

The Next-Generation
Integrated Lubrication System

LHL System

Lube Hybrid Lubrication



Keeping machinery running all over the world

An innovation of lubrication technology

Purpose of the LHL system

The LHL system will better protect your critical factory machinery and provide a safer, more hygienic production environment.

Features of the LHL system

The LHL system will precisely deliver the exact amount of lubricant required at a specific time in order to optimize performance of production machinery even under harsh conditions. In addition, the revolutionary lubricant developed for the LHL system helps to provide a cleaner and healthier factory environment. The LHL system is an exciting new solution that increases the value of your production.



CEO **Eijiro Horikoshi**

Eijiro Horikoshi

To help the precision machinery users, machine manufacturers and bearing manufacturers that form our customer base in the 21st century to overcome the global environmental problems they face today. With this in mind, we will continue to consider the relationship between lubrication technologies and our customers' needs. To this end, we aim to continue achieving energy and resource savings through wear reduction, contamination prevention, maintaining bearing performance and stabilizing machine functions, as advocated in tribology.

We are giving careful consideration to the various conditions in which precision machines are used around the world, and continue to verify in-house the convenience, reliability, and

durability of machinery using our LHL lubrication technologies. In doing so, we are able to share our problem awareness with machine users, bearing, and machine manufacturers throughout the world, provide support for their industries, and pro-actively work on solutions together as if we were one team.

We have made it our mission to stick to the origin of value creation. In other words, we are determined to continue responding to the various applications of our worldwide customers and providing solutions that make our customers truly happy, while adhering to continuous improvement of the LHL lubrication equipment and the LHL system concepts.

Benefits of the LHL System

Cost Savings

- The LHL system needs only a fraction of the lubricant quantity compared to oil lubrication systems. The lower lubricant requirement of LHL significantly reduces lubricant costs and lubricant entering the coolant tank. Less lubricant in the coolant tank prevents degradation and hazardous waste disposal, ultimately extending tool life, reducing maintenance costs, and enhancing the machine's life expectancy.
- Unlike conventional lubricating oil, LHL hybrid grease creates and maintains an ideal oil film on your machines' bearing surfaces without being washed away by coolant, thereby substantially extending their life. The extended life of these areas reduces not only maintenance costs, but also machine downtime.
- If the LHL System is adopted throughout an entire facility, inventory management will be streamlined and the need to keep many different kinds of spare parts and lubricants for multiple lubrication systems is eliminated.

Performance Enhancement

- The automated LHL system minimizes labor needed for inspection processes normally associated with conventional manual grease systems. This prevents operator errors that can cause machine downtime or even machine failure.
- Unlike conventional lubricating oil, LHL hybrid grease is only available in cartridges so it is fully protected against external contaminants unlike refilling a conventional pump, resulting in a significant reduction in lubrication system problems.
- Unlike conventional lubricating oil, LHL hybrid grease creates and maintains an ideal oil film thickness on your machines' bearing surfaces without being washed away by coolant. Thus, reducing wear of these critical areas and ensures stable machine performance and improved longevity.

Automation

- The LHL system will require far less refilling labor due to its lower lubricant consumption. This will boost production efficiency by reducing the operator workload and minimizing interruptions.
- Unlike lubricating oil, LHL hybrid grease is not a hazardous material and does not require special management and monitoring of storage quantities, which helps save on storage space.
- The decreased lubricant consumption of LHL systems eliminates the need to run skimmers in the coolant tank. As a result, the coolant lasts longer, make-up coolant requirement is decreased, and your tool life is dramatically increased. Furthermore, the treatment and disposal of tramp oil in the coolant becomes less labor intensive and more cost effective.

Working Environment

- Because the LHL system requires much less lubricant compared to conventional oil lubrication, it helps to prevent coolant degradation and associated odors, therefore LHL contributes to a more pleasant working environment.
- LHL hybrid grease is packaged in convenient, easy to use cartridges, which eliminates the problem of lubricant spills on the floor, therefore LHL contributes to a cleaner and safer working environment.
- Since some machines require a great deal of lubrication, the oil often drips onto the factory floor. Switching to the LHL system resolves this problem, also resulting in a cleaner, and a safer working environment.

Next-generation lubricant significantly reducing friction and wear

- Prevents excess abrasion of high-load bearing Box & V-Way, Gib, and Plain Bearing surfaces
- Forms and maintains a strong oil film on Roller Bearings, Ball Screws, and Linear Rolling Surfaces
- Prevents rust with excellent anti-rust properties; will not emulsify in cutting fluids
- Creates an ideal lubrication effect with a proper lubricant volume at a precisely timed interval

Integrating the Advantages of Oil and Grease

| | | |
|--|---|--|
| Advantages of Oil Liquidity Excellent transport properties No solidification | + | Advantages of Grease High load-carrying capacity Wear resistance Water resistance Excellent oil film Maintenance properties Adherent properties |
|--|---|--|



LHL-X100

Typical Properties of LHL-X100

| | | |
|---|------------|------|
| Appearance | Semi-fluid | |
| Color | Yellow | |
| Worked Penetration | 460 | |
| Drip Point °C | 180 | |
| Copper Corrosion (100 deg°C/ 24h) | Pass* | |
| Evaporation Loss (99deg°C/ 22h) w.t.% | 0.31 | |
| Oil Separation (100deg°C/ 24h) w.t.% | N/A | |
| Oxidation Stability (99deg°C/ 100h) kPa | 5 | |
| Four Ball N & (kgf) | LNL | 1236 |
| | WL | 1569 |
| | N LWI | 480 |
| Thickener | Urea | |
| Base oil viscosity mm ² /s (100°C) | 12.2 | |
| Base oil viscosity index | 97 | |

*No change in color into green or black on copper plate is observed.

