30
Lunch: 13:30

Chair: Alif Nur Irvan, Yip-Mei Loh

Fast-Tracking University Education for Youth Employment: Empirical Evidence from University Graduates in Rwanda	Fred Alinda, Marjorie Negesa, Gerald Karyeija Uganda Management Institute, Uganda
Effect of Appropriately Selected Corporate Identity to the Business Model of SME's in Czech Republic	Vlastimil Bijota Palacky University Olomouc, Czech Republic
The Impact of Entrepreneur to Develop Economy in Indonesia	Alif Nur Irvan, M. Varaby Wahyu Islamic University of Indonesia, Indonesia
Investigating the Relationship between Growth, Beta and Liquidity	Zahra Amirhosseini, Mahtab Nameni Islamic Azad University Shahr-e-Qods Branch, Iran, Islamic Republic Of
Socrates' Mythological Role in Plato's Theaetetus	Yip Mei Loh Chung Yuan Christian University , Taiwan

February 8, 2017 Ijsselmeer Room
Session V: 07:45-08:30

Chair: Chin-Wen Chien Chien

Structuring Taiwanese Elementary School English Teachers' Professional Dialogue about Teaching and Learning through Protocols	Chin-Wen Chien National Tsing Hua University, Taiwan
Number Variation of the Personal Pronoun We in American Spoken English	Qiong Hu, Ming Yue Zhejiang University, China
The Communicative Nature of Linguistic Interference in Learning and Teaching of Slavic Languages	Kseniia Fedorova Kazan Federal University, Russian Federation

Session II: 10:05-10:50
Coffee Break: 10:50-11:00

Group photo will be taken before coffee break in the conference room.
You can share the photos you have taken at
http://waset.org/conference/2017/02/amsterdam/photos

Chair: Goitseone Malumbela, Ivana Barisic

Resources and Strategies towards the Development of a Sustainable Construction Materials Industry in Botswana	G. Malumbela, E. U. Masuku Botswana International University of Science and Technology, Botswana	
Pervious Concrete for Road Intersection Drainage	Ivana Barišić, Ivanka Netinger Grubeša, Ines Barjaktarić University of Osijek, Croatia	
Technologies for Alignment of Multiple-Seated Shaft Lines and Rudder Propeller Installation	Konstantin N. Morozov, Aleksandr O. Mikhailov Shipbuilding & Shiprepair Technology Center, Russian Federation	
Sliding Shear Behavior of Squat Heavyweight Concrete Shear Walls	Keun-Hyeok Yang, Yong-Ha Hwang, Jin-Kyu Song Kyonggi University, Korea, Republic Of	e-Poster

February 7, 2017 Ijsselmeer Room
Session III: 11:00-12:20

Chair: Xi Xiao, Feng-Tsai Weng

Analytics Model in a Telehealth Center Based on Cloud Computing and Local Storage	L. Ramirez, E. Guillén, J. Sánchez Nueva Granada Military University, Colombia	
Privacy-Preserving Location Sharing System with Client/Server Architecture in Mobile Online Social Network	Xi Xiao, Chunhui Chen, Xinyu Liu, Guangwu Hu, Yong Jiang Tsinghua University, China	
Biogas Control: Methane Production Monitoring Using Arduino	W. Ait Ahmed, M. Aggour, M. Naciri Ibn Tofail University, Morocco	
Lubrication Performance of Multi-Level Gear Oil in a Gasoline Engine	Feng-Tsai Weng, Dong- Syuan Cai, Tsochu-Lin National Formosa University, Taiwan	
H-Infinity and RST Position Controllers of Rotary Traveling Wave Ultrasonic Motor	M. Brahim, I. Bahri, Y. Bernard Paris-Sud University, France	
Effect of Gas-Diffusion Oxynitriding on Microstructure and Hardness of Ti-6Al-4V Alloys	Dong Bok Lee, Min Jung Kim Sungkyunkwan University, Korea, Republic Of	e-Poster

發表論文

Lubrication Performance of Multi-Level Gear Oil in a Gasoline Engine

Feng-Tsai Weng, Dong- Syuan Cai., Tsochu-Lin

***Abstract*—**A vehicle gasoline engine converts gasoline into power so that the car can move, and lubricants are important for engines and also gear boxes. Manufacturers have produced numbers of engine oils, and gear oils for engines and gear boxes to SAE International Standards. Some products not only can improve the lubrication of both the engine and gear box but also can raise power of vehicle this can be easily seen in the advertisement declared by the manufacturers. To observe the lubrication performance, a multi-leveled (heavy duty) gear oil was added to a gasoline engine as the oil in the vehicle. The oil was checked at about every 10,000 kilometers. The engine was detailed disassembled, cleaned, and parts were measured. The wear of components of the engine parts were checked and recorded finally. Based on the experiment results, some gear oil seems possible to be used as engine oil in particular vehicles. Vehicle owners should change oil periodically in about every 6,000 miles (or 10,000 kilometers). Used car owners may change engine oil in even longer distance.

