DOMINO®

Ultimate Sampling System (USS)

User Guide

NOTICE

This User Guide covers **all** *DOMINO*® Ultimate Sampling System probes and components.

One or more section(s) may not apply to the product you have.

NOTICE

The first charge of the Indicator requires 6 hours.

DO NOT use the Indicator during the first charging cycle.

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SECTION 1
INTRODUCTION

This section contains general information on the *DOMINO*®
Ultimate Sampling System, including descriptions of
the available system configurations.

Chapters in this section...

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CHAPTER 1
GENERAL INFORMATION

This chapter contains general information on
the *DOMINO*® USS System including critical safety information.

Topics in this chapter...

Safety

Trademarks

Feedback

Recycling/Disposal

De-commissioning and Disposal

Doble Service Center

Warranty

Safety

Safety should always be the first priority of every user.

Before using this product familiarize yourself with
the features and functions of each equipment item.

Before starting any procedure, read through the entire instructions
and do not proceed if you have any doubt about their meaning.

Throughout the manual, important safety considerations
are highlighted as follows:

WARNING	Warnings alert you to a potential personnel hazard. If you do not read and follow instructions very carefully at this point, there is a risk of injury or even death.

CAUTION	Cautions warn you of a potential equipment hazard. If you do not read and follow instructions carefully at this point, the product could be damaged or important data could be lost.

NOTE	Notes highlight important information on using or understanding the product.

TIP	Tips contain important information that can save time and effort when using the product.

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Feedback

The Doble Customer Documentation Team welcomes your comments and suggestions on the quality and usefulness of this publication. If you find errors or have other suggestions for improvement, please indicate the section, chapter, topic, and page number. You can send comments to us by e-mail at:

domino@doble.com

Recycling/Disposal

	Recycle all applicable material.

	Dispose of batteries and the unit in accordance with all federal, state, and local regulations. **DO NOT** dispose of with regular household refuse.

De-commissioning and Disposal

WARNING	Contaminated parts can be detrimental to health and environment. Before beginning to work, and after completing the work, determine whether any of the parts - especially the probe, filter, or sampling cell - have been contaminated during the measurement process and thus may require decontamination.
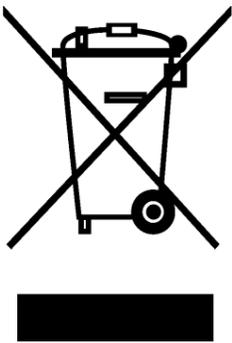
Adhere to the relevant regulations and take the necessary precautions when handling contaminated parts.

1. Contaminated components, if any, must be decontaminated according to the relevant federal, state, and local regulations.

2. The battery packs and/or alkaline batteries must be removed as described in Replacing The Battery Pack on page 70 and Using Alkaline Batteries on page 71.

3. Dismantled parts must be separated according to the materials and disposed of according to relevant federal, state, and local regulations.

Doble Service Center

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You can also request customer service from links on our website.

Warranty

Equipment Limited Warranty

Doble Engineering Company (DOBLE) warrants the products that it manufactures to be free from defects in material and workmanship for a period of one year from the date shipped from the factory.

During the one-year warranty period, DOBLE will repair or replace, at its option, any defective products or components thereof at no additional charge, provided that the product or component is returned, shipping prepaid, to DOBLE. The Purchaser is responsible for insuring any product or component so returned and assumes the risk of loss during shipment. All replaced products and components become the property of DOBLE.

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CHAPTER 2
DOMINO® USS QUICK START

The *DOMINO*® Ultimate Sampling System enables reliable and high performance moisture-in-oil and dewpoint measurements.

The first time out of the case, follow these steps:

1. **Familiarize yourself with the system components.**

   The *DOMINO*® Ultimate Sampling System consists of a hand held indicator and a probe that is installed on the process. There are a variety of fittings and accessories supplied for each probe type. For more information see Chapter 3, The *DOMINO*® Ultimate Sampling System on page 11.

2. **Prepare the Indicator.**

   The first time you use the Indicator you must charge the internal battery and program the current date and time. For more information see Chapter 7, Indicator Quick Start on page 31.

3. **Configure and install the probe and begin to take readings.**

   Each different probe type requires configuration and installation on the process before taking readings. For more information see:

   - Chapter 14, Moisture-In-Oil Quick Start on page 75.