LHL resolves oil lubrication problems

The oil lubrication problems which machine tool users are facing

| | | |
|---|---|--|
| <ul style="list-style-type: none"> • Excessive Lubricant Consumption • Lubricant cost • Man-hours of refilling (lost productivity) • Contamination of machines and workshops • Storage and transportation of oil | <ul style="list-style-type: none"> • Excessive lubrication oil getting into cutting oil • Deteriorated cutting fluid • Poor working environment due to foul smell • Diminished tool life expectancy • Frequent replacement and disposal of cutting fluid | <ul style="list-style-type: none"> • Poor oil film retention • Rust and abrasion caused by cutting fluid washing oil away • Non-compatible lubricants causing machinery trouble |
| Reducing lubricant consumption | Preventing the deterioration and decomposition of cutting fluid | Reducing the abrasion of machine parts |

Comments about LHL from machine parts manufacturers

One of the advantages of oil lubrication is its good penetration between wear surfaces. We can expect the same penetration from LHL too, since it has properties similar to oil.

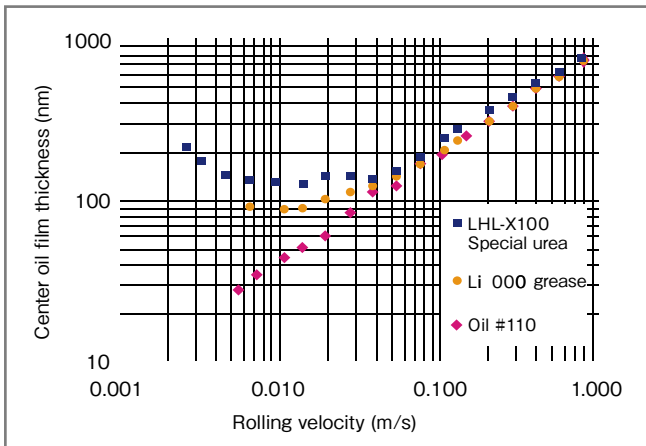
We had problems with mixtures of different types of grease. So, we think the dedicated cartridge for LHL is a great idea.

Depending on the place where parts were attached or their direction, we had oil being washed away, which led to lubrication failures. Naturally, then, water resistance is also important.

Particularly for machines used in environments exposed to water, we have high expectations of LHL's sealing properties, an advantage of grease, and of the water-resistance of urea grease.

LHL-X100 Performance Test Data Ambient Temperature Range -20°C~+120°C

Basic Oil Film Thickness Evaluation Test

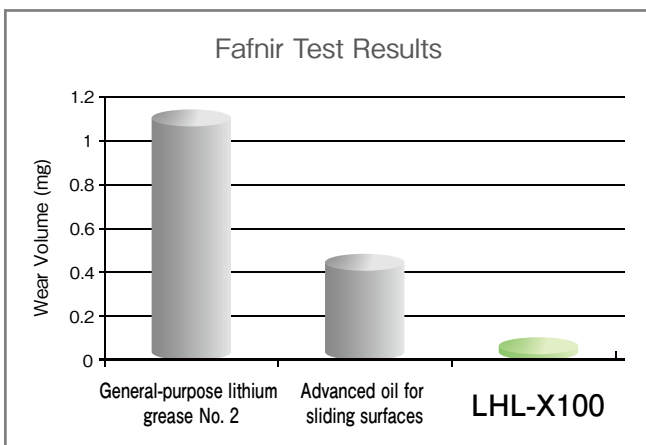


LHL-X100 special urea grease maintains its film thickness at lower speeds than that of oil-soap grease.

Test results on oil film thickness as a basis of lubrication performance shows that the oil film is thinnest when rolling velocity is zero (or closer to zero).

Compared to oil, grease can form thicker oil films. However, LHL X-100 special urea grease can form thicker oil films than lithium grease can, so it prevents insufficient oil films.

