Company & Products Introduction

Sep 2020

Lubrication Plus

Summary of Company

	SOLGE Corporation
CEO	**Tae Heon Kim**
Found	**July 1999**
Capital	**280 million Won (USD 240K)**
Location	**Daegu, Korea**
Scope	**Services (Laboratory, Consulting, Training)**
	Products (Analyzers, Oil Management Tools)
	R&D

주요현황

Company History

Lubrication Plus
SOLGE

1999-2009

1999
~
Found as a Korea franchise of Noria Corporation USA
Launched proactive Maintenance & Oil Analysis Program Training

2001
~
Performed Total Lubrication Consulting Service for customers (YNCC, Hyundai Motor, Samsung Corning,   GS Caltex..)

Development of Waterctor, patent registered

2006
~
Development of professional software for used oil analysis

Total Lubrication analysis service contract with Dupont, S-oil,
2009
~
POSCO...

Established Solge R&D Center

2010-2013

2010
~
Qualified as ISO training body
Development of Turbine Oil Monitoring System (TOMS) for East-West power plant

2011
~
Carrying out project for reduction gear **oil condition monitoring system for KTX high fast train** with KRRI

Won a prize for development of **Self diagnostic purifier for washing oil** for Hyundai and Kia Motors

2012
~
Development of oil circulation system for thrust bearing of water jet in Korea Navy

TOMS was patented

2013
~
Awarded qualified service provider from GS Power

Carrying out project with 5 power generation companies for developing sludge/vanish removing purifier for both turbine and EHC oil, TOMS F
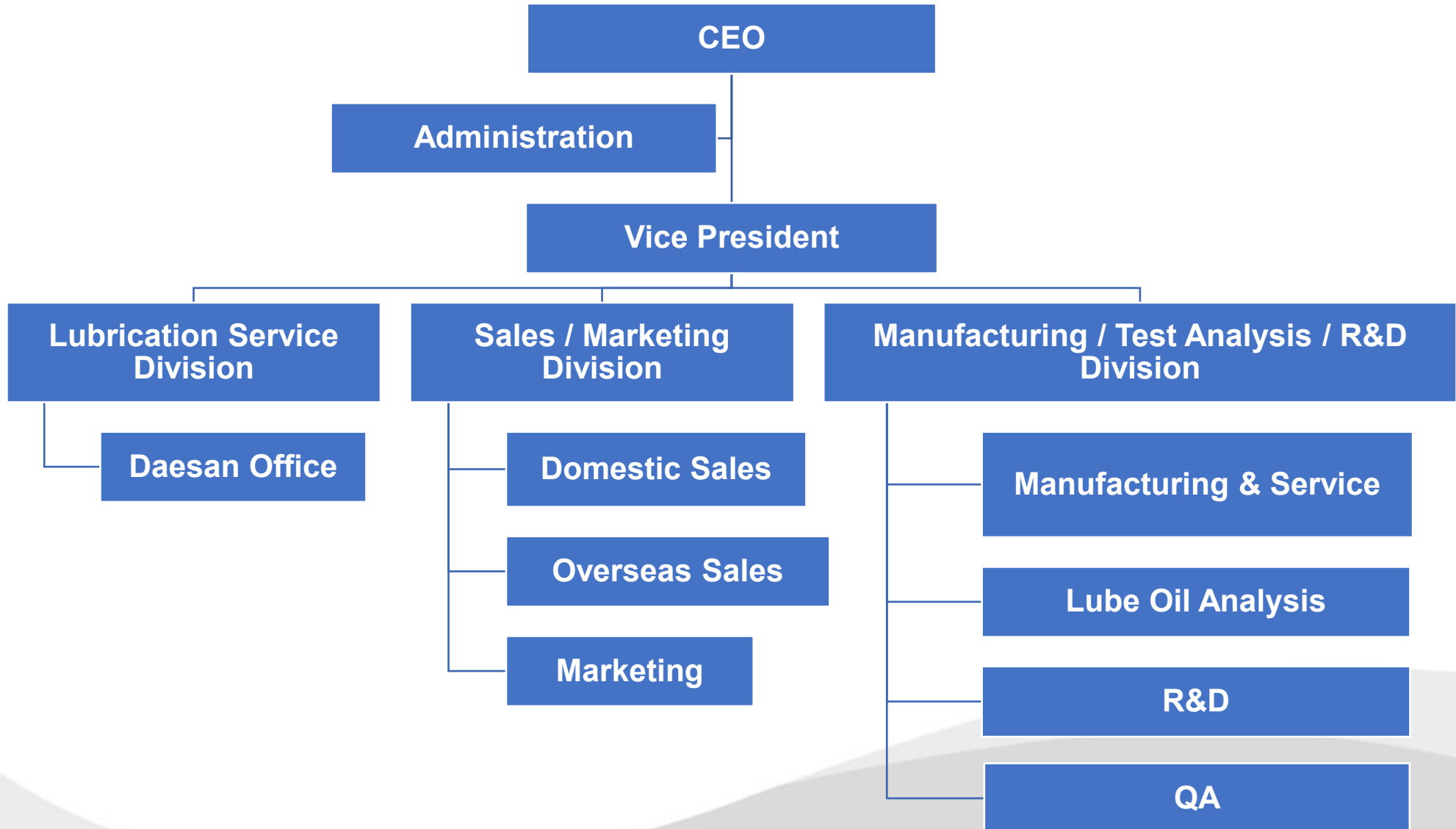
2014~

2014
~
Joined a member of WearCheck International

Move to new building and plant

2016
~
Government funded R&D Projects
1.VarTector (MPC Tester)
2.Module Breather, MBB
3.Total Varnish Purifier, TOMs-F

2018
~
"**Pre-Star Compa**ny" appointed by Daegu City in Sep 2019

2019
~
"**Global IP Star Company**" appointed by Chamber of Commerce in June 2019

2020
~
"Star Company" appointed by Government, Ministry of SMEs and Startups(MSS) in May 2020

TOMs-F(T/PE) was awarded "Excellent Purchasing Product" by Government Procurement Agency in July 2020.

Ex-Dri was awarded "2020 Innovative R&D product" by TIPA, Government Agency in July 2020.
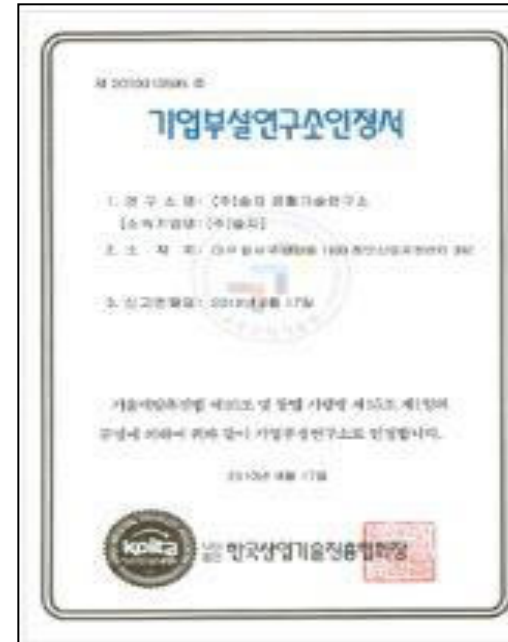
Company Organization

Organization chart:

- **CEO**
  - **Administration**
  - **Vice President**
    - **Lubrication Service Division**
      - Daesan Office
    - **Sales / Marketing Division**
      - Domestic Sales
      - Overseas Sales
      - Marketing
    - **Manufacturing / Test Analysis / R&D Division**
      - Manufacturing & Service
      - Lube Oil Analysis
      - R&D
      - QA

Certificates

Lubrication Plus
SOLGE

ISO9001 Recognized

ISO18436-4 Recognized

R&D center Recognized

Innovation Business (INNO-BIZ)Recognized

Certifications

Research & Development center certification

ISO9001:2015 Quality management

Patents : 16 patents

ISO 18436 -4– Deliver ISO compliant lube training

Business Scope

Lubrication Plus
SOLGE

Services

- Training
- Consulting
- Used oil analysis
- On-site Oil Filtering
 & Purification Service

Products

- Lubricant Maintenance
 Tools (Purifiers, Filters, Breathers,..)
- Condition Monitoring
 Devices (Oil Analyzers &
 On-line Sensor, Tools)
- AE sensor(Acoustic Emission)
- Oil (Industrial & Automotive
 /Royal Purple,.. etc.)

R & D

- Product Development
 (Government Projects,
 Customized Products)
- R&D Projects
- Publish Technical Materials

Business Flow

Services → **Products** → **R & D**

- **Training: Concept and Importance in Lubrication Management**
- **Consulting & Oil Analysis**

- **Provide Optimized Solutions according to Customer Needs**

- **Development of Customized Products to meet Customer's Requirements**

Service

Lubrication Plus
SOLGE
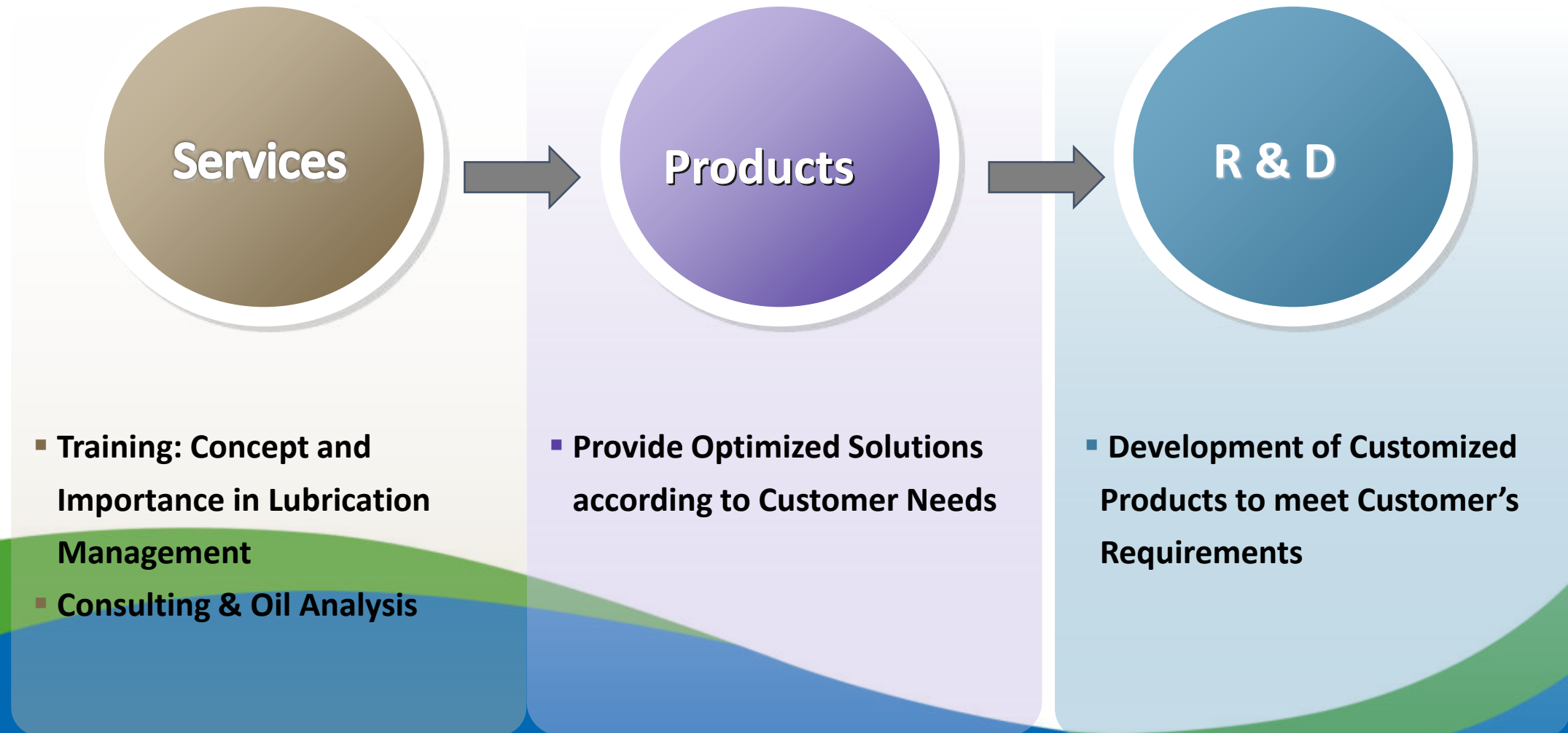
Services

- **Training**
- **Consulting**
- **Used oil analysis**
- **Improvement**
- **On-site Oil Filtering & Purification Service**

Products

- Lubricant maintenance tools (filter,breather,purifiers..)
- Condition monitoring devices (oil analyzers & On-line sensor, tools)
- AE sensor(Acoustic Emission)
- Oil (Ind. & Auto. /Royal Purple, etc.)

