

 INDUSTRIAL LUBRICANT STANDARD	SAE MS1002 DEC2010
	Issued 2001-07 Revised 2010-12
	Superseding MS1002 JUL2001
Lubricants, Industrial Oils, and Related Products Type C (Gears) Specification	

RATIONALE

The revision of SAE MS1002 was necessary to reflect changes to test limits, changes to test methods and additional standards that have been incorporated since SAE MS1002 was originally released.

FOREWORD

The SAE International Industrial Lubricants Committee has developed a number of industrial, non-production lubricant performance specifications.

The purpose of these voluntary SAE specifications is to:

- Define minimum performance requirements for industrial lubricants.
- Provide lubricant suppliers with performance targets for a minimum number of key industrial lubricants.
- Improve the availability of these lubricants to member companies.
- Provide a plant oriented, user friendly, classification system using common test standards and properties.

ISO Standard 6743 - Lubricants, industrial oils and related products (class L) - Classification is the foundation for these documents.

- Performance characteristics and test procedures are specified.
- For information, equivalent ISO, DIN, CEN, BSI, ASTM, AFNOR, CETOP, and IP test methods are referenced.¹

¹ International Standards Organization (ISO)
Deutsches Institut für Normung e. V. (DIN)
European Committee for Standardization (CEN)
American Society for Testing and Materials (ASTM)
Association of Française de Normalisation (AFNOR)
The Institute of Petroleum (IP) NOTE: Now combined with BSI
British Standards Institution (BSI), BS 2000: XXX where XXX is the corresponding IP number
European Committee on Hydraulic Oil and Pneumatics (CETOP)

SAE Technical Standards Board Rules provide that: "This report is published by SAE to advance the state of technical and engineering sciences. The use of this report is entirely voluntary, and its applicability and suitability for any particular use, including any patent infringement arising therefrom, is the sole responsibility of the user."

SAE reviews each technical report at least every five years at which time it may be reaffirmed, revised, or cancelled. SAE invites your written comments and suggestions.

Copyright © 2010 SAE International

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without the prior written permission of SAE.

TO PLACE A DOCUMENT ORDER: Tel: 877-606-7323 (inside USA and Canada)
Tel: +1 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: CustomerService@sae.org
SAE WEB ADDRESS: http://www.sae.org

**SAE values your input. To provide feedback
on this Technical Report, please visit
http://www.sae.org/technical/standards/MS1002_201012**

Industrial lubricant classifications targeted:

- a. Lubricants, Industrial Oils and Related Products - Classification (SAE MS1000)
- b. General purpose and total loss lubricants (SAE MS1001)
- c. Gear oils (SAE MS1002)
- d. Compressor oils (SAE MS1003)
- e. Hydraulic fluids (SAE MS1004)
- f. Fire resistant hydraulic fluids (SAE MS1005)
- g. Lubricants for spindle bearings and associated clutches (SAE MS1006)
- h. Slideway lubricants (SAE MS1007)
- i. Metal removal fluids (SAE MS1008)
- j. Lubricants for pneumatic tools (SAE MS1009)
- k. Turbine oils (SAE MS1010)
- l. Lubricating greases (SAE MS1011)

See SAE MS1000 - Index of lubricants and symbols.

NOTE 1: Environmental, Technical Reports, and/or health and safety regulations may present additional specifications to the supplier.

NOTE 2: There can be issues related to the quality of industrial lubricants that fall outside of the scope of this specification.

1. SCOPE

See Table 1.

TABLE 1 - SCOPE, FIELD OF APPLICATION, AND SYMBOLS

Code letter	General Application	Particular Application	More specific application	Composition and special properties	Symbol	Typical applications	Remarks
C	Gears	Enclosed gears	Continuous lubrication by splash circulation or spray	Refined mineral oils with oxidation stability, anti-corrosion (ferrous and non-ferrous metal) and anti-foam properties	CKB	Gears operating under light load	
				Oils of CKB type with enhanced extreme-pressure and anti-wear properties	CKC	Gears operating at a stabilized temperature of oil that remains normal or medium and under high load	See Appendix A
				Oils of CKC type with enhanced thermal/oxidative stability that permits use at a higher temperature	CKD	Gears operating at a high stabilized temperature of the oil and under high load	
				Oils of CKB type ensuring low coefficient of friction	CKE	Gears operating under high friction (e.g., worm gears)	
				Lubricants with oxidation stability, anti-friction and anti-corrosion (ferrous and non-ferrous) properties usable under extreme temperature conditions (low and high)	CKS	Gears operating at a very low, low or very high stabilized temperature of the fluid and under light load	1) See Appendix A 2) Categories of products that require high performance may be synthetic or contain synthetic bases that risk to pose the problem of compatibility with some equipment regularly used with mineral oils

