LUBRICATION · OIL ISO VG · GREASE NLGI · REGIMES · REFERENCE DOCUMENT · PUBLIC

Lubrication & grease guide

Choosing oil or grease for bearings, gears and slides — lubrication regimes, ISO VG and NLGI grades, thickener types, additives, and compatibility with seals and plastics.

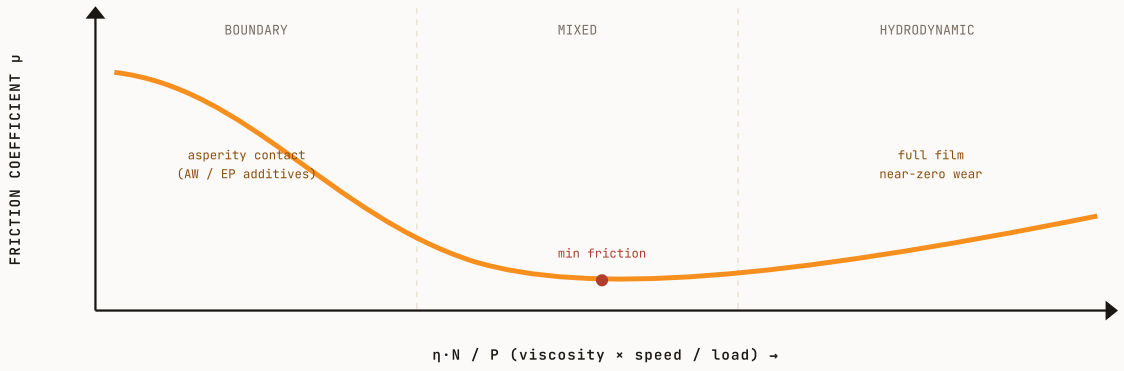
REVISION	ISSUED	OWNER	COMPANION
1.0	June 2026	Ideambox engineering	PDF reference

ABSTRACT

The right lubricant cuts friction and wear, carries heat away, keeps contaminants out and stops corrosion. Choosing it means matching the lubrication regime, the oil viscosity (ISO VG) or grease consistency (NLGI) and thickener, and the additives — while staying compatible with the seals and plastics it touches.

Section 1 covers how lubricants work and the regimes. Section 2 is oil vs grease. Section 3 is oil viscosity (ISO VG). Section 4 is grease (NLGI and thickeners). Section 5 covers additives and special lubricants. Section 6 is a selection and re-lubrication checklist.

STRIBECK CURVE — FRICTION VS. LUBRICATION REGIME



THE STRIBECK CURVE. AS SPEED/VISCOSITY RISES RELATIVE TO LOAD, CONTACT MOVES FROM METAL-TO-METAL (BOUNDARY) THROUGH MIXED TO A FULL FILM (HYDRODYNAMIC). THE LUBRICANT'S JOB IS TO KEEP YOU OUT OF THE HIGH-WEAR BOUNDARY REGION.

CONTENTS

1. How lubricants work — the regimes

A lubricant separates surfaces with a film. How complete that film is defines the **lubrication regime** (the Stribeck curve), and it drives friction and wear:

REGIME	FILM	FRICTION & WEAR	WHERE
Boundary	none — asperities touch	high friction, high wear	start/stop, low speed, high load
Mixed	partial film	moderate	transition speeds
Elastohydrodynamic (EHL)	thin film in concentrated contacts	low	rolling bearings, gears
Hydrodynamic	full film, surfaces separated	lowest friction, ~no wear	journal bearings at speed

The goal is to run in EHL/hydrodynamic and survive the boundary phase at start-up — which is what anti-wear (AW) and extreme-pressure (EP) additives are for.