***Keywords*—**Multi-level gear oil, engine oil, viscosity, abrasion.

I. Introduction

THE Society of Automotive Engineers (SAE) has established a numerical code system for grading motor oils [1], and also gear oil according to their viscosity characteristics [2]. Fig. 1 revealed viscosity characteristics comparisons of both motor oils and gear oil [3]. To determine the appropriate oil change interval, an oil condition sensor has developed that measures the electrical properties of engine oil, and correlates these electrical properties to the physical and chemical properties of oil [4].

Automobile engines can be classified in many several different ways such as: (i) Strokes per cycle, modern engines have four strokes per cycle: intake, compression, power, and exhaust. (ii) Types of fuel used, gasoline engine or diesel engine. (Hi) Number of cylinders. (iv) Arrangement of cylinders. (v) Firing order. (vi) Arrangement of valves. Gear oils have great thermal stability which is adaptable to various temperatures and they also protect gearboxes and steering gears for heavy duty operation. Engine oil could be mixed into additives to improve the properties or to lower cost. Owing to the use of spent oil or recycled refined oil, environmental pollution can be decreased [5], [6].

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Some motor owners confuse engine oil with gear oil. The goal of this research is to investigate possibility for gear oil be used in a motor engine as oil. There may be some possibility according to the classifications of SAE standards in Fig. 1. The purpose of this paper is to assess the mileage interval of motor oil change and to determine if gear oil can be used as an alternative oil in a motor engine.

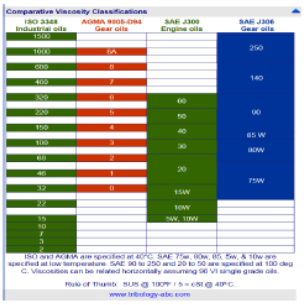

Fig. 1 Viscosity characteristics of engine oils, and gear oil [3]

II. Experiments and Results

In this experiment, gear oil of the brand Taiwan CPC (grade 80W/90) was used as engine oil. The oil was sampled and checked every 10,000 kilometers without replacing it to elicit reduced engine lubrication. The vehicle used in the experiment is a 1997 Honda Accord with 170,000 km of mileage. The experiments were conducted from April 2015 to May 2016, and involved road driving a distance of about 300 km/day.

After completing 100,000 km of road testing, the engine was disassembled and all parts were cleaned and checked. The oil analysis was trusted to a professional lab, SIGNUM. Results of the gear oil analysis was in Fig. 2. According to the oil analysis, the quantity of iron was alert, which reveals the wear of engine components. The level of iron is extremely high, and the quantity of other elements, such as Si, Pb, Al, as well as the oil viscosity is high, too. This shows parts were subjected to severe wear for long distance driving with no oil change. Some engine parts showed serious evidence of oil engine sludge such as the lead ring of oil filter, oil pan and oil filter, piston rod, rocker chamber, and so on. Oil sludge is caused by reduced oil lubricating ability and affects the efficient operation of an engine. Fig. 3 shows the disassembled engine parts after completion of the experiments. All parts were reassembled after undergoing a thorough cleaning and the engine was then checked in accordance with the Honda Accord Service Manual [7]. Cylinder block warpage was checked using a feeler gauge, and results are shown in Table I [7]. Cylinder block warpage was within the normal range when compared with the standard value range. Cylinder block bore taper was checked using a cylinder bore gauge, the results of the measurement were recorded in Table II [7]. The results show that the cylinder block bore taper value for A and B was higher than the standard value indicating wear. Piston diameter was examined, and the piston rings end gap was checked using a feeler gauge, the results were recorded in Table III [7]. The third ring was not measured because it had already seized. Piston diameters were slightly smaller than new ones, while the piston rings end gap were smaller, too. The second ring end gap was much smaller, and this may be owing to the deformation of the piston rings which operated in extremely high engine temperatures for an extended period of time. The crankshaft main journal diameter was checked and the data recorded in Table IV [7]. The crankshaft main journal diameter value was normal. The connecting rod journal bore taper was recorded in Table V [7], and was also in the normal range. The camshaft lobe height was recorded in Table VI [7]. Fig. 4 illustrates the contaminates and sludge accumulated in the oil pump. Fig. 5 shows the contaminates and sludge accumulated on the oil screen. Fig. 6 reveals the contaminates and sludge accumulated around the oil sump. Fig. 7 shows the contaminates and sludge accumulated around the cylinder and engine chamber and the inner oil guide. Fig. 8 illustrates the dissembled pistons and connecting rods. Fig. 9 reveals damage to the bush bearing on the right hand side. Most engine parts were considered worn or damaged beyond repair such as the oil filter, third piston ring, and bush bearing. The sludge produced in the engine hindered the flow of the oil feed lubrication system. Sludge clogged the sump oil strainer, which resulted in insufficient lubrication leading to a build-up of sludge and carbon in the pistons. High oil temperature also caused the piston rings to lose elasticity and seize. Carbon accumulation and oxidation deposition could happen in the engine combustion chamber. Long-term accumulation of sludge brought out oil deterioration, which resulted in vicious oil, lower liquidity, and insufficient cooling.

