

DOMINO[®]



MOISTURE-IN-OIL INSTRUMENTS

The *DOMINO* is an accurate, simple, robust and versatile instrument offered by Doble Engineering. The *DOMINO*, Doble's Moisture-in-Oil instrument, measures just that: moisture in oil in terms of ppm and relative saturation plus the added benefit of temperature. It is an instrument that provides for the continuous reliable measurement of the water content of electrical insulating liquids and other types of oils.

TOGETHER WE POWER THE WORLD

Introduction:

In 1999, Doble introduced the first **DOMINO** that became an instant success. Its enthusiastic acceptance in the industry has placed it as another respected, superior quality instrument provided by Doble Engineering.

The success was due in main part to the variety of applications that it could be used. The variety of application uses, along with its robustness and Doble's technical expertise have made the **DOMINO** an industry standard. In 2007, Doble introduced the second generation of **DOMINO** and has been very well received by the industry. The new generation of **DOMINO** brings a progression from just a basic sensor to an instrument with many enhancements and added features from the first generation.

Features:

Why Measure Moisture in Oil?

The determination of moisture in insulating liquids is an essential part of any comprehensive maintenance or diagnostic program. Water is extremely detrimental to most oil filled systems and especially transformers and other liquid-filled electric apparatus. Knowing the water condition in real time is the best way to guard against harmful conditions that may exist or present themselves.

- **Instantaneous Results**— no waiting...the **DOMINO** provides continuous results in parts per million (ppm), relative saturation and temperature on a single easy to read display and records the values in real time.
- **An Effective Monitor**— continuously monitors oil reconditioning in systems as small as a single filter cartridge to as large as a mobile or stationary processing plant. Helps in determining filter changeout, process efficiency, and determination of when to terminate the processing effort. Readout is directly in ppm—no need for messy charts and conversions.
- **Simple to Use**— eliminates all harmful chemicals and laboratory systemic errors associated with Karl Fischer titrations, delicate Karl Fischer titration devices, sampling error, and contamination from ambient humidity.
- **QuickResponse** — In flowing oil at a velocity of 4 liters per minute or more (1 gallon/minute), the time for 100% response is 30 seconds or less. This means you can perform your job quicker and more accurately.
- **Easy installation**— the probe installs directly in the flowing oil up to 2271 liters per minute (600 gpm). As for the transmitter, just plug it in...it will start to measure and display immediately.



- **Immune to Interference**- accuracy of measurements is unaffected by the severe electrostatic and electromagnetic interference conditions which exist in substation environments.
- **Highest Accuracy**- at $\pm 1\%$ including non-linearity and repeatability – best in the industry!
- **Stable Calibration** calibration stability ensures accuracy and validity of the measurements.
- **Rugged and Reliable** robust design provides the accuracy of a laboratory instrument with durability for field use.
- **Flexible Configurations**- comes equipped with two or three analog outputs default set to 4 to 20 mA, depending on the model. Outputs are easily changed and selectable and scalable between 0-20 mA or 0-10 volts. Simple software commands allow configuration to be completed in a few minutes, even in the field. Operating parameters may be accessed and changed through the local display menu, or the serial bus.
- **Storage and Graphing Capabilities**- Data recording function is always on and collects data automatically into the memory of the device. Recorded data does not disappear from the memory when the power is switched off. Collected data can be observed in a form of a graph in the graphical view of the display or it can be listed out by using the serial line. If the model is provided with the optional display, the recorded quantities are always those selected for the display. Up to three quantities can be recorded at a time.

Description:

The **DOMINO** is comprised of a stainless steel probe, and a probe cable that connects the probe to the transmitter/display.

The stainless steel probe houses the moisture and temperature sensors and can be installed into any valve that is 1/2 inch National Pipe Thread (NPT) (15 mm) or larger. The probe forms an oil tight seal that allows installation in energized equipment. This robust sensor can withstand full vacuum and up to 580 psi of pressure and temperatures up to 180°C. The probe, which is placed directly in the insulating liquid, measures the capacitance of a thin polymer film. The capacitance changes proportionally to the change in relative saturation of water in the oil.

The probe cable is a specially designed to transmit the signals from the probe to the transmitter and can also withstand temperatures up to 160°C.