Fretting Resistance Test

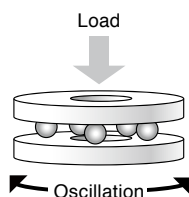


1. Evaluation method

Fafnir test (as per ASTM D 4170)

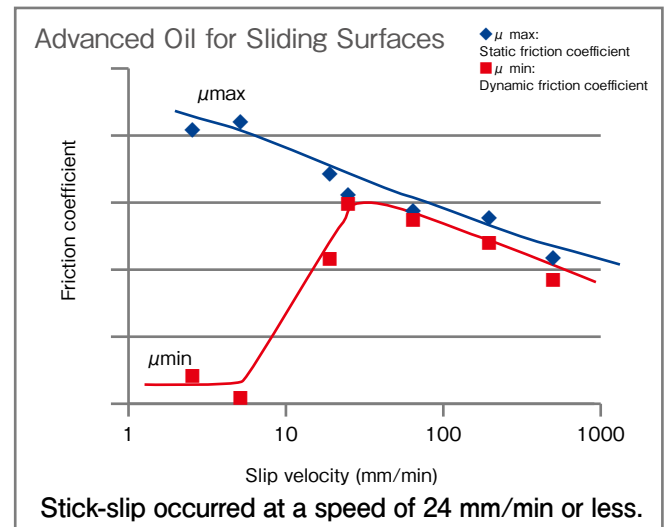
2. Test conditions (ASTM D 4170)

Bearings: ANDREWS W 5/8 (Use 2 sets.)
 Load: 2450 N (Contact pressure: 1861 MPa)
 Angle of oscillation: 12 degrees (Average rolling speed: 0.065 m/s)
 Oscillation cycle: 25 Hz
 Time: 22 hours
 Temperature: 25 degrees C
 Amount of grease per bearing set: 1.0±0.05 g
 Measured amount of wear: Measured amount of wear: Wear of each race way grinder per bearing set is reduced. (Gross mass wear of the test race way grinder is halved.)

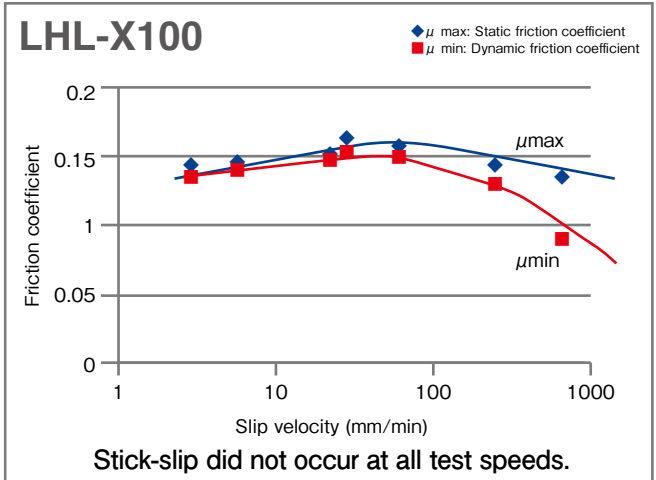


Friction Coefficient Test (Stick-Slip Resistance Performance)

LHL-X100 did not cause stick-slip at all test speeds. Compared to even the most advanced oils for sliding surfaces, LHL forms lubrication films on metallic sliding surfaces successively to avoid metallic contact, even in low-speed areas because of special urea structure and additive.



Stick-slip occurred at a speed of 24 mm/min or less.



Stick-slip did not occur at all test speeds.