TABLE 1 - SCOPE, FIELD OF APPLICATION, AND SYMBOLS (CONTINUED)

Code letter	General Application	Particular Application	More specific application	Composition and special properties	Symbol	Typical applications	Remarks
				Lubricants of type CKS usable under extreme temperature conditions (low and high) and under high load	CKT	Gears operating at a very low, low or very high stabilized temperature of the fluid and under high load	
			Continuous splash lubrication	Greases with extreme pressure and anti-wear properties	CKG ⁽¹⁾	Gears operating under light load	See Appendix A
	Open gears - may be fitted with safety guards	Intermittent or dip or mechanical application	Products usually of bituminous type with anti-corrosion properties		CKH	Cylindrical or bevel gears operating at medium ambient temperatures and generally under light loads	1) See Appendix A 2) AB oils as defined in Part 1, Type A (Total loss systems) may be used for the same applications as CKJ lubricants 3) These products can be used with a volatile diluent for ease of application (in this case, they shall be designated as follows: CKH-DIL or CKJ-DIL
				Products of CKH type with enhanced extreme-pressure and anti-wear properties	CKJ		
				Greases with improved extreme-pressure, anti-wear and anti-corrosion properties and improved thermal stability	CKL ⁽¹⁾	Cylindrical or bevel gears operating at high or very high ambient temperatures and under high load	See Appendix A
		Intermittent application	Products with improved anti-seizing properties that permit use under extreme load conditions, and products with anti-corrosion properties		CKM	Gears operating occasionally under exceptionally high loads	Products that cannot be sprayed

1. These applications may concern several greases. The grease designation according to ISO 6743-9 shall be indicated by the supplier.

2. REFERENCES

2.1 Applicable Documents

The following publications form a part of this specification to the extent specified herein. Unless otherwise indicated, the latest issue of SAE publications shall apply.

2.1.1 Publications

Referenced AFNOR, ASTM, BS, CEN, DIN, IP and ISO Standard hardcopies are available from the ILI Website (<http://www.ili-info.com>) or by contacting ILI at:

Europe

ILI, Index House, Ascot, Berkshire, SL5 7EU, UK
Tel: +44 (0)1344 636400 Fax: +44 (0)1344 291194
Email: databases@ili.co.uk

USA

ILI, 610 Winters Avenue, Paramus, NJ 07652, USA
Tel: 201-986-1131 Fax: 201-986-7886
Email: sales@ili-info.com

2.1.2 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 (outside USA), www.sae.org.

MS1000	Lubricants, Industrial Oils, and Related Products - Classification
MS1001	Lubricants, Industrial Oils, and Related Products Type A (General Purpose and Total Loss) - Specification
MS1003	Lubricants, Industrial Oils, and Related Products Type D (Compressor Oils) - Specification
MS1004	Lubricants, Industrial Oils, and Related Products Type H (Hydraulic Fluids) - Specification
MS1005	Lubricants, Industrial Oils, and Related Products Type HF (Fire-Resistant Hydraulic Fluids) - Specification
MS1006	Lubricants, Industrial Oils, and Related Products Type F (Lubricant for Spindle Bearings, and Associated Clutches) - Specification
MS1007	Lubricants, Industrial Oils, and Related Products Type G (Slideway Lubricants) - Specification
MS1008	Lubricants, Industrial Oils, and Related Products Type M (Metal Removal Fluids) - Specification
MS1009	Lubricants, Industrial Oils, and Related Products Type P (Pneumatic Tool Oils) - Specification
MS1010	Lubricants, Industrial Oils, and Related Products Type T (Turbine Oils) - Specification
MS1011	Lubricants, Industrial Oils, and Related Products Type X (Greases) - Specification

2.1.3 ANSI/AGMA Publication

Available from American National Standards Institute, 25 West 43rd Street, New York, NY 10036-8002, Tel: 212-642-4900, www.ansi.org.