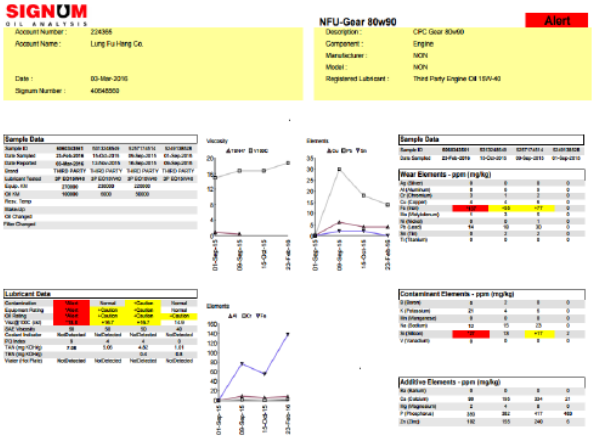

Fig. 2 Results of gear oil analysis

After completing 100,000 km of road testing, the engine was disassembled and all parts were cleaned and checked. The oil analysis was trusted to a professional lab, SIGNUM. Results of the gear oil analysis was in Fig. 2. According to the oil analysis, the quantity of iron was alert, which reveals the wear of engine components. The level of iron is extremely high, and the quantity of other elements, such as Si, Pb, Al, as well as the oil viscosity is high, too. This shows parts were subjected to severe wear for long distance driving with no oil change. Some engine parts showed serious evidence of oil engine sludge such as the lead ring of oil filter, oil pan and oil filter, piston rod, rocker chamber, and so on. Oil sludge is caused by reduced oil lubricating ability and affects the efficient operation of an engine. Fig. 3 shows the disassembled engine parts after completion of the experiments. All parts were reassembled after undergoing a thorough cleaning and the engine was then checked in accordance with the Honda Accord Service Manual [7]. Cylinder block warpage was checked using a feeler gauge, and results are shown in Table I [7]. Cylinder block warpage was within the normal range when compared with the standard value range. Cylinder block bore taper was checked using a cylinder bore gauge, the results of the measurement were recorded in Table II [7]. The results show that the cylinder block bore taper value for A and B was higher than the standard value indicating wear. Piston diameter was examined, and the piston rings end gap was checked using a feeler gauge, the results were recorded in Table III [7]. The third ring was not measured because it had already seized. Piston diameters were slightly smaller than new ones, while the piston rings end gap were smaller, too. The second ring end gap was much smaller, and this may be owing to the deformation of the piston rings which operated in extremely high engine temperatures for an extended period of time. The crankshaft main journal diameter was checked and the data recorded in Table IV [7]. The crankshaft main journal diameter value was normal. The connecting rod journal bore taper was recorded in Table V [7], and was also in the normal range. The camshaft lobe height was recorded in Table VI [7]. Fig. 4 illustrates the contaminates and sludge accumulated in the oil pump. Fig. 5 shows the contaminates and sludge accumulated on the oil screen. Fig. 6 reveals the contaminates and sludge accumulated around the oil sump. Fig. 7 shows the contaminates and sludge accumulated around the cylinder and engine chamber and the inner oil guide. Fig. 8 illustrates the dissembled pistons and connecting rods. Fig. 9 reveals damage to the bush bearing on the right hand side. Most engine parts were considered worn or damaged beyond repair such as the oil filter, third piston ring, and bush bearing. The sludge produced in the engine hindered the flow of the oil feed lubrication system. Sludge clogged the sump oil strainer, which resulted in insufficient lubrication leading to a build-up of sludge and carbon in the pistons. High oil temperature also caused the piston rings to lose elasticity and seize. Carbon accumulation and oxidation deposition could happen in the engine combustion chamber. Long-term accumulation of sludge brought out oil deterioration, which resulted in vicious oil, lower liquidity, and insufficient cooling.