R & D

- Product development (Engineered Products)
- Research project
- Publish Technical Materials

Training

Lubrication Plus SOLGE

🔸 **Noria 4-days Public Seminars, 6 times per year + ICML Exam Session**

🔸 **Provide Tribology Training, 3 times per year**
(Course contents from Japan Institute of Plant Maintenance)

🔸 **Special Seminar and Exhibition, 2 times per year**

Course	Period
POA: Practicing Oil Analysis course	Twice a year (4days)
AOA: Advanced Oil Analysis course	Once a year (4days)
FML: Fundamentals of Machinery Lubrication	Twice a year (4days)
AML: Advanced Machinery Lubrication	Once a year (4days)
Tribology level1	Twice a year (4days)
Tribology level 2	Once a year (4days)

NORIA

Machinery Lubrication

Japan Institute of Plant Maintenance

Consulting

Lubrication Plus
SOLGE

- **Lubrication Systems Audit**
- **Contamination Control**
- **Used Oil Analysis for Monitoring**
- **Hydraulic Systems Analysis & Retrofit**
- **Machinery Lubrication Systems Retrofit**

We provide a solution for optimum lube system maintenance strategy, oil cleanliness management, condition monitoring & translation program that perfectly fits with customer's needs through consultation.

Our specialists and skilled engineers have been successfully supporting customers in the industry based on 20 years experiences in the lube field and laboratory tests .

Seminar- Total Fluid Care Center

2017년도 6월 "유분석을 통한 상태진단(입문)" 교육 과정

Seminar- Total Fluid Care Center

WearCheck International

	Test List	Test Method	Measure
Condition	Acid Number (Color/Potentiometry)	ASTM D974/D664	mgKOH/g
	Base Number (Potentiometry)	ASTM D4739	mgKOH/g
	Viscosity (40℃/100℃)	ASTM D445	cSt
	Viscosity Index	ASTM D2270	
	Remaining Useful Life (RULER)+New oil	ASTM D6971 and D6810	RUL %
	FT-IR (Oil Degradation, Additive Depletion, Particles)	ASTM E2412	Abs
Contamination	Particle Counting	ISO 11500	Class
	Particle Counting(Filter Patch Scan)	ISO 4407	Class
	Moisture Contamination by KF/RH	ASTM D4928/D7546	ppm
	MPC(insoluble)	ASTM D7843	MPC Value
	MPC for Phosphate Ester Fluids	Solge method	Wt(mg)
Wear	Element Analysis(19metals)	ASTM D6595	ppm
	Element Analysis(10metals)	ASTM D7417	ppm
	Particle Quantifier		
	Patch test		
Others	Oil Separation	ASTM D1401	min
	Foamability (Seq I/ Seq I&II/ Seq I,II&III)	ASTM D892	ml
	RPVOT	ASTM D2272	min
	Colour	ASTM D1500	
	Gravity	ASTM D1298	
	Flash Point (COC)	ASTM D92	℃
	Pour Point	ASTM D97	℃
	Chlorine Content	KS M2457	mg/kg

Products

Services

- Training
- Consulting
- Used oil analysis
- Improvement
- Rentals

Products

- Lubricant Maintenance Tools (Filters,Breathers,Purifiers..)
- Condition Monitoring Devices (Oil Analyzers & On-line Sensor, Tools)
- AE sensor(Acoustic Emission)
- Oil (Industrial & Automotive /Royal Purple,.. etc.)

R & D

- Product development (Engineered Products)
- Research project
- Publish Technical Materials

Lubrication Plus **SOLGE**

Total Contamination Control Solution through SOLGE

ExFilSorb
Remove free water & parti.

Vacuum Purifier
Remove free/diss. water

DES-CASE
Particle + Water
Air Breather
Air Cont. Solution

TMR/Stealth
Prevent condensation & remove water in oil

HY-PRO,PARKER Oil Filter
High Quality, Absolute Filter

Water Cont. Solution

Particle Cont. Solution

ULTIDRI
Remove free & dissolved water

Lubrication Plus **SOLGE**

Magnetic Filter

Greasing Solution

Cont. Control Solution

Coalescing
Water & Particle removal for Diesel & Hyd. Oil

AN/Varnish Solution

Portable Solution

Analyzer Solution

Diagnostic Solution

Grease Supply Equipment

ECR
Remove Varnish & Sludge

VR(ICB)
Remove Varnish & Sludge

Filtering Cart

Oil Analyzer
Lab. & On-line

Diagnostics
AE, Fe Debris

Storage & Dispenser

Products / Purifiers, Filtering Machines

Lubrication Plus
SOLGE

GooD-A/N

Filter Cart

Panel Unit

OFU

Vacuum dehydration

TOMs-F

SVR1200

Ex-Dri

Coalescing Purifier

Products / Condition Monitoring Equipments and Sensors

Lubrication Plus
SOLGE

Particle counter	Moisture Analyzer	Wear Particle	Viscometer	AN/BN Accessories	Others	Sensor

Lubrication Plus
SOLGE

GooD-A/N

Filter Cart

Panel Unit

OFU

Purifiers, Filtering Machines

SVR1200

Ex-Dri

Coalescing Purifier

1. TOMs-F Total Purifier (Varnish, Acid, Particle, Water)

00. Certificate
- **"Excellent Purchasing Product"** designated by Purchasing Agent of the Government in July 2020
- Patented product

01. Features
- Removal of Varnish(MPC) and Acid (Removal of soluble and ionic degraded by-products)
- Particles (Beta raio 1,000)
- Oil condition monitoring (Contamination/Water/Color)
- No depletion of additives and no degradation

02. Removal Target
- **Degarded by-products (Varnish and Acid)**
- Particles (Beta ratio 1,000이상) and Water

03.Application
- **GasTurbine (TOMs-F-T)**
- **Steam Turbine EHC (TOMs-F-PE)**
- Compressor
- Hydraulic Equipment
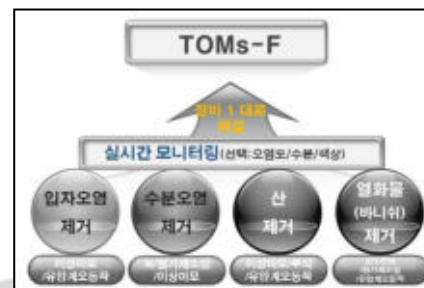
1. TOMs-F

Certificate of "Excellent Purchasing Product" by Government Purchasing Agency

1. TOMs-F Total Purifier (Varnish, Acid, Particle, Water)

■ Application

01. Turbine OIl (TOMs-F-T)

- Replacement of Centrifugal Purifier, Vacuum type Purifier, Coalescing Conditioner
- Prevents varnish deposition, extends turbine oil life, prevents bearing temperature rise, maintains turbine oil demulsibility and bubble properties

■ TOMs-F-T   [Mineral Oil, 32cSt]

경과시간 (HR)	오염도(NAS) 한국석유관리원	수분(ppm) 태안화력현장Lab.	산가(mgKOH/g) 한국석유관리원	MPC 해외 Lab.
정제 전	12이상	2,193	0.1	22
71	7	46.5(15Hr경과)	0.03	5.1
134	6	14.0(39Hr경과)	0.02	1
230	6	N/A	0.03	N/A
302	5	N/A	0.03	N/A
최종목표치	6등급 이하	50ppm 이하	0.05 이하	5이하
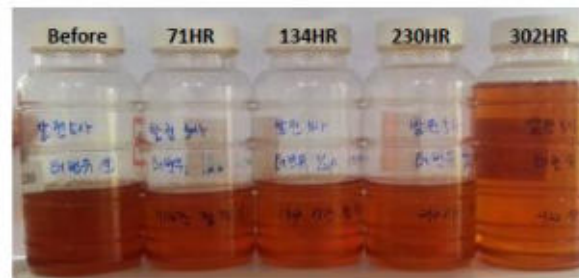
02. EHC HPU (TOMs-F-PE)

- Conditioner replacement (foreign diatomite filter) → Spec-in to Doosan Heavy Overseas Power Plants
- Oil color change prevention, reliable acid control, servo valve failure prevention, oil life extension, etc.

■ TOMs-F-PE   [EHC Oil, 46cSt]

경과시간 (HR)	오염도(NAS) 한국석유관리원	수분(ppm) 자체	산가(mgKOH/g) 한국석유관리원	비고
정제 전	8	560~583	0.3	
71	4	74~86	0.02	
134	5	58~64	0.02	
230	4	40~54	0.02	
302	4	59~66	0.03	
최종목표치	6등급 이하	80ppm 이하	0.08 이하	
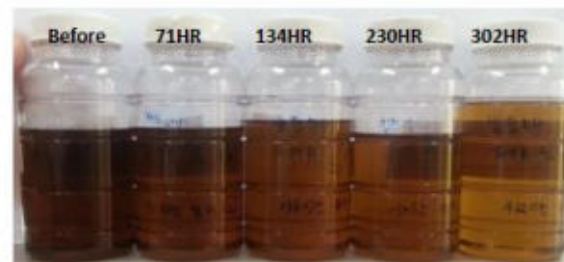
Lubrication Plus
SOLGE