ANSI/AGMA 9005-D94 Industrial Gear Lubrication

2.1.4 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org.

- ASTM D 92 Test Method for Flash and Fire Points by Cleveland Open Cup
- ASTM D 97 Test Methods for Pour Point Of Petroleum Products
- ASTM D 130 Method for Detection of Copper Corrosion from Petroleum Products by Copper Strip Tarnish Test
- ASTM D 445 Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (and Calculation of Dynamic Viscosity)
- ASTM D 471 Test Method for Rubber Property - Effect of Liquids
- ASTM D 664 Test Method for Neutralization Number of Petroleum Products by Potentiometric Titration
- ASTM D 665B Test Method for Rust-Preventing Characteristics of Inhibited Mineral Oil in the Presence of Synthetic Sea Water
- ASTM D 892 Test Method for Foaming Characteristics of Lubricating Oils
- ASTM D 974 Test Method for Acid and Base Number by Color-Indicator Titration
- ASTM D 1298 Test Method for Density, Relative Density (Specific Gravity), Or API Gravity of Crude Petroleum and Liquid Petroleum Products by Hydrometer Method
- ASTM D 2070 Standard Test Method for Thermal Stability of Hydraulic oils
- ASTM D 2140 Test Method for Carbon-Type Composition of Insulating Oils of Petroleum Origin
- ASTM D 2270 Practice For Calculating Viscosity Index from Kinematic Viscosity at 40°C and 100°C
- ASTM D 2422 Classification of Industrial Fluid Lubricants by Viscosity System
- ASTM D 2711 Test Method for Demulsibility Characteristics of Lubricating Oils
- ASTM D 2782 Test Method for Measurement of Extreme-Pressure Properties of Lubricating Fluids (Timken Method)
- ASTM D 2893 Test Method for Oxidation Characteristics of Extreme Pressure Lubrication Oils
- ASTM D 3238 Method for Calculation of Carbon Distribution and Structural Group Analysis of Petroleum Oils by the N-D-M Method
- ASTM D 4052 Test Method for Density and Relative Density of Liquids by Digital Density Meter

ASTM D 4172 Test Method for Wear Preventative Characteristics of Lubricating Fluid (Four-Ball Method)

ASTM D 5182 Test Method for Evaluating the Scuffing (Scoring) Load Capacity of Oils (FZG Visual Method)

ASTM E 1687 Standard Test Method for Determining Carcinogenic Potential of Virgin Base Oils in Metalworking Fluids

2.1.5 BS Publications

Available from British Standards Institution, Customer Services, 389 Chiswick High Road, London W4 4AL, United Kingdom, Tel: +44-0-20-8996-9001, www.bsi-global.com.

BS 188 Determination of the Viscosity of Liquids

BS 2000:PTA226 Methods of Test for Petroleum and Its Products - Petroleum Products - Calculation of Viscosity Index from Kinematic Viscosity

BS 4231 Classification for Viscosity Grades of Industrial Liquid Lubricants

2.1.6 DIN Publications

Available from Deutsches Institut für Normung e.V., Burggrafenstrasse 6, 10787 Berlin, Germany, www.din.de.

DIN 51 354/2 Mechanical Testing of Lubricants by the FZG Gear Rig Test Method; Method A/8,3/90 for Testing Lubricating Oils

DIN 51 519 Lubricants; ISO Viscosity Classification for Industrial Liquid Lubricants

DIN 51 558/1 Testing of Mineral Oils; Determination of the Neutralization Number, Colour Indicator Titration

DIN 51 561 Testing of Mineral Oils, Liquid Fuels and Related Liquids; Measurement of Viscosity Using the Vogel-Ossag Viscometer; Temperature Range: Approximately 10 to 150-Deg C (CANCELLED)

DIN 51 562/1 Viscometry - Determination of Kinematic Viscosity Using the Ubbelohde Viscometer - Part 1: Apparatus and Measurement Procedure