   - Chapter 20, Dewpoint Quick Start on page 125.

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CHAPTER 3
THE *DOMINO*® ULTIMATE SAMPLING SYSTEM

This chapter contains information on the types of *DOMINO*® USS Systems that are available.

Topics in this chapter...

About The *DOMINO*® Ultimate Sampling System (USS)

Types Of *DOMINO*® Ultimate Sampling Systems

About The *DOMINO*® Ultimate Sampling System (USS)

The *DOMINO*® Ultimate Sampling System enables reliable and high performance moisture-in-oil and dewpoint measurements.

The USS system consists of two main components:

- The *DOMINO*® USS Indicator controls the sensor probes and displays and stores the measurement results. The USS Indicator is a portable hand held unit powered by a rechargeable battery and can control up to two probes. It can also be connected to a PC for monitoring and data transfer and can provide a 0 to 1 V analog output.

- A *DOMINO*® USS sensor probe. There are two types of probes:

  - The *DOMINO*® USS Moisture-In-Oil Probe utilizes Doble's advanced *DOMINO*® technology to measure moisture-in-oil concentrations accurately in a measurement range from -40 ˚C (-40 ˚F) up to +60 ˚C (+140 ˚F.)

  - The *DOMINO*® USS Dewpoint Probe utilizes Doble's advanced *DOMINO*® dewpoint technology to measure dewpoint temperature accurately in a measurement range from -60 ˚C (-76 ˚F) up to +20 ˚C (+68 ˚F.)

  Probes are calibrated at Doble and can be delivered with or without a factory calibration certificate.

Additionally, all *DOMINO*® USS systems contain:

- *DOMINO*® Connects, a Microsoft Windows® environment software program that allows you to use a PC to monitor and configure the Indicator and to download recorded data.

- The necessary adapters to interface the included sensor probe(s) to a wide variety of process vessels including pressurized pipes and transformer drain valves.

- A rugged high-density polyethylene carrying case with a cushioned oil-resistant insert to safely store and transport all components.

Types Of *DOMINO*® Ultimate Sampling Systems

The *DOMINO*® USS comes in three different system configurations:

The *DOMINO*® USS Moisture-In-Oil System

(Doble Part Number 03D-1647-01)

Contains an Indicator and universal AC/DC adapter, one Moisture-In-Oil Probe, *DOMINO*® Connects software and interface cable, printed User Guide, Moisture-In-Oil Quick Start Guide, and adapters to interface the included probe, all in a rugged polyethylene carrying case. For more information see Chapter 4, The *DOMINO*® USS Moisture-In-Oil System on page 15.

The *DOMINO*® USS Dewpoint System

(Doble Part Number 03D-1677-01)

Contains an Indicator and universal AC/DC adapter, one Dewpoint Probe, *DOMINO*® Connects software and interface cable, printed User Guide, and adapters to interface the included probe, all in a rugged polyethylene carrying case. For more information see Chapter 5, The *DOMINO*® USS Dewpoint System on page 21.

The *DOMINO*® USS Complete System

(Doble Part Number 03D-1686-01)

Contains an Indicator and universal AC/DC adapter, two Moisture-In-Oil Probes, one Dewpoint Probe, *DOMINO*® Connects software and interface cable, printed User Guide, Moisture-In-Oil Quick Start Guide, and adapters to interface the included probes, all in a rugged polyethylene carrying case. For more information see Chapter 6, The *DOMINO*® USS Complete System on page 25.

Additionally, all system components and accessories can be ordered separately. For more information see Chapter 28, Options, Accessories, and Spares on page 179.

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CHAPTER 4
THE *DOMINO*® USS MOISTURE-IN-OIL SYSTEM

This chapter contains information on
the *DOMINO*® USS Moisture-In-Oil System.

Topics in this chapter...

About The *DOMINO*® USS Moisture-In-Oil System

Measured Variables

General Theory Of Operation

System Components

About The *DOMINO*® USS Moisture-In-Oil System

The *DOMINO*® USS Moisture-In-Oil system measures moisture-in-oil concentrations accurately in a temperature range from -40 ˚C (-40 ˚F) up to +60 ˚C (+140 ˚F.) The *DOMINO*® USS Moisture-In-Oil probe incorporates advanced *DOMINO*® technology, which enables reliable and high-performance moisture-in-oil-measurements.