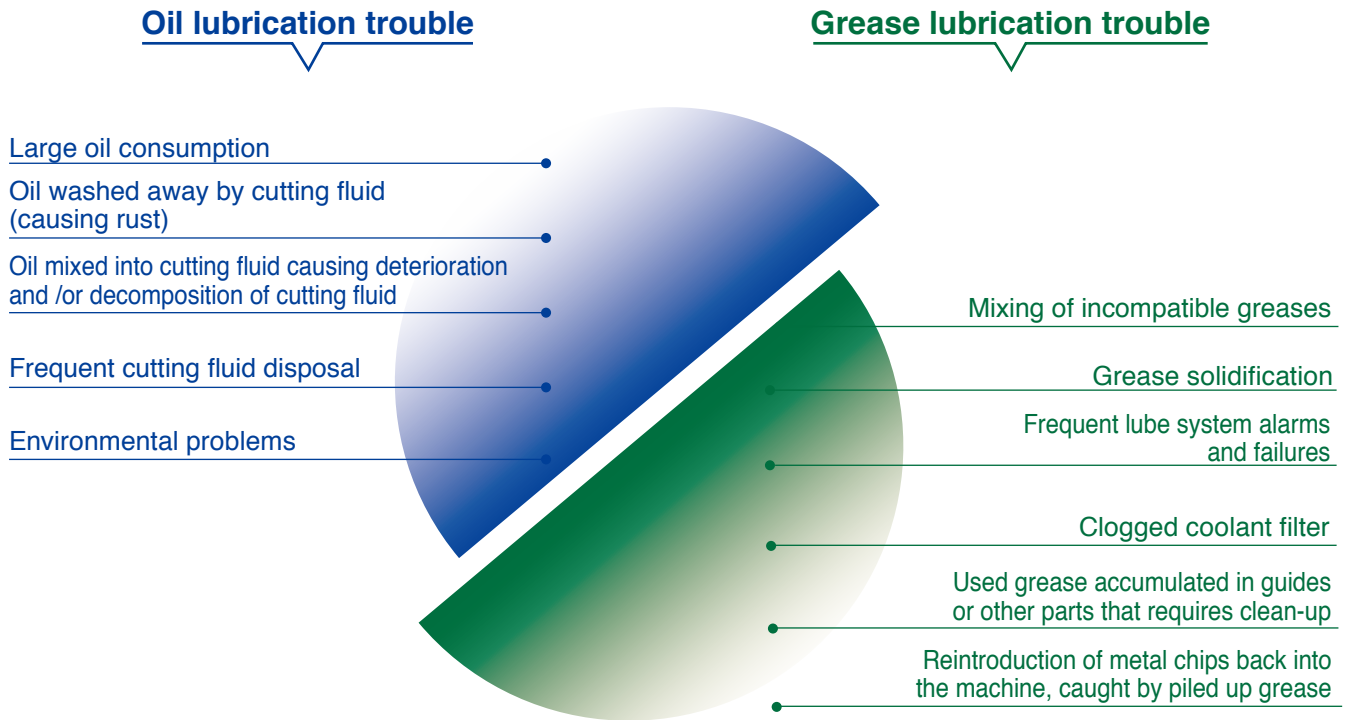
● Test method

1. Tester: Bowden tester
2. Test conditions Material: Steel-Steel Temperature: Room temperature Load: 4 kgf Speed: 3, 6, 24, 30, 60, 240, 600 mm

The Purpose of LHL System Development

Role of the LHL System in Machinery and Equipment Problem Prevention

What are the problems machine tool users are facing?



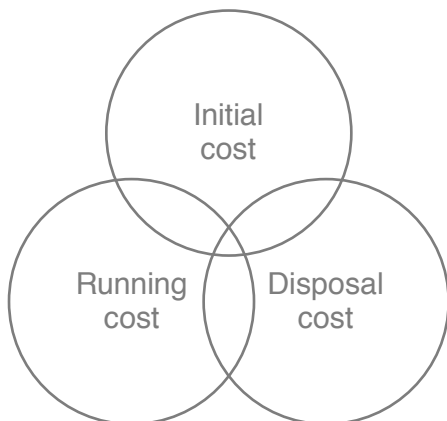
The Relationship Between Maintenance and LHL System

Proactive maintenance generates economical benefits

The purpose of proactive maintenance is to minimize the life cycle cost of machines. It doesn't only mean to ensure the best longevity of the machines, but also to generate economical benefits as we

maintain them. In this sense, a proactive maintenance program is very important.

Lubricant & coolant life cycle cost






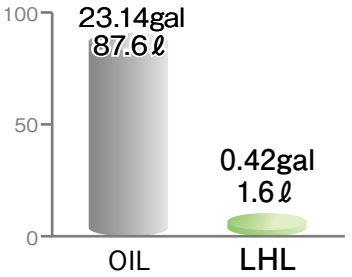
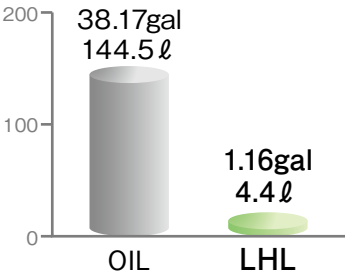
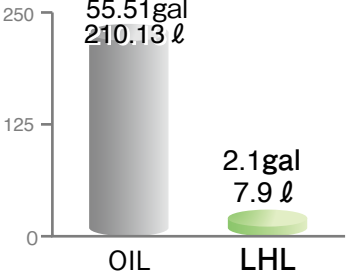
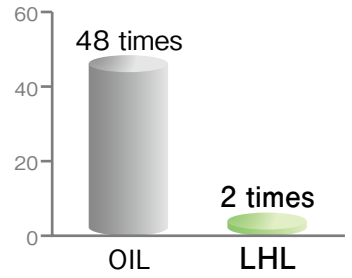
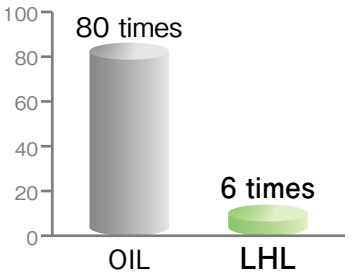
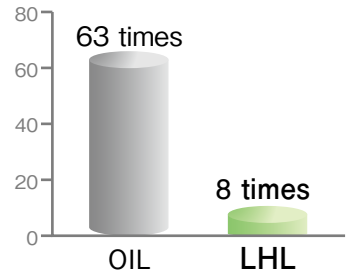
Reduction of life cycle cost