DIN 51 566 Testing of Lubricants; Determination of Foaming Characteristics (CANCELLED)

DIN 51 569 Determination of Viscosity of Mineral Oils, Liquid Fuels and Related Liquids at Temperatures from -55°C To Approximately 10°C Using the Vogel-Ossag Viscometer

DIN 51 585 Testing Of Lubricants; Testing Of Corrosion Protection Properties Of Steam Turbine Oils And Hydraulic Oils Containing Additives

DIN 51 757 Testing of Mineral Oils and Related Materials; Determination of Density

DIN 51 759/1 Testing of Liquid Mineral Oil Products; Method of Test for Copper Corrosion; Copper Strip Test (SUPERSEDED BY ISO 2160)

DIN 53 505 Testing of Rubber, Elastomers, And Plastics; Shore Hardness Testing A And D

DIN 53 521 Determination of the Behaviour of Rubber and Elastomers when Exposed to Fluids and Vapours

DIN 53 538/1 Standard Reference Elastomers; Acrylonitrile-Butadiene Rubber (NBR); Peroxide-Cured, For Characterizing Service Fluids With Respect To Their Action On NBR

DIN 53 538/2 Standard Reference Elastomers; Acrylonitrile Butadiene Rubber (NBR) With Low Acrylonitrile Content for Characterizing Test Liquids and Greases Bases on Mineral Oil

2.1.7 EPA Publications

Standard test methods of the U.S. Environmental Protection Agency. SW-846 Methods are available on-line (Website: <http://www.epa.gov/epaoswer/hazwaste/test/8xxx.htm>). Method 24 available in the Code of Federal Regulations in 40 CFR, Part 60, Appendix A).

EPA SW 846, Method 8082 Polychlorinated Biphenyls (PCB's) By Gas Chromatography

EPA SW 846, Method 8121 Chlorinated Hydrocarbons By Gas Chromatography: Capillary Column Technique

EPA SW 846, Method 8270C Semivolatile Organic Compounds By Gas Chromatography/Mass Spectrometry

2.1.8 IP Publications

Available from http://www.intertek-cb.com/news/IP_Methods.shtml. Europe +44 1708.680.248, North America 713.844.3263, Asia Pacific: +65 6322 8228.

IP 15 Petroleum Products - Determination of Pour Point

IP 19 Determination of Demulsibility Characteristics of Lubricating Oil

IP 36 Determination of Open Flash and Fire Point - Cleveland Method

IP 71(Sect. 1) Petroleum Products - Transparent and Opaque Liquids - Determination of Kinematic Viscosity and Calculation of Dynamic Viscosity

IP 135 Determination of Rust-Preventing Characteristics of Steam Turbine Oil In The Presence Of Water

IP 139 Petroleum Products and Lubricants - Determination of Acid or Base Number - Colour-Indicator Titration Method

IP 146 Determination of Foaming Characteristics of Lubricating Oils

IP 154 Petroleum Products - Corrosiveness to Copper - Copper Strip Test

IP 160 Determination of Density - Hydrometer Method

IP 166 Determination of Load-Carrying Capacity of Lubricants - IAE Gear Machine Method

IP 177 Test Method for Acid Number by Potentiometric Titration

IP 226 Petroleum Products - Calculation of Viscosity Index from Kinematic Viscosity

IP 240 Determination of Extreme-Pressure Properties of Lubricating Fluids (Timken Method)

IP 278 Determination of Seal Compatibility Index of Petroleum Oils

IP 334 Determination of Load Carrying Capacity of Lubricants - FZG Gear Machine Method

2.1.9 ISO Publications

Available from American National Standards Institute, 25 West 43rd Street, New York, NY 10036-8002, Tel: 212-642-4900, www.ansi.org.