`Viscosity`	A fluid's resistance to flow — the single most important oil property
`ISO VG`	Viscosity grade = kinematic viscosity in cSt at 40 °C (VG 46 ≈ 46 cSt)
`NLGI`	Grease consistency grade (000 fluid → 6 block); NLGI 2 is the default
`Dropping point`	Temperature at which a grease starts to liquefy — stay well below it
`Base oil`	The grease's "working fluid"; its viscosity matters as much as the thickener

2. Oil vs grease

- **Grease (≈ oil + thickener + additives) stays in place, seals out contaminants, and needs no circulation**
  ideal for sealed-for-life bearings, slow/intermittent motion, and inaccessible points. Limited cooling; can churn at high speed.
- **Oil cools and cleans (it carries heat and debris away), suits high speed and high temperature, and is easy to filter and change**
  but needs a sump, seals or a circulation system.

Default to **grease** for most rolling bearings and slides; choose **oil** for high speed, high heat, or where the oil must also cool (gearboxes, engines).

3. Oil viscosity (ISO VG)

Pick viscosity so the film survives at the operating temperature: **higher load or temperature → higher VG; higher speed → lower VG** (less churning/drag). Industrial oils use ISO VG (cSt at 40 °C):

ISO VG	TYPICAL USE
32	Hydraulics, high-speed spindles
46	Hydraulics, general bearings
68	Bearings, light gearing
100–150	Gearboxes
220–320	Heavy / slow gears, worm drives

(Engine oils use the SAE grades, e.g. 5W-30; the "W" number is cold-flow, the second is hot viscosity.)

4. Grease — NLGI and thickeners

Two choices: **consistency (NLGI)** and **thickener + base-oil**.

NLGI GRADE	CONSISTENCY	USE
000 / 00	fluid / semi-fluid	gearboxes, centralised systems
0 / 1	soft	low temperature, centralised lube
2	"normal"	most rolling bearings — the default
3	stiff	high speed, vertical shafts, sealing
4–6	block	special applications

THICKENER	MAX TEMP	WATER RESISTANCE	NOTES
Lithium 12-OH	~120 °C	good	general-purpose default
Lithium complex	~150 °C	good	higher temp, EP versions
Calcium sulfonate	~150 °C+	excellent	inherent EP + corrosion protection
Polyurea	~150 °C	good	long-life sealed bearings (e.g. motors)
PTFE / PFPE	very high	excellent	chemical / extreme temp; expensive
Clay (bentonite)	high (no melt)	moderate	non-melting, but no true dropping point

Match the **base-oil viscosity** to the application just like a straight oil — a stiff grease with thin base oil still under-lubricates a slow, heavy contact. And don't **mix incompatible thickeners** (e.g. lithium with polyurea) — they can soften and run out; purge fully when changing.

5. Additives and special lubricants

- **AW (anti-wear) and EP (extreme-pressure)**
  protect during boundary/shock loading (gears, heavily loaded bearings). EP additives can be corrosive to yellow metals (brass/bronze) — check compatibility.
- **Corrosion / oxidation inhibitors**
  extend life and protect idle parts.
- **Food-grade (NSF H1)**
  for incidental food contact (food, pharma, packaging machinery).
- **Dry-film (PTFE, MoS_2, graphite)**
  where oil/grease can't stay or attracts dirt; vacuum, dusty, or very slow high-load.
- **Plastics / elastomer-safe**
  many oils and EP greases attack plastics and swell elastomers; for plastic gears and seals use a verified plastics-compatible grease (often PTFE-thickened, synthetic base). Always check seal/O-ring compatibility (see the
  O-ring guide
).

6. Selection and re-lubrication checklist

- **Speed**
  high ndm favours oil or NLGI 2/3 with lower base-oil viscosity; low speed favours grease and higher viscosity.
- **Load & shock**
  add AW/EP; raise viscosity/VG.
- **Temperature**
  base-oil viscosity at temp; thickener max temp and dropping point with margin.
- **Environment**
  water (calcium sulfonate), dust (sealing grease or dry film), chemical (PFPE).
- **Compatibility**
  seals, elastomers, plastics, and yellow metals (EP).
- **Special needs**
  food-grade (H1), low-noise (filtered greases for quiet bearings).
- **Re-lube**
  set an interval from speed/temp (it falls fast as both rise); don't over-grease sealed bearings (churning, blown seals).