The *DOMINO*® USS Moisture-In-Oil System (Doble Part Number 03D-1647-01) contains an Indicator and universal AC/DC adapter, one Moisture-In-Oil Probe, *DOMINO*® Connects software and interface cable, printed User Guide, Moisture-In-Oil Quick Start Guide, and adapters to interface the included probe, all in a rugged polyethylene carrying case. The case can hold an additional Moisture-In-Oil probe and a Dewpoint Probe, available separately.

CAUTION	**Do not store the *DOMINO*® USS Moisture-In-Oil Probe in a high humidity environment.**
	Storing the *DOMINO*® USS in a high humidity environment will increase the sensor response time.

Measured Variables

The *DOMINO*® USS Moisture-In-Oil system cam measure the following:

Symbol	Variable	Units
RS	Relative Saturation	%
T	Temperature	°C/°F
H_2O	Mass concentration of water	ppm

General Theory Of Operation

Summary

The *DOMINO®* USS Moisture-In-Oil system determines the moisture content of dielectric liquids (such as in transformers or other electric apparatus or processing equipment.) Such liquids are herein referred to as "oils."

The *DOMINO®* Moisture-In-Oil sensor contains a thin polymer film that is immersed in the sample. That capacitance of this film changes in proportion to the change in relative saturation of water in the oil. Electronics in the Moisture-In-Oil Probe measure the capacitance of the sensor and convert it into a relative saturation reading.

The Moisture-In-Oil Probe also contains a temperature sensor. By using the sample temperature and the programmed characteristics of the particular type of oil, the sensor can calculate the current maximum solubility of water. Knowing both the current relative saturation and the maximum solubility of water, the probe can then calculate the mass concentration of water in the sample.

About the *DOMINO®* Moisture-In-Oil Sensor

The *DOMINO®* Moisture-In-Oil sensor is composed of an upper and lower electrode, a thin film polymer and a support base.

Upper
electrode

Active thin film
polymer

Lower
electrodes

Supporting glass
substrate
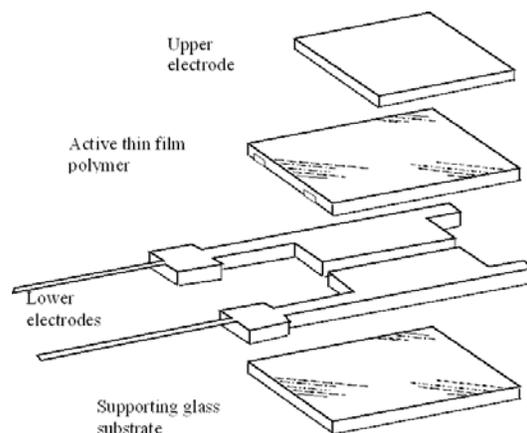
As the oil flows over the sensor, water vapor penetrates the upper electrode and reaches the thin-film polymer.

The amount of water vapor absorbed is dependent on the relative saturation of water in the oil. The polymer used for this application is dispersive, that is, its dielectric constant changes with changing water content.

The capacitance of the polymer, which is the dielectric constant of the material divided by the dielectric constant of vacuum (which is 1), is used to determine the relative saturation (RS) of water in the oil.

NOTE	Because the sensor relies on the movement of water molecules to and from the thin film polymer, oil flow around the sensor greatly facilitates this process. Little or no oil flow around the sensor will give low readings below the true water content.

Relative Saturation

Relative saturation (RS) is the actual concentration of water in the oil (W_c) relative to the maximum amount of water the oil can hold or saturation (S.) This can be expressed as follows:

(Equation 1) $RS = W_c / S \ (100\%)$

Where: RS is the Relative saturation in %
Wc is in ppm wt./wt.
S is in ppm wt./wt.

Note that the *DOMINO*® moisture-in-oil sensor does not have to use this equation to calculate relative saturation. The relative saturation is measured directly by the sensor itself and the Moisture-In-Oil Probe converts the measurement to a percentage and displays that. However the relationship shown in Equation 1 will prove useful in determining another useful quantity, namely water content.

