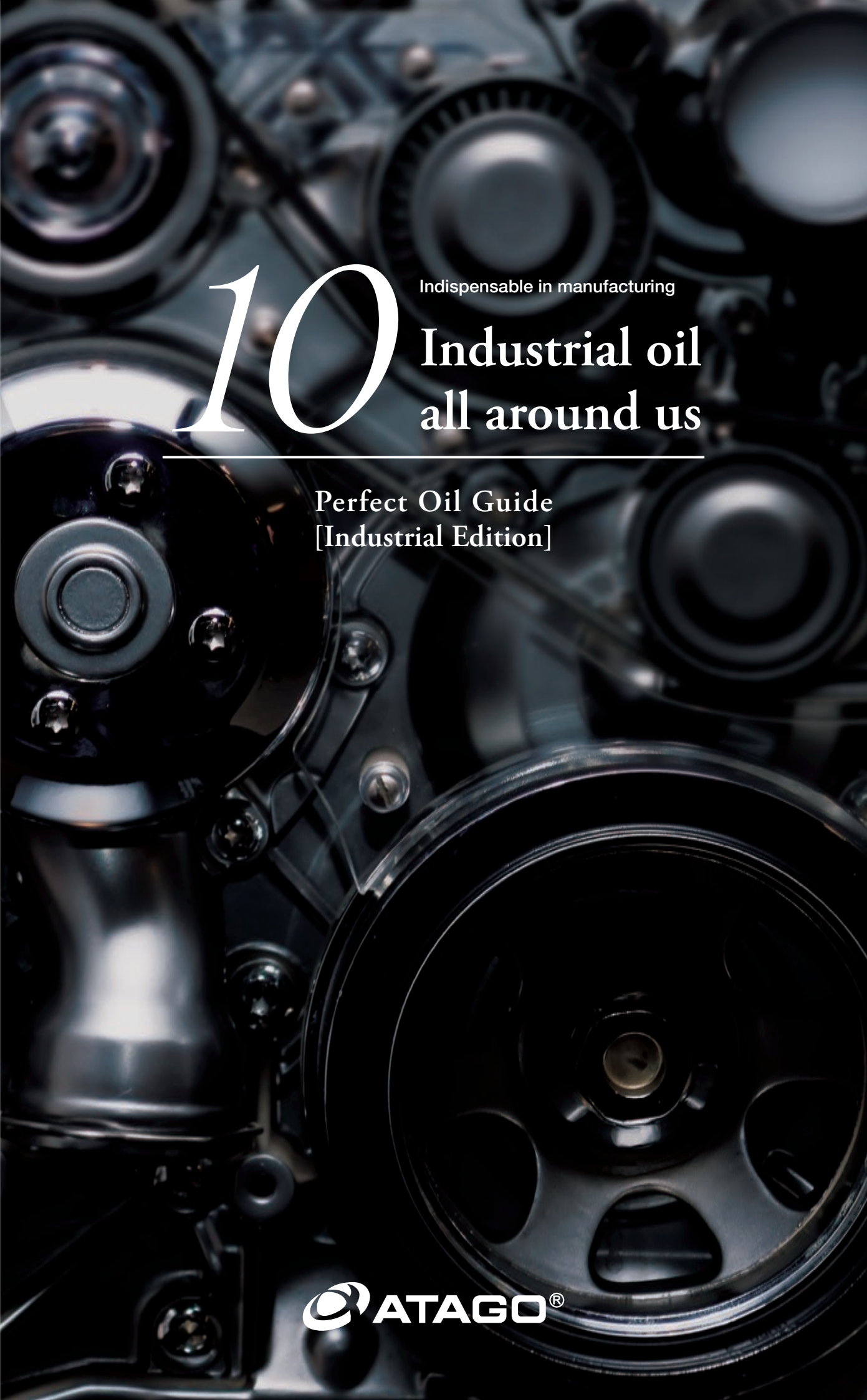

Indispensable in manufacturing

10 Industrial oil all around us

Perfect Oil Guide [Industrial Edition]

ATAGO®

Indispensable in manufacturing

10 Industrial oil all around us

There are various kinds of industrial oils with versatile use. In the field of manufacturing, like blood, not only lubricants help machinery to operate smoothly, it affects and determines quality of manufacturing. It Is also used in our familiar products, such as automotive and watches.This guidebook is the bible of selecting the concentration meters that can be used for industrial fluids. Its application and management methods are introduced in this guidebook using familiar products as an example.

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(Cutting Oil)

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(Cutting Oil)

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Automobile Cutting Oil

An automobile is made up of many parts and it can be divided into a body, a chassis, an engine, and a drive train.The body refers to bonnets, doors, trunk lids, and such that are basically consisted of steel plates. Chassis refers to parts related mainly to suspension, steering wheel, tires, wheels and so on referring to the main parts related to underbody.The engine, also known as the heart of an automobile, is an internal combustion engine that converts thermal energy into mechanical energy. Drive train is a generic term for drive system parts such as transmission, drive shaft, differential and such that transmit the output of engine to drive wheels. Safety always comes first for automobiles; hence, accuracy is required for each of these parts.

PICK UP

Cutting processing of steering knuckles, which is a part around a vehicle's underbody.

CM-BASEα has been installed to monitor the concentration of the cutting oil

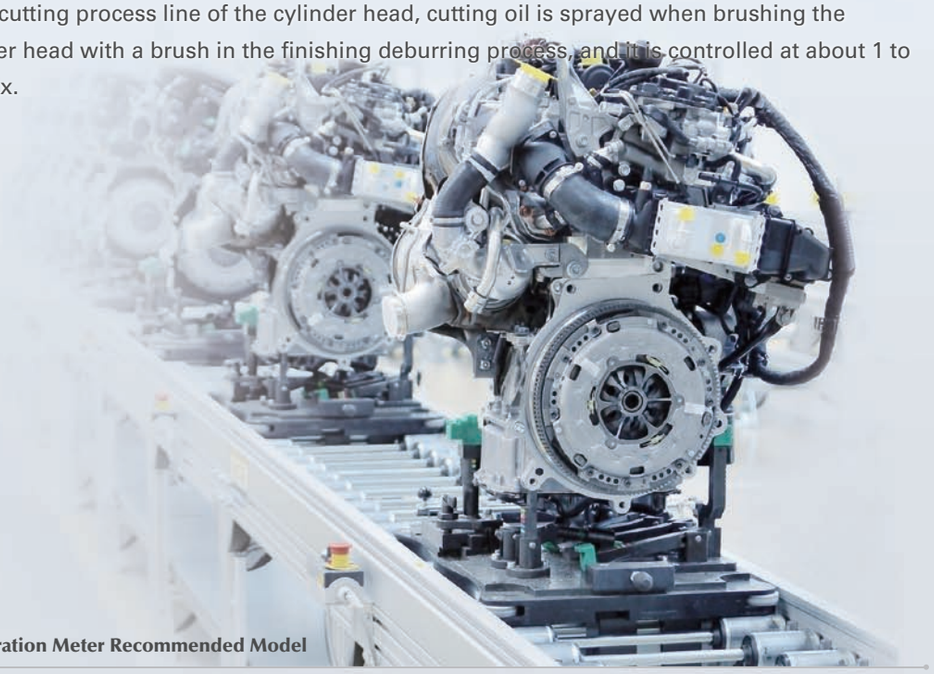
The hole of the knuckle steering is the part through which the drive shaft passes. It is the part where machining accuracy is required as if the machine surface becomes rough, it will directly affect its performance.The material is aluminum and so the Brix is maintained at higher percentage of about 13.1 to 13.5% to avoid welding.

PICK UP

Cutting processing of cylinder head of engine parts

CM-BASEα has been installed to monitor the concentration of the cutting oil

In the cutting process line of the cylinder head, cutting oil is sprayed when brushing the cylinder head with a brush in the finishing deburring process, and it is controlled at about 1 to 4% Brix.



Concentration Meter Recommended Model

Hand-held Type

PAL-1
Cat.No.3810

PAL-102S
Cat.No.4502

* Models such as PAL-S, and MASTER-53S are available to stably measure milky samples.

Liquid Immersion Type

PAN-1DC
Cat.No.3606

CM-BASEβ
(A) Cat.No.3616
(D) Cat.No.3626

In-Line Type

CM-800α
Cat.No.3564

CM-BASEα
(A) Cat.No.3603
(D) Cat.No.3604

Watch Cutting Oil

A watch is said to be the status of men and it is an important element of fashion. For businessmen fighting against time, many may spend money on watches as their partner of time. A watch, which is a precision machine, consists of at least several hundred parts, and when it comes to complicated watches the number of parts is countless. If each one of these parts is not processed with high accuracy, it will not be possible to accurately count the time. Concentration control of cutting oil is a must in the processing each part.

PICK UP

A well-established watch workshop in Switzerland

Hand-held concentration monitor MASTER-Series has been used.

Due to the nature of skilled trades information, a detailed information to when the concentration is checked and managed was not disclosed, however, it is not difficult to imagine how much precision is required for each of the tiny parts that make up its small body.

Concentration Meter Recommended Model

Hand-held Type

PAL-1
Cat.No.3810

PAL-102S
Cat.No.4502

* Models such as PAL-S, and MASTER-53S are available to stably measure milky samples.

Liquid Immersion Type

PAN-1DC
Cat.No.3606

CM-BASEβ
(A) Cat.No.3616
(D) Cat.No.3626

In-Line Type

CM-800α
Cat.No.3564

CM-BASEα
(A) Cat.No.3603
(D) Cat.No.3604

Aerospace · Aviation Cutting Oil

In today's age in the aerospace industry where the state-of-the-art technology of each country is questioned and the information is transmitted in real time regardless of the border with the advancement of the Internet, the aircraft industry that transports people and material goods will fiercely advance to its extreme. The number of parts that make up a jet passenger aircraft is said to be 5 to 6 million pieces. Many parts are made by cutting processing. The material is light and strong, and special alloy that can withstand high temperature and high pressure is used for the engine. In order to process these parts with high accuracy, cutting techniques appropriate for each of the materials are required.

PICK UP

Cutting processing of aircraft engine case

Digital Concentration Meter, PAL-102S has been used for concentration management of cutting oil

For machining of aluminum material, the cutting oil concentration is adjusted to 3 to 7%, and for difficult-to-cut materials, it is slightly increased to as high as 8 to 11%. The concentration of the cutting oil is being controlled taking in consideration subtle seasonal changes and it is adjusted by slightly lowering the concentration when evaporation is expected during the summer time and increasing the concentration during the wintertime.

PICK UP

Manufacturing turbine seals for engine parts

Digital Concentration Meter, PAL-102S has been used for concentration management of cutting oil

The concentration is maintained at about 5% with a daily inspection.

PICK UP

Turbine machining

Digital Concentration Meter, PAL-102S has been used for concentration management of cutting oil

Not only processing accuracy is important, concentration control is also managed to document quality control records to be provided to customers. It is managed with a cutting oil concentration of 4%.

Concentration Meter Recommended Model

Hand-held Type

PAL-1
Cat.No.3810

PAL-102S
Cat.No.4502

* Models such as PAL-S, and MASTER-53S are available to stably measure milky samples.

Liquid Immersion Type

PAN-1DC
Cat.No.3606

CM-BASEβ
(A) Cat.No.3616
(D) Cat.No.3626

In-Line Type

CM-800α
Cat.No.3564

CM-BASEα
(A) Cat.No.3603
(D) Cat.No.3604

Catheter Wire drawing Oil

Catheter is one of the treatment method used treating diseases such as myocardial infarction that are caused by clogging or narrowing of cardiac blood vessels (coronary arteries) that are commonly caused by cholesterol and the like. Conventionally, coronary artery bypass surgery, which is a large-scale surgical operation with thoracotomy, was common, but in recent years, a thin tube called a catheter can be inserted from the base of the wrist or foot into a blood vessel, and the narrowed blood vessel is expanded. Unlike major surgical operations, the pain experienced by the patients are minimal and it also allows for quicker recovery with least economic burden.

Advanced wire drawing technology is required to make the threadlike catheter while maintaining its strength. One of the most important elements for making good lined wire is said to be the concentration control of lubricant oil called wire drawing oil. The monitoring of the drawing oil concentration is effective for grasping processing condition and preventing accidents at wire drawing. In addition, it is also important for sustaining the life of a die which is also said to be the life of wire processing. The die is a part that is about 2.5 cm in diameter made of diamond with micron level holes in the center that gradually wears with use. To maintain the concentration, there are acid decomposition method, solvent extraction method, dry weight method, refractive index method and such. The least difficult method is the refractive index method.

Concentration Meter Recommended Model

Hand-held Type

PAL-1
Cat.No.3810

Liquid Immersion Type

PAN-1DC
Cat.No.3606

CM-BASEβ
(A) Cat.No.3616
(D) Cat.No.3626

In-Line Type

CM-800α
Cat.No.3564

CM-BASEα
(A) Cat.No.3603
(D) Cat.No.3604

* Models such as PAL-S, and MASTER-53S are available to stably measure milky samples.

Knife Grinding Lubricant, Quenching Oil, Anti-Rust Agent

A long ago, as a weapon today as a familiar tool such as knives and scissors, cutlery production is one the traditional techniques of Japan. Production of knives are famous in Seki of Gifu prefecture and Echizen of Fukui prefecture in Japan, Soloing in Germany and Sheffield in England.

PICK UP

Cutlery Manufacturer

Concentration meter plays active role where it is difficult to succeed just by craftsman's experience.

The sharpness that determines the quality is evolving by adding not only the succession of traditional techniques but also elements of modern technology. For example, some blade manufacturers control the thickness of the cutting edge with a precision of 1 / 100th with a CNC grinding machine. Naturally, concentration control of grinding lubricant is essential to obtain accuracy of 1 / 100th of a millimeter. After grinding, there is a step of finely grinding the blade using a feather cloth (= cloth abrasive grindstone). In order to soften the contact, a glue that has been melted by hot water is applied to the surface of the blade. The concentration of glue melted in hot water is difficult to control only by craftsman's experience. This is where refractometers can be useful.
In the final process, a rust preventive solution is applied to prevent the blade from rusting. Refractometers are used to monitor this concentration.

PICK UP

Hammer manufactured blade cutter

The temperature of the oil is about 20 to 25°C and the concentration is managed with Brix 4%

After forming the head of the hammer, temperature is heated up to 800°C to strengthen and cooled with hardened oil. Iron expands when heat is applied and condenses as it cools. Cooling it too quickly will cause it to crack.

PICK UP

Kitchen knife manufacture

PAL-AntiRust for concentration control of rust preventives have been used

After the finishing process, refractometers are used to measure the concentration of the anti-rust agent that is applied to cleaned blade to prevent from rusting.

Concentration Meter Recommended Model

Hand-held Type

PAL-1
Cat.No.3810

PAL-102S
Cat.No.4502

PAL-AntiRust
Cat.No.4537

Liquid Immersion Type

PAN-1DC
Cat.No.3606

CM-BASEβ
(A) Cat.No.3616
(D) Cat.No.3626

In-Line Type

CM-800α
Cat.No.3564

CM-BASEα
(A) Cat.No.3603
(D) Cat.No.3604

* Models such as PAL-S, and MASTER-53S are available to stably measure milky samples.

Zipper Mold Releasing Agent, Anti-Rust Agent

Zipper is known to have been invented by Whitcomb Judson (USA) in 1891 to solve inconveniences caused by tying shoelaces. In modern days, zipper is widely used in clothing and bags. In the United States, it is commonly called zipper and in Japan, "chuck" is the familiar name.

Zippers are manufactured by die casting where release agents are used in the process of extruding products from the mold. When the dilution ratio of the release agent is too low, coloring of the product occurs. If it is too high, it will seizure due to poor mold release.
Since force is applied when it is taken out of the mold, distorted products may be produced.
A warped zipper will not zip smoothly and its function may become compromised. By keeping the proper dilution concentration of the release agents, it can stabilize processing accuracy and protect the quality.
In addition, rust inhibitors are applied to zippers to prevent rust during processing.
Furthermore, it prevents stickiness, and it is necessary to managing the proper concentration for its proper shape.

Concentration Meter Recommended Model

Hand-held Type

PAL-Release Agent
Cat.No.4538

PAL-AntiRust
Cat.No.4537

* Models such as PAL-S, and MASTER-53S are available to stably measure milky samples.

Liquid Immersion Type

PAN-1DC
Cat.No.3606

CM-BASEβ
(A) Cat.No.3616
(D) Cat.No.3626

In-Line Type

CM-800α
Cat.No.3564

CM-BASEα
(A) Cat.No.3603
(D) Cat.No.3604

Utility Pole Insulating Oil

The utility pole has a role as a pillar that connects wires for electronic power, telephone, optical, TV and such communication cables that are spread around. In recent days, some utility poles are used as a wireless relay stations, for cellular phones and such, that serves collection of various functions that are indispensable for our lives. There used to be wooden pillars in the past, but now many are concrete utility poles.
Transformers used for power distribution are installed to the utility pole, and its inside is filled with insulating oil for cooling.

The quality of the insulating oil is specified in JIS C 2320-1999, and in addition to the one kind of mineral oil, there are alkylbenzene (2 types), polybutene (3 types), alkylnaphthalene (4 types), alkyldiphenylalkane (5 types), silicone oil (6 types), mineral oil · alkylbenzene (7 types) and so on. Insulating oil, which is initially pale yellow , will brown with use use and cause sludge [*1] that will cause issues for equipment. For this reason, oxidation and moisture values etc. are strictly maintained by maintenance control standards.