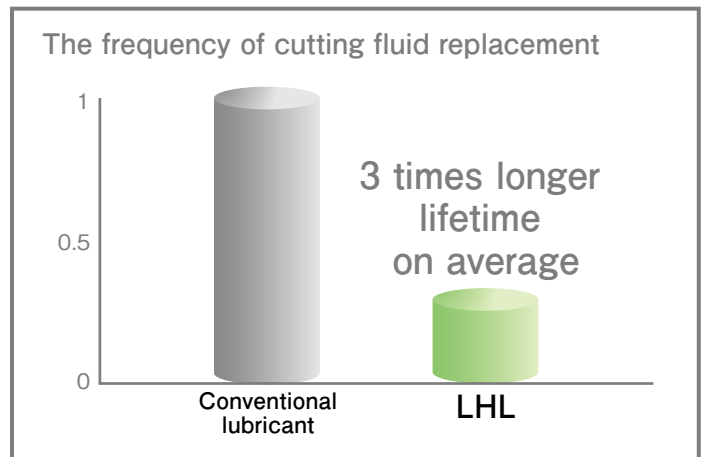
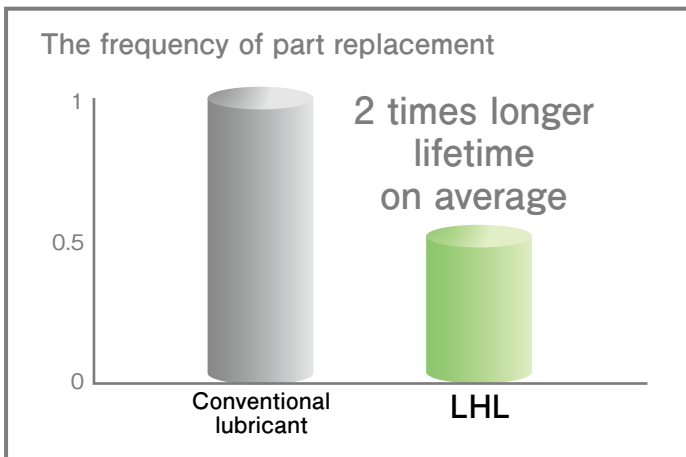


Benefits of LHL System

Production Cost Reduction

Comparison between lubricant consumption and machine tool maintenance costs

| Machining center | VMC-30 | | HMC-40 | | HMC-55 | |
|--|---|--|--|----------|---|----------|
| |  |  |  | | | |
| Lubrication system | Oil | LHL | Oil | LHL | Oil | LHL |
| Number of lubrication points | 23 | | 23 | | 25 | |
| Lubricant | OIL#68 | LHL-X100 | OIL#68 | LHL-X100 | OIL#68 | LHL-X100 |
| Cutting fluid | Water Soluble | | Water Soluble | | Water Soluble | |
| Lubricant consumption/cycle | 2.5ml | 1.45ml | 5.5ml | 2.5ml | 8.8ml | 4.12ml |
| Comparison of annual lubricant consumption |  | |  | |  | |
| Comparison of number of refills per year |  | |  | |  | |



*These comparisons are just examples. Actual results vary depending on machine operating conditions and environments.

*Please contact Lube USA for further details.

Reasons for Adopting the LHL System: Comments by LHL System Users

The reasons why LHL systems are purchased

Work pieces 4%

Auto parts manufacturer: K Company

· The reports from our factory workers say that because almost no LHL gets into the coolant, it produces minimal coolant contamination (it doesn't make the coolant slimy). Very low lubricant content in the coolant enables work pieces to be cut without any oil remaining on their surfaces.

Pipe fixtures manufacturer: S Company

· We have had no problems whatsoever since upgrading to LHL two years ago. Refilling labor has almost been eliminated. Furthermore, no oil sticking to the chips during dry cutting has made it very easy to recycle our waste materials.

Cleanliness of machinery 9%

Farming machinery engine manufacturer: Y Company

· We are located next to a lake and subject to stringent environmental conditions. Properly disposing of waste fluids containing lubricating oil and cutting fluids was a major problem and a costly expense. Since we changed from oil to the LHL system, there has been far less lubricant in the coolant tank and the tramp oil problem has disappeared, which we see as a major environmental benefit as well as a tremendous cost savings.

Motorcycle parts manufacturer: K Company

· Oil spills were an inevitable part of the oil refilling process, but with LHL there are no more spills and the factory is much cleaner as a result.

Auto parts manufacturer: F Company

· Die cast machines require a great deal of lubrication, and oil drips down from the machines onto the floor, making a mess. The LHL system is much cleaner and there are no longer pools of oil on the factory floor any more. It is not only better for the environment, but we also no longer have to worry about the safety of our workers incurring slip and fall injuries due to oil spills.

Coolant life 22%

Motorcycle parts manufacturer: K Company

· The workers are pleased that the coolant tank no longer smells so bad. The LHL system delivers environmental benefits and we are thinking of implementing it on a factory-wide basis as part of our ISO environmental program.

Valve manufacturer: S Company

· Every year at the end of summer the workers would complain about the coolant smell so we would replace it at the start of autumn. Since changing to LHL last year, we have not had any complaints. I am certain that the improvement is due to LHL.

Auto parts manufacturer: J Company

· Without a doubt, there is less dripping from the vertical axis guides with LHL compared to normal oil and the oil film lasts longer, which helps to extend the life of these parts.

· Unlike oil, LHL-X100 does not mix with coolant. Even if it gets into the coolant tank, LHL-X100 simply floats on the coolant surface. Therefore, it can easily be removed to prevent the coolant from becoming sticky. LHL-X100 is not only easier to use than oil, but it also makes the coolant last longer.

Grease solidification 2%

Auto manufacture: S Company

· We no longer have grease solidification issues since switching from a progressive grease system to the LHL system. The progressive system we had been using discharged large quantities of grease, and frequently alarmed for clogging caused grease solidification between blocks. The LHL system produces a better lubrication film using far less lubricant and trouble free operation.

