
**Lubricants, industrial oils and
related products (Class L) — Family D
(compressors) —**

**Part 3:
Specifications of categories DRA,
DRB, DRC, DRD, DRE, DRF and
DRG (lubricants for refrigerating
compressors)**

*Lubrifiants, huiles industrielles et produits connexes (classe L) —
Famille D (compresseurs) —*

*Partie 3: Spécifications pour les catégories DRA, DRB, DRC, DRD, DRE,
DRF et DRG (lubrifiants pour compresseurs frigorifiques)*



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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 28, *Petroleum and related products, fuels and lubricants from natural or synthetic sources*, Subcommittee SC 4, *Classifications and specifications*.

A list of all parts in the ISO 6521 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

Lubricants for refrigerating compressors are used in a large variety of environments, mainly with respect to the refrigerant used. This document covers the lubricants used in refrigerating compressors, in which the lubricant is in contact with the refrigerant that is compressed.

There is a distinction between lubricants that are miscible and those that are not miscible in the refrigerant.

The lubricants for these applications can vary in composition, from straight mineral oils to more complex blends, based on mineral oils, synthetic oils (e.g. poly α -olefins, esters, poly-glycols), and additives.

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Lubricants, industrial oils and related products (Class L) — Family D (compressors) —

Part 3:

Specifications of categories DRA, DRB, DRC, DRD, DRE, DRF and DRG (lubricants for refrigerating compressors)

1 Scope

This document specifies the minimum requirements for mineral or synthetic based lubricants intended for use in all types of refrigerating compressors.

NOTE This document can be read in conjunction with ISO 6743-3.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 2592, *Petroleum and related products — Determination of flash and fire points — Cleveland open cup method*

ISO 2719, *Determination of flash point — Pensky-Martens closed cup method*

ISO 2909, *Petroleum products — Calculation of viscosity index from kinematic viscosity*

ISO 3016, *Petroleum and related products from natural or synthetic sources — Determination of pour point*

ISO 3104, *Petroleum products — Transparent and opaque liquids — Determination of kinematic viscosity and calculation of dynamic viscosity*

ISO 3170, *Petroleum liquids — Manual sampling*

ISO 3448, *Industrial liquid lubricants — ISO viscosity classification*

ISO 3675, *Crude petroleum and liquid petroleum products — Laboratory determination of density — Hydrometer method*

ISO 3771, *Petroleum products — Determination of base number — Perchloric acid potentiometric titration method*

ISO 6245, *Petroleum products — Determination of ash*

ISO 6296, *Petroleum products — Determination of water — Potentiometric Karl Fischer titration method*

ISO 6618, *Petroleum products and lubricants — Determination of acid or base number — Colour-indicator titration method*

ISO 6619, *Petroleum products and lubricants — Neutralization number — Potentiometric titration method*

ISO 6743-3, *Lubricants, industrial oils and related products (class L) — Classification — Part 3: Family D (Compressors)*

ISO 12185, *Crude petroleum and petroleum products — Determination of density — Oscillating U-tube method*

ISO 12937, *Petroleum products — Determination of water — Coulometric Karl Fischer titration method*

ISO 20764, *Petroleum and related products — Preparation of a test portion of high-boiling liquids for the determination of water content — Nitrogen purge method*

DIN 51538, *Testing of lubricants — Testing of resistance of refrigerator oils to ammonia*

3 Terms and definitions

No terms and definitions are listed in this document.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <http://www.electropedia.org/>

4 Sampling

Sampling of compressor oils for the purpose of this document, unless otherwise specified, shall be carried out in accordance with the relevant procedure described in ISO 3170. The sample shall be evaluated on a representative portion. Any drum, barrel, tanker compartment or any type of container delivered to the end user may be sampled and analysed, at the discretion of the purchaser.

5 Requirements for oils operating in refrigerating compressors

5.1 General

The lubricant chosen for a refrigerating system shall be

- suitable to effectively lubricate the mechanical parts of the compressor, and
- compatible with the refrigerant.

The compatibility covers the following aspects:

- chemical compatibility at high temperatures;
- miscibility and solubility characteristics.

Additionally, the lubricant should be as dry as possible.

5.2 Compatibility with the refrigerant

The compression of the refrigerant warms up not only the refrigerant itself, but also the oil. The final compression temperature might increase, leading to thermal stress for the oil. At these temperatures, the lubricant should not chemically react with the refrigerant.