The transmitter and display is in a NEMA 4 housing thus providing a durable weather proof package that can be mounted outdoors. Either 10-35 VDC/24 VAC or 100-240 VAC powers the transmitter. The transmitter converts the measured RS to a concentration value that most people are familiar with, parts per million (ppm) wt./wt. which is displayed. The conversion is preset for electrical insulating mineral oil but can be easily configured for many other insulating liquids, natural esters, lubricating oils, hydraulic oils and others, which have different solubility characteristics for water.

DOMINO® Measurements:

DOMINO firmware is configured to display the following measured and calculated quantities:

- Relative Saturation in Percent (%RS, 0 to 100%)
- Temperature, (-40 to 180°C)
- Parts per Million, mg/kg (ppm)

Relative Saturation (RS)

In addition to the results in ppm, relative saturation and temperature is displayed. RS is the actual amount of water measured in the oil in relation to the solubility level at that temperature. RS is expressed in units of percent, and is the concentration of water in the oil relative to the solubility or concentration of water the oil can hold at the measurement temperature.

RS can provide extremely useful information about the dielectric breakdown strength of an insulating liquid especially in transformers subjected to severe thermal cycling.

For example, at 100 percent saturation the dielectric breakdown voltage of an oil will always be low regardless of its concentration in ppm.

Reliable Measurements Comparison to Karl Fischer:

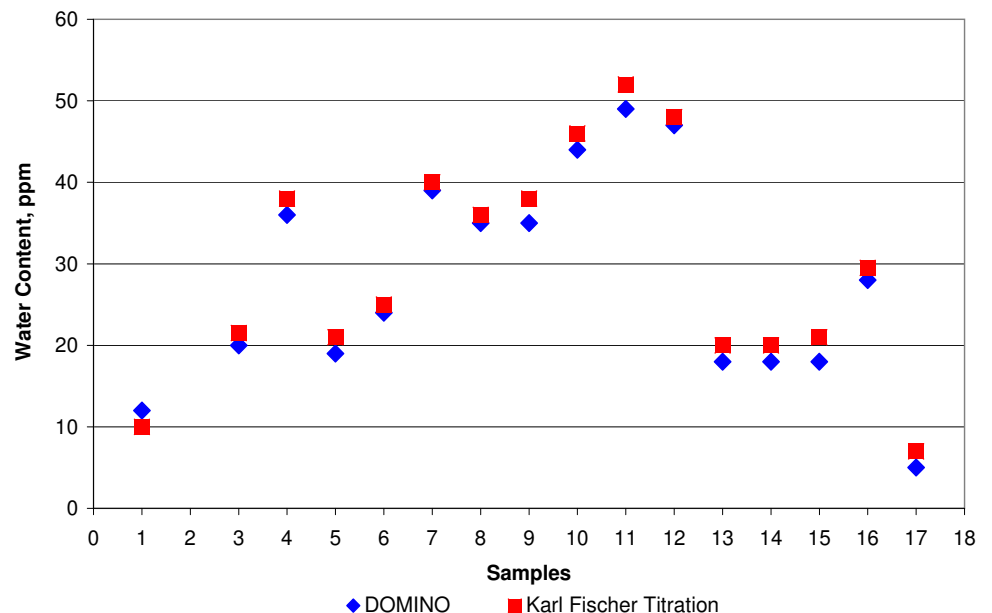
Moisture measurements can be greatly affected by chemical interferences. These factors can result in seriously erroneous results.

The accuracy of the moisture measurement is directly related to the quality of the transmitted signal, the accuracy and stability of the sensor and its comparison to the Karl Fischer titration measurement for moisture.

The **DOMINO**'s proprietary signal reception and processing ensures stable and accurate measurements.

The **DOMINO** provides ppm results that are comparable to the traditional KarlFischer titration for the determination of water in electrical mineral oil because it is based on an algorithm using the Karl Fischer method. The instrument can also be easily configured by the user for insulating liquids with different water solubility characteristics than mineral oil. The measurement of water by this instrument is not affected by certain contaminants in the oil which occasionally adversely alter the results of the chemical test for water by ASTM Test Method D 1533 or IEC60814.

DOMINO Versus Karl Fischer Titration



Models:

The **DOMINO** incorporates many options in our base unit such as two or three selectable and scalable analog outputs and a serial bus. Most models include a keypad and display and are powered by either by 10-35 VDC/24 VAC or a 100-240VAC power supply. **DOMINO** models have various cable lengths from the probe to the transmitter (display/keypad), can be mounted permanently or temporarily. There are even three models that have an alarm output. These options enable you to fit the product to your needs.