Reference of TOMs-F for Power Plant

No	Customer	Fuel	Date	Purifier Model	Qty	Turbine Model
1	GS Power		2015 Nov	TOMs-F-T-M	1	
2	POSCO Power		2015 Nov	TOMs-F-PE	1	
3	Busan Natural Gas	Gas	2015 Dec	TOMs-F-PE-M	1	
	2015 Total				**3**	
4	Sancheong Pumped Storage	Water	2016 Oct	TOMs-F-T-M	2	
5	Korea Middle Power (Incheon)	Gas	2016 Dec	TOMs-F-T-M	1	
6	Korea Western Power (Incheon)		2016 Dec	TOMs-F-T-M	2	
7	Korea Western Power (Incheon)		2016 Dec	TOMs-F-T-M	2	
8	Korea Southern Power (Andong)		2016 Dec	TOMs-F-PE-M	1	
	2016 Total				**8**	
9	Korea Southern Power (Boryung)	Gas	2017 Apr	TOMs-F-T-M	1	
10	Korea Southern Power (Boryung)	Gas	2017 Apr	TOMs-F-PE-M	1	
11	Korea Southern Power (Busan)		2017 Apr	TOMs-F-T-M	1	
12	Korea East-West Power (Honam)		2017 May	TOMs-F-T	2	
13	Korea Western Power (Pyeongtaek)		2017 May	TOMs-F-T-M	1	
14	GS EPS		2017 June	TOMs-F-T-M	1	
15	Sancheong Pumped Storage	Water	2017 June	TOMs-F-T-M	1	
16	Hanwha Energy (Gunsan)		2017 July	TOMs-F-T-M	1	
17	Korea East-West Power (Ulsan)		2017 Aug	TOMs-F-T-M	1	
18	Korea Middle Power (Incheon)	Gas	2017 Sep	TOMs-F-T-M	2	
19	Korea Western Power (Incheon)		2017 Nov	TOMs-F-T-M	2	
20	Korea Western Power (Incheon)		2017 Nov	TOMs-F-PE-M	1	
21	GS Donghae Power	Coal	2017 Nov	TOMs-F-T	1	
22	GS Donghae Power	Coal	2017 Nov	TOMs-F-PE	1	
23	Korea Western Power (Taean)	Coal	2017 Dec	TOMs-F-T-M	1	
24	Korea Western Power (Taean)	Coal	2017 Dec	TOMs-F-PE-M	2	
25	Korea Southern Power (Hadong)	Coal	2017 Dec	TOMs-F-PE-M	1	
26	Korea Middle Power (Jeju)	Oil	2017 Dec	TOMs-F-T-M	2	
27	Korea District Heating (Paju)		2017 Dec	TOMs-F-T-KDHC	2	
	2017 Total				**23**	
28	Korea District Heating (Dongtan)		2018	TOMs-F-T-KDHC	2	
29	Korea District Heating (Pangyo)		2018	TOMs-F-T-KDHC	1	
30	Korea District Heating (Hwaseong)		2018	TOMs-F-T-KDHC	3	
31	Korea District Heating (Gwanggyo)		2018	TOMs-F-T-KDHC	1	
32	Korea District Heating (Suwon)		2018	TOMs-F-T-KDHC	1	
33	Korea District Heating (Daegu)		2018 Feb	TOMs-F-T-KDHC	1	
34	LINDE Korea		2018 Mar	Purifier	1	
35	Korea District Heating (Gangnam)		2018 June	TOMs-F-T-KDHC	1	
36	GS Caltex		2018 June	Purifier	1	
37	Hanwha TOTAL		2018 Oct	Purifier	1	
38	Korea District Heating (Samsong)		2018 Oct	TOMs-F-T-KDHC	1	
39	Korea Middle Power (Incheon)	Gas	2018 Oct	TOMs-F-T-M	1	
40	Korea Middle Power (Jeju)	Oil	2018 Nov	TOMs-F-T-M	1	
41	Korea Southern Power (Andong)		2018 Nov	TOMs-F-PE-M	1	
42	Korea Southern Power (Samcheok)		2018 Dec	TOMs-F-T-M	1	
43	Hyundai Steel		2018 Dec	TOMs-F-HD	2	
44	Pocheon IPP	Gas	2018 Dec	TOMs-F-PE-M	1	
45	Pocheon IPP	Gas	2018 Dec	TOMs-F-T-M	2	
46	POSCO Energy		2018 Dec	TOMs-F-PE	1	
47	Yeongheung Thermal Power		2018 Dec	TOMs-F-PE-M	1	
48	CGN Yeulchon Power		2018 Dec	TOMs-F-PE-M	1	
49	CGN Yeulchon Power		2018 Dec	TOMs-F-T-M	1	
	2018 Total				**27**	
50	Korea District Heating (Samsong)		2019	TOMs-F-T-KDHC	1	
51	Korea Western Power (Gunsan)		2019	TOMs-F-T-M	2	
52	Korea District Heating (Cheongju)		2019	TOMs-F-T-KDHC	1	
53	Korea Western Power (Taean)	Coal	2019	TOMs-F-PE-M	3	
54	Korea District Heating (Dongtan)		2019	TOMs-F-T-KDHC	2	
55	Korea District Heating (Daegu)		2019	TOMs-F-T-KDHC	1	
56	Korea Middle Power (Seoul)	Gas	2019	TOMs-F-T-M	2	
57	Korea Middle Power (Seoul)	Gas	2019	TOMs-F-PE	1	
58	TongYoung Eco Power	Gas	2020	TOMs-F-T	1	
59	KEPCO (Mexico)		2019	TOMs-F-T-M	1	
60	Space Tech (Indonesia)		2019	TOMs-F-T-IND-A	1	
61	Space Tech (Indonesia)		2020	TOMs-F-T-IND-A	1	
62	Lotte Chemical (Uzbekisatn)		2019	TOMs-F-T	1	
63	KORES (Mexico)		2020	TOMs-F-T	1	
	~ 2020 Total				**19**	
62						
63	**Cumulative Total (Nov 2015 - Aug 2019)**				**80**	

Export : 6 units (Mexico, Indonesia, Uzbekistan, Jordan, Saudi Arabia)

1. TOMs-F Installation Photos

02. <u>Ex-Dri</u> / Nitrogen Stripping Disk Type Dehydration Purifier

00.Certificate
- **"2020 Excellent R&D Innovative Product"** by Small and Medium Business Administration of the Government in July 2020
- Patented Product

01.Features
- **The world's first disk type dehydration purifier**
- Very effective removal even with **high viscosity (460 cSt) oil**
- **No depletion of additives**. No degradation.
- Simple operation and few breakdown factors.

02.Removal Target
- **All 3 types of Water (Dissolved / Emulsified / Free)**
- **Particle** (Beta ratio 1,000)
- **Sludge, Acid and Varnish (VR Type)**
- **Quick removal of a large amount of free water (CO Type)**

03.Application
- **Steam / Gas Turbine**
- Compressor,..etc

Ex-Dri 통합 Purifier
입자,수분, 슬러지 바니쉬제거 가능 Purifier(고점도 사용가능)
LUBORACO

(02) Ex-Dri / **Nitrogen Stripping Disk Type Dehydration Purifier**

Certificate of "**Excellent R&D Innovative Product**" by Small and Medium Business Administration of the Government
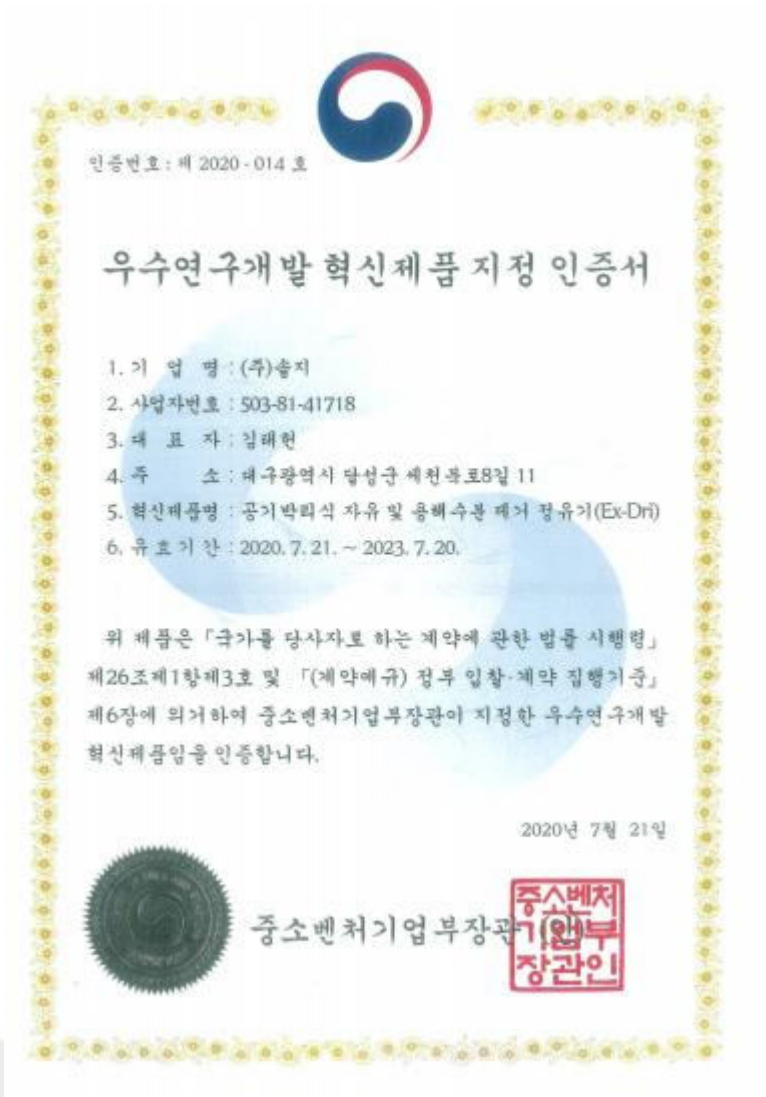
Type and Specification

Model	Dimension (mm)	Flow Rate (LPM)	Input Power	Removal Target				Cover
				Water	Particle	Varnish, Acid	Large Amount of Water	
EX-DRI-35	1715×1000×1650H	35	2.2kw,Ø3,60Hz	◎	◎			Yes
EX-DRI-50	1715×1000×1650H	50	2.2kw,Ø3,60Hz	◎	◎			Yes
EX-DRI-CO-35	1640×1250×1650H	35	2.2kw,Ø3,60Hz	◎	◎		◎	No
EX-DRI-VR-35	1640×1250×1650H	35	2.2kw,Ø3,60Hz	◎	◎	◎		No
EX-DRI-CO-50	1640×1250×1650H	50	2.2kw,Ø3,60Hz	◎	◎		◎	No
EX-DRI-VR-50	1640×1250×1650H	50	2.2kw,Ø3,60Hz	◎	◎	◎		No

(02) Ex-Dri / Nitrogen Stripping Disk Type Dehydration Purifier

Test Condition

- Purifier   Ex-Dri (35 lpm), Dry Nitrogen Purging 60 lpm (60°C)
- Contaminants   Water 10 liters, Agitating 30 minutes, Target Contamination 50,000 ppm
- Measurement   COMPUTRAC Moisture Analyzer

Operating Hour	Water (ppm)	Measuring Time
0.5	46,587	10:26
1	35,647	11:30
2	30,899	12:30
3	28,851	13:30
4	24,994	14:30
23	13,693	9:30

Operating Hour	Water (ppm)	Measuring Time
24	12,749	10:30
28	7,498	14:30
47	519	9:15
48	285	10:15
49	189	11:15
51	162	13:18
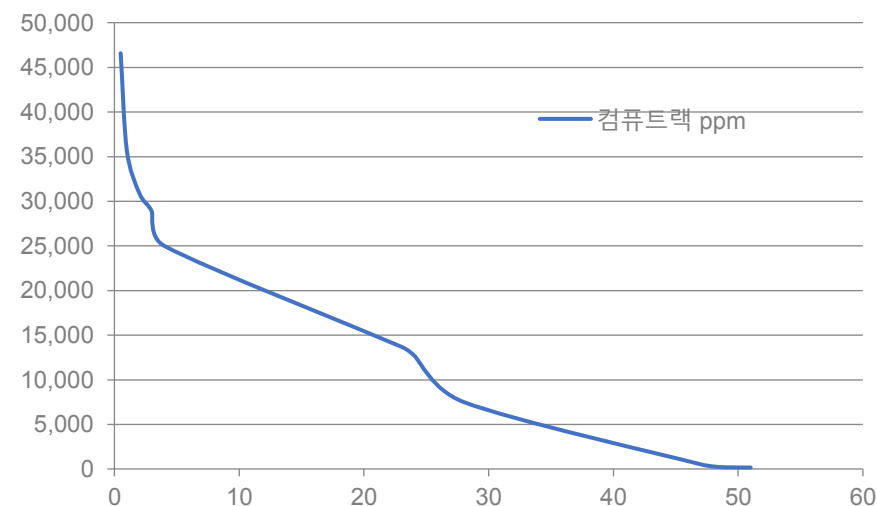
Water Removal Capacity : 2 liters / hr

Reference and Installation Photos of Ex-Dri

No	Customer	Fuel	Date	Qty
	Reference of Ex-Dri			
1	LG Chemical	Compressor oil	2019	1
2	JeonJu Paper	Lube oil		1
3	Korea Southen Power	Steam Turbine		1
4	KHNP	HPU		1
5	Hyundai Steel	Lube oil	2015 Nov	3
	2019 Total			**7**
	Cumulative Total (2019 - Present)			**7**