5.3 Miscibility with the refrigerant

This characteristic is important at the evaporator level of the refrigerating circuit. The lubricant carried over from the compressor into the evaporator shall be sufficiently miscible with the refrigerant at the evaporator temperature so that the mixture of oil and refrigerant stays monophasic after expansion in the evaporator. If the lubricant separates in the evaporator due to poor miscibility with the refrigerant, fluid may get trapped in the evaporator, leading to loss of cooling capacity/efficiency and insufficient oil

return to the compressor. Miscibility curves are established for oil/refrigerant pairs; they are used to ensure that the selected lubricant matches the solubility requirements for the application.

5.4 Solubility with the refrigerant

This characteristic is important to ensure that the lubricant having absorbed the gaseous refrigerant under the temperature/pressure conditions at the compressor keeps sufficient viscosity to correctly lubricate the compressor. Viscosity/Pressure/Temperature (VPT) diagrams are established for the various oil/refrigerant combinations. The oil/refrigerant mixture viscosity should match the compressor manufacturer requirement.

5.5 Water content

The specified values are maximum permissible values for fresh oils. The water contents specified depend on the chemical nature of the lubricating oil; polyalkylene glycols are much more hygroscopic than polyol esters, themselves more than hydrocarbon type oils.

Refrigerating oils are normally delivered in gas-tight metal packages, designed to avoid any moisture ingress, even after long periods of storage. Partly used containers should be always resealed and used as rapidly as possible. Good handling and storage practices are of utmost importance.

Before filling a compressor, the lubricant should be dried and degassed under vacuum.

6 Specifications

6.1 General

All categories mentioned below are defined in accordance with ISO 6743-3. All Specification tables are available in [Annex A](#).

6.2 Specifications for ISO-L-DRA refrigerating compressor oils

ISO - L - DRA are refrigerating compressor oils that are not miscible with ammonia (R717 refrigerant). ISO - L - DRA are typically highly refined mineral oils, naphthenic or paraffinic, poly α -olefins or alkyl benzenes.

These lubricants shall be in accordance with specifications given in [Table A.1](#).

6.3 Specifications for ISO-L-DRB refrigerating compressor oils

ISO - L - DRB are refrigerating compressor oils that are miscible with ammonia (R717 refrigerant).

ISO - L - DRB are typically polyalkylene glycols.

These lubricants shall be in accordance with specifications given in [Table A.2](#).

6.4 Specifications for ISO-L-DRC refrigerating compressor oils

ISO - L - DRC are refrigerating compressor oils that are not miscible with hydrofluorocarbons.

ISO - L - DRC are typically highly refined mineral oils, naphthenic or paraffinic, poly α -olefins or alkyl benzenes.

These lubricants shall be in accordance with specifications given in [Table A.3](#).

6.5 Specifications for ISO-L-DRD refrigerating compressor oils

ISO - L - DRD are refrigerating compressor oils that are miscible with hydrofluorocarbons (HFC).

ISO - L - DRD are typically polyol esters, poly-vinyl ethers, polyalkylene glycols.

These lubricants shall be in accordance with specifications given in [Table A.4](#).

6.6 Specifications for ISO-L-DRE refrigerating compressor oils

ISO - L - DRE are refrigerating compressor oils that are miscible with chlorofluorocarbons (CFC) and hydrochlorofuorocarbons (HCFC). ISO - L - DRE are typically highly refined mineral oils, naphthenic or paraffinic, poly α -olefins, alkyl benzenes, polyol esters, polyvinyl ethers.

These lubricants shall be in accordance with specifications given in [Table A.5](#).

6.7 Specifications for ISO-L-DRF refrigerating compressor oils

ISO - L - DRF are refrigerating compressor oils that are miscible with carbon dioxide (R744 refrigerant). ISO - L - DRF are typically highly refined mineral oils, naphthenic or paraffinic, alkyl benzenes, polyalkylene glycols, polyol esters, polyvinyl ethers.

These lubricants shall be in accordance with specifications given in [Table A.6](#).

6.8 Specifications for ISO-L-DRG refrigerating compressor oils

ISO - L - DRG are refrigerating compressor oils that are miscible with hydrocarbon type refrigerants (R600 series). ISO - L - DRG are typically highly refined mineral oils, naphthenic or paraffinic, poly α -olefins, alkyl benzenes, polyalkylene glycols, polyol esters, polyvinyl ethers.