The method of measuring the refractive index of electrical insulating oil is described in JIS C 2101 [*2] in Electric Insulation Oil Test Method for refractive index and average dispersion [*3] .
The refractive index (wavelength 589 nm) of the electrical insulating oil varies depending on its type, but 1.460 to 1.480 is the most common kind. Abbe refractometer and digital refractometer RX series can be used for refractive index (wavelength 589 nm) measurement.
Also, a multiwavelength Abbe refractometer can be used to measure "refractive index at wavelength 486 nm" and "refractive index at wavelength 656 nm". Only when a refractive index is required, a high accurate digital refractometer RX - 5000α is recommended. With RX-5000α, dark color sample which is hard to measure with Abbe can be measured.

*1 Sludge is a muddy substance produced by deterioration of insulating oil.
*2 In JIS C 2101, the word "ratio dispersion" is also written. Specific dispersion = average dispersion / density × 10000. The purpose of finding the refractive index and specific dispersion is for quality control. The refractive index varies depending on the composition of the insulating oil and the amount of impurities contained in the oil. Also, the specific dispersion of mineral insulating oil depends mainly on the structure and number of aromatic compounds in the oil.
*3 Average dispersion is the difference between "refractive index at wavelength 486 nm" and "refractive index at wavelength 656 nm".

Concentration Meter / Refractometer Recommended Model

Analog Type

DR-A1-Plus
Cat.No.1311

Digital Type

RX-5000α
Cat.No.3261

* Contact ATAGO for details.

Refractometer · Concentration Meter

Lens Grinding Lubricant

One of the themes of this guide is a concentration meter. ATAGO has manufactured a refractometer (concentration meter) for more than 70 years since 1940. The lens is one of the key elements of the refractometer. Generally speaking, if one says a lens, then that might trigger to imagine a camera or glasses, but the as importantly, lenses are crucial elements of refractometers.

PICK UP

Lens processing of ATAGO

High precision cutting and polishing technology is required for lens processing for optical products

Processing begins with a grinding process of rough rubbing that first adds a constant curve (R) to the upper surface of a spherical lens such as a convex lens or a concave lens. For processing, a machine called curve generator is used along with other tools such as artificial diamonds. Next, is the precision grinding process where coarse surface from rough finishing is grinded finer. Artificial diamonds are used during this process as well. In this grinding process, grinding lubricant is used, and it plays many roles such as lubrication, washing, cooling, workability, rust prevention and so and is indispensable for maintaining quality.
Concentration management is important to maximize the function of grinding lubricant. After the grinding process is completed, the lens surface is smoothly polished during the polishing process. If lenses are not polished well, the overall image will be blurry and not tie in together which defeats the principle of refractometer that uses phenomenon of light refraction.
The polishing process is a process that requires high technology.
Finally, the completed lens is cleaned to remove dirt. Even if you can process high-quality lenses, it is fatal if they are dirty. In the cleaning process, many layers of cleaning process are included to thoroughly remove contamination by using such solution as alkaline cleaning solution, neutral detergent and IPA. If the cleaning solution become dirty and contaminated, cleaning lenses in such solution does not make sense, so the concentration of contamination of the cleaning solution is also monitored with a refractometer. The quality and precision of the lens directly affect the quality of the refractometer. At ATAGO, for a refractometer to be the unsung hero behind our customer's quality product, we manufacture each one of them with all our heart to with quality improvement.

Concentration Meter Recommended Model

Hand-held Type

PAL-1 Cat.No.3810
PAL-102S Cat.No.4502
* Models such as PAL-S, and MASTER-53S are available to stably measure milky samples.

Liquid Immersion Type

PAN-1DC Cat.No.3606
CM-BASEβ (A) Cat.No.3616 (D) Cat.No.3626

In-Line Type

CM-800α Cat.No.3564
CM-BASEα (A) Cat.No.3603 (D) Cat.No.3604

Bullet Train Lubricant

"Shinkansen," the world understands this word with no explanation. Not only the worldwide boasted technology, speed, accuracy and punctuality number of accidents, comfort level and so on that Shinkansen provides is a claim to fame. On October 1, 1964, the first train connecting Tokyo and Shin-Osaka called Tokaido Shinkansen traveled at a speed of 210 kilometers.
The opening of the Shinkansen train which Japanese railway engineers and researchers were wished for. Even now that high-speed railroads have spread worldwide, Japan's high-speed rail technology is the highest in the world and it is not an exaggeration to say that the world is longing for it. Shinkansen is one of the symbol of manufacturing country, Japan. A number of parts make up the shinkansen's body. It is precision parts that support the comfort of the Shinkansen under the rim.

Water-soluble cutting oil is used during metal processing parts for Shinkansen, and various other cleaning agents are used for cleaning metal processed products. The Shinkansen runs with on wheels, and there are many rotating parts which require lots of lubricating oil. Specific bearing oil is used for different parts of the Shinkansen, for example, axle oil for axle bearing, gear oil for drive gear unit, torque converter oil for brake pressure intensifying cylinder, compressor oil for rotary air compressor. Refractive index and viscosity are also measured for these oils during the production processes. Furthermore, the inspection of the Shinkansen is conducted every other day, alternating inspection once every 30 days (or 30,000 km), a truck inspection (fundamental inspection) every year and a half (or 600,000 km) and general inspection once every three years (or 1.2 million kilometers) is conducted. In these inspection processes, the remaining amount and properties of oil are also checked.

Refractometer Recommended Model

Digital Type

RX-7000i Cat.No.3279
* Contact ATAGO for details.

RX-7000α Cat.No.3262
* Contact ATAGO for details.

NAR-2T Cat.No.1220
* Contact ATAGO for details.

Viscometer Recommended Model

Digital Viscometer

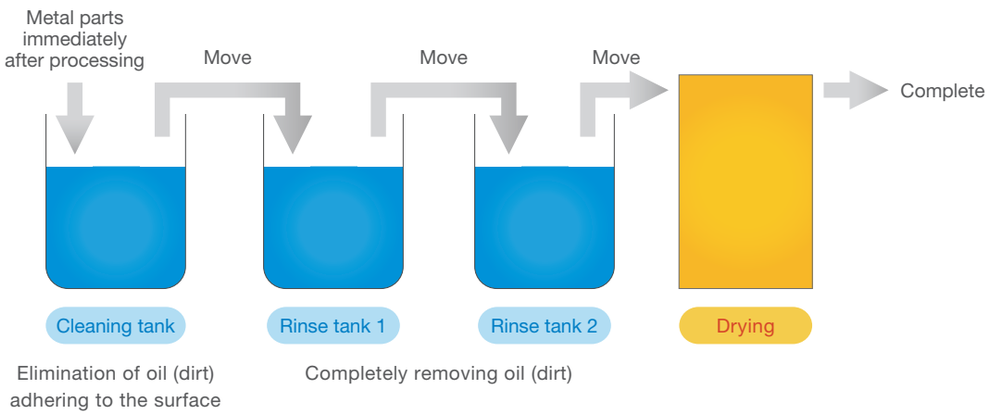
VISCO™ Cat.No.6800

Cleaning Device

Cleaning Solution

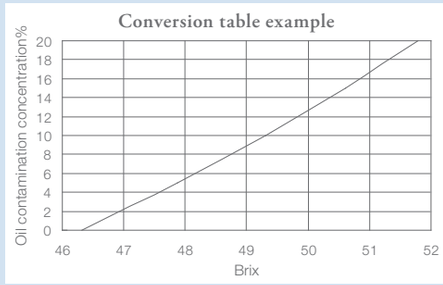
Processed parts become finished products after the washing process.
Even parts that have been machined to high precision, it is not acceptable to have oil and dust stains etc. on the finished parts. In the last washing process, only those that have been properly cleaned can be parts that make up the product. In the cleaning process, there are usually several tanks. Most of the oil (dirt) adhering to the surface is washed and removed in a cleaning tank, and the remaining oil (dirt) is completely removed in rinse tank 1 and rinse tank 2. Finally, it is dried and any remaining washing solution on the surface is removed. The type of cleaning solution used in each tank depends on the material and properties of the parts to be cleaned.
As for the type of cleaning solution, hydrocarbon-based or petroleum-based cleaning liquid is often used for metal parts immediately after processing.

• Washing process



Cleaning solution filled in the washing tank is a clean new liquid at first, but as cleaning of metal parts is repeated, dirt will mix into the cleaning solution. As the amount of contamination increases, parts will become washed in a dirty solution. So it is necessary to exchange or refine the solution. A refractometer can be used to grasp the concentration% of contamination.
At what contamination concentration% to replenish or refine the cleaning solution is determined by considering the properties of dirt and use of the metal parts.
In the rinse tank, the parts are washed with hydrocarbon and petroleum-based cleaning solution or water. The contamination concentration is commonly controlled so that it is 1% or lower and for precision metal parts, 0.1% or lower. Our customer have chosen ATAGO's benchtop refractometer RX series. Select an appropriate model depending on the type and control parameter.

To manage concentration of a cleaning solution, a conversion graph of refractometer (Brix%) and contamination (oil) concentration% (absolute concentration value) is required. For details on how to calculate the conversion factor, see P. B9.



Concentration Meter Recommended Model

Hand-held Type

PAL-Hydrocarbon Cleaner
Cat.No.4558

Digital Type

RX-5000i-Plus
Cat.No.3275

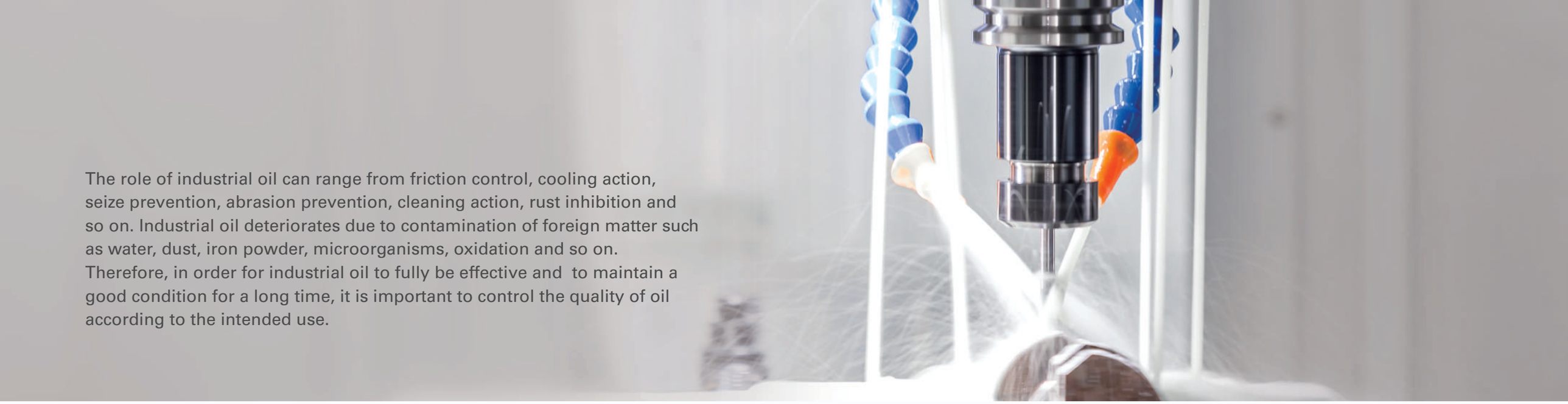
Please turn over and flip upside down from the next page.

Perfect Oil Guide

[Industrial Edition]

To users measuring concentration,
viscosity, pH, refractive index of industrial oil

ATAGO®



The role of industrial oil can range from friction control, cooling action, seize prevention, abrasion prevention, cleaning action, rust inhibition and so on. Industrial oil deteriorates due to contamination of foreign matter such as water, dust, iron powder, microorganisms, oxidation and so on. Therefore, in order for industrial oil to fully be effective and to maintain a good condition for a long time, it is important to control the quality of oil according to the intended use.

Industrial Oil

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3 Oil and pH ····· B16
4 Oil and Viscosity ····· B18
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Cleaning Solution

1 Types and Uses ····· B26
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PAL-S ····· B33
PAL-102S ····· B33
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PR-201α ····· B37
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All ATAGO products are designed and manufactured in Japan.

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ISO9001

HACCP GMP GLP
ATAGO products comply with HACCP,GMP, and GLP system standards.

* Specifications and appearance are subject to change without notice.

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Industrial Oil

Types and Uses

Cutting oil

Lubricating oil used for cutting metal

The main work is a lubrication action to reduce friction between the cutter and the workpiece to reduce the cutting resistance and a cooling action to remove the frictional heat generated between the cutter and the workpiece. This can extend the life of the cutter, improve the quality of the finished surface, improve the processing accuracy such as dimensional accuracy. The standard of cutting oil is specified in JIS K 2241, and it is divided into water-insoluble cutting oil and water-soluble cutting oil. Water-insoluble cutting oil is mainly suitable for cases where processing precision is required because it is mainly composed of mineral oil and is excellent in lubricity and anti-weldability. However, because it corresponds to the dangerous goods of the Fire Service Act, precautionary measures against fire hazards are necessary. Water soluble cutting oil is particularly good for cooling because it is diluted with water and has the advantage over water-insoluble cutting oil that there is little danger of smoke, ignition and fire.

Grinding lubricant

Solution that plays an important role in grinding

Grinding is a machining method that scrapes the surface of a material with a grinding wheel that rotates at high speed and finishes it to the required size, shape and surface roughness. Imagine the figure of sharpening the kitchen knife with a grindstone. The grinding is the result of advancement in the practice of knife sharpening. The role of grinding lubricant is to reduce grinding resistance, increase lubricity, and cool the heat from friction. This keeps the condition of the grindstone satisfactory and maintains high accuracy. It also serves to prevent corrosion of metal and adhesion of metal chips. There are water-soluble grinding lubricant and water-insoluble grinding lubricant. In general, it is water-soluble grinding lubricant that is more common and it can be divided into emulsion, solubles, and chemicals. Solubles are most suitable for grinding, but water-insoluble grinding lubricant is more suitable when finished surfaces are more strictly required.

Anti-rust agent

As the name suggests, liquid agent to prevent rust

Rust is generated when processed metal surface come in contact with oxygen and water etc. If it rusts, it cannot be used as a metal part and the product value will be reduced. Anti-rust agent is used not only in the final steel product but also when rust occurs between primary processing and secondary processing. There are two types of anti-rust agents, water soluble and organic solvents, but water soluble anti-rust agent is increasingly becoming more popular.
Water-soluble agent has less risk of ignition, explosion, poisoning, etc., and is operator and environmental friendly. In JIS Z 0103, it is classified into its use and type of metal anti-rust agents according to its use and purpose such as water solubility, vaporizability, grease form, etc.

Hydraulic oil

Fluid used in hydraulic machinery

Hydraulic machinery is used as a driving source for machine tools, construction machinery such as hydraulic excavators, industrial vehicles such as forklift, agricultural machinery such as tractor, and specially equipped vehicle such as dump truck. Hydraulic systems use a fluid to transmit forces from one location to another using the Pascal's law. The fluid used as a power transmission medium in hydraulic equipment is called hydraulic fluid, and it also has functions such as lubrication, rust prevention, and cooling. As classification, there are petroleum (mineral oil) and flame retardant. For flame retardancy, water - based hydraulic fluids and water glycol fluids are commonly used.

Rolling oil

Lubricating oil used in rolling process

Rolling is a processing method in which materials such as metal are thinly extended between rolling rolls. Lubricating oil used in rolling process is called rolling oil, which plays a role of reducing friction between the metal and the roll and imparting cooling properties. Many rolled products such as roofs, walls, household electrical appliances, beverage cans and so on are familiar everyday goods. During the rough rolling process, a cooling effect is expected from the rolling oil to compensate for the great amount of thermal energy released from substantial stretching of the rolling sheet. In the finish rolling process, it is necessary to increase the amount of oil to ensure lubricity so as to achieve the required surface accuracy. However, it is better to use less oil for the later cleaning process. For the finishing process of rolling, it is important to precisely control concentration in consideration of the washability of the subsequent process.

Mold-releasing agent

Lubricating oil used in die casting process

The main function is to reduce seizure between heated material and metal mold in die casting process and reduce friction when extruding product from metal mold. Die-casting is a casting method in which molten metal is pressed into a precision mold at high temperature, and casting is produced through cooling and solidification processes. Seizing, a failure caused by the die-casting process will degrade product quality, yield, and production efficiency such as damage to the mold. The release agent is like applying cooking oil to the baking mold beforehand so that it will not stick. Water based type is the mainstream for release agents, due to fire hazards and work environment problems.

Wire drawing oil

Lubricating oil used for wire drawing

Drawing processing is a type of metal processing that reduces the diameter of a wire material such as a wire and extends it long. The processed wires can be seen at various places such as leads of thermocouple thermometers of airplanes, ships and automobiles, nickel chromium wire used for heating appliances, home appliances, copper nickel wires used for toilet seat heaters, etc. are manufactured by stretching the metal wire using a tool called a die. Drawing oil has the functions of improving the quality of the wire, preventing wear of the die, cooling the frictional heat, and improving workability.

Quenching oil

Mineral oil for heat treatment used for quenching

Iron and steel is an alloy of iron and carbon. As the temperature rises, the crystal structure and properties change at a certain temperature. Utilizing such property of alloy, techniques such as "anneal" to soften the steel, and "quench" to make it hard, are commonly used. Mineral oil for heat treatment used for quenching of steel and the like is called quenching oil. In JIS K 2242, ease of hardening and oil temperature and so on are determines. Selection of the quench oil requires to consider facts such as work type, shape and required hardness.