Water Content

The actual concentration of water in the oil (W_c) can be calculated from the measured relative saturation (RS) if the saturation concentration of the oil (S) are known. This is easily done by rearranging Equation 1 to solve for W_c.

(Equation 2) $W_c = RS /S (100\%)$

            Where: W_c is in ppm wt./wt.
                             RS is the Relative saturation in %
                             S is in ppm wt./wt.

There are two quantities required to solve Equation 2:

- The relative saturation (RS) is measured directly by the sensor.

- The saturation concentration of the oil (S) has the following logarithmic relationship to the temperature of the oil:

(Equation 3) $\text{Log } S_o = (\text{Coefficient A})/K + \text{Coefficient B}$

            Where: S_o is the solubility of water (in ppm)
                             K is the temperature in Kelvin (°C + 273)
                             Coefficient A = a constant specific to the oil type
                             Coefficient B = a constant specific to the oil type

There are three quantities required to solve Equation 3:

- The temperature (K) is measured directly by the sensor.

- The two coefficients (Coefficient A and Coefficient B) that are specific to each oil type are experimentally determined and are known for numerous types of oils. The *DOMINO*® USS Moisture-In-Oil Probe is pre-programmed with the proper coefficients for four common oil types. For more information on the selecting, changing, and determining coefficients for unknown oil types, see Chapter 17, Changing Moisture-In-Oil Settings on page 99.

Once the temperature is measured, and an oil type selected, the actual solubility is calculated. That result is used with the measured relative saturation to solve Equation 2 and display the water content.

System Components

The *DOMINO*® USS Moisture-In-Oil System (Doble Part Number 03D-1647-01) includes the following components in a rugged high-density polyethylene carrying case.

USS Moisture-In-Oil Probe

USS Indicator   Indicator Universal Power Adapter

Protective cap   Plastic wrench   Manual press tool

USS Manifold   1" NPT to
(has 2" NPT bushing)   1/2" NPT bushing

NPT-ISO adapter   Spare quick connect plug
(used in pressure applications)

CHAPTER 5
THE *DOMINO*® USS DEWPOINT SYSTEM

This chapter contains information on
the *DOMINO*® USS Dewpoint System.

Topics in this chapter...

About The *DOMINO*® USS Dewpoint System

Measured Variables

System Components

About The *DOMINO*® USS Dewpoint System

The *DOMINO*® USS Dewpoint system measures dewpoint temperature accurately in a temperature range from -60 ˚C (-76 ˚F) up to +20 ˚C (+68 ˚F.) The *DOMINO*® USS Dewpoint Probe incorporates advanced *DOMINO*® technology, which enables reliable and high-performance dewpoint measurements.

The *DOMINO*® USS Dewpoint System (Doble Part Number 03D-1677-01) contains an Indicator and universal AC/DC adapter, one Dewpoint Probe, *DOMINO*® Connects software and interface cable, printed User Guide, and adapters to interface the included probe, all in a rugged polyethylene carrying case. The case can hold an additional two Moisture-In-Oil probes.

Measured Variables

The *DOMINO*® USS Dewpoint system cam measure the following:

Symbol	Variable	Units
$T_{d/f}$	dewpoint/frost point (See note 1 below)	°C/°F
T_d	dewpoint temperature (See note 2 below)	°C/°F
T	temperature	°C/°F
$T_{d/f}$	dewpoint/frost point in the atmospheric pressure	°C atm/°F atm
T_d	dewpoint in the atmospheric pressure	°C atm/°F atm
RH	relative humidity	%
H_2O	humid air /dry air	ppm_v/ppm_w

Note 1. $T_{d/f \ d/f}$ shows the dewpoint temperature above the freezing point
(0 °C/32 °F) and frost point temperature T_o (dewpoint over ice)
below the freezing point. This is considered as the industry
standard.

Note 2. T_d shows the dewpoint over water throughout the entire
measurement range.

System Components

The *DOMINO*® USS Dewpoint System (Doble Part Number 03D-1677-01)
includes the following components in a rugged high-density polyethylene
carrying case.