Fig. 10 revealed measurement of cylinder block warpage. Measurement of cylinder block bore taper was illustrated in Fig. 11. Measurement method of piston diameter and piston rings end gap was illustrated in Fig. 12. While the measurement of crankshaft main journal diameter and clearance was described in fig. 13. Fig. 14 shows measurement of connecting rod journal and clearance. Measurement of Camshaft height clearance was illustrated in Fig. 15.

Fig. 3 Disassembled engine parts

Fig. 4 Contaminates and sludge accumulated in the oil pump

Fig. 5 Contaminates and sludge accumulated on the oil filter

III. Discussion and Recommendations

Piston diameters and piston rings end gaps were smaller compared to new ones. Deformation of the piston rings did occur, which may be the result of the engine operating over a long period at an extremely high temperature without an oil change.

Fig. 6 Contaminates and sludge accumulated in the oil pump

Fig. 7 Contaminates and sludge accumulated around the cylinder and engine chamber and inner oil guide

Fig. 8 Dissembled pistons and connecting rods

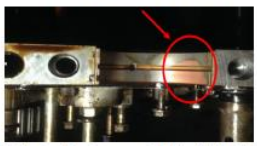

Fig. 9 Bush bearing shows damage on the right hand side after 100,000 km

Some manufacturers recommend an oil change about every 10,000 miles. Vehicle manufacturers suggest that oil should be changed every 3,000 to 5,000 miles (approximately 5,000 km to 8,000 km). Vehicle owners should change the oil regularly, or when it looks black and sticky.

A used car can run 100,000 kilometers without an oil change, because engine technology reliability is in progress. The new car and high performance vehicle owner would not change oil over time, although gear oil is cheaper and can be used in a motor engine as engine oil.

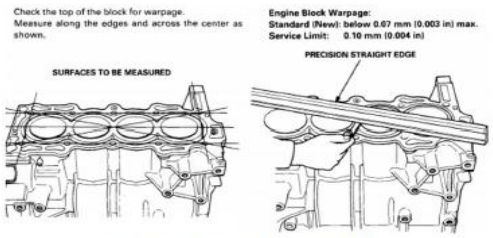

Fig. 10 Measurement of cylinder block warpage [7]

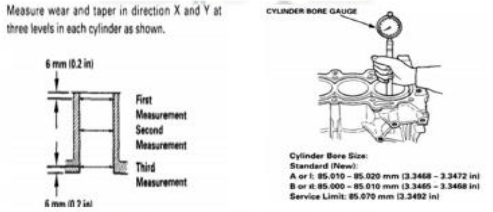

Fig. 11 Measurement of cylinder block bore taper [7]

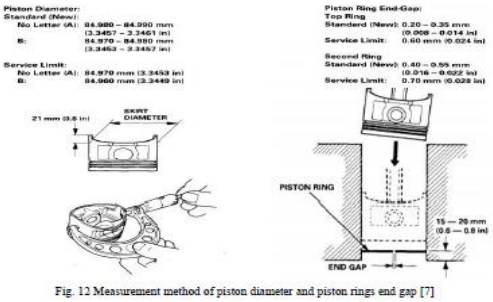

Fig. 12 Measurement method of piston diameter and piston rings end gap [7]

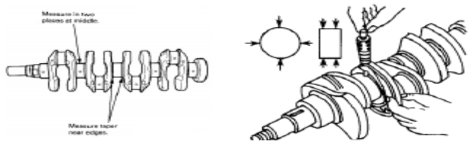

Fig. 13 Measurement of crankshaft main journal diameter and clearance [7]

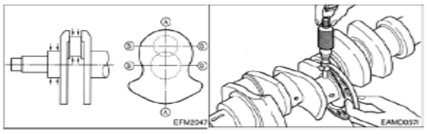

Fig. 14 Measurement of connecting rod journal and clearance [7]