These lubricants shall be in accordance with specifications given in [Table A.7](#).

6.9 Additional data

Upon request of the end user, the data shown in [Table 1](#) for refrigerating compressor oils should be made available from the supplier.

Table 1 — Additional data

Property	Unit	Test method
Colour	rating	ISO 2049 ^[1]
Flock point (in presence of the considered refrigerant)	°C	DIN 51351 ^[4]
Copper corrosion (3 h, 100 °C)	rating	ISO 2160 ^[2]
Dielectric strength	kV	IEC 60156 ^[3]
Miscibility curves with the refrigerant		DIN 51514 ^[5]
PVT Diagram (Daniel Plots) (Kinematic viscosity of the oil/ refrigerant mixture as a function of temperature and pressure for an oil content between 70 % and 100 % m/m)		
ASHRAE Sealed Glass Tube Method to Test the Chemical Stability of Materials for Use Within Refrigerant Systems — (oil/refrigerant mixtures in presence of metal catalysts -Cu, Fe, Al, for two weeks at 175 °C)	rating	ANSI/ASHRAE Standard 97-2007 ^[6]
Mechanical properties in presence of the refrigerant		Test methods and conditions need to be agreed between the end user and the supplier.

Annex A
(normative)

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Table A.1 — Specifications of ISO-L-DRA refrigerating compressor oils
(Ammonia refrigerating compressor oils, not miscible with ammonia)

Property	Test method	Unit	Requirements for ISO-L-DRA oils				
			22	32	46	68	100
Viscosity grade	ISO 3448		22	32	46	68	100
Kinematic viscosity at 40 °C	min.	mm ² /s	19,8	28,8	41,4	61,2	90
	max.	mm ² /s	24,2	35,2	50,6	74,8	110
Kinematic viscosity at 100 °C	ISO 3104	mm ² /s	Report				
Viscosity index	ISO 2909		Report				
Appearance	Visual	rating	Bright and clear				
Density	ISO 12185 or ISO 3675	kg/m ³	Report				
Pour point (max.)	ISO 3016	°C	-30	-24	-21	-15	-9
Flash point (min.) (open cup)	ISO 2592	°C	150	160	160	170	170
Flash point (min.) (closed cup)	ISO 2719	°C	140	150	150	160	160
Neutralization number (max.)	ISO 6618 or ISO 6619	mg KOH/g	0,08				
Total base number	ISO 3771	mg KOH/g	Report				
Ash content (max.)	ISO 6245	% m/m	0,01				
Water content ^a (max.)	ISO 6296 or ISO 12937	mg/kg	50 ^{b,d} 80 ^{c,d}				
Testing of lubricants for refrigeration compressors for resistance to ammonia	DIN 51538		Report the total base number (ISO 3771) increase after 168 h at 120 °C				

^a In case of dispute, use ISO 20764.

^b Valid for mineral oil and poly α-olefin type lubricants in gas tight metal container, at delivery stage.

^c Valid for alkyl benzene type lubricants in gas tight metal container, at delivery stage.

^d In containers other than gas tight containers, limit shall be discussed between the end user and the supplier.



Table A.2 — Specifications of ISO-L-DRB refrigerating compressor oils
(Ammonia refrigerating compressor oils, miscible with ammonia)

Property	Test method	Unit	Requirements for ISO-L-DRB oils		
Viscosity grade	ISO 3448		46	68	100
Kinematic viscosity at 40 °C	min.	mm ² /s	41,4	61,2	90
	max.	mm ² /s	50,6	74,8	110
Kinematic viscosity at 100 °C	ISO 3104	mm ² /s	Report		
Viscosity index	ISO 2909		Report		
Appearance	Visual	rating	Report		
Pour point (max.)	ISO 3016	°C	-21	-15	-9
Density	ISO 12185 or ISO 3675	kg/m ³	Report		
Flash point (min.) (open cup)	ISO 2592	°C	160	170	170
Flash point (min.) (closed cup)	ISO 2719	°C	150	160	160
Neutralization number (max.)	ISO 6618 or ISO 6619	mg KOH/g	Report		
Total base number	ISO 3771	mg KOH/g	Report		
Ash content (max.)	ISO 6245	% m/m	Report		
Water content ^a (max.)	ISO 6296 or ISO 12937	mg/kg	350 ^{b,c}		
Testing of lubricants for refrigeration compressors for resistance to ammonia	DIN 51538		Report the total base number (ISO 3771) increase after 168 h at 120 °C		

^a In case of dispute, use ISO 20764.