Insulating oil

Role of insulation and cooling of electrical equipment

Insulating oil plays the role of insulation and cooling of electrical equipment such as transformers, capacitors, cables, capacitors and others. If abnormal overheating or insulation deterioration occurs inside the equipment, the decomposition gas and deterioration products generated from the insulating oil will dissolve and cannot fulfill the role of electronic equipment. In JIS C 2320, its characteristics are specified in detail.

Oil and Concentration

There are many types of industrial oils such as water-soluble cutting oils, lubricating oils, mold release agents, etc., used by diluting with water. Strictly managing these dilution ratios (concentration control) stabilizes processing accuracy, maintains quality, and prevents problems in advance.

When the concentration is too low

- Fluctuating accuracy varies easily
- Lifespan of tool drops due to rust and discoloration
- Progress of putrefaction of oils

When the concentration is too high

- High spending cost on oil
- Stickiness around the machine
- Operator's hands may become irritated

There are two main types of concentration management

Measurement of initial dilution concentration

For water-soluble oils, the stock solution is diluted with water. In order to fully derive the performance of the oil agent, it is necessary to grasp the dilution concentration% and perform proper dilution. The proper concentration varies depending on the type of oil and processing conditions, for example, it is said that the proper concentration of cutting processing is 5 to 10% and the grinding processing is about 4 to 7%.

Measurement for proper replenishment concentration

Concentration of liquid in use will change due to evaporation over time and adhesion to machine tools and processed parts. Various problems will occur when the concentration is outside the prescribed range, so it is necessary to regularly manage it to confirm the concentration during use and to maintain a constant concentration.

Method for controlling concentration of water-soluble oil agent

Concentration management is generally done with a refractometer

A refractometer uses a unit called Brix% which is a scale that is converted from a refractive index. Therefore, a Brix% and absolute value percentage of an oil agent will differ from each other. In day-to-day process control, there are cases where Brix%, which is a unit of refractometer, is used, and other times, it is converted to an actual concentration. In order to convert to the absolute value of concentration, a conversion factor can be calculated by creating a conversion graph as follows.

Many oil manufactures often provide concentration and conversion factor.
Please contact the oil manufacture directly.

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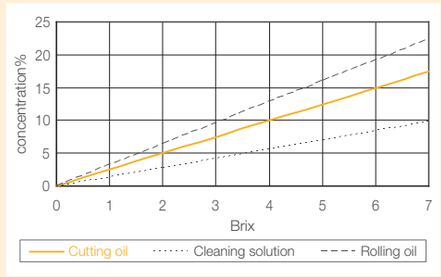
• Calculating for conversion factor

Using the cutting oil graphed on the right as an example, mix 10 g of the stock solution and 90 g of water to make a solution with a concentration of 10%. If this liquid is measured with a refractometer, Brix measurement was 4.0%, then conversion factor will be 10.0 / 4.0 = 2.5. For this diluted solution of cutting oil, the value obtained by multiplying the measured value Brix% of the refractometer by 2.5 is the actual concentration of the cutting oil.



• Determination of dilution ratio

The dilution ratio is the value obtained by dividing 100 by the "actual oil concentration".
In the case of 10% concentration, 100/10 = 10, the dilution ratio will be 10 times.

Brix%····· A scale obtained by converting the refractive index into "the number of grams of sucrose contained in 100 g of sucrose solution"

Water-soluble

Example of Concentration

Concentration control of cutting oil

Measurement of initial dilution concentration

At the initial dilution, using a refractometer, the dilution can be checked to see if concentration is appropriate.

Concentration measurement for replenishment

• Proper replenishment

Concentration of used liquid will change due to evaporation and adhesion to machine tools and processed parts over time. When refilling to initial dilution concentration, concentration is controlled with a refractometer. The most serious concern when the concentration is too high is skin irritation. Conversely, if the concentration is too low, there is a possibility of rusting the machine.

• Easy replenishment

This is only for agitable cutting oil; however, mixture can be managed by using a refractometer during bubbling process when blending water and stock solution directly into the tank.

* Please contact the oil manufacturer to see if the oil is agitable or not.

Improvement of processing technology and skill by digitization

Although concentration factors are typically provided by oil manufacturers, but since it is only a general concentration that can be used, so the concentration that meets the characteristics of the specific work and required accuracy must be studied independently. Improvement of processing techniques and skills will be promoted by numerical significance.

Cost reduction through concentration management

• Prevention of decay

Managing and controlling appropriate concentration can delay the progress of spoilage of the lubricant which can lead to cost reduction. In addition, preventing decay leads to avoiding large amounts of waste oil, which can be environmentally viable. Depending on the frequency of use, we recommend that concentration management be done once a week.

• Oil concentration according to cutting conditions

Cases have been reported in which crude processing is performed at low concentration and finishing processing is performed at high concentration, thereby reducing the amount of stock solution used by several thousand yen per month. The cost effectiveness can be obvious by using a refractometer, but in many cases, the concentration depends on intuition of the processor and have failed.

Confirmation of the functionality of filtration tank

By measuring concentration at the three locations, tanks, septic tanks, and injection sites, it is possible to check the function of the filtration tank, such as the influence of hydraulic oil and other contamination, and the effect of purification and lifting oil removal.

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• Collection sites suitable for concentration measurement

Concentration varies in tanks, injection sites, and septic tanks. Moreover, the concentration is inconsistent in the tank. The most stable concentration can be collected at the injection site, however, please pay attention to safety.

• Precautions when using refractometer to measure concentration

Concentration can be measurement with refractometers for emulsion, soluble, and chemical samples. Measurement values may not be stable for milky white samples or samples containing other oils. Once the solution is placed on the sample stage, stirring it with chopstick like material may stabilizes measurements. There are also models such as PAL-S and MASTER-53S for milky and hard to stabilize samples.

Emulsion ····· Similar to oil, spoils fast, sticky, when diluted with water, it becomes milky liquid
Soluble ····· When diluted with water, it becomes translucent or transparent liquid
Chemical ····· Close to water, difficult finished surface

Control of Each Oil Agent

Concentration control of wire drawing oil

Measurement of initial dilution concentration

At the initial dilution, by using a refractometer, the dilution can be checked to see if concentration is appropriate.

Concentration measurement for proper replenishment

• Proper replenishment

Concentration of used liquid will change due to evaporation and adhesion to machine tools and processed parts over time. When refilling this to initial dilution concentration, concentration is controlled with a refractometer. The most serious concern when the concentration is too high is skin irritation. Conversely, if the concentration is too low, there is a possibility of rusting the machine.

• Easy replenishment

This is only for agitable wire drawing oil; however, mixture can be managed by using a refractometer during bubbling process when blending water and undiluted solution directly into the tank.

* Please contact directly to the manufacturer of oil in use for good or bad stirring.

Improvement of processing technology and skill by digitization

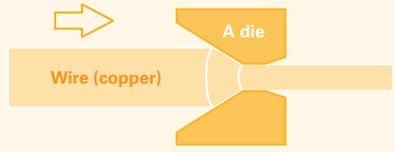
Although concentration factors are typically provided by oil manufactures, it is a general concentration, and so the concentration that meets the characteristics and required accuracy of the work must be studied independently by the operator.
For wire drawing work, mechanical and wire drawing oils differ at the process stage, such as emphasis on lubricity at the beginning and washability at the latter stage. In order to efficiently utilize different machines and oils, it is important to estimate the machining state, focusing on concentration control.

Cost reduction through concentration management

As wire drawing oil is very expensive, not letting it spoil will be the most cost-effective way of reduction. There seems to be a lot of cases where there is no periodic full replacement of drawing oil, half exchanges, one third exchange, etc. are carried out. If it spoils, the whole oil must be replaced with incurred cost. The basis of spoilage prevention is by concentration control. It is important to maintain the concentration recommended by wire drawing oil manufacturers. Depending on the frequency of use, we recommend that concentration management be done once a week.

Confirming the function of filtration tank

By measuring concentration at the three locations, tanks, septic tanks, and injection sites, it is possible to check the function of the filtration tank, such as the influence of hydraulic oil and other contamination, and the effect of purification and lifting oil removal.



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• Collection sites suitable for concentration measurement

Concentration varies in tanks, injection ports, septic tanks. The concentration is inconsistent in the tank. The most stable concentration can be collected at the injection site, however, please pay attention to safety.

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Concentration can be measured with refractometers for emulsion, soluble, and chemical samples. Measurement values may not be stable for milky white samples or samples containing other oils. Once the solution is placed on the sample stage, stirring it with chopstick like materials may stabilizes measurements. There are also models such as PAL-S and MASTER-53S for milky and hard to stabilize samples.

Concentration control of grinding lubricant

Dilution concentration measurement

Normally, the concentration of grinding lubricant is low, and 50-fold dilution is standard. Because water will come into contact with metals, rusting is the first issue. Concentration management of grinding lubricant is important to prevent rusting of work materials and machine tools. In general FC materials and castings are easy to rust, SUS is hard to rust. Also, it is said that it is less likely to rust during the winter.

Improvement of processing technology and skill by digitization

Although concentration factors are typically provided by oil manufacturers, but since it is only a general concentration that can be used, so the concentration that meets the characteristics of the specific work and required accuracy must be studied independently. By considering concentration change of the grinding lubricant, it is possible to more deeply consider the processing mechanism that have not been thought of before; allowing for amplified attention of the processor and lead to the improvement of processing skills.

Confirming the function of filtration tank

Contamination in grinding lubricant is mainly powder of work material and grinding stone. Therefore, either a paper filter or a magnetic separator is always incorporated into the grinding system. With the magnetic separator, grinding stone cannot be removed, so paper filter is the best method. When a new grinding lubricant is introduced, the validity of the filtration device can be measured by refractometer.

As a refractometer measures in units of Brix% scale, the measured value is different from the actual concentration of grinding lubricant. Actual concentration can be calculated using Brix% and the conversion coefficient of actual concentration. For details on how to calculate the conversion factor, see P. B9.

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Collection sites suitable for concentration measurement

In terms of reproducibility based on the concentration distribution, it is best to collect the solution at the exhaust nozzle, however, considering safety, collection at the tank is commonly practiced especially with the possibility of getting caught in the cutlery.

Concentration control of anti-rust

Dilution concentration measurement

For rust preventives, the stock solution is diluted with water. This dilution concentration is apparent with refractometer PAL-AntiRust. By knowing the numerical value, the concentration does not have to be increased more than needed and it can also prevent from harming the steel while conserving the stock solution.

Since the refractometer is in units of Brix%, the read value is different from the actual concentration of the anti-rust agent. Please contact the oil agent manufacturer you use for conversion factor of actual concentration and refractometer value Brix%. The conversion factor can also be obtained by the method described on P. B9.

Concentration control of quenching oil

Measurement of initial dilution ratio

A refractometer is used for concentration management of water-soluble quenching oil. In the initial dilution concentration management, a refractometer is used as the only concentration meter. Quenching oil is normally managed with dilution magnification, but if it is near 1,000 L, a flow meter or other equipment is required to measure the capacity. With a refractometer, concentration can be measured during when water is added directly from the hose to the stock solution while agitating, making it easy to make solution concurrently measuring concentration.

Proper replenishment

Concentration of used liquid will change due to evaporation of and adhesion to machine tools and processed parts over time. When refilling to initial dilution concentration, concentration is controlled with a refractometer. In order to obtain the proper concentration, it is necessary to replenish quenching oil diluted thinner than the initial dilution concentration to the quenching oil being used. As quenching oil changes in concentration every day, concentration control by refractometer is essential.

Improvement of processing technology and skill by digitization

Although concentration factors are typically provided by oil manufacturers, but since it is only a general concentration that can be used, so the concentration that meets the characteristics of the specific work and required accuracy must be studied independently. Improvement of processing techniques and skills will be promoted by numerical significance. The refractometer is used as an indispensable item for workers. By measuring different concentration with a flexibility, improvement of new technology can be expected.

Cost reduction through concentration management

• Preventing wasteful use of stock solution

Cost is reduced if most diluted amount of lubricant is used. Concentration management is indispensable in order to use the least amount of lubricant without losing its function.

• Prevention of decay

Quenching oil will decay due to microbial breeding, changes in water quality, contamination, and so on. To prevent decay, it is necessary to manage concentration above a certain level. The standard of concentration can be checked by the standard dilution ratio provided by the manufacture. The first step in preventing decay is proper concentration control with refractometer which is suggested by the oil manufacture. Every day concentration control creates synergies with prevention of decay of oils, consideration of the environment by waste reduction, cost savings due to long-term use.

Concentration meter recommended model

Oil Agent Type (water-soluble)	Hand-held refractometer	When turbidity is strong	Immersion Refractometer	In-line Refractometer
Cutting oil	PAL-1 PAL-102S	PAL-S MASTER-53S	PAN-1DC Digital output CM-BASEβ Digital / analog output	CM-BASEα CM-800α
Grinding lubricant	PAL-1 PAL-102S	PAL-S MASTER-53S	PAN-1DC Digital output CM-BASEβ Digital / analog output	CM-BASEα CM-800α
Anti-rust agent	PAL-AntiRust	PAL-S MASTER-53S	PAN-1DC Digital output CM-BASEβ Digital / analog output	CM-BASEα CM-800α
Wire drawing oil	PAL-1	PAL-S MASTER-53S	PAN-1DC Digital output CM-BASEβ Digital / analog output	CM-BASEα CM-800α
Quenching oil	PAL-1 PAL-102S PAL-α	PAL-S MASTER-53S	PAN-1DC Digital output CM-BASEβ Digital / analog output	CM-BASEα CM-800α
Rolling oil	PAL-1 PAL-102S PAL-α	PAL-S MASTER-53S	PAN-1DC Digital output CM-BASEβ Digital / analog output	CM-BASEα CM-800α
Release agent	PAL-Release Agent	PAL-S MASTER-53S	PAN-1DC Digital output CM-BASEβ Digital / analog output	CM-BASEα CM-800α

* A dark black release agent sample cannot be measured. Only milky white samples can be measured.
* The use of continuous measurement type depends on the operating environment, Please contact ATAGO.

Oil and pH

pH is the degree of acidity and alkalinity of the aqueous solution. When pH 7.0 is neutral, it becomes acidic as it goes below it, and alkalinity increases as it goes above it. Most of the water-soluble oils are slightly alkaline, pH 8.5 to 9.0.

pH of water-soluble oil agent

pH control with appropriate threshold is important

The general environment in which water-soluble oils is used is in favorable conditions for microorganisms (bacteria, yeast, molds) to propagate. Proliferation of microorganisms decay oil and causes processing defects. In addition, processed parts and machine tools will rust due to deterioration of rust prevention. In addition, some microorganisms emit serious putrefaction odor, causing deterioration of work environment inside the factory.
Proliferation of microorganisms is likely to occur in solutions that are weakly acidic to weakly alkaline, and as decay progresses, pH will decrease, which is an indicator of management. At the same time, high pH is not good either. The skin can be affected by alkaline state, oils with a high pH tend to cause dermatitis.

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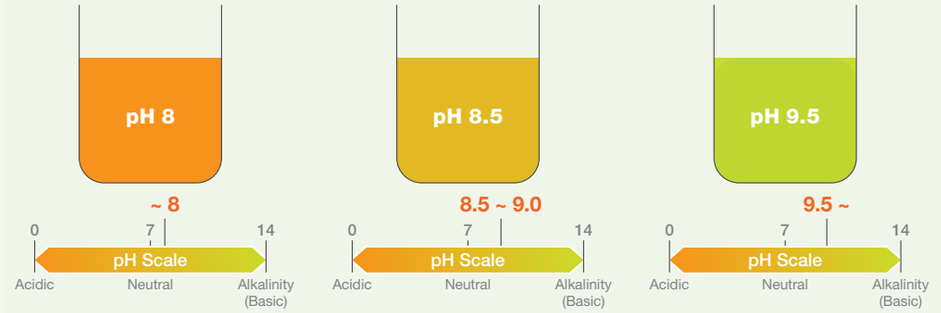
• Water soluble cutting oil and pH



When the pH is too low	Appropriate pH	When the pH is too high
· Progression of decay · Degradation of emulsification stability · Rusting		· Skin irritation and offensive odor · Discoloration of the work material · Decrease in life span of machine tool

• Hydraulic oil (water-glycol type) and pH

Managing pH in hydraulic fluid (water-glycol type).
In the case of fresh oil, the pH is 10.0 and pH 9.0 to 11.0 is appropriate. When it falls below pH 9.0, deterioration starts. The lower the pH value is, the more degradation progresses.

pH meter recommended model

Hand-held Type
DPH-2

Oil and Viscosity

Viscosity is a quantity expressing the magnitude of resistance in flow. By knowing the viscosity of oil, you can grasp the physical properties of the oil. There are several types of viscometer such as capillary type, falling ball type, rotating type, etc. based on detection principle. Depending on the type and standard of oil such as petroleum, lubricating oil, hydraulic fluid, select which detection principle to use the viscometer.

What is kinematic viscosity

Kinematic viscosity = viscosity / density

In the field of petroleum and lubricants, kinematic viscosity may be used , as measurement items, and it is stipulated in JIS standard.

Necessity of viscosity control

Proper viscosity is required

• Lubricating oil used for machine tools and others

Appropriate viscosity is required for each. Depending on the viscosity, processing performance and wear degree of rotating parts will change.

When a heavy load is applied

High viscosity lubricant is used. The oil film becomes strong and lubricity of the friction surface increases.

When moving at high speed

Low viscosity lubricant is used. Because it is smooth, resistance is less and more suitable.

* However, if the viscosity is too high, the resistance becomes large, and if it is too low, the oil film breaks and it becomes difficult to obtain the lubrication effect, so the balance is necessary.