Auto parts manufacturer: T Company

· We have switched to LHL in order to eliminate the grease solidification issues we had. After switching to LHL, we feel much safer as our visual inspections (although limited to parts that can be visually inspected from outside the machine) prove that all parts are properly lubricated. This is a huge improvement.

Lifespan of machine parts 37%

Auto manufacturer: H Company

· Excellent lubricant penetration is observed on LM guides. What we have experienced is that the machine is under considerably less load when moving.

Auto parts manufacturer: M Company (lubrication of sliding surfaces)

· With oil lubrication, the machine had to be re-built every three years, including replacing the Turcite, at a cost of around \$60,000. Since switching over to LHL more than three years ago, we have found that static accuracy remains well within our tolerances and re-building is not yet required. The Turcite is lasting significantly longer than before.

Auto parts manufacturer: S Company

· Although we are too busy to calculate the precise numbers from the repair history, we know that when we were using oil lubricant, the ball screws and support bearings on the lower toolpost failed on a regular basis. We have been upgrading to LHL regularly. The first upgraded machines are now more than three years old, and there is no doubt that we are experiencing far fewer failures thanks to LHL.

Using less lubricant 26%

Engine parts manufacturer: N Company (lubricating box ways)

· The LHL system uses less lubricant and requires less refilling labor compared to oil lubrication, thereby dramatically reducing contamination of water-soluble coolant and making it easier to clean the coolant tank when replacing the coolant.

Industrial electric machinery manufacturer: H Company

· The LHL system is more than just a cost-effective solution. We appreciate the regular visits by your representatives and the fact that only three LHL cartridge replacements are required per machine per year, exactly as stated in your cost-benefit document. Everyone in our plant is asking for LHL upgrades.

Industrial plastic parts manufacturer: S Company

· Conventional oil lubrication systems require frequent refilling work. Some machines have lubrication pumps installed in hard-to-reach locations, which makes refilling even harder. The LHL system offers an easy way of refilling and our people love it.

LHL Major Clients

■ AISIN SEIKI ■ KOYO MACHINE INDUSTRIES ■ CITIZEN SEIMITSU ■ JATCO ■ TAIYO KOKI ■ TSUGAMI ■ DENSO
 ■ TOSHIBA MACHINE ■ TOYOTA ■ HINO MOTORS ■ FANUC ■ SUBARU ■ BROTHER ■ HOWA MACHINERY
 ■ HONDA ■ MAKINO ■ MITSUBISHI HEAVY INDUSTRIES ■ MINEBEA ■ MURATEC ■ MORI SEIKI ■ UD TRUCKS
 ■ MAZAK ■ NORGREN ■ CAMPBELL GRINDER ■ ENTEGRIS ■ PHOENIX MANUFACTURING ■ GOODRICH
 ■ GE AVIATION ■ SAUER DANFOSS ■ IMTW ■ DYNOMAX ■ PARKER HANNIFIN ■ OPTIPRO ■ EMCO GEARS
 ■ CATERPILLAR ■ NIIGATA ■ BELMONT ■ SMITH & WESSON ■ JTEKT AUTOMOTIVE ■ COLT DEFENSE

✳LHL systems have also been installed on many die-cast machines with successful results.

LHL System Products

S Series LHL Specialized Pump for LHL

Developed based on our 50-year history of successes and failures



P-102

P-107

Specifications

- Power: DC24V
- Power consumption: 24W
- Discharging pressure: 5MPa/8MPa
- Discharging time : No restriction
- Interval time : More than 10 seconds
- Wiring method: Terminal connection
- Manual override switch: Optional
- Grease level switch: Yes
- Cover: Non combustible plastic (UL94-V0)
- Protection class: IP54
- CE approval: Yes
- Pump air bleeding: No restriction

■ Blue Color Variant



P-102

P-107

■ Battery Operated Variant for Special Applications*



BT-102

* Contact Lube USA for more information.

■ Examples of the Installation on Machine Tools



Specialized metering valves for LHL¹

Positive Displacement valve with straight thread and push-to-connect fitting offer easier tail tubing connection and installation into junctions.



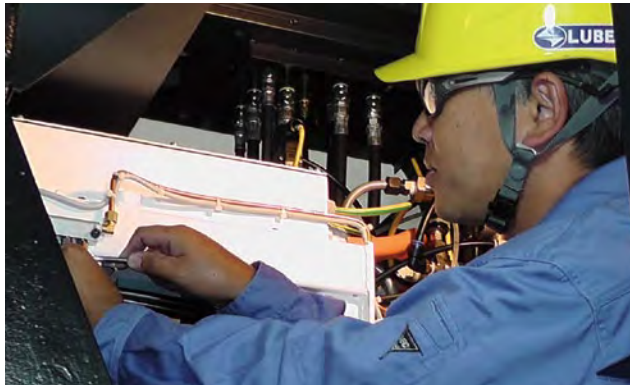
- ①②③ S series Model: MU
- ④⑤ S series Model: MDP
- ⑥⑦ Junction for MU metering valve

¹Other specialized pumps and valves are available depending on the machine application. Contact Lube USA for more information.