^b Valid for products in gas tight metal container, at delivery stage (most often poly glycols).

^c In containers other than gas tight containers, limit shall be discussed between the end user and the supplier.

Table A.4 — Specifications of ISO-L-DRD refrigerating compressor oils
(HFC refrigerating compressor oils, miscible with HFC)

Property	Test method	Unit	Requirements for ISO-L-DRD oils																
			7	10	15	22	32	46	68	100	150	220	320	460					
Viscosity grade	ISO 3448																		
Kinematic viscosity at 40 °C	min.	mm ² /s	6,12	9,0	13,5	19,8	28,8	41,4	61,2	90	135	198	288	414					
	max.	mm ² /s	7,48	11,0	16,5	24,2	35,2	50,6	74,8	100	165	242	352	506					
Kinematic viscosity at 100 °C	ISO 3104	mm ² /s	Report																
Viscosity index	ISO 2909		Report																
Appearance	Visual	rating	Bright and clear																
Density	ISO 12185 or ISO 3675	kg/m ³	Report																
Pour point (max.)	ISO 3016	°C	-39	-39	-39	-39	-39	-39	-39	-39	-39	-39	-39	-39	-39	-39	-39	-39	-39
Flash point (min.) (open cup)	ISO 2592	°C	130	130	150	150	160	160	170	170	170	170	170	210	210	210	210	210	210
Flash point (min.) (closed cup)	ISO 2719	°C	120	120	140	140	150	150	160	160	160	160	160	200	200	200	200	200	200
Acid number	ISO 6618 or ISO 6619	mg KOH/g	Report																
Water content ^a (max.)	ISO 6296 or ISO 12937	mg/kg	100 ^{b, d} 350 ^{c, d}																
Refrigerant miscibility	DIN 51514		Report																

^a In case of dispute, use ISO 20764.

^b Valid for ester type lubricants in gas tight metal container, at delivery stage.

^c Valid for poly-glycol type lubricants in gas tight metal container, at delivery stage.

^d In containers other than gas tight containers, limit shall be discussed between the end user and the supplier.

Table A.5 — Specifications of ISO-L-DRE refrigerating compressor oils (CFC and HCFC refrigerating compressor oils, miscible with CFC and HCFC)

Property	Test method	Unit	Requirements for ISO-L-DRE oils											
			22	32	46	68	100	150	220	320				
Viscosity grade	ISO 3448		22	32	46	68	100	150	220	320				
Kinematic viscosity at 40 °C	min.	mm ² /s	19,8	28,8	41,4	61,2	90	135	198	288				
	max.	mm ² /s	24,2	35,2	50,6	74,8	100	165	242	352				
Kinematic viscosity at 100 °C	ISO 3104	mm ² /s	Report											
Viscosity index	ISO 2909		Report											
Appearance	Visual	rating	Bright and clear											
Density	ISO 12185 or ISO 3675	kg/m ³	Report											
Pour point (max.)	ISO 3016	°C	-30	-24	-21	-18	-9	-9	-9	-9	-9			
Flash point (min.) (open cup)	ISO 2592	°C	150	160	160	170	170	210	210	210				
Flash point (min.) (closed cup)	ISO 2719	°C	140	150	150	160	160	200	200	200				
Ash content (max.)	ISO 6245	% m/m	0,01 ^e											
Acid number (max.)	ISO 6618 or ISO 6619	mg KOH/g	0,02 ^e											
Water content ^a (max.)	ISO 6296 or ISO 12937	mg/kg	30 ^{b, d} 100 ^{c, d}											
Refrigerant miscibility	DIN 51514		Report											

^a In case of dispute, use ISO 20764.

^b Valid for hydrocarbon type oils (e.g. mineral oils, alkyl benzenes) in gas tight metal container, at delivery stage.

^c Valid for ester type oils in gas tight metal container, at delivery stage.

^d In containers other than gas tight containers, limit shall be discussed between the end user and the supplier.

^e Not applicable for products containing additives. For products containing additives, ash content and acid number shall be obtained from the supplier.