• When lubricating oil or hydraulic fluid is pumped

The efficiency varies with viscosity.
The lower the viscosity, the worse the lubricity, and the higher the viscosity the poor the oil flow, the more burden the rotating parts will wear. However, when the viscosity is too high, the resistance is large, and if it is too low, the oil film breaks and it becomes difficult to obtain the lubrication effect, so the balance is necessary.

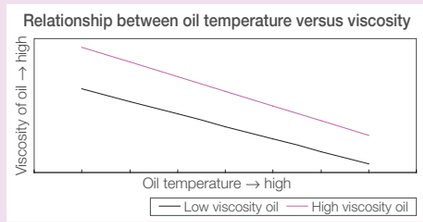
• Hydraulic fluid

Even in hydraulic fluid, as the hydraulic equipment becomes larger, use a highly viscous oil (within the range of 28.80 to 74.80 mm^2 / s in kinematic viscosity). Therefore, lubricating oil and hydraulic fluid are classified according to ISO standard according to the viscosity value in 20 stages.

ISO viscosity Grade number	Kinematic viscosity range mm^2 / s	JIS standard	Use
ISO VG2	1.98 or more and 2.42 or less	K2239 Bearing oil	bearing
ISO VG3	2.88 or more and 3.52 or less		
ISO VG5	4.14 or more and 5.06 or less	K2239 Bearing oil	bearing
ISO VG7	6.12 or more and 7.48 or less		
ISO VG10	9.00 or more and 11.00 or less	K2239 Bearing oil	bearing
ISO VG15	13.50 or more and 16.50 or less		
ISO VG22	19.80 or more and 24.20 or less	K2239 Bearing oil	bearing
ISO VG32	28.80 or more and 35.20 or less	K2213 Turbine oil 2 kinds	Gear (medium load) Sliding surface Hydraulic actuation
ISO VG46	41.40 or more and 50.60 or less	K2213 Turbine oil 2 kinds	Hydraulic actuation
ISO VG68	61.20 or more and 74.80 or less	K2213 Turbine oil 2 kinds	Gear (medium load) Sliding surface Hydraulic actuation
ISO VG100	90 or more and 110 or less	K2219 1 type for gear oil industry	
ISO VG150	135 or more and 165 or less	K2219 1 type for gear oil industry	Gear (medium load) Gear (high load) Sliding surface
ISO VG220	198 or more and 242 or less	K2219 1 type for gear oil industry	Sliding surface
ISO VG320	288 or more and 352 or less		Gear (medium load)
ISO VG460	414 or more and 506 or less		Gear (medium load)
ISO VG680	612 or more and 748 or less		
ISO VG1000	900 or more and 1100 or less		
ISO VG1500	1350 or more and 1650 or less		
ISO VG2200	1980 or more and 2420 or less		
ISO VG3200	2880 or more and 3520 or less		

* ISO VG10 to VG22 for spindle oil, ISO VG32 to VG68 for turbine oil, ISO VG 100 to 150 for motor oil, and ISO VG 220 for cylinder oil.

Viscosity varies with temperature. The higher the temperature, the lower the viscosity. Therefore, proper temperature and viscosity management is required.



Recommended viscometer model

Rotary Viscometer
VISCO™

Oil and Moisture

Hydraulic oil is an oil used as a power transmission medium among hydraulic devices used in many machinery such as machine tools, construction machinery, automobiles, ships and the like, and has functions of lubrication, rust prevention, cooling, etc. Here, we will explain the relationship between oil and moisture taking water-glycol system which is the main hydraulic oil of water based hydraulic fluid type as an example.

Relationship between hydraulic fluid, moisture and deterioration

It causes oil corrosion and machine malfunction

• Effects of reduced moisture

If hydraulic oil is continued to be used in hydraulic equipment, moisture will decrease due to evaporation caused by heat or the like.
As moisture decreases, problems such as deterioration may compromise flame retardancy.

• Adverse effects of moisture contamination

Moisture may be mixed in machine tools using water-soluble cutting oil or hydraulic machines used outdoors. Even in fresh oil, it contains about 20 to 40% moisture, but when excessive contamination occurs, it separates from the oil, rusting the moving parts and tanks, galling or clogging the valves and pumps causing cavitation by sudden change in pressure.
In addition, cutting oil additives may react with additives of hydraulic fluid, or it may become insoluble in oil, and form sticky sludge that adheres to small parts of hydraulic equipment and cause malfunctioning. As mentioned above, the change in moisture content not only promotes the decay of oil but also greatly damages the hydraulic machine itself. Therefore, it is necessary to manage the amount of water.

How to manage the moisture content

Water content can be measured using refractometers

The refractometer, PAL-Moisture can be used for simple way to measure moisture %. Keeping the moisture% of hydraulic fluid at the proper amount can improve hydraulic oil quality.

The relationship between refractive index and moisture% varies depending on the type of hydraulic fluid. The scale of the refractometer (Brix%) is a basic scale obtained by converting the refractive index into the concentration of sugar solution. Therefore, it is necessary to calculate the conversion table of actual moisture% and moisture% by refractometer for each type of hydraulic fluid as follows.

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• Example of conversion table

If the moisture is 30%, (It is written on the purchased hydraulic oil.)

① Add 10 g of water to 90 g of hydraulic oil and mix.
The moisture% of this liquid is 90 × 0.30 + 10 = 37%

② Add 20 g of water to 80 g of hydraulic oil and mix.
The moisture percentage of this liquid is 80 × 0.30 + 20 = 44%

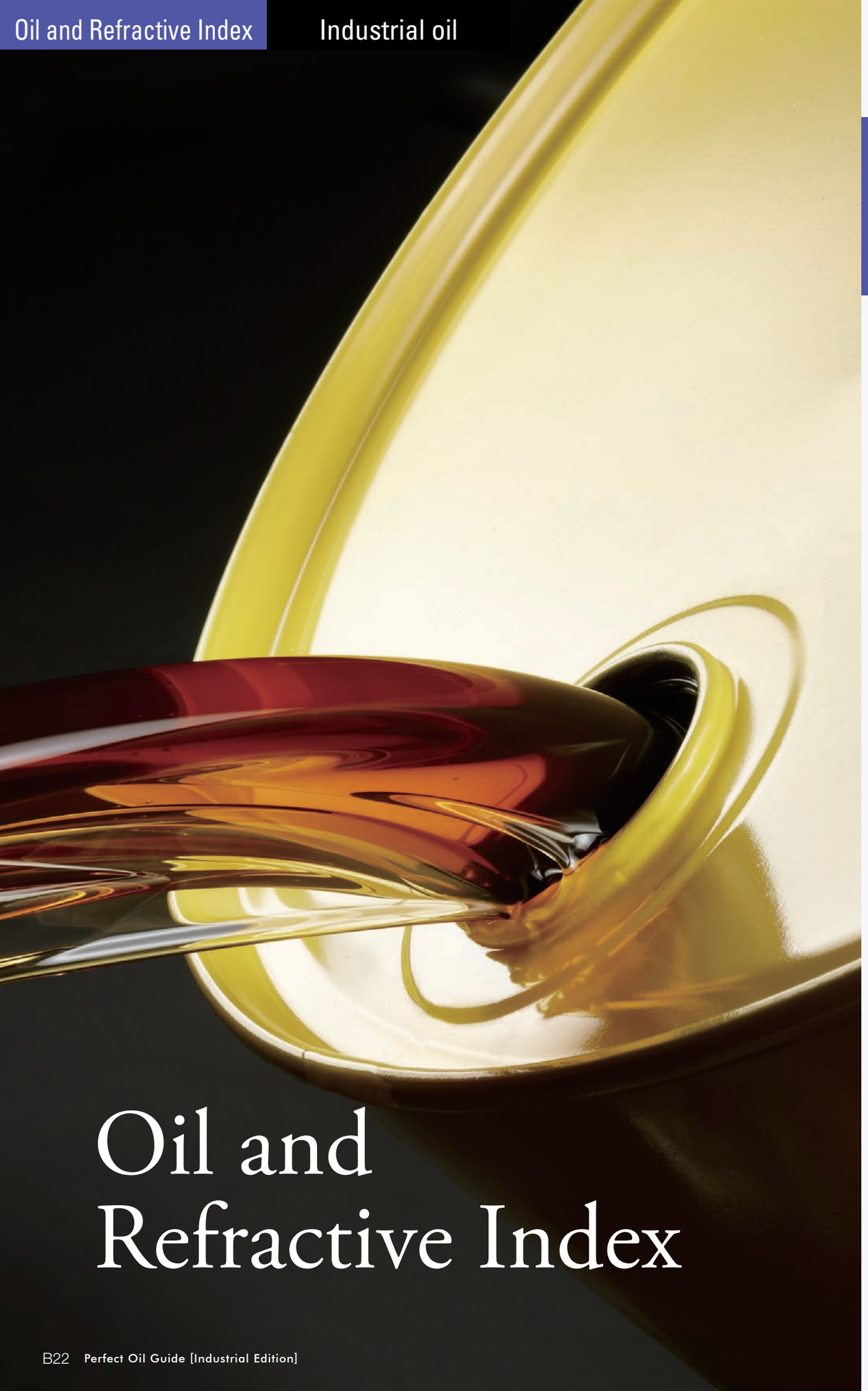
③ Measure the stock solution and the liquid of ① ② with the PAL-Moisture and obtain the moisture value of each.

④ From ③, create a graph of "% moisture to actual moisture" of the refractometer and extend the graph to the range of moisture of 30% or less to create a conversion graph.

Recommended moisture meter model

Hand-held Type	High Precision Type	In-line Refractometer
PAL-Moisture	RX-5000i-Plus	CM-800α

Brix% ····· A scale obtained by converting the refractive index into "the number of grams of sucrose contained in 100 g of sucrose solution"



Oil and Refractive Index

One of the indicators to know the physical properties of oil is the refractive index. Refractive index is an optical representation of the material's density to air (or vacuum). Specifically, it is the ratio of light speed. For example, if the speed at which light travels through an oil is 1.5 times slower than the speed at which it travels in air (or vacuum), the index of refraction of that oil will be 1.5. The refractive index depends on the physical properties and composition of the oil, so you can identify the type of oil by knowing the refractive index.

Method for measuring refractive index

Devices measuring the refractive index are called refractometers

At ATAGO, "Digital Refractometer RX" and "Abbe Refractometer" are available for high-precision measurement, "Pocket Refractometer PAL" and "Hand-held Refractometer" for easy measurement. As the refractive index varies with temperature, it may be measured at a predetermined temperature. Depending on the type of oil, it is often measured at 20°C, 23°C and 25°C. For some types of lubricating oil, the melting point temperature is high and it is sometimes measured at 40°C or 70°C.

One example refractive index of industrial oil

Oil type	Refractive index (25°C)
Crude oil	1.460 to 1.530
Diesel #1	1.459 to 1.465
A heavy oil	1.461 to 1.486
B heavy oil	1.505 to 1.519
C heavy oil	1.515 to 1.542
Lubricant	1.480 to 1.518
Gasoline (regular)	1.421 to 1.429
Gasoline (high octane)	1.433
Kerosene	1.447

Reference) Japanese Industrial Standard related to refractive index measurement
JIS C2101 Electric insulating oil test method
JIS K0062 Method for measuring the refractive index of chemical products
JIS K0517 Method for measuring refractive index of high purity hydrocarbon

Recommended refractometer model

Hand-held Type	Abbe Refractometer	High Precision Type
PAL-RI	DR-A1-Plus	RX-5000i-Plus
	NAR-2T In the case of high temperature measurement	RX-7000i In case of wide range measurement

Cleaning Solution

Types and Uses

Quality control of cleaning agent is import as it becomes unclean as they are used like industrial oils. Like industrial oil, quality control of cleaning agent is important as it becomes unclean with use. There are various types of contamination, such as dust in the air, particulate contamination such as cutting powder and polishing powder, oil such as processing oil, organic contamination such as solder flux, adhesive, release agent, etc., and inorganic contamination such as oxide film from the metal surface. Cleaning agents are roughly divided into three types: water-based cleaning agent, semi-aqueous based cleaning agent, and non-aqueous cleaning agent according to its components and action.

Water-based cleaning agent
- Alkaline
- Acid
- Neutral

Semi-aqueous based cleaning agent
- Non-Aqueous mixture

Non-aqueous cleaning agent
- Hydrocarbon type
- Alcohol type
- Silicone type
- Fluorine type
- Chlorinated
- Other

Water-based cleaning agent

Classified as acidic, alkaline, and neutral

Water based detergent contains surfactant as an essential ingredient with water as a solvent.
It is classified as acidic, neutral, alkaline according to pH.
Alkaline base has been used mainly as a result of the strength of detergency, but with performance improvement of the neutral type, and for safety factor as well, it is more commonly used.

Acidic type

Due to safety to the human body and concerns of metal corrosion, it is limited to some uses such as scale removal and precleaning before plating.

Neutral type

It is generally applied to nonferrous light metals such as copper and aluminum, stainless steel and glass resin, which is suitable for removing aqueous processing oil, low viscosity oil processing oil, dust and the like.

Alkaline type

It is the most widely used detergent in the metal industry, and it is effective for rust preventive oil which is hard to remove in neutral system, oil-based processing oil with high viscosity, inorganic and particulate contamination.

Semi-aqueous based cleaning agent

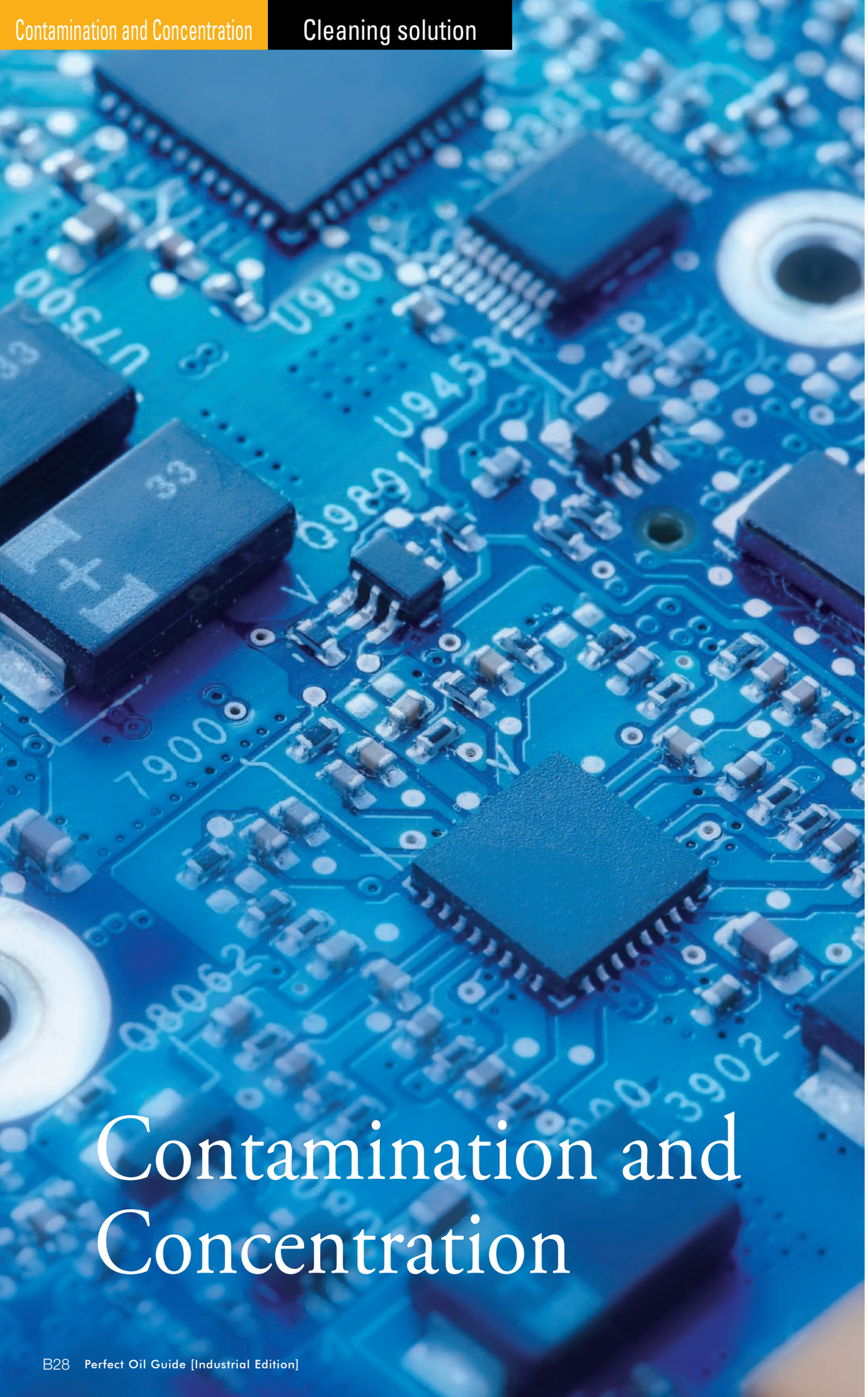
Aqueous and solvent based cleaning agent

Semi-aqueous based cleaning agent is a type of cleaning agent that combines organic solvent and water. It is excellent for cleaning flux and wax. Because it is relatively expensive, it is usually used for washing components such as substrates, electronic parts, liquid crystals that require particular reliability. Glycol ether type and N-methyl-2-pyrrolidone (NMP) are classified as non-hazardous that contain about 5 to 25% of water in solvent and do not show flash point for fire hazard.