02. Ex-Dri Nitrogen Stripping Disk Type Dehydration Purifier

[Comparision of Water Removal Technology]

Technoloy	Removal Target			Depletion of Additives	Oil Degradation	Price	Maintenance Cost	Failure	
	Free Water	Dissolved Water	Particle						
Air Stripping (EX-Dri)	Yes	Yes	Yes	No	No	High	Medium	Few	
Centrifugal	Yes	No	Y (Big) N (Small)	Possible	No	Very High	High	Many	
Vacuum	Yes	Yes	Yes	Yes	Possible (Heater)	High	High	Many	
Coalescing	Y	No	Yes	No	No	Low	Low	Few	

03. <u>OFU</u> / Oil Filtration Unit Series

01. Features
- Portable Multi-Purpose Purifier
- **26" Single or dual common housing** with various filters for **particles, water acid and varnish**
- **Economic purification solution** for 2 or more contaminants
- User can install different filters in turn on the single or dual common housings depending on the removal targets
- Ergonomic design allowing easy and convenient to handle and move

02. Removal Target
- Particle
- Water
- Acid
- Solid Varnish
- Soluble Varnish

03. Application
- Lubrication system
- Hydraulic system
- Reduction gearbox and pump
- Storage tank

03. OFU / Oil Filtration Unit Series

▪ OFU Types Available
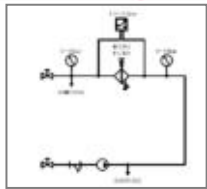
[Single Housing]
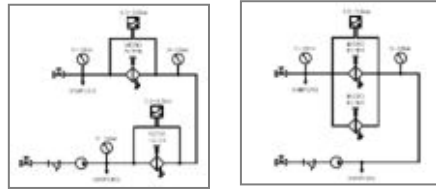
[Double Housing] (Serial / Parallel)
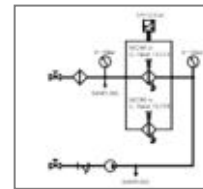
[Combined Composite Resin Filter Housing]
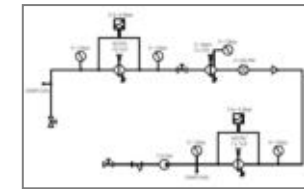
[Large Capacity Composite Resin Filter (LVR)]

▪ Use for

- Circulation Purification
- New Oil Purification and Filling
- Reservoir Flushing
- Piping Flushing

▪ Applicable Type of Oil

- Mineral Oil
- Synthetic Oil (including Phosphate ester)

▪ On-line Monitoring Function (Optional)

Particle or Water Sensor

Oil-Mon Sensor

- **Particle**   Optical particle counter sensor, ISO/NAS grade displayed
- **Water**   Measurement of saturated water % in the oil
- **Oil-Mon Sensor** Real-time measurement of Contamination / Water / Oxidation/ Temperature
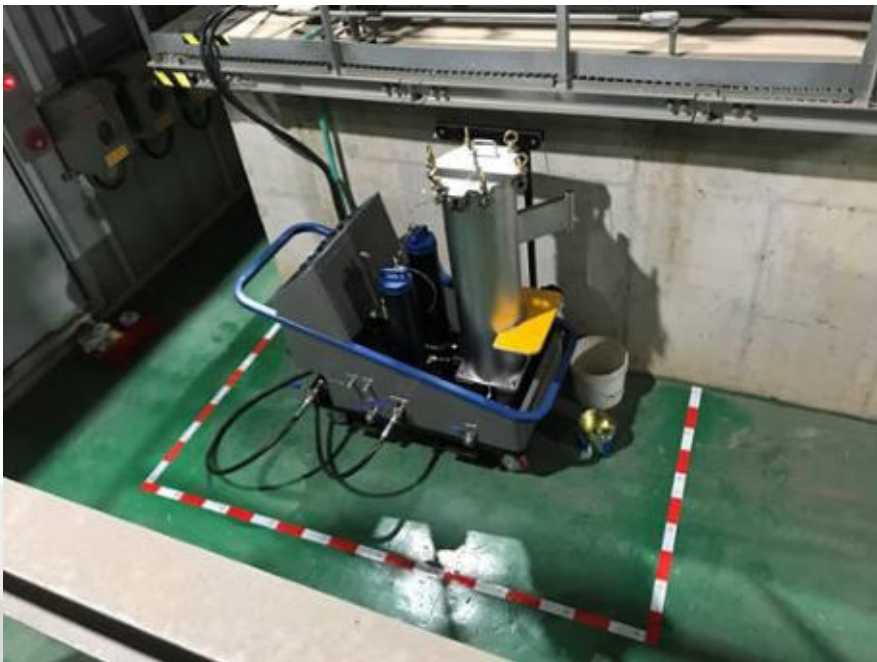
04. Good - A/N / Dry Air / Nitrogen Purging Unit

01.Features

- Energy source is **utility air**. Cost saving.
- The most economical and effective water removal solution particularly for **high viscosity gear oil**
- Optimized for **Steam Turbine EHC Unit**
- No ingress of external contaminants into the reservoir during operation.
- Semi-permanent life span and few consumables due to no rotating components inside.
- Low price and maintenance cost

02. Removal Target
All kinds of water (Dissolved / Emulsified / Free)

03.Application

- Reduction **gearbox oil with high viscosity**
- **EHC oil of steam turbine**
- **Hydrophilic (water friendly) synthetic oils** such as **phosphate ester oil and polyol ester oil**
- Hydraulic and lubrication oil
- Anti-rust oil

Part Number	GooD-A	GooD-N
Generating Gas	Dry Air	Dry Nitrogen
Dew point (℃)	Below -40 ℃	Below -60℃
Inlet / Outlet	1/2" PT	1/2" PT
Size (L*OD[mm])	590*55	856*110
N2 Outlet	14.2L/Min	21.2L/Min
Max Air Consumption (@100psi)	15.8L/Min	38L/Min
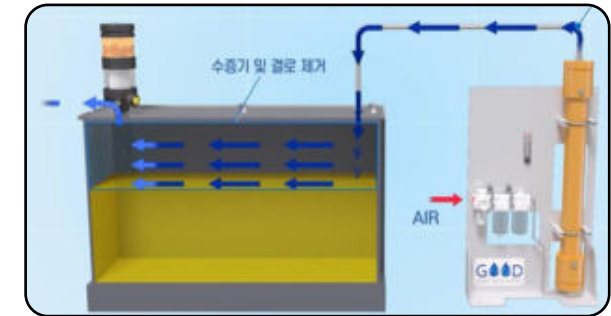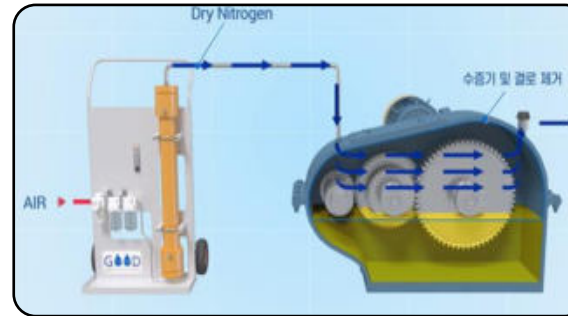
[EHC unit of Steam Turbine]

GooD-A / N should be installed far away from air breather
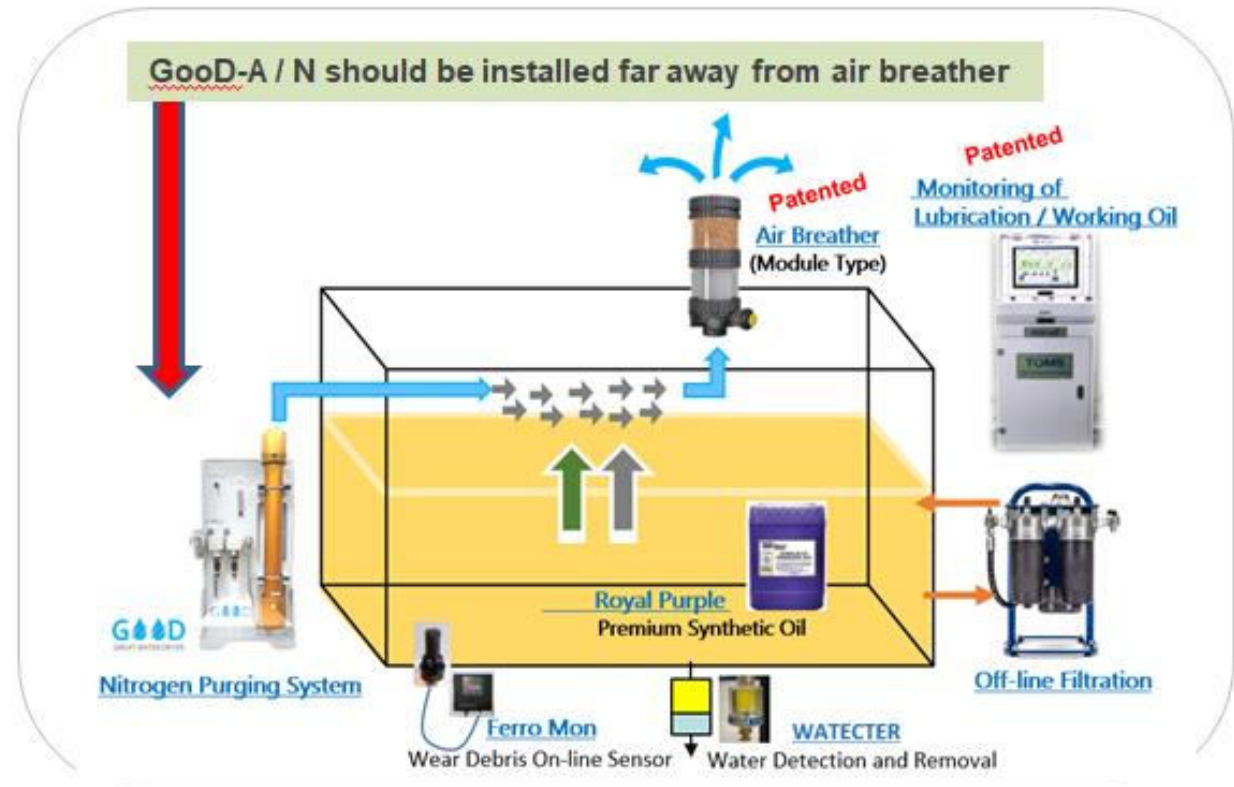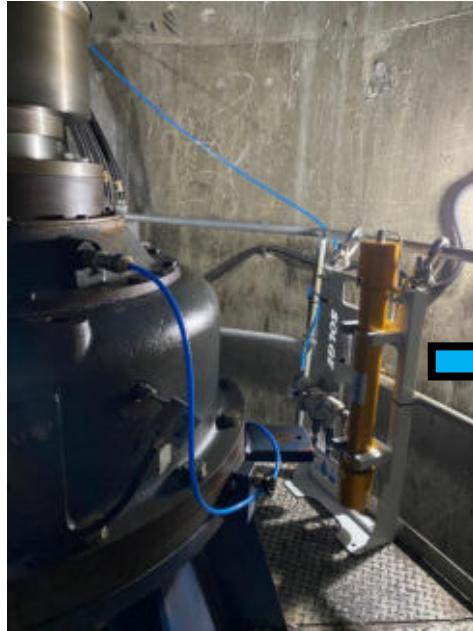
01-07	385	50
01-08	260	50
01-09	310	50
01-10	480	50
01-13	1700	50
01-14	1200	50
01-15	1060	50
01-16	680	50
01-17	780	50
01-20	1050	50
01-21	832	50
01-22	875	50
01-23	520	50
01-26		50
01-28	270	0
01-29	275	0