USS Dewpoint Probe

Sampling cell
(installed at factory

USS Indicator

Indicator Universal Power Adapter

NIP08, type D
quick connect adapter
(installed at factory)

Type 3/8" - 1/4"G
adapter

Type 3/8" - 1/2"G
adapter

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CHAPTER 6
THE *DOMINO*® USS COMPLETE SYSTEM

This chapter contains information on
the *DOMINO*® USS Complete System.

Topics in this chapter...

About The *DOMINO*® USS Complete System

Measured Variables

System Components

About The *DOMINO*® USS Complete System

The *DOMINO*® USS Complete system measures:

- Moisture-in-oil concentrations accurately in a temperature range from -40 ˚C (-40 ˚F) up to +60 ˚C (+140 ˚F.) The *DOMINO*® USS Moisture-In-Oil probe incorporates advanced *DOMINO*® technology, which enables reliable and high-performance moisture-in-oil measurements.

- Dewpoint temperature accurately in a temperature range from -60 ˚C (-76 ˚F) up to +20 ˚C (+68 ˚F.) The *DOMINO*® USS Dewpoint Probe incorporates advanced *DOMINO*® technology, which enables reliable and high-performance dewpoint measurements.

The *DOMINO*® USS Complete System (Doble Part Number 03D-1677-01) contains an Indicator and universal AC/DC adapter, two Moisture-In-Oil Probes, one Dewpoint Probe, *DOMINO*® Connects software and interface cable, printed User Guide, Moisture-In-Oil Quick Start Guide, and adapters to interface the included probe(s), all in a rugged polyethylene carrying case.

Measured Variables

For a listing of the variables that can be measured using the included Moisture-In-Oil Probes, see Chapter 4, The *DOMINO*® USS Moisture-In-Oil System on page 15.

For a listing of the variables that can be measured using the included Dewpoint Probe, see Chapter 5, The *DOMINO*® USS Dewpoint System on page 21.

System Components

The *DOMINO®* USS Dewpoint System (Doble Part Number 03D-1677-01) includes the following components in a rugged high-density polyethylene carrying case.

Two (2) USS Moisture-In-Oil Probes

USS Dewpoint Probe

Sampling cell (installed at factory

USS Indicator

Indicator Universal Power Adapter

Moisture-In-Oil Probe accessories
(see page 23)

Dewpoint Probe accessories
(see page 27)

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SECTION 2
WORKING WITH THE INDICATOR

This section contains information on configuring and using
the *DOMINO*® USS Indicator.

Chapters in this section...

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CHAPTER 7
INDICATOR QUICK START

The *DOMINO*® USS Indicator is a portable hand held device used to read and control *DOMINO*® USS probes.

The first time out of the case, follow these steps:

1. **Charge the Indicator.**

   For more information see the topic Charging The Battery Pack on page 69.

CAUTION	DO NOT use the Indicator during the first charging cycle. The Indicator CAN be used during subsequent charging cycles.

2. **Press the** Power On/Off **button to turn on the Indicator.**

   You may be automatically prompted to select the user interface language and set the date and time per the steps below.

   If a probe is not connected you may be prompted to turn off the Indicator and connect a probe. That is not necessary to perform the steps below.

3. **Select the user interface language.**

   The Indicator is shipped with English set as the default user interface language. If that is acceptable you can skip this step. For more information see the topic Selecting The Interface Language on page 40.

4. **Set the date and time.**

   As the Indicator is shipped with the battery uncharged it does not have the current time and date stored. Set these values now. For more information see the topic Setting The Date And Time on page 44.

   The Indicator is now ready for use.

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CHAPTER 8
ABOUT THE INDICATOR

This chapter contains general information
on the *DOMINO*® USS Indicator.

Topics in this chapter...

About The Indicator

Connections And Controls

The Basic Display

Using The Keypad

The Indicator Menus

About The Indicator

The *DOMINO*® USS Indicator is a portable hand held device used to read and control *DOMINO*® USS probes.

The Indicator has the following features:

Numerical and graphical display of measured variables.
Up to three variables can be displayed at any one time and the user can switch back and forth to a real time graphical display of one of them. For more information see the topic Displaying Data Graphically on page 52.

Data recording capability.
The Indicator can record up to 2700 data points of any measured quantity. For more information see the Chapter 11, Recording Data on page 59.