Non-aqueous cleaning agent

Hydrocarbon and chlorine cleaning agents are mainstream

Non-aqueous detergents are categorized according to their structure and inflammability, etc. The common types are hydrocarbon and chlorine cleaning agent. Although it is flammable, hydrocarbon cleaners are very popular because a technology to safely use it is well established, low in toxicity, inexpensive, and recyclable. In the past, there were not much variety of washing solution were available as it is now, and kerosene was used to clean the metal parts. Many people may remember wiping the cloth with kerosene for oil dropping of the bicycle chain. From this, even now days, kerosene is used to clean metal plates, metal rods and metal parts. Caution is required as it is flammable.



Contamination and Concentration

Concentration control of water-based cleaning agent

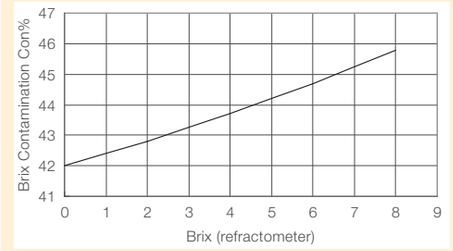
Dilution concentration is measured with refractometer

Depending on the application and type, the water-based cleaning agent is diluted 10 to 100 times with water, but it should be diluted to the proper concentration in order to maximize the effect. Also, as the number of times of washing increases, the washing liquid in use becomes dirty and detergency drops, so it is necessary to add new washing liquid or replace it with fresh oil. Refractometers are active at such initial dilution and periodic inspection during use.

Concentration control of Semi-aqueous based cleaning agent

Grasp flux mixing concentration% with refractometer

For example, in the manufacture of electronic boards, after attaching the electronic parts to the board, washing with flux removal of lead-free solder is done. In the washing process, the substrates flow one by one through the washing tank, the rinse tank, and the hot air drying tank in the order of washing → rinsing → drying. At the beginning, clean cleaning liquid, when repeating washing, the flux melts into the liquid, and if it dissolves more than a certain ratio the cleaning effect will drop and exchange. A refractometer works effectively when grasping the flux mixing concentration% at this time. The graph below is a conversion graph between the refractometer reading (Brix) and the flux mixed concentration%.



* This is one of the example. Conversion depends on liquid type

Concentration management of Semi-aqueous based cleaning agent

Degree of contamination for hydrocarbon-based cleaning liquid

Degree of contamination is explained by taking a hydrocarbon-based cleaning liquid which is mainstream in precision cleaning of industrial products as an example among Non-aqueous cleaning agents.
Hydrocarbon is a generic term for compounds consisting solely of carbon and hydrogen, and its kind exists in countless numbers depending on the number of carbons and structure. Many hydrocarbon-based detergents currently in use are not merely refined crude petroleum but rather purified refined or chemically synthesized and used as undiluted solution. Cleaning solution filled in the cleaning tank is brought in by contamination by washing parts, and the cleaning effect diminishes. In order to continue stable washing, it is necessary to check the degree of contamination so as not to use a cleaning agent that is dirty over a certain ratio. A refractometer is utilized as a method. Although the refraction index of the processing oil and the refraction index of the cleaning solution are different, since the refractive index of the liquid in which the two are mixed is proportional to the mixing ratio, the concentration of the contaminant substance can be estimated. Since the refractive index varies depending on the measurement temperature, temperature correction is required, but if you use a refractometer with a temperature correction function, you can easily find the degree of contamination. By confirming the degree of contamination, it is possible to maintain long-term cleaning performance and greatly reduce the amount of detergent used and waste fluid throughput.

Refractometer recommended model

Types of cleaning solution	Hand-held Type	High Precision Type	In-line Refractometer
Water-based cleaning agent	PAL-Cleaner	PAL-5000i-Plus RX-007α For very low concentration	CM-800α CM-BASEα PRM-2000α For very low concentration
Semi-aqueous based cleaning agent	PAL-α	PAL-5000i-Plus	CM-800α CM-BASEα
Non-aqueous cleaning agent	PAL-Hydrocarbon Cleaner For measuring dirty tank	PAL-5000i-Plus For measuring clean tank	

Product Lineup

PRODUCTS

Concentration Meter

	PAL-1	PAL-α	PAL-S	PAL-102S	PAL-AntiRust	PAL-Release Agent
						
Cat.No.	3810	3840	3860	4502	4537	4538
Measurement Items	Brix	Brix	Brix	Cutting oil	Anti-rust agent	Release agent

Concentration Meter

	PAL-Cleaner	PAL-Hydrocarbon Cleaner	MASTER-53S	NASTER-20α	PR-101α	PR-201α
						
Cat.No.	4536	4558	2355	2381	3442	3452
Measurement Items	Cleaning solution	Contam.	Brix	Brix	Brix	Brix

In-line Refractometer

	CM-800α	CM-BASEα	CM-BASEβ	PAN-1DC
				
Cat.No.	3564	(A)3603 (D)3604	(A)3616 (D)3626	PAN-1DC 3606, (M)3607, (L)3608
Measurement Items	Brix	Brix	Brix	Brix

pH Meter

	DPH-2
	
Cat.No.	4320
Measurement Items	pH

Moisture Refractometer

	PAL-Moisture
	
Cat.No.	4573
Measurement Items	Moisture content = 100 – Brix

Viscometer

	VISCO™
	
Cat.No.	6800
Measurement Items	Viscosity Torque

Refractometer / Concentration Meter

	PAL-RI	DR-A1-Plus	RX-5000i-Plus	RX-007α
				
Cat.No.	3850	1311	3275	3921
Measurement Items	Refractive Index	Refractive Index (nD) Brix	Refractive Index (nD) Brix 100 user scales	Refractive Index (nD) Brix 30 user scales

* For details such as piping list, please refer to "Inline Refractometer Guide."

Concentration Meter

NFC (Near Field Communication)
Measurement history (up to 100 items) can be read by touching a contactless IC card reader / writer connected to an Android smartphone or a personal computer.

* The N-Mark is a trademark or registered trademark of NFC Forum, Inc. in the United States and in other countries.

Output
NFC Forum Type 4 Tag
ISO/IEC 14443 Type A
Output category Date Time, Brix [%] ,Temp [degC]
(e.g.) 2017/08/17 09:30:45, 12.3, 20.4

* Scheduled to be installed sequentially.

NFC Equipped Model

0.0 to 53.0 Brix

PAL-1

Digital Hand-held
"Pocket" Refractometer

NFC Equipped Model

Wide Brix Range

PAL-α

Digital Hand-held
"Pocket" Refractometer

Mode S
The function to suppress variation (Mode S) is carried.

NFC Equipped Model

Improved Repeatability

PAL-S

Digital Hand-held
"Pocket" Refractometer

NFC Equipped Model

Cutting Oil

PAL-102S

Digital Hand-held "Pocket"
Cutting oil Refractometer

Measurement Items	Brix
Measurement Range	Brix: 0.0 to 53.0% (Automatic Temperature Compensation)
Measurement Accuracy	Brix: ±0.2%

Specifications

Cat.No.	3810
Model name	PAL-1
Measurement range	Brix : 0.0 to 53.0% Temperature : 10.0 to 100℃
Resolution	Brix : 0.1% Temperature : 0.1℃
Measurement accuracy	Brix : ±0.2% Temperature : ±1℃
Temperature compensation range	10 to 100℃
Ambient temperature	10 to 40℃
Power supply	Size AAA alkaline battery × 2
International protection class	IP65 Water resistant
Dimension and weight	5.5(W)× 3.1(D) ×10.9(H) cm, 100g (Main unit only)

Measurement Items	Brix
Measurement Range	Brix: 0.0 to 85.0% (Automatic Temperature Compensation)
Measurement Accuracy	Brix: ±0.2%

Specifications

Cat.No.	3840
Model name	PAL-α
Measurement range	Brix : 0.0 to 85.0% Temperature : 10.0 to 100℃
Resolution	Brix : 0.1% Temperature : 0.1℃
Measurement accuracy	Brix : ±0.2% Temperature : ±1℃
Temperature compensation range	10 to 100℃
Ambient temperature	10 to 40℃
Power supply	Size AAA alkaline battery × 2
International protection class	IP65 Water resistant
Dimension and weight	5.5(W)× 3.1(D) ×10.9(H) cm, 100g (Main unit only)

Measurement Items	Brix
Measurement Range	Brix: 0.0 to 93.0% (Automatic Temperature Compensation)
Measurement Accuracy	Brix: ±0.2%

Specifications

Cat.No.	3860
Model name	PAL-S
Measurement range	Brix : 0.0 to 93.0% Temperature : 10.0 to 100℃
Resolution	Brix : 0.1% Temperature : 0.1℃
Measurement accuracy	Brix : ±0.2% Temperature : ±1℃
Temperature compensation range	10 to 100℃
Ambient temperature	10 to 40℃
Power supply	Size AAA alkaline battery × 2
International protection class	IP65 Water resistant
Dimension and weight	5.5(W)× 3.1(D) ×10.9(H) cm, 100g (Main unit only)

Measurement Items	Cutting oil
Measurement Range	Cutting oil: 0.0 to 70.0% (Automatic Temperature Compensation)
Measurement Accuracy	Cutting oil: ±0.2%

Specifications

Cat.No.	4502
Model name	PAL-102S
Measurement range	Cutting oil : 0.0 to 70.0% Temperature : 10.0 to 75.0℃
Resolution	Cutting oil : 0.1% Temperature : 0.1℃
Measurement accuracy	Cutting oil : ±0.2% Temperature : ±1℃
Temperature compensation range	10 to 75℃
Ambient temperature	10 to 40℃
Power supply	Size AAA alkaline battery × 2
International protection class	IP65 Water resistant
Dimension and weight	5.5(W)× 3.1(D) ×10.9(H) cm, 100g (Main unit only)

NFC Equipped Model

Anti-rust

PAL-AntiRust

Digital Hand-held “Pocket”
Anti-rust Refractometer

Measurement Items Anti-rust

Measurement Range Anti-rust: 0.00 to 25.00%
(Automatic Temperature Compensation)

Measurement Accuracy Anti-rust: ±0.10%

Specifications

Cat.No.	4537
Model name	PAL-AntiRust
Measurement range	Anti-rust : 0.00 to 25.00% Temperature : 10.0 to 100˚C
Resolution	Anti-rust : 0.01% Temperature : 0.1˚C
Measurement accuracy	Anti-rust : ±0.10% Temperature : ±1˚C
Temperature compensation range	10 to 100˚C
Ambient temperature	10 to 40˚C
Power supply	Size AAA alkaline battery × 2
International protection class	IP65 Water resistant
Dimension and weight	5.5(W)× 3.1(D) ×10.9(H) cm, 100g (Main unit only)

NFC Equipped Model

Release Agent

PAL-Release Agent

NEW

Digital Hand-held “Pocket”
Release agent Refractometer

Measurement Items Release agent

Measurement Range Release agent: 0.00 to 25.00%
(Automatic Temperature Compensation)

Measurement Accuracy Release agent: ±0.10%

Specifications

Cat.No.	4538
Model name	PAL-Release Agent
Measurement range	Release agent : 0.00 to 25.00% Temperature : 10.0 to 100˚C
Resolution	Release agent : 0.01% Temperature : 0.1˚C
Measurement accuracy	Release agent : ±0.10% Temperature : ±1˚C
Temperature compensation range	10 to 100˚C
Ambient temperature	10 to 40˚C
Power supply	Size AAA alkaline battery × 2
International protection class	IP65 Water resistant
Dimension and weight	5.5(W)× 3.1(D) ×10.9(H) cm, 100g (Main unit only)

NFC Equipped Model

Cleaner

PAL-Cleaner

Digital Hand-held “Pocket”
Cleaner Refractometer

Measurement Items Cleaner

Measurement Range Cleaner: 0.00 to 25.00%
(Automatic Temperature Compensation)

Measurement Accuracy Cleaner: ±0.10%

Specifications

Cat.No.	4536
Model name	PAL-Cleaner
Measurement range	Cleaner : 0.00 to 25.00% Temperature : 10.0 to 100˚C
Resolution	Cleaner : 0.01% Temperature : 0.1˚C
Measurement accuracy	Cleaner : ±0.10% Temperature : ±1˚C
Temperature compensation range	10 to 100˚C
Ambient temperature	10 to 40˚C
Power supply	Size AAA alkaline battery × 2
International protection class	IP65 Water resistant
Dimension and weight	5.5(W)× 3.1(D) ×10.9(H) cm, 100g (Main unit only)

NFC Equipped Model

Hydrocarbon Cleaner Contamination

PAL-Hydrocarbon Cleaner

Digital Hand-held “Pocket” Hydrocarbon
Cleaner Contamination Refractometer

Measurement Items Hydrocarbon cleaner contamination

Measurement Range Contam.: 0.0 to 30.0%
(Automatic Temperature Compensation)

Measurement Accuracy Contam.: ±1.0%

Specifications

Cat.No.	4558
Model name	PAL-Hydrocarbon Cleaner
Measurement range	Contam. : 0.0 to 30.0% Temperature : 10.0 to 10.0˚C
Resolution	Contam. : 0.1% Temperature : 0.1˚C
Measurement accuracy	Contam. : ±1.0% Temperature : ±1˚C
Temperature compensation range	10 to 100˚C
Ambient temperature	10 to 40˚C
Power supply	Size AAA alkaline battery × 2
International protection class	IP65 Water resistant
Dimension and weight	5.5(W)× 3.1(D) ×10.9(H) cm, 100g (Main unit only)

Left 0.2% Right 0.5%
inclement double scale.

Milky Sample

MASTER-53S

Hand-held Milky sample Refractometer

In the conventional hand-held refractometer, it is a hand-held refractometer specialized for cloudy samples where the boundary line was unclear and difficult to read.

Measurement Items Brix

Measurement Range Brix: 0.0 to 53.0%
(Automatic Temperature Compensation)

Measurement Accuracy Brix: ±0.2% (at 20˚C)

Specifications

Cat.No.	2355
Model name	MASTER-53S
Measurement range	Brix : 0.0 to 53.0%
Minimum scale	Brix : 0.2% (Left 0.2%, Right 0.5%)
Measurement accuracy	Brix : ±0.2% (at 20˚C)
Repeatability	Brix : ±0.1% (at 20˚C)
International protection class	IP65 Water resistant
Dimension and weight	3.2(W)× 3.4(D) ×16.8(H) cm,130g

Low Concentration

MASTER-20α

Hand-held Refractometer

It is a model developed for low concentration Brix 20% and below.

Measurement Items Brix

Measurement Range Brix: 0.0 to 20.0%
(Automatic Temperature Compensation)

Measurement Accuracy Brix: ±0.2% (10 to 30˚C)

Specifications

Cat.No.	2381
Model name	MASTER-20α
Measurement range	Brix : 0.0 to 20.0%
Minimum scale	Brix : 0.1%
Measurement accuracy	Brix : ±0.2% (10 to 30˚C)
Repeatability	Brix : ±0.1%
International protection class	IP65 Water resistant
Dimension and weight	3.2(W)× 3.4(D) ×20.7(H) cm,165g

Low & Middle Concentration

PR-101α

Digital Refractometer

High accuracy (±0.1%) available in a compact model.

Measurement Items Brix

Measurement Range Brix: 0.0 to 45.0%
(Automatic Temperature Compensation)

Measurement Accuracy Brix: ±0.1%

Specifications

Cat.No.	3442
Model name	PR-101α
Measurement range	Brix : 0.0 to 45.0%
Resolution	Brix : 0.1%
Measurement accuracy	Brix : ±0.1%
Temperature compensation range	5 to 40˚C
Ambient temperature	Equivalent to temperature compensation range.
Power supply	006P dry battery (9V)
International protection class	IP64 Water resistant
Dimension and weight	17(W)× 9(D) ×4(H) cm,300g (Main unit only)

Wide Range

PR-201α

Digital Refractometer

It is a compact and highly accurate digital concentration meter.

Measurement Items Brix

Measurement Range Brix: 0.0 to 60.0%
(Automatic Temperature Compensation)

Measurement Accuracy Brix: ±0.1%

Specifications

Cat.No.	3542
Model name	PR-201α
Measurement range	Brix : 0.0 to 60.0%
Resolution	Brix : 0.1%
Measurement accuracy	Brix : ±0.1%
Temperature compensation range	10 to 40˚C
Ambient temperature	Equivalent to temperature compensation range.
Power supply	006P dry battery (9V)
International protection class	IP64 Water resistant
Dimension and weight	17(W)× 9(D) ×4(H) cm,300g (Main unit only)

In-line Brix Monitor

CM-800α

PROFIBUS compatible

VARIVENT compatible

High temperature resistant, lightweight, compact, yet reasonable

- Continuous measurement inline, monitoring concentration and mixing ratio
- Compatible with various types of fittings such as straight type, L shape and tube diameter

Packing contents

· Main unit	1
· Power (DC24V) cable	1
· O-ring (Silicon)	1
· O-ring (EPDM)	1
· Instruction manual	1
· Inspection certificate	1

<Front: display section>

<Back: detection section>

Measurement Items	Measurement Range	Measurement Accuracy
Brix	Brix: 0.00 to 80.0% (Automatic Temperature Compensation)	Brix: ±0.1% (at Brix: 0.00 to 80.0%)

CM series

In-line Ethylene Glycol Monitor

CM-800α-EG Cat.No. 3531

• E.G. • Freezing point

In-line Propylene Glycol Monitor

CM-800α-PG Cat.No. 3532

• P.G. • Freezing point

Specifications

Cat.No.	3564
Model name	CM-800α
Measurement range	Brix: 0.00 to 80.0% Temperature: -15 to 160°C/5 to 320°F
Resolution	Brix: 0.01 or 0.1% (by selection; 0.00 to 9.99%) Brix: 0.1% (10.0 to 80.0%) Temperature: 1°C/1°F
Measurement accuracy	Brix: ±0.1% (based on sucrose solution) Temperature: ±1°C/±1°F
Temperature compensation range	5.0 to 100.0°C (Automatic Temperature Compensation range)
Ambient temperature	5 to 40°C
Indication	Brix: -2.0 to 80.5%
Source	LED (Approximating to D-Line wavelength)
Measurement Interval (Same as output interval)	Approx. 1 second per measurement (factory default). There are 5 options of the interval.
Temperature sensor	Thin film platinum sensor

Materials in contact with the solution	Prism: Artificial sapphire Prism stage: SUS316L
Resistible pressure on the prism unit	0.98MPa (10kgf/cm²)
Output method	· Recorder output: DC 4 to 20mA Any value between Brix 1% through 80% can be set. Temperature: -15.5 to 160.5°C = 4 to 20mA · RS-232C output
Power supply	DC24V (Allowable fluctuation is ±10%) AC adapter AD-32, AD-33 or AD-34 (optional): AC 100-240V 50/60Hz
Power consumption	3VA
International protection class	IP67 Water resistant
Dimensions and weight	16×16.7×11cm, 2.4kg (Main unit only)

[* 1] DC cables can be ordered up to 5 m. Please inquire for pricing information.