LHL System Service

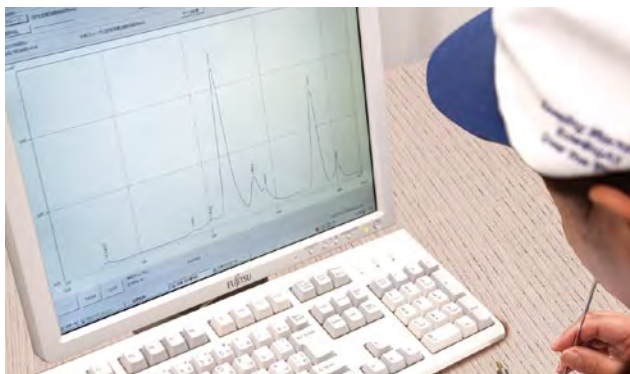
Installation on production machines

You can install the LHL system on any production machine currently operating anywhere in the world.



Diagnostic analysis for machine life extension

LRA analysis (fluorescent X-ray analysis) enables real-time analysis of wear conditions of machine components operated at your production site. Based on the results of such analyses and abundance of previous data, we understand the lubrication conditions that best fit your machines (in terms of environment and other conditions). We provide minimum quantity lubrication (MQL) information based on our findings.



3D piping diagram management

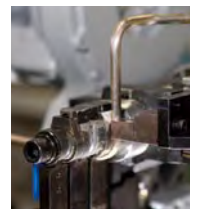
We can make a three-dimensional drawing of a system kit for the lubrication system you adopt and deliver it as a data storage/ system kit.

This reduces the total cost of piping and installation work, and enables you to install the system more safely and securely without any trouble.



Automated steel pipe bending using “bending machine”

- High-precision bending that maintains machine aesthetics when installed.
- Automated processing improves quality and consistency.
- The pipes are pre-bent into ready-to-install configurations—No need for specialized bending techniques.
- Rigidity of steel piping eliminates need for numerous tube clips to be installed
- As steel piping improves lubricant flow, pump operating time can be shortened to save energy.
- Rugged in external environments (heat, deterioration, external shocks).



LHL Retrofit Panel & Remote Sensors

LHL Retrofit Panel Generation II • Generation III

Makes replacing an existing lubrication system easier and more cost effective

Generation II LHL Retrofit Panels: LHL P09 • LHL P10 • LHL P12 • LHL P13

■ Generation II LHL Panel with Zen Controller



LHL P10

Specifications

Power: AC 88-264V, DC24V (special order)
Input current: 3.5/2 A, 6A
Pump: LHL P09/ LHL P12, EGM-II; LHL P10/ LHL P13, P-107
Discharging pressure: 5MPa/ 8MPa
Discharging time : 7 min maximum
Interval time : 4 Hours, adjustable, optional cycle count
Wiring method: Fork or loop terminal connection
Coded security lockout: No
Manual override: Yes
Grease level switch: Yes
Pressure detection for LHL P09/ LHL P12: 1 remote sensor
Pressure detection for LHL P10/ LHL P13: 1 to 3 remote sensors
PLC feedback for previous signal detection: Yes
Alarm feedback: Via original oil lube pump level switch or other means
Retrofit panel selection is based upon the the specific application of your machine.

LHL P09 & LHL P10 Retrofit Panels

The LHL P09 & LHL P10 use an EGM pump or a P-107 pump respectively. Both Retrofit Panels are intended to replace Single Line Resistance Systems and provide override of the machine's original pressure detection circuit via a timed dummy signal. These retrofit panels are also suitable for installations onto machines with no previous automatic centralized lubrication system.

LHL P12 & LHL P13 Retrofit Panels

The LHL P12 & LHL P13 use an EGM pump or a P-107 pump respectively. Both Retrofit Panels are intended to replace Positive Displacement Injection Systems and provide override of the machine's original pressure detection circuit via a relay. This is done through the original oil lube pump wiring circuit that is monitored and controlled by the machine PLC.

Generation III LHL Retrofit Panel: LHL P X1

■ Generation III LHL Panel with Touch Screen-PLC



LHL P X1

Specifications

Power: AC 88-264V, DC24V (special order)
Input current: 3.5/2 A, 6A
Pump: P-107, P-207; EGM-II (special order) Two Pumps
Capable Discharging pressure: 5MPa/ 8MPa
Discharging time : 7 min maximum
Interval time: 4 Hours, adjustable, optional cycle count
Wiring method: European terminal connection
Coded security lockout: Yes, 3 levels of access
Manual override: Yes
Grease level switch: Yes
Pressure detection: 1 to 3 remote sensors
PLC feedback for previous signal detection: Yes
Alarm feedback: Via original oil lube pump level switch and screen flashing
Retrofit panel settings are based upon the the specific application of your machine.

LHL P X1 Retrofit Panels

The LHL P X1 uses a P-107/ P-207 (or special order EGM-II) pump . The LHL P X1 is intended to replace Single Line Resistance Systems or Positive Displacement Injection Systems.

In Single Line Resistance systems, the LHL P X1 provides override of the machine's original pressure detection circuit via a timed dummy signal.

In Positive Displacement Injection Systems, the LHL P X1 provides override to the machine's original pressure detection circuit via a relay. This is done through the original lube pump wiring circuit that is monitored and controlled by the machine PLC.