Lubrication Plus
SOLGE

Filters, Breathers and Others

01. MBB / Module Type Air Breather (Particle and Water)

01.Feature

- **The World first Module Type Air Breather**
- User can select **multiple combinations** such as particle / water / particle + water depending on site conditions.
- **Longer life span of water module** than competitors due to **integrated check valves** and more desiccant volume
- **Easy recognition of replacement time**
  - Water module : Visual check (Orange → Violet)
  - Particle module : DP indicator
- Excellent durability with engineering plastic materials

02. Purpose

- Protect system from ingress of water and particles

03.Application

- Reduction gearbox, Pump
- Lubrication oil tank/reservoir
- Hydraulic oil tank/reservoir
- Large oil storage tank
- Various reservoirs
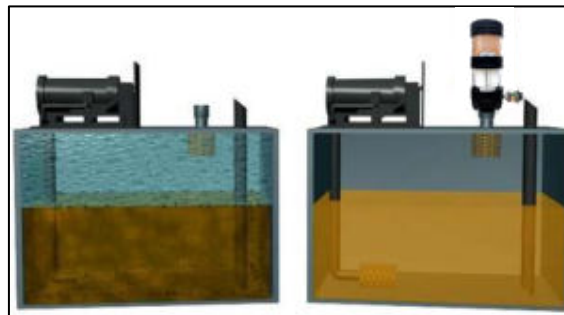
01. MBB / Module Type Air Breather (Particle and Water)

Lubrication Plus SOLGE

- **Air Flow of MBB when breathing in and out**

Particle Module
Water Module
Mist module

- **Module Replacement**

DP Indicator

Water Module : By visual check
(Orange → Violet)

Particle Module :
By DP Indicator

- **Components and Combination**
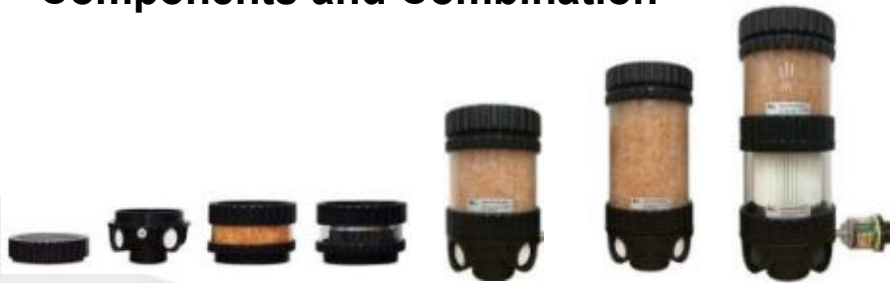
Components

Fully Assembled

Re-usable Cap

Replacement Particle Module

Replacement Water Module

Re-usable Mist filter Adaptor (Optional)

Re-usable Adaptor

Particle Module
Moisture Module
Mist Module

-39-
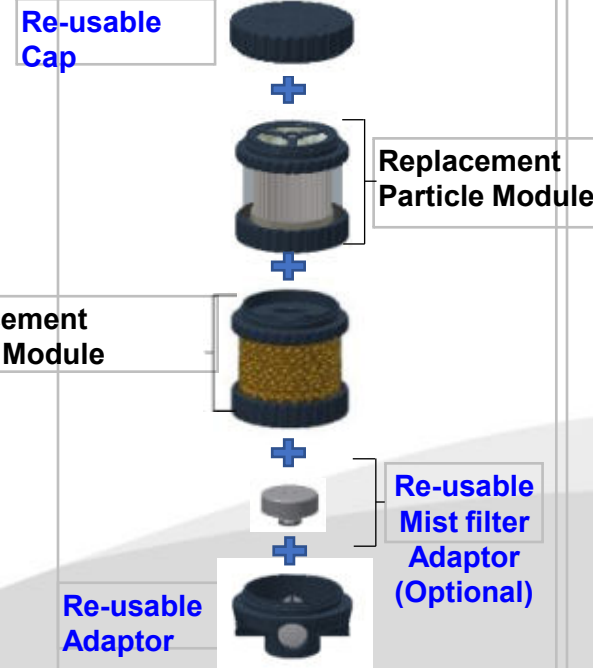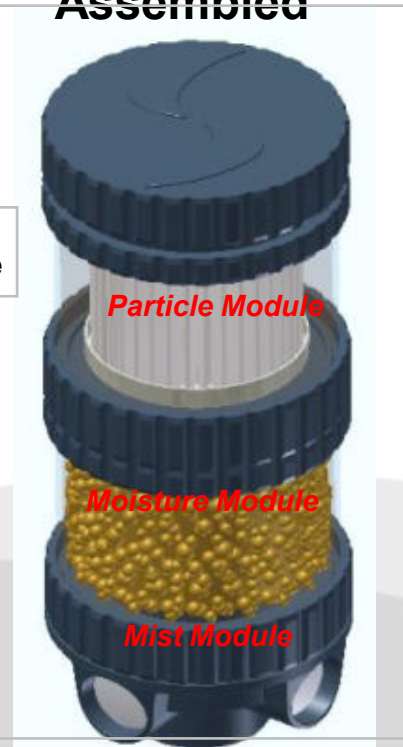
- **Comparison Test**
  - Period : Jan 9 – Aug 14 2017 (**Longer than 7 months**)

MBB

Competitor

- **Installation Photos**
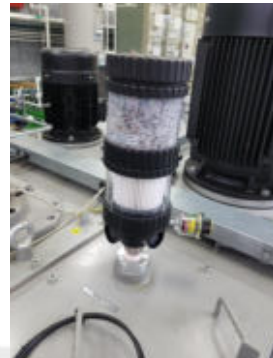
02. <u>M2 Breather</u> / Compact Sized Air Breather

▪ **Shield for Small Equipments such as Pumps or Gearboxes**

▪ **Specifications and Features**

- Applied fine filter to catch above 1μm particles

- **Hydrophobic filter media** does not allow ingress of water

- Do not require separate as sealed by O-ring

- Corrosion resistance and robust

▪ **Application**

- Pump, Gerarbox, Small Equipment **where**

  vent plugs are installed
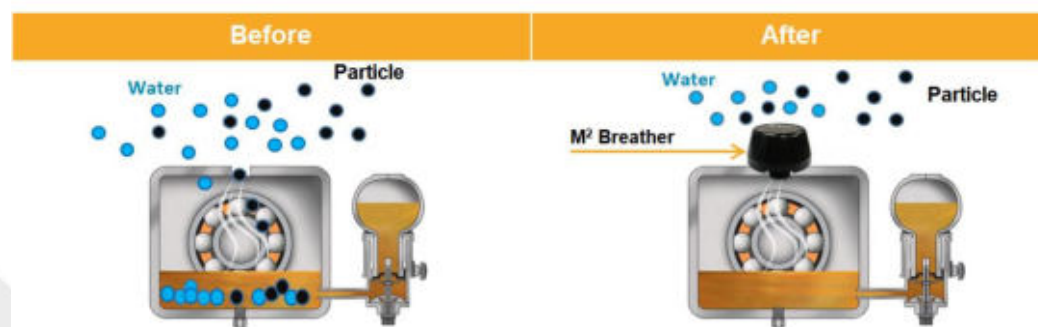
Robust Housing

Connector
Easy connection to adaptor or gearbox

Hydrophobic Media
Blocks particles and water from atmosphere

Male PF 3/8"

Before	After
Water Particle	Water Particle
	M² Breather

02. M2 Breather / Compact Sized Air Breather

New M2   Used M2 after 1 year

Contaminated Vent Plugs

Replacement of vent plug with M2 breather

-43-

[Case Study]

M2 Breather
coupled with oil
mist adaptor

1 μm, Hydrophobic media

수 분 (ppm)

500 이하	
1,000 이상	
#2	#3
164	259
211	182
187	231
315	400
274	285
291	352
427	388
414	234
309	192
470	299
OH	138

(Before)

수 분 (ppm)

500 이하	
1,000 이상	
#2	#3
72	135
58	175
68	134
140	87
59	68

(After)

Water (ppm) in #2 & #3 Equipment before and after with M2

03. <u>Watector</u> / Dual Chamber Sight Glass

01.Features

- Free water in oil has a higher specific gravity than oil, so it separates from oil and sinks to the bottom, and can be visually observed with a Watector, and water can be discharged.

- **World's first double housing** prevents oil leakage due to external shock or frozen water during cold weather

- Easy to detect water and drain water thru drain valve

- **Built-in magnet rod collects ferrous wear particles** and user can diagnose if damages in the equipment

- Excellent durability with **engineering plastic** materials

02.Purpose

- Detect water ingress
- Detect iron wear
- Water drain

03.Application

- Reducer bottom
- Lubrication tank bottom
- Hydraulic tank bottom
- Various reservoirs bottom

Vertical Installation   Horizontal Installation   Iron Particles

WATECTOR(Water Detector)

오일 중 수분 감지 및 분리기   QUMENSUS

03. <u>Watector</u> / Dual Chamber Sight Glass

▪ **Installation Photos**
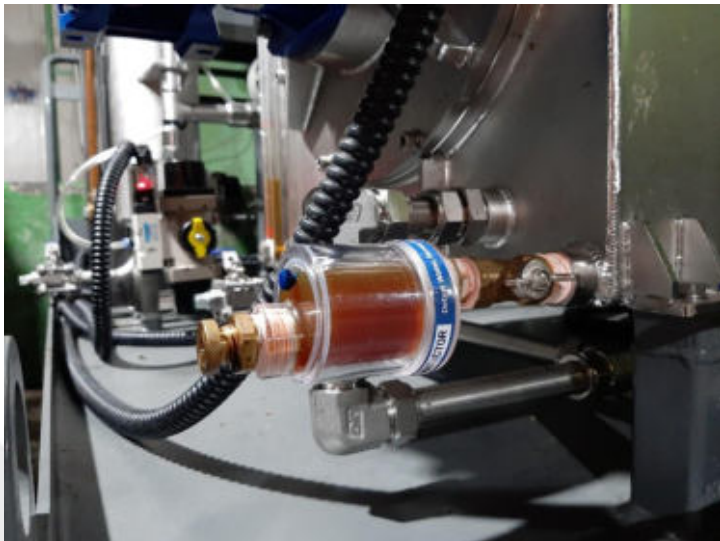
04. 3D X-Vision / 3- Dimensional Oil Gauge

01. Features

- Provide **good visibility from any angles** and guarantee good visibility because **external contaminants does not stick to the glass surface** even when used for long period on site
- Can be used as **sampling port**
- Collection of wear particles by built-in magnetic rod(Optional)
- **Double transparent glass** prevents oil leakage when broken by external shock.
- Robust and safe glass of chemical resistance and shock resistance materials

02. Purpose

- Oil level check
- Collection of wear particles by built-in magnetic rod (Optional)