In-line Refractometer

check **The material of the wetted part can be custom ordered**

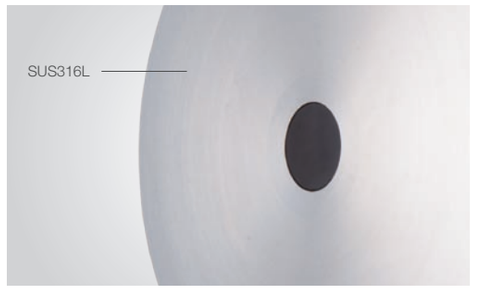
Past results: Titanium, Hastelloy etc * Please contact our sales department for details.

SUS (standard specification)	Titanium	Hastelloy
Stainless steel with high strength and excellent corrosion resistance. Sanitary specification.	Metal with high strength, light weight, corrosion resistance, heat resistance. In particular, it has higher corrosion resistance to salt than the stainless steel.	Alloy with high corrosion resistance and heat resistance. Especially, it is resistant to hydrochloric acid and sulfuric acid, and it is corrosion resistant even at high temperature. * Hastelloy is a trademark of Haines Corporation, USA.

CM-800α Features

Strong adhesion of oil film system

SUS316L was adopted as the wetted part, and the prism stage is full flat. It is highly resistant to adhesion of oil such as cutting oil and floating oil contained in cleaning liquid.



Responsive to the era of IoT

Equipped with recorder output (4 to 20mA) and RS-232C output, it can be automatically controlled as an IoT device in conjunction with an external device.

Simple and easy to use

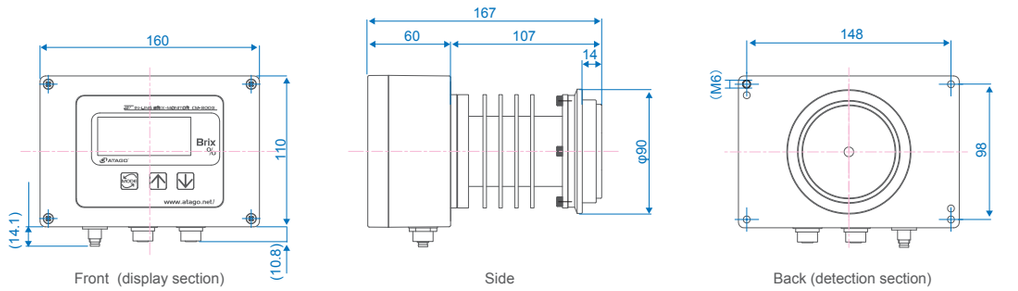
When ↓ key is pressed during Brix measurement, the measured temperature (liquid temperature) is displayed.

With automatic temperature correction function

Temperature correction can be set according to the sample solution, so that the correct concentration (Brix%) is always displayed and outputted even if the solution temperature changes.

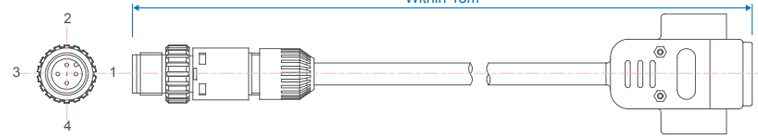
Dimensions (unit of length: mm)

* For details such as piping list, please refer to "Inline Refractometer Guide.



Front (display section) Side Back (detection section)

RS-232C output

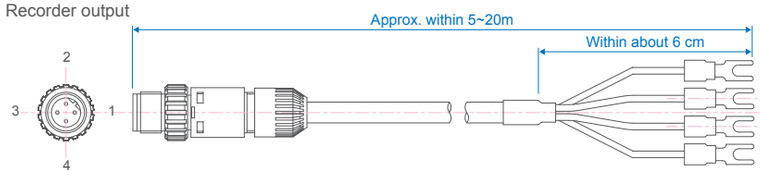


Pin number	Cord color
1	Black
2	Black / White

Pin number	Cord color
3	Red
4	Shield

Pin number	Cord color	Signal
2	Black	TXD
3	Black / White	RXD
5	Red	S.GND
7	Fold	
8		

Recorder output



Pin number	Cord color	Polarity
1	Red	Brix +
2	Red / White	Brix -
3	Black	Temperature +
4	Black / White	Temperature -

In-line Brix Monitor

CM-BASEα

PROFIBUS compatible *(D)only

VARIVENT compatible

Measure the concentration of water-soluble cutting oil etc. continuously

- Compact inline model with φ90 mm
- Monitor concentrations and mixing ratios

Packing contents
CM-BASEα(A)

- Main unit ····· 1
- Power and Recorder output cable ····· 1
- O-ring (Silicon) ····· 1
- O-ring (EPDM) ····· 1
- Bracket ····· 1
- Instruction manual ····· 1
- Inspection certificate ··· 1

Packing contents
CM-BASEα(D)

- Main unit ····· 1
- Power and RS-232C cable ····· 1
- O-ring (Silicon) ····· 1
- O-ring (EPDM) ····· 1
- Bracket ····· 1
- Instruction manual ····· 1
- Inspection certificate ··· 1

<Front: display section>

<Back: detection section>

Measurement Items	Brix	Measurement Range	Brix: 0.0 to 33.0% (Automatic Temperature Compensation)	Measurement Accuracy	Brix: ±0.5% (at Brix: 0.0 to 33.0%)

Specifications

Cat.No.	3603	3604
Model name	CM-BASEα(A)	CM-BASEα(D)
Measurement range	Brix: 0.0 to 33.0%	
Resolution	Brix: 0.1%	
Measurement accuracy	Brix: ±0.5% (at Brix: 0.0 to 33.0%)	
Temperature compensation range	10 to 50°C	
Ambient temperature	5 to 40°C	
Indication	Brix: -2.0 to 33.5%	
Source	LED (Approximating to D-Line wavelength)	
Measurement Interval	Approx. 2 seconds	
Temperature sensor	Thin film platinum sensor	
Materials in contact with the solution	Prism: Sapphire Prism stage: SUS316L	
Resistible pressure on the prism unit	0.98MPa (10kgf/cm²)	

Output method	DC 4 to 20mA	RS-232C
Power supply	DC24V (Allowable fluctuation is ±10%)	
Power consumption	0.6VA	
International protection class	IP64 Water resistant	
Dimensions and weight	9×9×5.79cm, 820g (Main unit only)	

CM-BASEα (A)

The Brix value is output with a current of 4 to 20 mA DC, and Brix: -2.0 to 33.5% = DC 4 to 20 mA. Cable can be extended by option.

CM-BASEα (D)

Brix value is output by RS - 232C. Cable can be extended by option..

Communications parameters	Baud rate: 2400bps Data length: 7bit	Parity: Even Stop bit: 1bit	
Transmit data	Brix,temperature	Brix 19.5% Temp. 20.3°C	19.5, 20.3

check **The material of the wetted part can be custom ordered**

Past results: Titanium, Hastelloy etc * Please contact our sales department for details.

SUS (standard specification)	Titanium	Hastelloy
Stainless steel with high strength and excellent corrosion resistance. Sanitary specification.	Metal with high strength, light weight, corrosion resistance, heat resistance. In particular, it has higher corrosion resistance to salt than the stainless steel.	Alloy with high corrosion resistance and heat resistance. Especially, it is resistant to hydrochloric acid and sulfuric acid, and it is corrosion resistant even at high temperature. * Hastelloy is a trademark of Haines Corporation, USA.

CM-BASEα Features

Two models are available according to output method

There are two models CM-BASEα(A) that outputs the Brix value with a current of 4 to 20 mA and CM -BASEα(D) that outputs the Brix value and temperature with RS-232C.

Indicator lamp notification

You can see at a glance with indicator lights.
Green: Blinks while zero is being adjusted, and lights during measurement.
Red: Blinks or lights up when an error occurs.

Bracket included

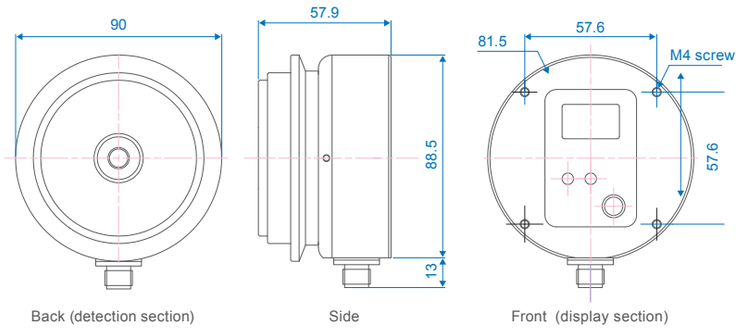
A bracket that makes installation easier on site is included. It can be installed in any direction, up, down, left or right.

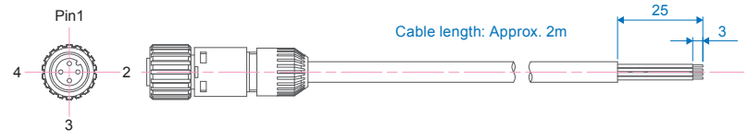
Selected for IoT tool and recipe for small and medium-sized manufacturing industry

A tool selected by small and medium-sized manufacturing industry that can be used easily at low cost.

Dimensions (unit of length: mm)

* For details such as piping list, please refer to "Inline Refractometer Guide.





CM-BASEα(A)

Pin number	Cord color	Signal
1	Red ●	DC24V input
2	Black / White ●○	GND (DC4 to 20mA)
3	Black ●	GND (DC24V)
4	Red / White ●○	DC4 to 20mA output

CM-BASEα(D)

Pin number	Cord color	Signal
1	Red ●	DC24V input
2	Black / White ●○	GND (RS-232C)
3	Black ●	GND (DC24V)
4	Red / White ●○	RS-232C

In-line Brix Monitor

CM-BASEβ

PROFIBUS compatible
*(D)only

Concentration monitor that can be used at the edge of the tank

- Monitor concentrations and mixing ratios
- Power supply and electric output cable are put together into one

Packing contents
CM-BASEβ(A)

- Main unit ····· 1
- Power and Recorder output cable ····· 1
- Instruction manual ····· 1
- Inspection certificate ··· 1

Packing contents
CM-BASEβ(D)

- Main unit ····· 1
- Power and RS-232C cable ····· 1
- Instruction manual ····· 1
- Inspection certificate ··· 1

<Front: display section>

<Side>

Measurement Items	Measurement Range	Measurement Accuracy
Brix	Brix: 0.0 to 33.0% (Automatic Temperature Compensation)	Brix: ±0.5% (at Brix 0.0 to 33.0%)

Specifications

Cat.No.	3616	3626
Model name	CM-BASEβ(A)	CM-BASEβ(D)
Measurement range	Brix: 0.0 to 33.0%	
Resolution	Brix: 0.1%	
Measurement accuracy	Brix: ±0.5% (at Brix 0.0 to 33.0%)	
Temperature compensation range	10 to 50°C	
Ambient temperature	5 to 40°C	
Indication	Brix: -2.0 to 33.5%	
Source	LED (Approximating to D-Line wavelength)	
Measurement Interval	Approx. 2 seconds	
Temperature sensor	Thin film platinum sensor	
Materials in contact with the solution	Prism: Sapphire Prism stage: Aluminum	
Output method	DC 4 to 20mA	RS-232C
Power supply	DC24V (Allowable fluctuation is ±10%)	

Power consumption	0.6VA
International protection class	JIS-C 0920 class 5 sprayer jet type (the prism head part is class 7 water weight) IEC standard 529 IP 65 (prism head part is IP 67)
Dimensions and weight	9×9×5.77+20cm, 873g (Main unit only)

CM-BASEβ(A)

The Brix value is output with a current of 4 to 20 mA DC, and Brix: -2.0 to 33.5% = DC 4 to 20 mA. Cable can be extended by option.

CM-BASEβ(D)

Brix value is output by RS - 232C. Cable can be extended by option.

Communications parameters	Baud rate: 2400bps Data length: 7bit	Parity: Even Stop bit: 1bit	
Transmit data	Brix,temperature	Brix 19.5% Temp. 20.3°C	19.5, 20.3

check **The rod length of the mounting part can be custom ordered**

* Please contact our sales department for details.

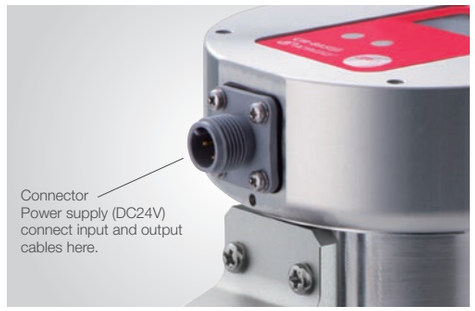
CM-BASEβ Features

Two models are available according to output method

Output of DC 4 to 20 mA which was not possible with PAN-1 DC though the same mounting method is possible.
There are two models CM-BASEβ(A) which outputs Brix value with current value of DC 4 to 20 mA and CM-BASEβ(D) which outputs Brix value and temperature by RS-232C.

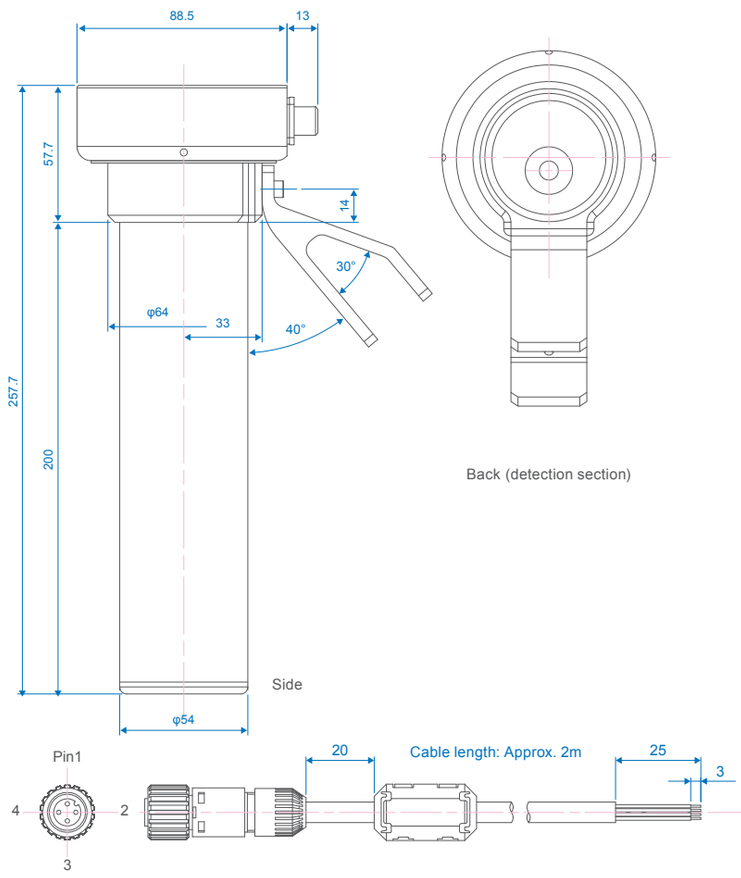
Light body

The material of the body uses light weight and durable aluminum. Thereby reducing costs. It is easier to use than ever.



Dimensions (unit of length: mm)

* For details such as piping list, please refer to "Inline Refractometer Guide.