Model	Power	Display	Cable Length	Digital output	Analog Outputs	Alarm Relay
LV-2	10-35 VDC/24 VAC	No	2 m	RS 232C	2 (ppm, T)	None
LVD-AL-2	10-35 VDC/24 VAC	Yes	2 m	RS 232C	3 (ppm, T, RS)	1
LVD-AL-10	10-35 VDC/24 VAC	Yes	10 m	RS 232C	3 (ppm, T, RS)	1
HVD-2	100-240VAC	Yes	2 m	RS 232C	3 (ppm, T, RS)	None
HVD-5	100-240VAC	Yes	5 m	RS 232C	3 (ppm, T, RS)	None
HVD-10	100-240VAC	Yes	10 m	RS 232C	3 (ppm, T, RS)	None

Applications:

The success of **DOMINO** has translated to its use in a diverse group of applications. Some are:

- Continuous measurement in oil processing equipment
- Transformers and other electrical apparatus including OEM installations
- Generator thrust bearing systems
- Cable insulating liquid systems
- Hydraulic liquid systems
- Portable, discrete measurement of water in insulating liquids
- Laboratory assessment of water in insulating liquids
- Applicable for use in many different types of insulating liquids, such as:
 - Transformer mineral oil
 - Silicone insulating liquids
 - Cable insulating liquids
 - Vegetable based insulating liquids such as BIOTEMP® and Envirotemp FR3®
 - Other insulating liquids such as R-TEMP®, ECO Fluid®, Opti-cool®, Midel 7131®, Reolec® 138, and BETA Fluid®.
 - Generator thrust bearing oils
 - Hydraulic oils
- Use as a stand alone sensor or part of sensor array for on-line monitoring

Accessories:

- Universal mounting bracket
- Stainless steel ball valve
- Stainless steel nipple
- RS-485 module

Under the same **DOMINO** product line, Doble also offers a line of portable moisture-in-oil and dew point instrumentation termed USS or Ultimate Sampling System, refer to Doble Marketing Brochure *MKT-SL-DOMINO*. USS for details on these products



DOMINO® USS System

Specifications:

Measured Variables:

Relative Saturation (RS)	0 to 100%
Concentration (parts per million of water) (ppm)	mg/Kg
Accuracy, including non linearity (and repeatability)	0-90% RS \pm 1% (90-100% RS \pm 2%)
Temperature Measurement Range	-40 to 180°C

Sensor Types:

Water Sensor	Thin film polymer
Temperature	Pt 100 RTD 1/3
Pressure range of sensor head (probe)	40 bar (0-580 psi)

Outputs:

Two/Three analog outputs (depends on model)	Scalable between 0-20 mA or 0-10V
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Relative Saturation in Oil	0 to 100% RS
Temperature Measurement Range	-40 to 180°C
Other Outputs Selectable and Scaleable from	0-20 mA or 0-10 V
Ppm in oil (depends on model)	0...100, 200, 500 (can be scaled to any value)
Serial Output	RS232C (RS485, optional)

Display:

Display Menu Languages	LCD with backlight, graphic trend display of any parameter English, French, Spanish, German, Japanese, Russian, Swedish and Finnish
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Operating Temperature Range	-40 to 60°C
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Power Requirements:

General:

Operating temperature range	-40 to +60°C for electronics
Cable Length	2 m, 5 m or 10 m
(Transmitter to Probe)	(78.7 in., 197 in. or 394 in.)
CE Marked	

Probe Assembly:

Sensor Protection	Stainless Steel Filter
O-ring Material	Viton
Probe Dimensions	176mm L x 13.5mm dia (6.93in.L x 0.53 in. dia)

Transmitter Housing Assembly:

Housing Material	G-AISI 10 (DIN 1725)
Housing Classification	IP 65 (NEMA 4)
Housing Assembly Size (see diagram)	187 mm x 116 mm x 77mm (7.20 in. x 4.57 in. x 3.03 in.)

DOMINO®

THE DOBLE DIFFERENCE

Obtaining accurate moisture temperature data is a necessary step in determining the condition of electrical apparatus or the insulating liquid—but the data by itself may not always be sufficient to identify potential problems especially in transformer systems.

Doble Engineering developed one of the first analytical techniques for the measurement of dissolved water in oil and also developed probably the first on-line moisture monitors albeit much different than today's **DOMINO**.

This type of dedication has led us to be the industry leader in this field. Doble is the only company in the industry with the knowledge base necessary to provide accurate and expert interpretation of these types of measurements.



Specifications are subject to change without notice.

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