ISO 868	Plastics and ebonite - Determination of indentation hardness by means of a durometer (Shore hardness)
ISO 1817	Rubber vulcanized - Determination of the effect of liquids
ISO 2160	Petroleum products - Corrosiveness to copper - Copper strip test
ISO 2592	Petroleum products - Determination of flash and fire points - Cleveland open cup method
ISO 2909	Petroleum products - Calculation of viscosity index from kinematic viscosity
ISO 3016	Petroleum products - Determination of pour point
ISO 3104	Petroleum products - Transparent and opaque liquids - Determination of kinematic viscosity and calculation of dynamic viscosity
ISO 3448	Industrial liquid lubricants - ISO viscosity classification
ISO 3675	Crude petroleum and liquid petroleum products - Laboratory determination of density or relative density - Hydrometer method
ISO 4406	Hydraulic fluid power - Fluids - Method for coding level of contamination by solid particles
ISO 6072	Hydraulic fluid power - Compatibility between elastomeric materials and fluids
ISO 6247	Petroleum products - Lubricating oils - Determination of foaming characteristics
ISO 6618	Petroleum products and lubricants - Determination of acid or base number - Colour-indicator titration method
ISO 6743/0	Lubricants, industrial oils and related products (Class L) - Classification - General
ISO 6743/9	Lubricants, industrial oils and related products (Class L) - Classification - Family X (Greases)
ISO 7120	Petroleum products and lubricants - Petroleum oils and other fluids - Determination of rust - Preventing characteristics in the presence of water
ISO 7619	Rubber - Determination of indentation hardness by means of pocket hardness meters

2.2 Related Publications

The following publications are provided for information purposes only and are not a required part of this SAE Technical Report.

2.2.1 ASTM Publications

Available from ILI as referenced in 2.1.1.

ASTM D 4927 Test Method for Elemental Analysis of Lubricant & Additive Components - Barium, Calcium, Phosphorus, Sulfur & Zinc by Wavelength-Dispersive X-Ray Fluorescence Spectroscopy

ASTM D 4951 Test Method for the Determination Of Additive Elements In Lubricating Oils by Inductively Coupled Plasma Atomic Emission Spectrometry

2.2.2 BS Publication

Available from ILI as referenced in 2.1.1.

BS 903: PTA 35 Physical Testing of Rubber - Temperatures, Humidities and Times for Conditioning and Testing of Test Pieces

3. CONCEPT

The lubricants defined by this specification are high quality products of types CKB, CKC, and CKE containing anti-corrosion, anti-wear, rust and oxidation stability additives. They are intended for the lubrication of open and enclosed gears and worm gear drives with bronze components.

Properties for Types CKD, CKS, CKT, CKG, CKH, CKJ, CKL, and CKM are not addressed in this document.

4. REQUIREMENTS AND TESTING

See Table 2.

Also reference ANSI/AGMA 9005-D94 - Industrial Gear Lubrication

Type C lubricating oils shall be compatible with all materials normally encountered, including elastomer seals, coatings, metallic and non-metallic components, etc.

TABLE 2 - TYPE C (GEARS)

Property Type of Lubricating Oil	Requirements CKC	Requirements CKE	Testing as specified in ISO	Technical Equivalent Standards DIN	Technical Equivalent Standards ASTM	Technical Equivalent Standards IP/BS
Base Oil Specification:						
Paraffinic, Naphthenic, Aromatic Content	Report	Report			D 3238 D 2140	EPA SW-846 TN 8270C EPA SW-846 TN 8082 EPA SW-846 TN 8121
Total PNA, ppm	100 Max.	100 Max.				
Total PCB, ppm	Not Detectable	Not Detectable				
Total Organic Halogens, ppm	Not Detectable	Not Detectable			E 1687	
Ames Mutagenicity: Fold Increase Mutagenicity Index Mutagen Potency Index	Report 1 Max Report	Report 1 Max Report				
Gear rig test by the FZG method: minimum passing power stage. (At test conditions as stated in ASTM D 5182).	11 min.	12 min.		51 354 Part 2	D 5182	IP 334 IP 166
Tinken OK load, kg	≥ 20	≥ 27				IP 240
Four ball wear test (20 kg load) wear scar diameter, mm	≤ 0.45	≤ 0.35			D 2782 D 4172	
Foam Volume, in ml. Seq. I Seq. II Seq. III per ASTM D 892	≤ 50/0 ≤ 50/0 ≤ 50/0	≤ 50/0 ≤ 50/0 ≤ 50/0	6247	51 566	D 892	IP 146
Thermal stability Comparative IR Scan Acid Number Change Viscosity Change Sludge, mg/ 100 ml Copper rod color (Cinn. Mil.) Copper weight loss, mg Steel rod color (Cinn. Mil.)	Report ≤ 0.15 ≤ 5% ≤ 25 ≤ 5 ≤ 10 1 max.	Report ≤ 0.15 ≤ 5% ≤ 25 ≤ 5 ≤ 10 1 max.			D 2070 (except 75 ml oil, 101 °C, 72 h)	
Oxidation stability (EP oils) Viscosity increase at 100 °C Precipitation number Comparative IR scan	NA	≤ 6% (12% for ISO 680) ≤ 0.1 Report			D 2893	
Demulsibility Water in oil after 5 h Emulsion after centrifuge Total free water	≤ 1% ≤ 2 ml ≥ 60 ml	NA			D 2711	IP 19