03. Application

- All lubrication and hydraulic reservoir and tank

입체 유면계 (3D X-Vision)
여러 방향에서 적정유면 및 오일상태 감시가 용이한 입체형 유면계

QUMENSUS

04. 3D X-Vision / 3- Dimensional Oil Gauge

▪ **Installation Photos**

Flat Type Oil Level Gauge

3D X-Vision

Sampling Port Adaptor
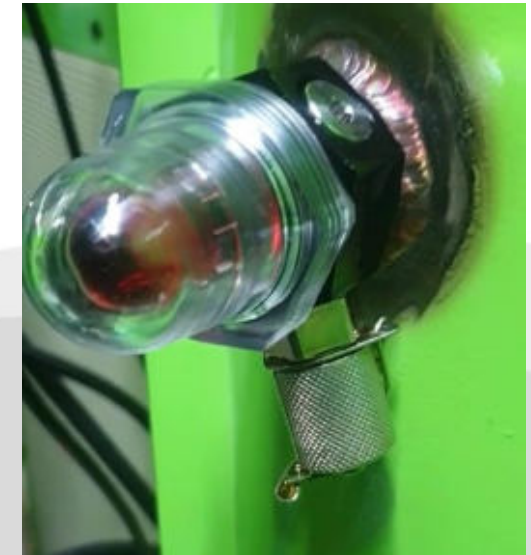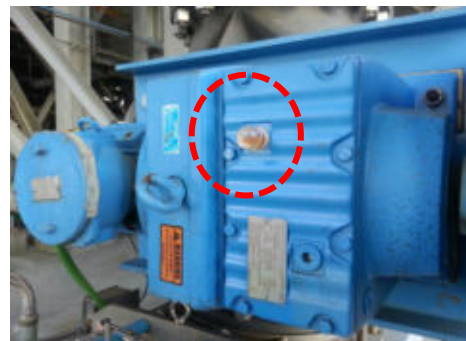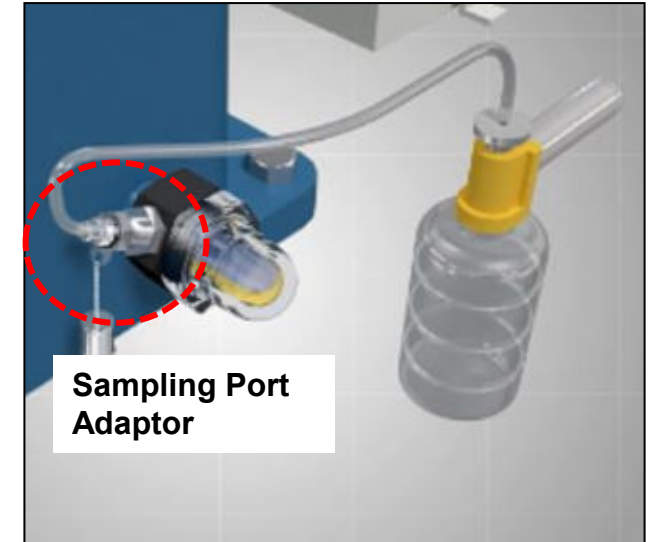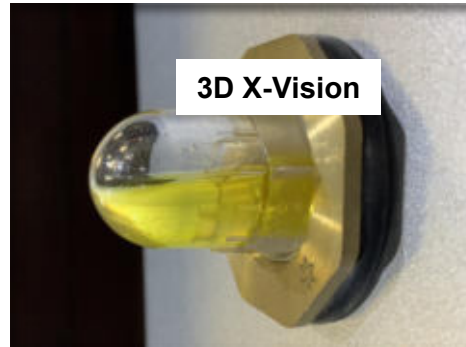
05. <u>Ferro Block Pad</u> / Magnetic Pad

01. Features

- Collect fine particles with 1μm or less
- Can apply for high viscosity oil (low differential pressure)
- Remove non-ferrous metal particles
- **Extend particle filter media life spa**n
- Permanent life span
- Silicone pad with excellent chemical resistance

02. Purpose

- Collection of metal paricles

03. Application

- **Spin-on filter** for mobile equipment
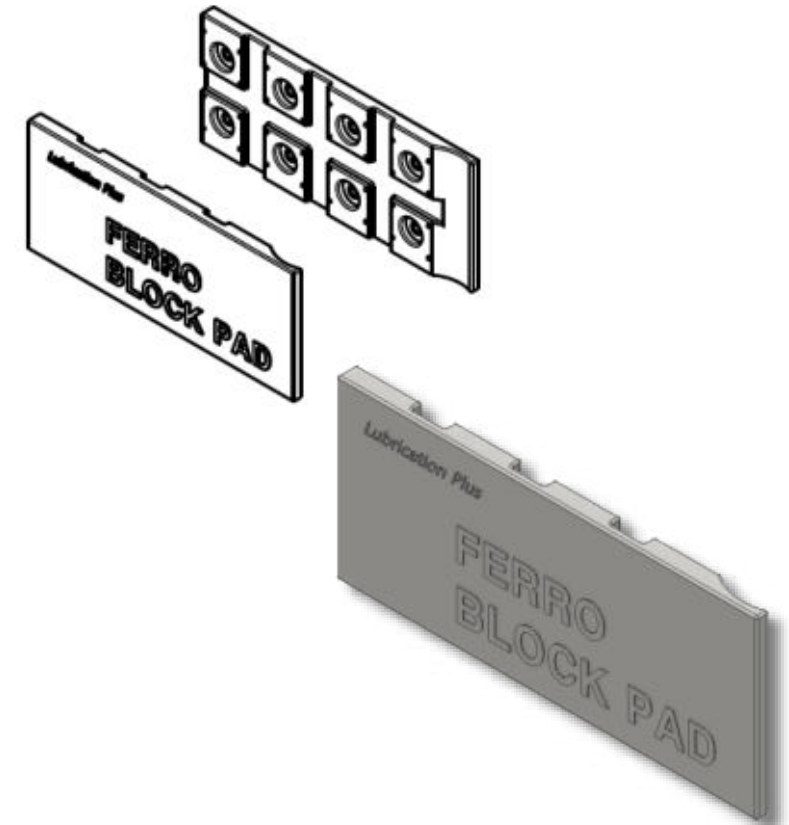
Condition Monitoring Equipments and Sensors
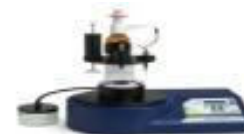
01. Vartector

World's First MPC Tester complied with ASTM D7843

▪ What is **Vartector ?**

It is **World's 1st MPC (Membrane Patch Colorimetry) Tester** that confirms to **ASTM D7843** (Standard Test Method for Measurement of Lubricant Generated Insoluble Color Bodies in In-Service Turbine Oils using Membrane Patch Colorimetry). It quantifies the varnish potential of **Turbine, EHC, Hydraulic Oils in CIE delta E value**.

Vartector
The World's First Stationary MPC Tester

VARTECTOR
Varnish Potential Evaluation System

Lubrication Plus
www.lubricationplus.net

01. Vartector

World's First MPC Tester complied with ASTM D7843

▪ **Features**

- **Fully Automation**: Process of loading, validating, and testing the samples is done automatically within 10 seconds after patching.

- Display: Patch image, **MPC delta E, delta L, a, b value**, **Trending per machine** to be managed.

- **MPC tester for laboratory** analyzer that **meets ASTM D7843 for the first time in the world**

- **Automatic Diagnostic Reporting**: Automatic diagnosis of the measured result (**normal a, normal b, caution, warning**)

- **Automatic Validation**: Automatically performs device validation after power on.

- **Trend management**

- Advanced Software: The software allows **trend management**, creating report (with captured image), **saving up to 1000 data**, setting **automatic** repeat tests (1-10) **and** **calibration** of the tester

▪ **Application**

- Laboratory

VarTector

Good	Monitor	Abnormal	Critical

01. Vartector

World's First MPC Tester complied with ASTM D7843

Mineral Turbine Oils Application

As the varnish value increases, bearing vibration and temperature hunting occurs, and varnish layer is formed on the surface of the bearing. It interrupts the flow of turbine oil, reduces cooling , brings early clogging of the filter. Varnish attached to the cooler brings ineffective cooling to the turbine oil and temperature rise, accordingly can cause shut down of the equipment.

"Oxidation of turbine oil changes fluid properties, and reduces machine life."

Normal A	Normal B	Caution	Warning
<15	15 - 29	30 - 40	>40

Progression of oil degradation = Increase of MPC value

Vibration and temperature hunting of bearings

Early clogging of line filter

Temperature rise due to varnish attached to the cooler

World's First MPC Tester complied with ASTM D7843

PE(Phosphate ester) Oil Application – EHC Oil

EHC oil can easily be hydrolyzed by water and degradation progresses by oxidation, thermal deterioration,.. etc.. As a result of the degradation, varnish and soot are generated, and the degree of varnish formation and soot can be managed as MPC (ΔL or $\Delta a + b$) values.

It is possible to quantify by measuring ΔL and $\Delta a + b$ of varnish and soot respectively, which can not be distinguished by conventional MPC gravimetric method.

For instance, if ΔL and $\Delta a + b$ are high, the risk of varnish and soot is high. If $\Delta a + b$ is low and ΔL is high, it is contamination of soot.

When $\Delta a + b$ is low and ΔL is also low, the patch has a light yellow color, and it means very good oil condition. Control oil oxidation is the main cause of oil deterioration and causes valve sticking. Carbide mainly causes valve wear which brings leaking and valve sticking.

Controlling heat

Oxidation

Hydrolysis

: Varnish (oxidation) = A + b increase

Thermal degradation

: Soot = ΔL increase
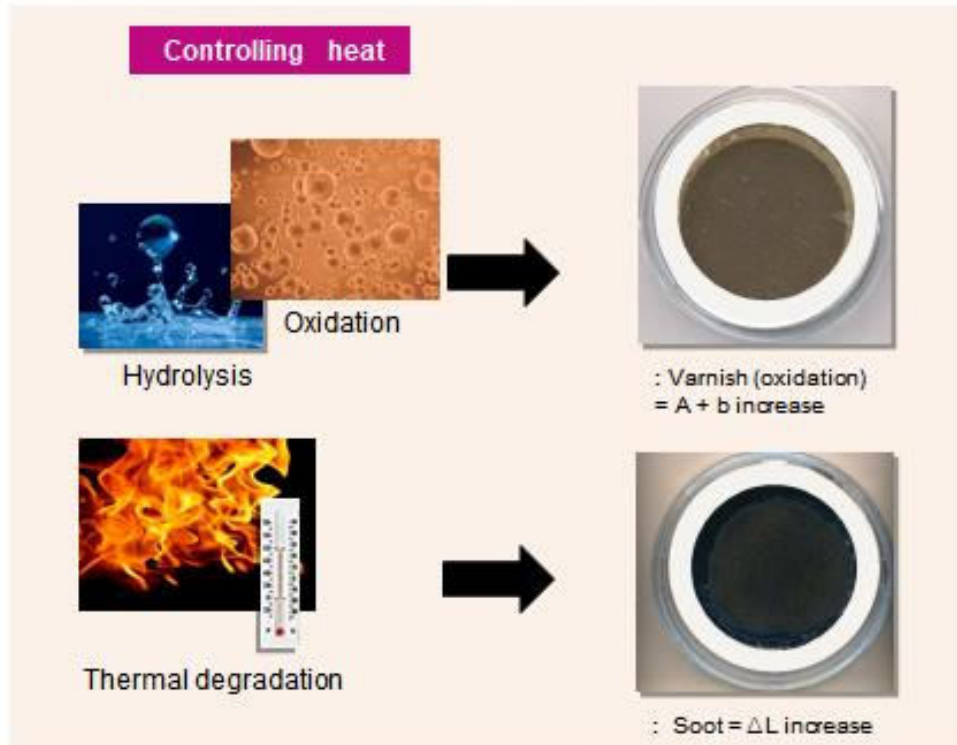
- Oxidation ($\Delta a + b$ ↑): Oil with high ΔE and high $\Delta a + b$

30.52 31.34 32.19 35.7 36.37 40.56 42.76

45.38 52.23 53.1 57.02 57.94 67.65

- Bad valve control
- Valve Sticking
- Oil degradation

- Carbonization (ΔL ↑): Oil with high ΔE and high ΔL

30.55 34.3 46.29 46.47 46.89 54.43 60.19

62.08 68.1 69.14 76.87 77.15 77.22

- Pressure issue for leakage
- Valve Sticking

02. Ferro-Mon Sensor /

Real-time Ferrous Particles Monitoring Sensor

01. Features

- **Real-time** monitoring sensor of **ferrous particles** amount (Fe saturation %): 0 ~ 100%

- User can select standard **1-channel sensor** (particles) or **2-channel sensor (fine particles and large particles)**
  - Large particles : Abnormal wear condition
  - Fine particles : Normal wear condition

  - **Visual alarm signal** and value are displayed on the control box
    - Full scale and zero setting depending on application can be done on site and in the PC software.