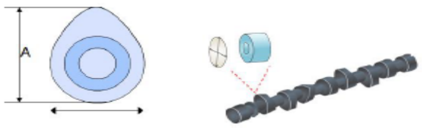

Fig. 15 Measurement of Camshaft height clearance [7]

TABLE I
CYLINDER BLOCK WARPAGE

Cylinder Block Warpage (mm)	1	2	3	4	5	6	Service limit
	0.03	0.015	0.03	0.03	0.05	0.05	0.10

TABLE II
CYLINDER BLOCK BORE TAPER

Cylinder block bore taper (mm)	1	2	3	4	Standard	
Bore A	85.26	85.22	85.24	85.22	85.010	85.020
Bore B	85.25	85.25	85.23	85.24	85.000	85.010
Taper AB	0.01	0.03	0.01	0.02	0.005	

TABLE III
PISTON DIAMETER AND PISTON RINGS END GAP

piston diameter (mm)	1	2	3	4	Standard
	84.960	84.965	84.960	84.970	84.980~84.990
piston rings end gap					Standard
top ring	0.19	0.19	0.19	0.19	0.2~0.35
Second ring	0.24	0.24	0.24	0.24	0.4~0.55

TABLE IV
CRANKSHAFT MAIN JOURNAL DIAMETER AND CLEARANCE

Main journal diameter (mm)	1	2	3	4	5	Standard	
A	49.99	49.98	49.97	49.99	50.00	Journal 1.4	49.984 50.008
B	49.995	49.985	49.975	49.99	49.99	Journal 2	49.976 50.000
Taper AB	0.005	0.005	0.005	0	0.01	Journal 3	49.972 49.996
						Journal 5	49.988 50.012

TABLE V
CONNECTING ROD JOURNAL CLEARANCE

connecting rod journal (mm)	1	2	3	4	standard
A	44.985	44.99	44.985	44.99	44.976~45.000
B	44.985	44.985	44.985	44.985	
Taper AB	0	0.005	0	0.005	

TABLE VI
CAMSHAFT HEIGHT CLEARANCE

Camshaft height (mm)	1	2	3	4	5	6	7	8	Standard
Intake A	38.70	38.71	38.72	38.72	38.72	38.71	38.72	38.73	38.741
B	33.42	33.40	33.41	33.40	33.40	33.41	33.41	33.42	
Exhaust A	38.96	38.96	38.95	38.95	38.96	38.96	38.96	38.96	38.972
B	34.04	34.05	34.04	34.035	34.035	34.035	34.035	34.04	

IV. CONCLUSIONS

To investigate whether multi-level (heavy duty) gear oil has the same lubricating effect as engine oil, gear oil was added to the gasoline engine of a Honda Accord. The engine oil performance was checked every 10,000 kilometers in driving test.

The results show that: 1) Multi-level gear oil seems possible to be used as oil in a gasoline engine. 2) Impurities in the engine caused wear on the parts. 3) The viscosity of the oil increased when the driving test was completed, which indicates that car owners must conduct periodical oil changes. 4) Engine oil can be changed approximately every 10,000 km in older vehicles. 5) Average fuel consumption is 11.5km/l per 100,000 km.

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REFERENCES

[1] Standard: J300_201501. Issuing: Fuels and Lubricants Tc 1 Engine Lubrication. Publisher: SAE International. Revised: 2015-01-20.
[2] Standard: J306_ 200506. Issuing: Fuels and Lubricants Tc 1 Engine Lubrication. Publisher: SAE International. Revised: 2005-06-14.
[3] Viscosity Classifications, Comparative Viscosity Classifications, tribology-abc.com.uk. http://www.tribology-abc.com/abc/viscosity.htm. 07.Aug.2016
[4] Amiyo Basu, Axel Berndorfer, Carlos Buelna, James Campbell et al., "Smart sensing of Oil Degradation and Oil Level Measurements in Gasoline Engines", SAE Technical Paper 2000-01-1366, 2000, doi:10.4271/2000-01-1366.
[5] Christopher D. DeDene, and Zhanping You. "The Performance of Aged Asphalt Materials Rejuvenated with Waste Engine Oil". J. Pavement Res. Technol. 7(2):145-152.
[6] Cock, V. R. 1998. Laboratory Handbook for Mineral Oil and Organic Oil Analysis. Academy Press, London. 111-113.
[7] Accord Service Manual, (1994~1997). Engine Block. pp7-15~7-22.