TABLE 2 - TYPE C (GEARS) (CONTINUED)

Property Type of Lubricating Oil	Requirements CKB	Requirements CKC	Requirements CKE	Testing as specified in ISO	Technical Equivalent Standards DIN	Technical Equivalent Standards ASTM	Technical Equivalent Standards IP/BS
Corrosive effect on steel	Not exceeding degree of corrosion ISO 7120 - 0 - A	Not exceeding degree of corrosion ISO 7120 - 0 - A	Not exceeding degree of corrosion ISO 7120 - 0 - A	7120	51 585	D 665B	IP 135
Corrosive effect on copper 3 hours at 100 °C	Not exceeding degree of corrosion 1B; ISO 2160 - 100A3	Not exceeding degree of corrosion 1B; ISO 2160 - 100A3	Not exceeding degree of corrosion 1B; ISO 2160 - 100A3	2160	51 759	D 130	IP 154
ISO viscosity classification	VG 68 < ----- > VG1000	VG 68 < ----- > VG1000	VG 320 <---> VG 1000	3448	51 519	D 2422	BS 4231
Kinematic viscosity in mm ² /s at 40 °C	ISO Grade ± 10%	ISO Grade ± 10%	ISO Grade ± 10%	3104	51 561, 51 562 Part 1; or 51 569	D 445	IP 71 BS 188
Viscosity index	VG 68 through VG 460 ≥ 90 VG 680 ≥ 90 VG 1000 ≥ 84	VG 68 through VG 460 ≥ 90 VG 680 ≥ 90 VG 1000 ≥ 84	VG 68 through VG 460 ≥ 90 VG 680 ≥ 90 VG 1000 ≥ 84	2909		D 2270	IP 226 BS 2000; PTA226
Pour Point, °C	VG 68 to VG 150 ≤ -15 VG 220 to VG 320 ≤ -10 VG 460 to VG 1000 ≤ 0	VG 68 to VG 150 ≤ -15 VG 220 to VG 320 ≤ -10 VG 460 to VG 1000 ≤ 0	VG 68 to VG 150 ≤ -15 VG 220 to VG 320 ≤ -10 VG 460 to VG 1000 ≤ 0	3016		D 97	IP 15
Flash Point, °C	VG 68 to VG 150 ≥ 190 VG 220 to VG 320 ≥ 200 VG 460 to VG 1000 ≥ 210	VG 68 to VG 150 ≥ 190 VG 220 to VG 320 ≥ 200 VG 460 to VG 1000 ≥ 210	VG 68 to VG 150 ≥ 190 VG 220 to VG 320 ≥ 200 VG 460 to VG 1000 ≥ 210	2592		D 92	IP 36
Level of contamination by solid particles, max. ⁽¹⁾	20/18/14	20/18/14	20/18/14	4406			
Neutralization number (acid or alkaline), in mg KOH/g	Report	Report	Report	6618	51 558 Part 1	D 664 D 974	IP 139 IP 177
Density at 15 °C in g/mL	Report	Report	Report	3675	51 757	D 1298 D 4052	IP 160
Behavior towards the SRE-NBR 1 sealant or others as agreed upon sealant ¹				1817 6072	53 521	D 471	IP 278
Relative change % in volume ⁽²⁾	-10 to 10	-10 to 10	-10 to 10				
Change in Shore A Hardness	-7 to 10	-7 to 10	-7 to 10	1817 868 7619	53 521 in conjunction with 53 505	D 471	