- **Communication with PC or PLC** is possible

- **Wireless communication with LoRa communication** is available as optional.

Ferro-Mon Sensor
Ferrous Wear Particle Real-time Monitoring Sensor
QUMENSUS

02. Ferro-Mon Sensor /

Real-time Ferrous Particles Monitoring Sensor

02. Purpose
- Monitor wear condition of the equipment to prevent catastrophic failure at early stage

03. Application

- Wind Turbine Gearbox

- Cooling Tower Gearbox

- Agitator or Extruder Gearbox

- Multi-stage Gearbox

- Pump

- Rotating Machinery such as Compressor

- 4-cycle Engine

- Locomotive (High Speed Train) gearbox

[Standard, 1 Channel]

[Wireless Communication, 2 Channel]
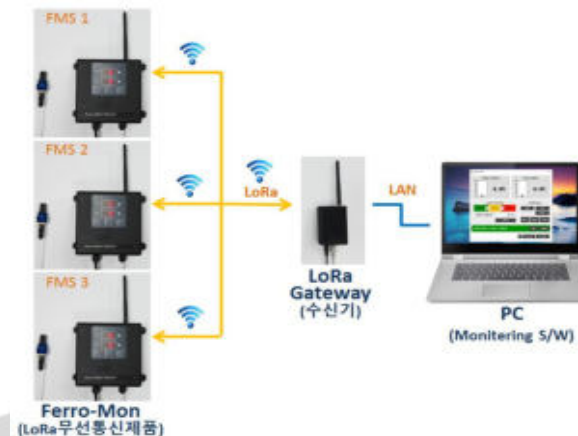
■ LoRa Wireless Communication   ■ PC Sofrware
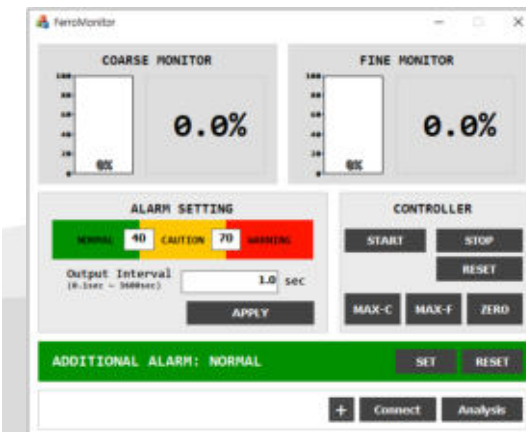
02. Ferro-Mon Sensor /

Real-time Ferrous Particles Monitoring Sensor

Signal of abnormal wear
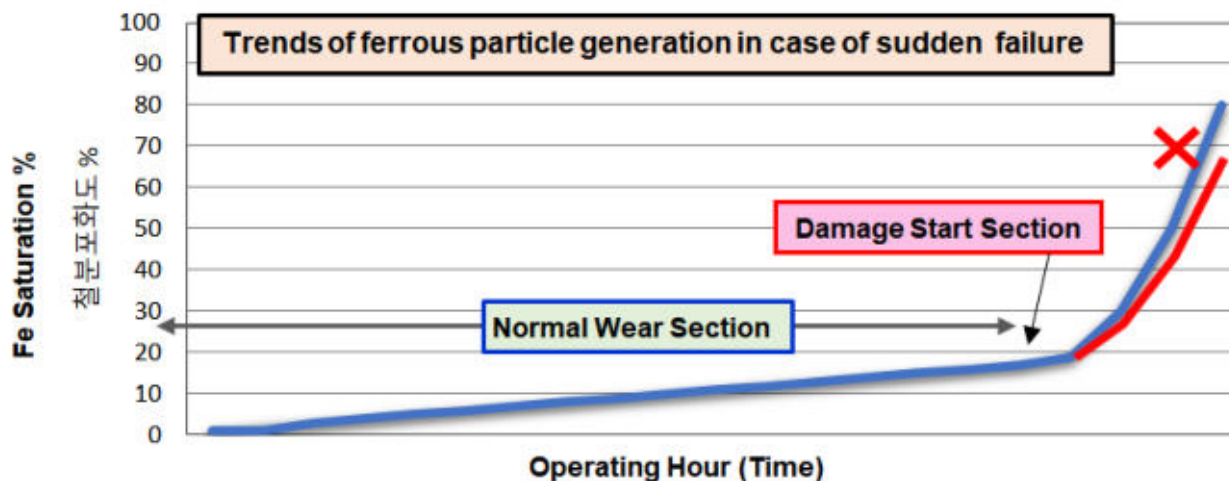
[Example of failure detection by using ferrous particle saturation sensor]

Installation Positions

- **Recommended Positions ( )**
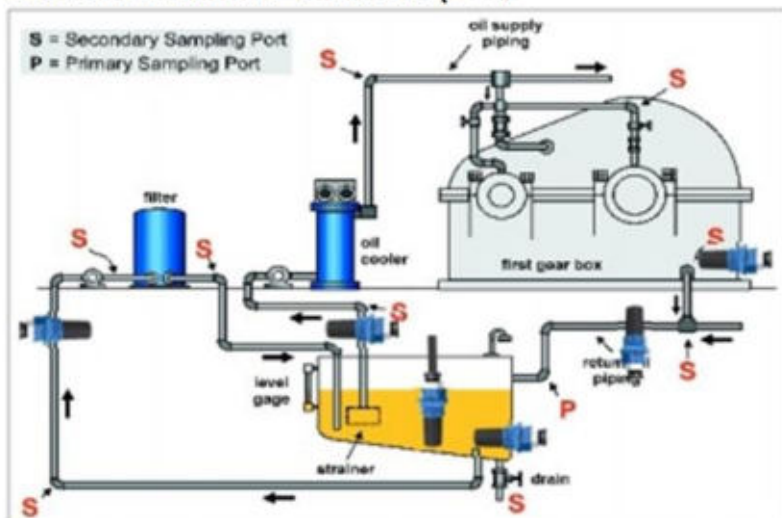
[Gearbox (Forced Circulation Type)]
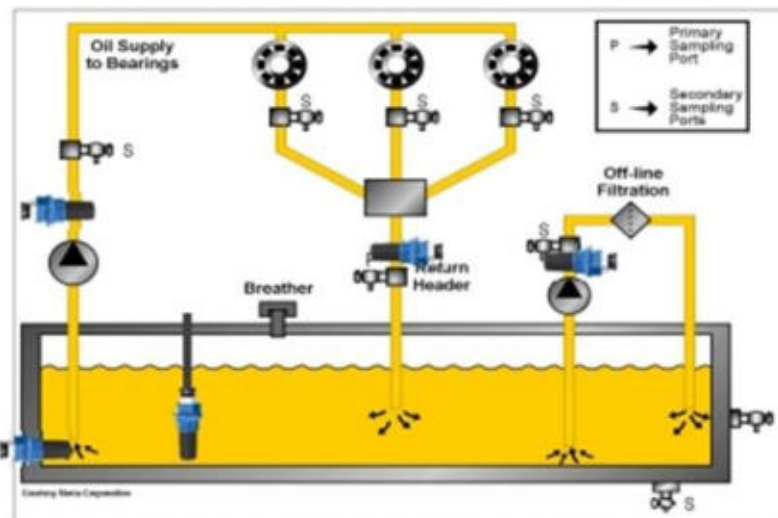
[Bearing Lubrication System]

02. <u>Ferro-Mon Sensor</u> /

Real-time Ferrous Particles Monitoring Sensor

▪ **Installation Examples and Photos**

[Wind Turbine Gearbox]
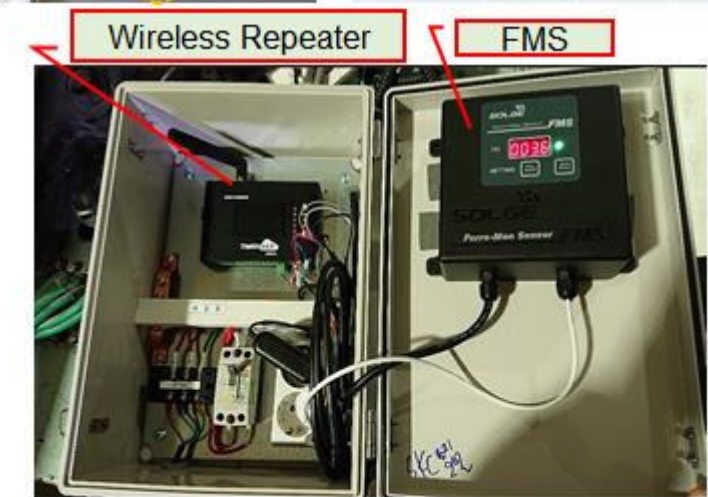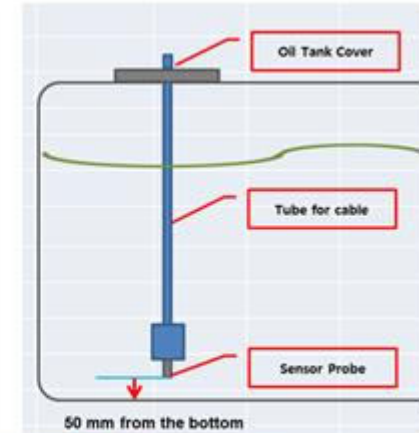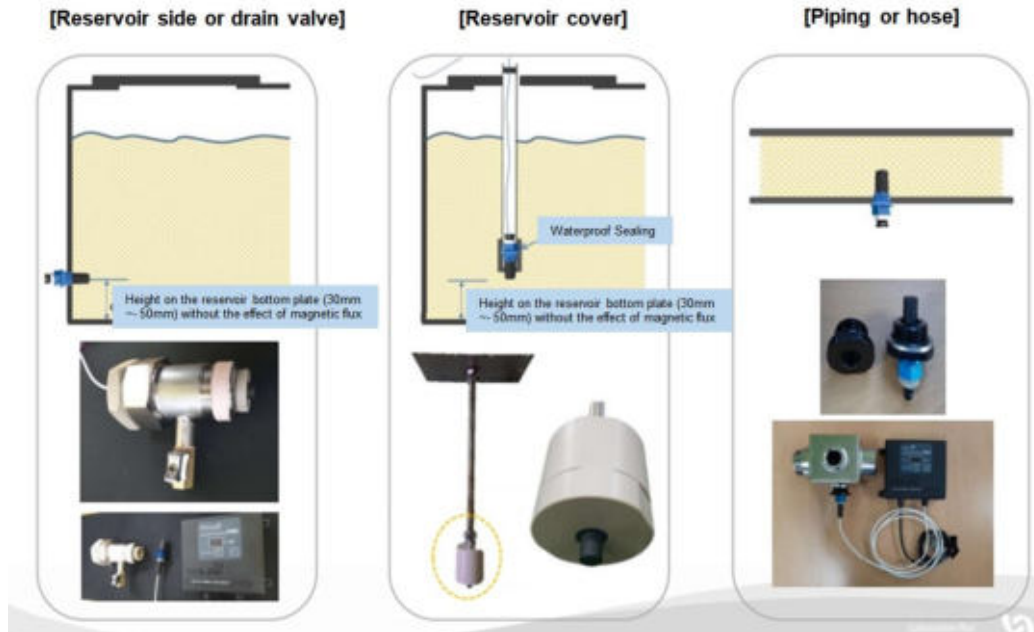
[Extruder Gearbox Oil Tank / Wireless Communication]

03. <u>Oil-Mon Sensor</u> /
Real-time oil condition monitoring sensor(water/particle/acid)

01.Features

- Measure multiple **4 parameters by one sensor**
- Can initialize and set maximum scale in the controller
- Easy to check visually the measuring values on the controller
- Alarm sounds when an alarm occurs
- **Real-time data transmission by connecting to PC**

02.Purpose

▪ Real-time oil condition monitoring
(**Water, Particle, Oxidation, Temperature**)

03.Application

- HPU (Hydraulic Power Unit)
- Air Compressor
- Wind Turbine Gearbox
- Reducer
- Bearing
- 4-stroke Diesel Engine
- Pump

03. Oil-Mon Sensor /
Real-time oil condition monitoring sensor(water/particle/acid)

04. Specification

- **Contamination** (Particles)
   Range : 0~1,000ppm (0~100%)
   Accuracy : 20 ppm

- **Oxidation** (Degradation / Oil Life Span)
   Range : 0~100%

- **Water in Oil** (Relative Humidity)
   Range : 0~100% RH
   Accuracy : ±3% RH

- **Temperature**
   Range : -20~85◦C
   Accuracy : max. ±2 ◦C

▪ **Synergy when combined with Ferro-Mon Sensor**

Machine Health	Oil Health
Ferro-Mon 철 미모분 감시	Oil-Mon 오일상태 감시

- Oil-Mon sensor monitors oil condition, whilst
  Ferro-Mon sensor monitors equipment condition.