CM-BASEβ(A)

Pin number	Cord color	Signal
1	Red ●	DC24V input
2	Black / White ●○	GND (DC4 to 20mA)
3	Black ●	GND (DC24V)
4	Red / White ●○	DC4 to 20mA output

CM-BASEβ(D)

Pin number	Cord color	Signal
1	Red ●	DC24V input
2	Black / White ●○	GND (RS-232C)
3	Black ●	GND (DC24V)
4	Red / White ●○	RS-232C

Digital Immersion Refractometer

PAN-1DC

Continuous measurement is possible without any special equipment

- No special equipment is needed for the set-up
- Monitor concentrations and mixing ratios
- Changes are not overlooked with constant management

Just hook

Packing contents

- Main unit 1
- Power and RS-232C cable 1
- Instruction manual 1

Measurement Items	Measurement Range	Measurement Accuracy
Brix	Brix: 0.0 to 42.0% (Automatic Temperature Compensation)	Brix: ±0.2%

Specifications

Model name/Cat.No.	PAN-1DC	: 3606
	PAN-1DC (M)	: 3607
	PAN-1DC (L)	: 3608
Measurement range	Brix	: 0.0 to 42.0%
	Temperature	: 10.0 to 99.9°C
Resolution	Brix	: 0.1%
	Temperature	: 0.1°C
Measurement accuracy	Brix	: ±0.2%
	Temperature	: ±0.5°C
Measurement Interval	Automatically measures again in 35 seconds.	
Temperature compensation range	10 to 95°C	
Ambient temperature	10 to 45°C	

Output method	RS-232C output
Transmit data	Temperature, Brix Example) Temperature 20.3°C Brix 19.5% → 20.3, 19.5
Power supply	DC 24V (Allowable fluctuation is ±10%)
Power consumption	0.6VA
International protection class	JIS-C 0920 class 5 sprayer jet type (the prism head part is class 7 water weight) IEC standard 529 IP 65 (prism head part is IP 67)
Dimensions and weight	PAN-1DC : 8.×30×7.2cm, 680g (Main Unit only) PAN-1DC (M) : 8.×40×7.2cm, 710g (Main Unit only) PAN-1DC (L) : 8.×60×7.2cm, 780g (Main Unit only)

check **The rod length of the mounting part can be custom ordered**

The PAN-1DC's rod length can be extended up to 120cm in 10cm increments.

* Please contact our sales department for details.

Cat.No.3609 Rod Length: 60cm, 70cm, 80cm, 90cm, 100cm, 110cm, 120cm

* All other specifications are the same as tha PAN-1DC.

PAN-1DC Features

Automatic continuous measurement allows for continual management

Once START is pressed, the unit continues to take measurements every 35 seconds.

Rugged construction for reliable long-term performance!

The immersed part is made of SUS 316L stainless-steel.

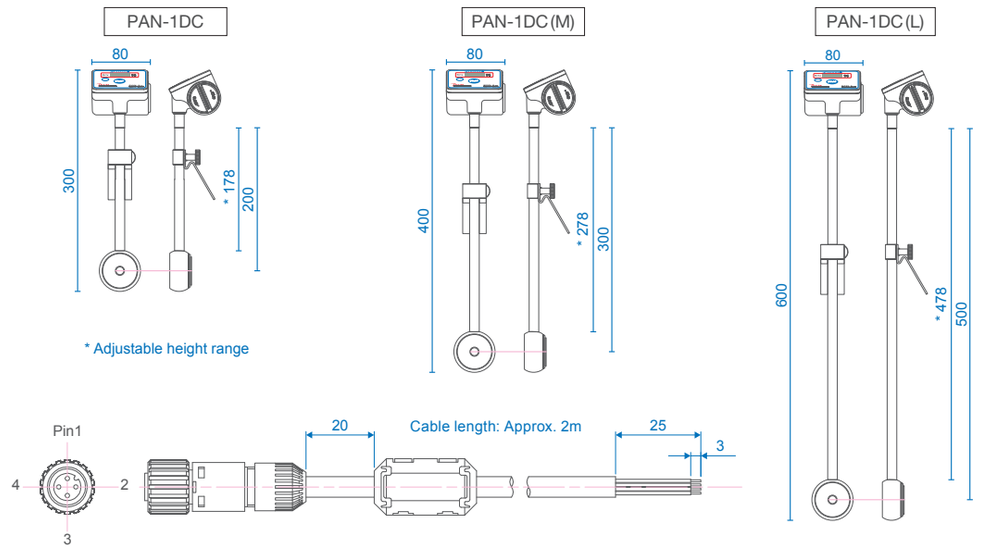
Simply clip onto the edge of a tank

It can be carried and can be installed just by hooking it on the tank edge. Continuous measurement is possible without any special equipment.

Dimensions (unit of length: mm)

* For details such as piping list, please refer to "Inline Refractometer Guide.

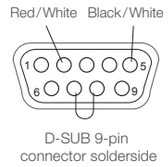
Choose from 3 options the length best suited for your application.



Connecting the cable to the PAN-1DC's connector located on the side provides power supply (DC24V) input, as well as Brix value output (via RS-232C). A cable with connector is available as an optional accessory. The cable can be extended to a custom length of up to 15m. For details, please refer to pg.B32.

Pin number	Cord color	Signal
1	Red ●	DC24V
4	Red / White ●○	RS-232C

Pin number	Cord color	Signal
3	Black ●	GND(DC24V)
2	Black / White ●○	GND(RS-232C)



D-SUB 9-pin connector solderside

Digital pH Meter

DPH-2

Versatile use widely with waterproof design

- The electrode can be washed with tap water
- Water soluble cutting oil, Alkaline cleaning liquid, etc.
- Portable unit that can be carried to the factory site

Easy measurement with one hand

Buffer solution for DPH-2

Part No.	Part name	Contents
RE-99210	<Buffer solution for pH Meter> pH 4.01	Approx. 500mL
RE-99212	<Buffer solution for pH Meter> pH 7.00	Approx. 500mL
RE-99214	<Buffer solution for pH Meter> pH 10.01	Approx. 500mL

*Warranty period for these solutions is 10 months

Measurement Items pH

Measurement Range pH 0.0 to 14.0 (Automatic Temperature Compensation)

Measurement Accuracy pH ±0.1 (pH 2.0 to 12.0)

Specifications

Cat.No.	4320
Model name	DPH-2
Measurement range	pH 0.0 to 14.0
Resolution	pH 0.1
Measurement accuracy	pH ±0.1 (pH 2.0 to 12.0)
Temperature compensation range	0.0 to 50.0°C (Automatic Temperature Compensation)

Calibration	3 points (4.0, 7.0 and 10.0)
Power supply	4×Watch batteries (LR44)
International protection class	IP67 Water resistant
Dimension and weight	4.5(W)× 3(D) ×16.3(H) cm, 90g (Main unit only)

Calibrate at 3 points (pH 4.0, 7.0, 10.0).
However, if the pH value of the sample is 7.1 or higher, it is 2 points of pH 7.0 and pH 1.0, if it is less than 7.0 it can be 2 points of pH 7.0 and pH 4.0.

Digital Hand-held "Pocket" Moisture Refractometer

PAL-Moisture

To those who want to measure water content

- Sample volume is 0.3 mL
- Measurement time is about 3 seconds
- Portable unit that can be carried anywhere

About measured values

The moisture scale of this product is calculated by the following formula.
"Moisture = 100 - Soluble Solid Content"
Simply use it as a moisture meter.

Moisture content = 100 – Brix (%)

NFC Sequential Equipped Model

Measurement Items Moisture content

Measurement Range Moisture content: 7.0 to 100% (Automatic Temperature Compensation)

Measurement Accuracy Moisture content: ±0.2% (sucrose solution)

Specifications

Cat.No.	4573
Model name	PAL-Moisture
Measurement range	Moisture content: 7.0 to 100% Temperature: 10.0 to 100˚C
Resolution	Moisture content: 0.1% Temperature: 0.1˚C
Measurement accuracy	Moisture content: ±0.2% (sucrose solution) Temperature: ±1˚C

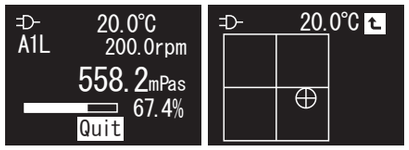
Temperature compensation range	10 to 100˚C
Ambient temperature	10 to 40˚C
Power supply	Size AAA alkaline battery × 2
International protection class	IP65 Water resistant
Dimension and weight	5.5(W)× 3.1(D) ×10.9(H) cm, 100g (Main unit only)

VISCO™

Introducing a New Type of Instrument. Taking You Beyond the Limits.

- Various selection of measurement
- Compact and easily carried with one hand
- Quick measurements anywhere

The simple display is easily and readily understood. A fully digital display allows for anyone to quickly and easily read results.



Measurement screen

Level adjustment screen

Packing contents

· Main unit	1
· Stand	1
· S Beaker (15mL)	1
· L Beaker (100mL)	1
· AC adapter	1
· Spindles (A1, A2 and A3)	one each
· Temperature sensor	1
· Small volume beaker attachment	1
· USB Mini-B cable (1m)	1
· 1.5V AA alkaline batteries	4
· Instruction manual	1
· Inspection certificate	1
· Spindle stand	1
· Protective cap	1
· Carrying case	1

Measurement Items Viscosity Torque%

Measurement Range

Viscosity
A1 50 to 200,000mPa·s, 50 to 200,000cP
A2 100 to 600,000mPa·s, 100 to 600,000cP
A3 500 to 2,000,000mPa·s, 500 to 2,000,000cP
(1mPa·s=1cP)

Torque 0.0 to 100.0%

Specifications

Cat.No.	6800	6820
Model	VISCO™	VISCO™-895 *
Measurement Range	Viscosity : A1 50 to 200,000mPa·s, 50 to 200,000cP A2 100 to 600,000mPa·s, 100 to 600,000cP A3 500 to 2,000,000mPa·s, 500 to 2,000,000cP (1mPa·s=1cP) Torque : 0.0 to 100.0% (recommended torque : 10.0 to 100.0%) Temperature : 0.0 to 100.0°C / 32.0 to 212.0°F	
Resolution	Viscosity : lower than 100mPa·s : 0.01mPa·s 100mPa·s or higher lower than 10,000mPa·s : 0.1mPa·s 10,000mPa·s or higher : 1mPa·s Torque : Lower than 10% : 0.01% 10% or higher : 0.1% Temperature : 0.1°C / 0.1°F	

Measurement Accuracy	Viscosity : ±1% of Maximum Viscosity Temperature : ±0.2°C / ±0.4°F	
Speed	0.5 to 250 rpm, Number of speeds : 20	
Sample Temperature Range	10.0 to 40.0°C / 50.0 to 104.0°F	
Ambient Temperature	10 to 40°C	
Computer Output	Output : USB - PC	
Power Supply	DC6V (AA alkaline batteries 1.5V × 4) AC adapter : AC100 to 240V, 50 / 60Hz	
Battery Life (Approx.)	Approx. 7 hours (continuous operation at 60rpm)	
Materials	Housing: SUS, Aluminum · Legs, and stand + screw: SUS	Housing, legs, and stand + screw: Aluminum
Dimensions and weight	12×12×20cm, 1.2kg (Main unit only), Stand+screw : 0.5kg Small volume beaker attachment: 0.1kg	12×12×20cm, 895g (Main unit only), Stand+screw : 275g Small volume beaker attachment: 0.1kg

* The body, legs and stage of the VISCO™-895 are made from light-weight aluminum.

Never take glass (on site) ever again

Disposable container requires no washing after each measurement.

Package A, which includes a specialized adapter for use with disposable containers such as paper cups, is available at ATAGO.

VISCO™ Package A Cat.No.6810
VISCO™-895 Package A Cat.No.6830

- VISCO™ (Including accessories)
- Cup Adapter (with 100pcs cups*) RE-78141

* 50pcs of paper cups and 50pcs of plastic cups are included.

Cup adapter Paper cup Plastic cup Cup adapter setup example

Ultra Low adapter (ULA)

Sample adapter (ULA) which can measure low viscosity of 1 to 2,000 mPa·s

VISCO™ Package B Cat.No.6811
VISCO™-895 Package B Cat.No.6831

- VISCO™ (Including accessories)
- Ultra Low adapter (ULA) RE-77120

Ultra Low adapter setup example

One Hand. One Touch. One Button. VISCO™

Set-up
ONE TOUCH™
VISCO is very easy to set-up. The spindle can be attached with just one touch — simply insert the spindle in the instrument. Absolutely no complicated set-up required.

Preparation
ONE HAND™
Measurement preparation can easily be done with just one hand. Place the beaker underneath the pre-set area and place the instrument on the stand. No troublesome height adjustment necessary.

Measurement
ONE BUTTON™
Operation requires only one dial button. All operations can be performed with the simple act of "sliding" or "pushing" the dial button. No more accidental operations due to pushing the wrong button.

Optional Accessories

Part No.	Part name
< Container >	
RE-79100	Beaker S (0.5oz/15mL)
RE-79101	Beaker L (0.5oz/15mL)
RE-78141	Cup Adapter (with 100pcs cups) * 50pcs of paper cups and 50pcs of plastic cups are included.
RE-79102	Paper Cup (90mL, 100pcs)
RE-79103	Plastic Cup (90mL, 100pcs)
< Ultra Low Adapter (ULA)>	
RE-77120	Ultra Low Adapter (ULA)- Sample Adapter for Low Viscosity Sample • Sample cylinder • Cylinder holder • Hook • Hook holder • UL spindle • UL stand • Extension (threaded tip)
RE-77107	UL spindle (with hook and hook holder)
RE-77121	Sample cylinder (with cap and o-ring)
RE-77117	UL spindle 3pcs (with hook, hook holder, UL spindle 3pcs)
< Temperature sensor >	
RE-75540	Temperature sensor

Part No.	Part name	
< Spindle >		
RE-77104	A1 Spindle	
RE-77105	A2 Spindle	
RE-77106	A3 Spindle	
RE-77114	A1 Spindle 5pcs	
RE-77115	A2 Spindle 5pcs	
RE-77116	A3 Spindle 5pcs	
RE-77100	Set of spindles (A1,A2,A3)	
< Viscosity Standard Liquid >		
RE-89030	Viscosity Standard Liquid 2	100mL
RE-89031	Viscosity Standard Liquid 5	100mL
RE-89036	Viscosity Standard Liquid 200	100mL
RE-89037	Viscosity Standard Liquid 500	100mL
RE-89038	Viscosity Standard Liquid 1000	100mL
RE-89039	Viscosity Standard Liquid 2000	100mL

* Standard liquid with JCSS calibration certificates are available (JS2.5 to JS160000). Contact ATAGO for further details.

Digital Hand-held “Pocket” Refractometer- Refractive Index

PAL-RI

For liquid managed by refractive index

- Sample volume is 0.3 mL
- Measurement time is about 3 seconds
- Portable unit that can be carried around the factory

NFC Equipped Model

Measurement Items Refractive Index

Measurement Range Refractive Index: 1.3306 to 1.5284

Measurement Accuracy Refractive Index: ±0.0003 (water at 20°C)

Specifications

Cat.No.	3850
Model name	PAL-RI
Measurement range	Refractive Index : 1.3306 to 1.5284 Temperature : 5.0 to 45.0°C
Resolution	Refractive Index : 0.0001 Temperature : 0.1°C
Measurement accuracy	Refractive Index : ±0.0003% (Water at 20°C) Temperature : ±1°C
Ambient temperature	10 to 40°C
Power supply	Size AAA alkaline battery × 2
International protection class	IP65 Water resistant
Dimension and weight	5.5(W)× 3.1(D) ×10.9(H) cm, 100g (Main unit only)

Abbe Refractometer

DR-A1-Plus

Reliable instruments used in research room, laboratories, etc.

- Digital display
- Compatible with dark colored samples

Circulate constant temperature water around the prism section

(Option)

Circulating Constant Temperature Bath

60-C5

A circulating water bath for precise temperature control of refractometers without Peltier. The temperature range can be set from 10 to 60°C and its compact, easy to use design makes it optimal for connecting to a refractometer.

Cat.No.	1923
Model name	60-C5
Tank capacity	1.0 L
Temperature setting range	10 to 60°C (water)
Minimum temperature indication	0.1°C
Constant-temperature accuracy	±0.2°C
Power consumption	250VA
Power supply	AC 100 to 240V , 50/60Hz
Dimensions and weight	204×336×289mm, 9.0kg (main unit only)

Refarence: RI = Refractive Index (nD)

Measurement Items RI Brix

Measurement Range RI : 1.3000 to 1.7100 Brix : 0.0 to 100.0%

Measurement Accuracy RI : ±0.0002 Brix : ±0.1%

Specifications

Cat.No.	1311
Model name	DR-A1-Plus
Measurement range	Refractive Index (nD) : 1.3000 to 1.7100 Brix : 0.0 to 100.0% (ATC is executed at 5 within 50°C)
Resolution	Refractive Index (nD) : 0.0001 Brix : 0.1%
Measurement accuracy	Refractive Index (nD) : ±0.0002 Brix : ±0.1%
Measurement temperature	5 to 50°C
Ambient temperature	5 to 40°C
Output	(1) Digital Printer DP-63(C) (Optional) (2) Communication system: RS-232C
Power supply	AC adapter (100 to 240V (50/60Hz) AC input)
Power consumption	16VA
Dimension and weight	13×29×31cm, 6.0kg (main unit) 10.5×17.5×4cm, 0.7kg (AC adapter)

Just by aligning the refraction boundary line with the cross line, the refractive index and Brix are digitally displayed together with the temperature on the display.

Automatic Digital Refractometor

RX-5000i-Plus

The most accurate digital refractometers in the world

- ATAGO's Flagship, Most Accurate and Full Range.
- Experience the ease of touch-screen technology.
- Programmable User Scale.