The LHL P X1 retrofit panel is also suitable for installations onto machines with no previous automatic centralized lubrication system.

The LHL P X1 is capable of operating two pumps in tandem or independently for special lubricant or larger machine requirements.

Remote Sensors Appropriate for any LHL System

MGL Positive Displacement Injector with Electronic Feedback



The MGL is an Injector that is normally utilized to monitor lubrication at critical points on a machine, such as a ball screw. It is usually mounted just before one of the farthest injector manifolds from the pump.

The MGL ranges in delivery volumes of .1mL, .2mL, .3mL, and .5mL per cycle.

Please note that LHL P09 & LHL P12 panels can only utilize one remote sensor, where as LHL P10, LHL P13, & LHL P X1 can utilize up to three.

GPL Pressure Switch with Electronic Feedback

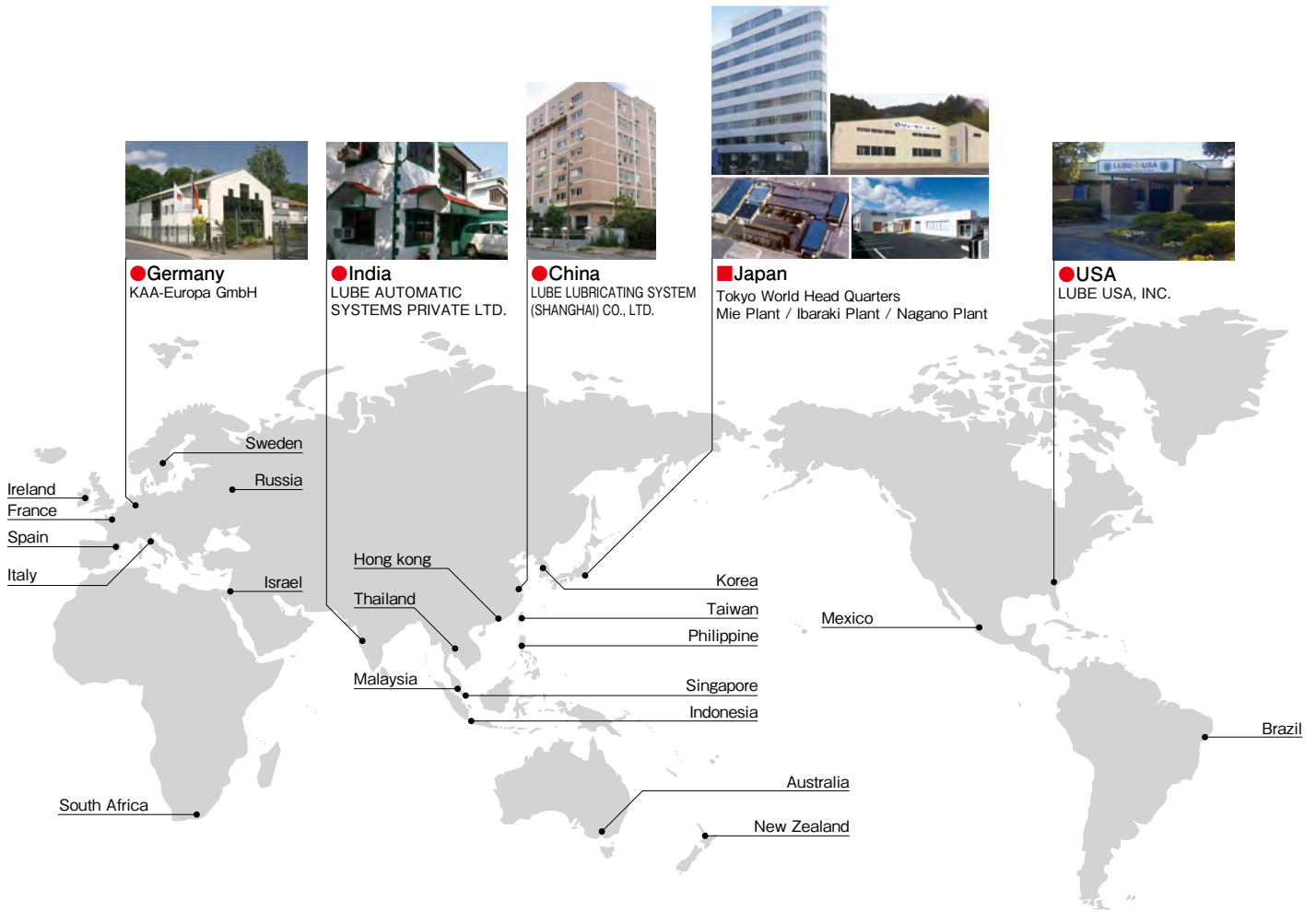


The GPL is a pressure switch normally utilized to monitor the entire lubrication system on a machine. It is usually mounted just before one of the farthest injector manifolds from the pump.

The GPL is available in 3 MPa & 5.5 MPa pressure ratings. The GPL is available with either DIN plug connector or a flying lead wiring connection method.

Please note that LHL P09 & LHL P12 panels can only utilize one remote sensor, where as LHL P10, LHL P13, & LHL P X1 can utilize up to three.

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