- **Combined use of Oil-Mon Sensor and Ferro-Mon Sensor** will be very useful tool and bring synergy effect for stable operation of the equipment, which leads to **pro-active maintenance**.

03. Oil-Mon Sensor /

Real-time oil condition monitoring sensor(water/particle/acid)

▪ **Connection to PC**

▪ **Installation Example**

Input 12~36 VDC
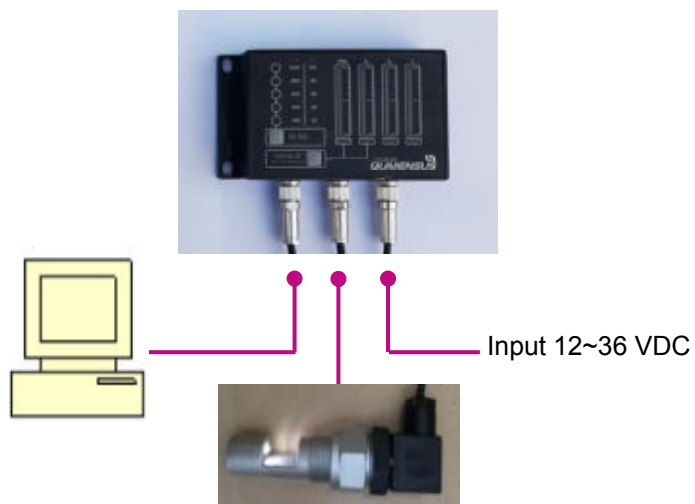
- Oil-Mon sensor can be connected to PC to change settings. Measurement data can be transferred to PC in real time.

- Internal Flash Memory : 64K Bytes

- SD Card : 8G Bytes
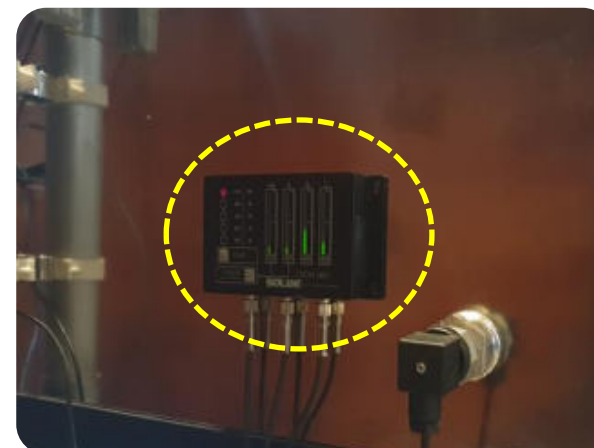
04. ParVision-Pro / Diagnosis Equipment of Contamination/ Particle/Water/ Shape & Life Span

01. Features

- Measuring and Diagnosis by One Equipment

- ALL in ONE" innovative diagnosis equipment for **contamination, water, particle shape/type and life span of lubrication oil and diesel fuel.**

- **Photo of particle size shap**e are displayed in the monitor and it helps identification of **type of wear such as fatigue wear, cutting wear.**

- Contamination grade with **ISO/NAS/SAE** available.

- Unlike existing contamination measuring equipment, **bubbles are excluded from counting** and user can get more accurate values.

02. Application

- HPU
- Bearing
- Transmission
- Mobile Equipment

- Gearbox
- Wind Turbine
- Pump
- Diesel Fuel

- Air Compressor
- Diesel Engine
- Other Lubrication Facility

04. <u>ParVision-Pro</u> / Diagnosis Equipment of Contamination/ Particle/Water/ Shape & Life Span

Lubrication Plus
SOLGE

Functions

- **Particle Contamination & Shape**
  - Particle Counter equipped with **CCD camera** counts number of contaminants and describes as **NAS1638, ISO4406, SAE AS4059**.
  - Particle sizes are 4, 6, 14, 38, 70, above 100μm.
  - Image of particles are filmed and stored. Particularly, **bubbles are excluded from counting**, so more accurate values are measured.
    → It **makes up for weakness of typical laser particle counter**.
  - **Particles bigger than 20μm are classified into category of Fatigue Wear, Sliding Wear, Cutting Wear, Fiber**. If type of wear is diagnosed, it is easy to prepare improvement countermeasure.

- **Water (Relative Humidity , Saturation %)**
  - Sensor measures saturation of water in the oil as **RH (Relative Humidity)%.**
  - Displayed as saturaton [%]. Water in the oil is displayed as % till it reaches free water (saturation 100%).
    For instance, 70%~80% values are stable as it means no free water in the oil.

- **Oil Life (Oil Degradation)**
  - Possible to **predict oil life span** based on **more than 500 references stored in the particle counter**, i.e., not necessary to set up initial value from new oil.
  - By predicting life span of oil, user can decide oil change time, operating time of purifier.

04. <u>ParVision-Pro</u> / Diagnosis Equipment of Contamination/ Particle/Water/ Shape & Life Span

Example of Monitor Displays
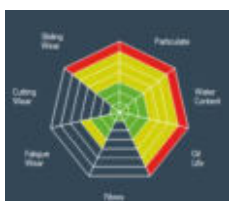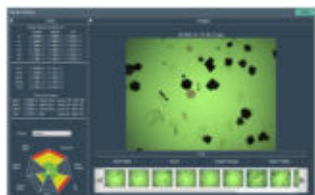
- **Particle Analysis**
  - Display counting number of particles (4, 6, 14, 21, 38, 71 & 100μm)
  - Display class of ISO, NAS, SAE in graph.
  - Provide photos of particles images. Can measure size of each different particle.
  - Classification and description of particles wear type (Fatigue/Sliding/Cutting/Fiber)
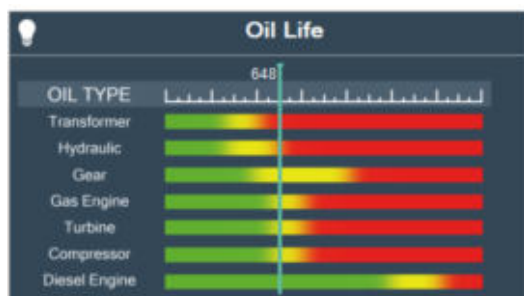
- **Oil Life Span Analysis**
  - Display life span for various oil types such as hydraulic oil, gear oil and turbine oil by comparing with 500 stored references for each different type of oils.
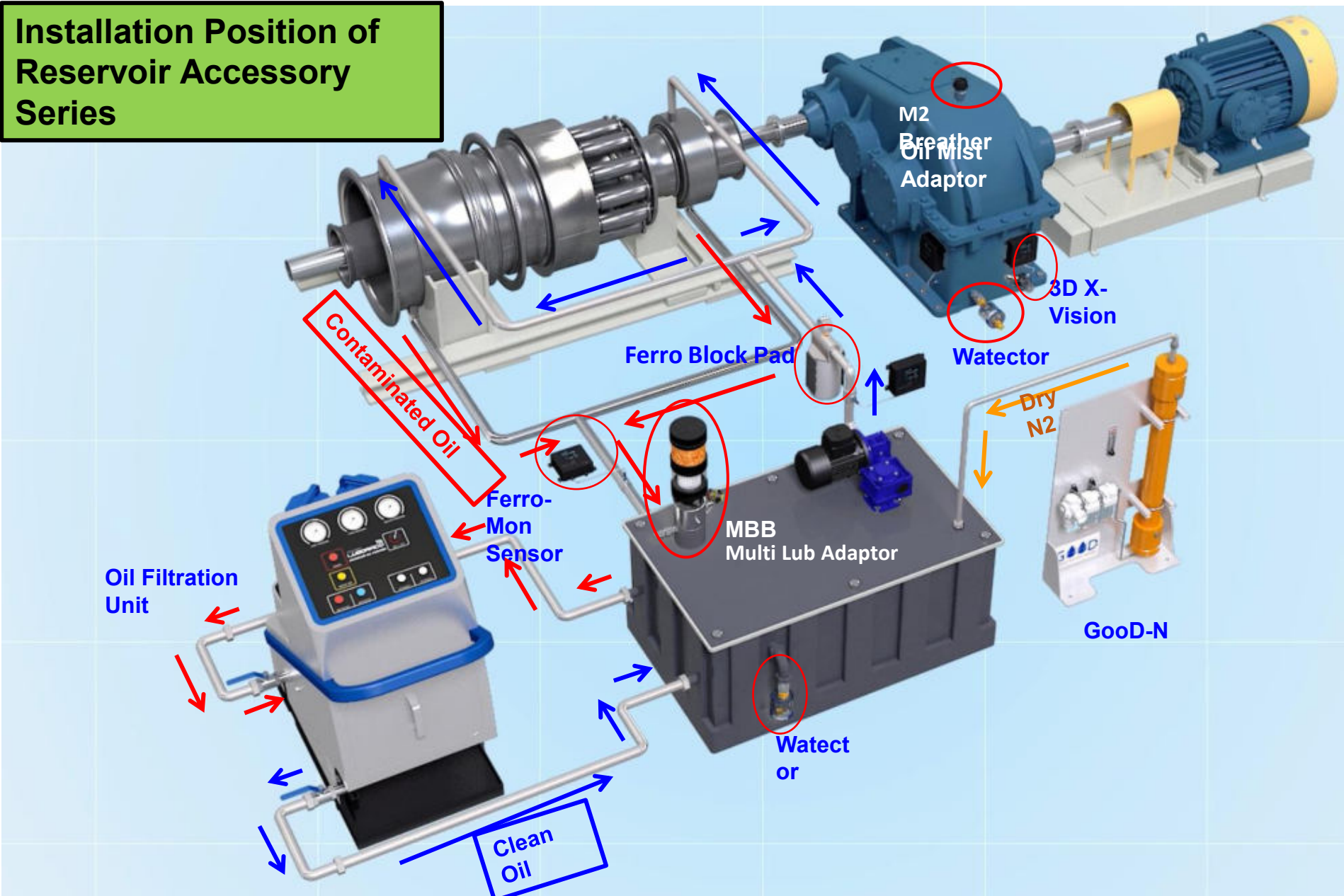 - For easy visual check, life span is displayed as bar chart.

- **Water Contents Analysis**
  - Display relative humidity as %
  - Display trend and status value (When measuring, temperature value is displayed.)

Installation Position of Reservoir Accessory Series

M2 Breather Oil Mist Adaptor

3D X-Vision

Watector

Ferro Block Pad

Contaminated Oil

Dry N2

Ferro-Mon Sensor

MBB Multi Lub Adaptor

GooD-N

Oil Filtration Unit

Watector

Clean Oil

![Lubrication Plus SOLGE logo]

Office

Contact

E	cs@solge.com
T	+82 53 588 3301
F	+82 53 588 3151
Web	www.lubricationplus.net
YouTube	Enter "lubrication plus"

R&D Center & Commercial Laboratory