Measurement Items Refractive Index (nD)
Brix

Measurement Range Refractive Index (nD) : 1.32422 to 1.58000
Brix : 0.000 to 100.000%

Specifications

Cat.No.	3275
Model name	RX-5000i-Plus
Measurement system	Optical-refraction critical-angle detection system
Measurement range	Refractive Index (nD) : 1.32422 to 1.58000 Brix : 0.000 to 100.000% (ATC) User scale : 100
Resolution	Refractive Index (nD) : 0.00001 Brix : 0.001% Temperature : 0.01°C
Measurement accuracy (*repeatability)	Refractive Index (nD) : ±0.00002 *±0.00001 Brix : ±0.010% *±0.010% Temperature : ±0.05°C
Mode	MODE-S, 1, 2, 3, T
Constant temperature setting range	5.00 to 75.00°C (No lower than 10°C below or higher than 55°C above the ambient temperature)

Environmental operating conditions	Temperature 5 to 40°C; Humidity 90%RH and below, Altitude 2,000m above sea level
Display method	7.5-inch color LCD + touch screen
Output	Computer - USB, Printer and PC (via RS-232C)
Light source	LED (Approximating to D-Line wavelength)
Materials	Prism : Synthetic sapphire Sample stage : SUS316
Power supply	AC100 to 240V 50/60Hz
Power consumption	90VA
Dimensions and weight	37×26×14cm, 6.6kg (main unit only)

Measurement accuracy
When measuring a sucrose solution of up to 50% Brix or standard refractive index solution in MODE-1 at 20°C

Refarence: ATC = Automatic Temperature Compensation

5 measurement modes to pick the best way to measure your sample

The measurement method, time taken, repetitions, and target temperature will vary with each mode

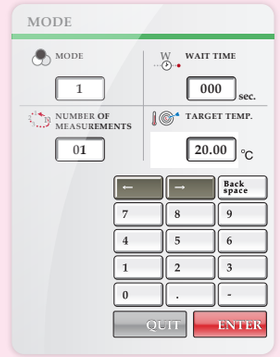
MODE-1
Displays the measurement value once the sample reaches the target temperature.

MODE-2
Measures Refractive Index and temperature at fixed intervals and displays the estimated measurement value at the target temperature.

MODE-3
Provides an option to turn the thermo-module off. Without temperature control, the measurement value is displayed 4 seconds after the START key is pressed.

MODE-T
Equipped only on the RX-5000i-Plus, MODE-T is recommended for users who place importance on obtaining highly repeatable results (Brix 0.001%).

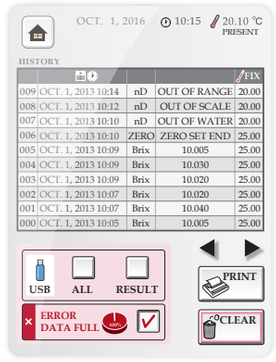
MODE-S
Displays the measurement value once a certain level of sample stability is achieved.



Measurement history

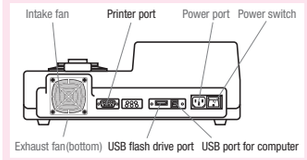
Recall the last 500 measurements

Exporting data to a USB drive or printer is only one touch away. The RX-i series is also equipped with a RS-232C port for direct computer connection.



FDA 21 CFR Part11 Software

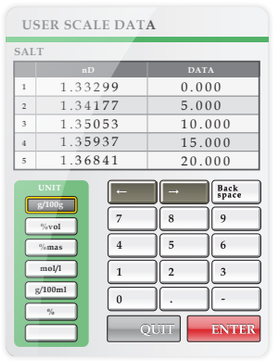
Software for compliance with 21 CFR Part 11 requirements on electronic records and electronic signatures. Cat.No.3167



User scales

Input original scales

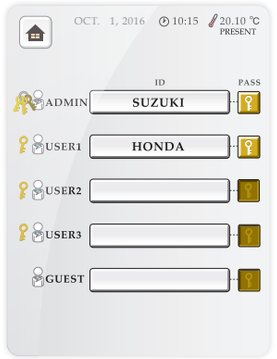
In addition to the “refractive index (nD)” and “Brix” scales, concentration scales for specific samples can easily configured. Simply program 3 to 4 data points corresponding to refractive index values and concentration.



Operator specific security features help protect the device

4 security levels and ability to set up to 5 password-protected profiles

System-level function to limit usage combined with password protection to give control of the device’s security.



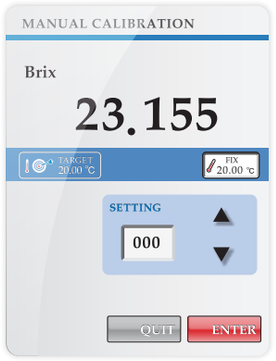
Calibration certificate

A calibration certificate can be ordered with each instrument for an additional charge. Please contact your ATAGO representative for further details.

When using multiple units…

Manual calibration

With the manual calibration feature, measurement values can be adjusted to be consistent within accuracy when using 2 or more units.



Automatic Digital Refractometor

RX-007α

The RX-007α is suitable for measuring water soluble samples with very low concentration (5.000% or less) at a very high accuracy of ±0.005%.

- Measured with high accuracy (± 0.005%)
- Ideal for management of low concentration aqueous solutions such as anti-rust agents
- Thermo module (thermostat) installed

Measurement Items Refractive Index (nD)
Brix

Measurement Range Refractive Index (nD) : 1.330150 to 1.341500
Brix : 0.000 to 5.000%

Specifications

Cat.No.	3921	
Model name	RX-007α	
Measurement system	Optical-refraction critical-angle detection system	
Measurement range	Refractive Index (nD)	: 1.330150 to 1.341500
	Brix	: Brix : 0.000 to 5.000% (Automatic Temperature Compensation is executed at 5 to 50°C)
	User scale	: 30
Resolution	Refractive Index (nD)	: 0.000001
	Brix	: 0.001%
	Temperature	: 0.01°C
Measurement accuracy	Refractive Index (nD)	: ±0.000010 (at 20°C) (under specified ambient temperature and constant temperature)
	Brix	: ±0.005% *
	Temperature	: ±0.05°C
Mode	MODE-1, 2	

Constant temperature setting range	15.00 to 30.00°C (The lower limit is the room temperature -5°C)
Environmental operating conditions	Using temperature:15 to 30°C, humidity: Max.90%RH
Display method	LCD with illuminating backlight
Output	Printer and PC (via RS-232C)
Light source	LED (Approximating to D-Line wavelength)
Materials	Prism : Optical glass Sample stage : SUS316
Power supply	AC100 to 240V 50/60Hz
Power consumption	65VA
Dimensions and weight	37×26×14cm, 6.7kg (Main unit only)

* However, at ambient temperature of 15°C, constant temperature of 15°C, 20°C
At ambient temperature of 20°C., constant temperature of 15°C., 20°C., 25°C.
At ambient temperature 25°C, constant temperature 20°C, 25°C
Environmental temperature 30°C and constant temperature 25°C (MODE-1)

2 measurement modes to choose from to measure the sample in the best way

MODE-1 For maximum accuracy, MODE-2 For fast results

MODE-1
Displays the measurement value once the sample reaches the target temperature.

MODE-2
Measures Refractive Index and temperature at fixed intervals and displays the estimated measurement value at the target temperature.

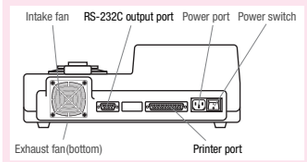
Measurement history

Recall the last 30 measurements

The measurement results can be checked immediately.
Print with a touch of a button. Printer can be selected from either thermal or printer.
Thermal and dot matrix printing options are available.
The data result can be outputted to PC. With RS-232C cable, input and output communication is possible to a PC.
Connection with USB is possible with RS-232C/USB cable. Equipped with FDA 21 CFR Part 11 supporting software.

FDA 21 CFR Part11 Software

Software for compliance with 21 CFR Part 11 requirements on electronic records and electronic signatures. Cat.No.3167



User scales

Input original scales

In addition to the “refractive index (nD)” and “Brix” scales, concentration scales for specific samples can easily configured. Simply program 3 to 4 data points corresponding to refractive index values and concentration.

When using multiple units…

Manual calibration

With the manual calibration feature, measurement values can be adjusted to be consistent within accuracy when using 2 or more units.

Built-in Peltier Thermo-module

Automatic measurement when set temperature is reached

Simple measurement by just placing the sample on the prism and pressing the button. It is equipped with a thermos-module (thermostat function), no circulating water bath is necessary. Measurement starts automatically after reaching the set temperature.

Calibration certificate

A calibration certificate can be ordered with each instrument for an additional charge. Please contact your ATAGO representative for further details.

Optional Accessories

● Key Cover
Part No. RE-58120
Prevent accidental system changes by covering all but the START and ZERO keys.

OPTIONS

PAL

● PAL-case
Part No. RE-39409

● PAL-Silicone Cover
Part No. RE-39413

● Strap
Part No. RE-39410

● MAGIC™
Part No. RE-39446

● Small Volume Sample Adapter
Part No. RE-39447

RX

● MAGIC™ (Metal)
Part No. RE-56180

● MAGIC™ (Resin)
Part No. RE-56185

● Fan filter replacement (a set of 12)
Part No. RE-58001

PAN

● Cable with incl. connector for PAN-1DC
Part No. RE-75101
A cable with an included 9 pin D-sub connector for RS-232C output and AC adapter for power supply (DC24V) input. Standard length is 2m. Cable can be extended up to 15m.

CM series

● Bracket for CM-BASEα
Part No. RE-67500
It is a bracket to attach CM-BASEα on the wall etc.

● Stand for CM-800α
Part No. RE-8607
The picture is an example of the actual in-line Brix monitor (CM-800α) and the AC adapter, AD-32 mounted on the stand.

● AC adapter (CM series only)
Cat.No.3527 AD-32 (AC100V)
Cat.No.3528 AD-33 (AC110-120V)
Cat.No.3529 AD-34 (AC220-240V)
Used to convert AC100 to DC24V and to supply power.

● US-α
Cat.No.9112-1 For 1S fitting
Cat.No.9112-2 For 2S fitting
Cat.No.9112-3 For 3S fitting
Prevents adhesion of prism surface. It is possible to replace with the mounting position of conventional piping.

● Manual prism wiper
RE-67590
Manually wipe the adhesion on the prism face.

RE-67508

● Connector with manual prism wiper
RE-67591 Hose Connector 12mmΦ
RE-67592 Compression Fitting 10mmΦ

Consumable Parts For In-line Monitor

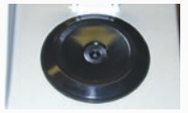
Parts No.	Name	Description
RE-68100	O-ring (Silicon)	O-ring used to connect the sample inlet unit to the prism stage unit.
RE-68115	O-ring (EPDM)	
RE-68002	O-ring (Viton)	

* These items should be monitored and replaced as necessary. To place an order, please contact an Authorized ATAGO Distributor.

Cable For In-line Monitor

Parts No.	Name
RE-65374	Recorder output cable (5m)
RE-65375	Recorder output cable (10m)
RE-65376	Recorder output cable (15m)
RE-65377	Recorder output cable (20m)
RE-65378	Recorder output cable (Length customizable)
RE-5677	RS-232C output cable with 25 pin D-sub connector (15m)
RE-65330	RS-232C output cable with 9 pin D-sub connector (15m)
RE-5647	RS-232C output cable with 25 pin D-sub connector (Length customizable within 15m)
RE-65331	RS-232C output cable with 9 pin D-sub connector (Length customizable within 15m)
RE-65110	Cable for CM-BASE

RX series customization



Sample stage: PTFE+ Teflon® coating example

Sample stage: PEEK coated example

Compatible to strong acids and chemical samples

The wetted parts can be customized with materials that are resistant to corrosive chemicals, such as acids, bases, and solvents.

Sample stage
- Special coatings (PEEK, Teflon ®, etc.)
- Custom materials (Hastelloy ®)

Body case
- Special coatings (PEEK, PTFE, etc.)

Cover plate
- Custom materials (PVC resin, fluorine resin, etc.)

Teflon ® is a registered trademark of DuPont, USA.
Hastelloy ® is a registered trademark of Haynes Corporation, USA.

Digital Printers

Model name / Cat.No.		Intended models	Power supply	Power consumption	Dimensions and weight
• Thermal printers					
DP-RX	Cat.No.3121	RX-α series	AC adapter (Input voltage : AC100 to 240V)	13VA	17×16×7cm, 580g (main unit only)
DP-63	Cat.No.3118	RX-i series			
DP-63(C)	Cat.No.3136	DR-A1-Plus			
• Dot matrix printers					
DP-RD	Cat.No.3122	RX-α series	AC adapter (Input voltage : AC100 to 240V)	7VA	11×18×9cm, 470g (main unit only)
DP-AD	Cat.No.3123	RX-i series			

Sucrose Solutions (for calibration) · Standard Liquids · Test Pieces

Sucrose Solutions

< Analog Hand-held, PAL, PR-α,NAR, RX series (excluding RX-007α) >

Part No.	Part Name	Contents
RE-110010	10% Sucrose Solution (±0.03%)	Approx. 5mL
RE-110020	20% Sucrose Solution (±0.03%)	Approx. 5mL
RE-110030	30% Sucrose Solution (±0.03%)	Approx. 5mL
RE-110040	40% Sucrose Solution (±0.04%)	Approx. 5mL
RE-110050	50% Sucrose Solution (±0.05%)	Approx. 5mL
RE-110060	60% Sucrose Solution (±0.05%)	Approx. 5mL

Warranty period: 6 weeks from date of manufacture. *1

< For high precision RX series (excluding RX-007α) >

Part No.	Part Name	Contents
RE-111001	10% Sucrose Solution (±0.01%)	Approx. 5mL
RE-112001	20% Sucrose Solution (±0.01%)	Approx. 5mL
RE-113001	30% Sucrose Solution (±0.01%)	Approx. 5mL
RE-114002	40% Sucrose Solution (±0.02%)	Approx. 5mL
RE-115002	50% Sucrose Solution (±0.02%)	Approx. 5mL

Warranty period:10 days from date of manufacture. *1

< For low concentration RX series >

Part No.	Part Name	Contents
RE-110250	0.25% Sucrose Solution (±0.005%)	Approx. 5mL
RE-110500	0.50% Sucrose Solution (±0.005%)	Approx. 5mL
RE-111000	1.00% Sucrose Solution (±0.005%)	Approx. 5mL

Warranty period: 6 weeks from date of manufacture. *1

Standard Liquids

Part No.	Part Name	Contents
RE-99010	Standard Liquid LK	Approx. 5mL
RE-9325	Standard Liquid LG	Approx. 5mL

Warranty period: 1 year from date of manufacture. *1

Test Piece

Part No.	Part Name
RE-1195	Test Piece A (nD 1.516)
RE-1197	Test Piece C (nD 1.620)

* Monobromonaphthalene (4mL) standard included

*1 Warranty period may vary depending on storage conditions.

User Testimonials

Feedback from customers using ATAGO products.

Pocket Refractometer
Cutting Oil &
Digital pH Meter user

PAL-102S
DPH-2

Metal Processing K Company

We are metalworking company that process metals using machine tools. The processed goods are used as parts for automobiles and electrical products.
When metal material is cut with a machine tool, heat is generated by friction. Therefore, cutting oil is continuously applied to the part to be cut with the blade to cool the heat. Some craftworkers refer to cutting oil as "coolant", which literally means "cooling liquid." Another reason for using cutting oil is for lubrication. To smoothly craft metallic material with a blade, cutting oil is continuously applied to the blade as a lubricant. Cutting oil can either be water-soluble or water-insoluble and it is chosen depending on the purpose of processing and the person in charge, but we use water-soluble cutting oil. Several types of water-soluble cutting oils are purchased and used separately for each metal material (brass, aluminum, stainless steel, etc.).
The water-soluble cutting oil is purchased as a concentrate where water is added to it. The majority of the time it is diluted to 3 to 10%, and it's changed somewhat depending on the metal material, difficulty of processing, processing time, and blade condition. We use PAL-102S to measure this concentration to keep proper concentration with PAL-102S. On the other hand, when cutting oil is stored in the tank and used repeatedly, the quality of cutting oil changes little by little. As the change progresses, the hands touching the oil may get rough or the oil may deteriorate, causing odors. Of course, this also affects the processing state. In order to grasp the change in the solution, pH is measured. For water-soluble cutting oil, pH 8.5 to 9.0 is common, and when it exceeds this range, we are replacing oil in the tank.

PAL-102S

DPH-2

Abbe Refractometer
&
Digital Refractometer User

NAR-2T
RX-7000i

Lubricant Oil Production Company S

At our company, the refractive index is measured as one of manufacturing inspection criteria (quality control) of lubricating oil.
There are many types of lubricating oil depending on refining process and application. Also, the nature of the oil varies depending on its type. Therefore, quality inspection after production of lubricating oil is very important, and mistakes are not allowed. There are several quality inspection items, such as density in addition to the refractive index, but the refractive index is convenient because it can be easily measured in a short time. Depending on the type of lubricant, the melting point is as high as 40°C 70°C, and the refractive index may be measured not only at 20°C 25°C but also at 40°C or 70°C. Conventionally, it is measured with an Abbe refractometer NAR-2T for high temperature measurement and a circulating constant temperature bath. For measurement at 70°C, silicone oil is circulated around the prism part of the Abbe refractometer, NAR-2T. In addition, many types of lubricating oil are dark in color. This makes it difficult to see the refraction field (boundary line) with an Abbe refractometer.
Recently, a digital refractometer RX-7000i has also been installed and is used in combination with the Abbe refractometer. The RX-7000i can measure up to 75°C. The temperature on RX-7000i is not controlled by circulating constant temperature bath rather, electronic heating and cooling device around the prism part that controls the temperature making temperature adjustment much more easily done. Furthermore, when oil is placed on the prism and measurement key is pressed, measurement is carried out automatically and the refractive index is displayed, so it is possible to measure dark colored oil with confidence. We will continue to use Abbe refractometer NAR-2T in conjunction with digital refractometer RX-7000i, but the frequency of using RX-7000i may become more due to its ease of use.

NAR-2T

RX-7000i

Please turn over and flip upside down from the next page.