Analog voltage output signal.
The Indicator can output an analog voltage between 0 to 1 Volt that is proportional to any of the measured variables. For more information see the topic Using The Analog Output on page 56.

Dual probe capability.
The Indicator can read and control two probes simultaneously. For more information see the topic Viewing Data From Two Probes on page 50.

Dual power source capable.
The Indicator is normally powered by a rechargeable NIMH battery pack but can also run off of four AA alkaline batteries. For more information see the topic Chapter 13, Indicator Maintenance on page 67.

Easy PC connectivity.
DOMINO® Connects, a Microsoft Windows® environment software program included with all USS systems, allows you to use a PC to monitor and configure the Indicator and to download recorded data.
For more information see the topic Chapter 26, Using *DOMINO*® Connects on page 157.

Connections And Controls

The USS Indicator has the following connections and controls:

Back view

Front view

Display

Keypad

Battery
Compartment

Bottom view

Top view

Power
connector

Port I   Port II

If a single probe is used it can be
connected to either port.

The Basic Display

When the Indicator is turned on, the quantities currently selected display.
The example below is when a Dewpoint Probe is attached.
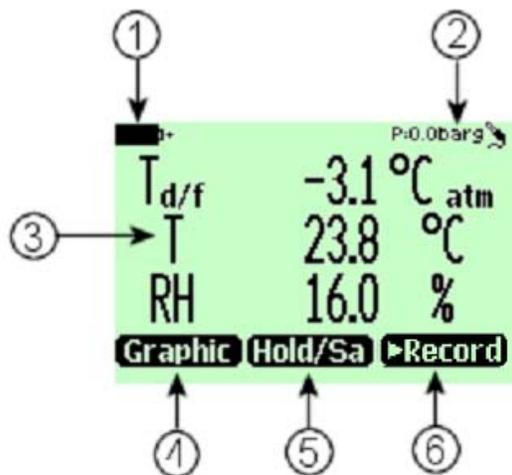
The following numbers refer to the callouts above.

1   The state of the battery.

2   The pressure settings (for Dewpoint Probes only.)

3   The currently selected quantities. Up to three quantities can be displayed at a time. For more
    information see the topic Specifying The Displayed Quantities And Units on page 48.

4   The Graphic shortcut button that changes the display into a curve mode.
    For more information see the topic Displaying Data Graphically on page 52.

5   The Hold/Sa shortcut button that holds the display and allows you to save the reading
    into memory. For more information see the topic Holding And Saving The Data Display
    on page 51

6   The ⚑Record shortcut button that takes you to the Recording/Viewing menu.
    For more information see the topic Recording Data on page 60.

NOTE	The Graphic, Hold/Sa and Record shortcut buttons are the factory defaults. You can change them to refer other functions. For more information see the topic Changing The Shortcut Keys on page 42.

Using The Keypad

Use the keypad below the display to operate the Indicator.
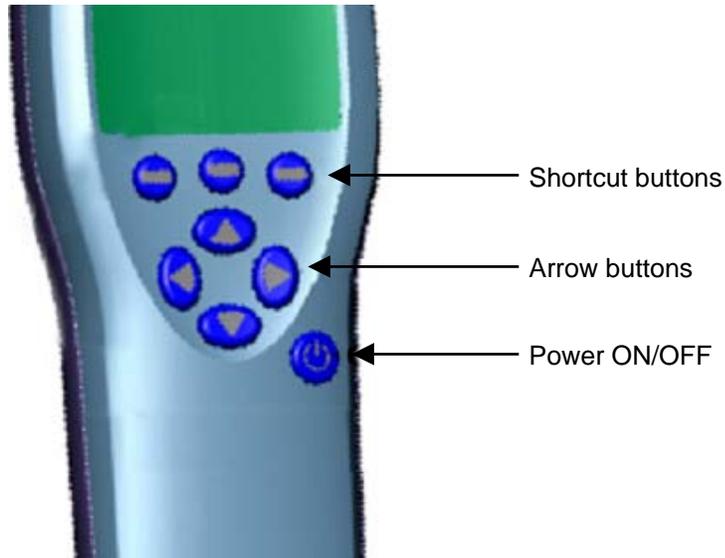
⏻	**POWER ON/OFF** button	Press to turn the Indicator on or off
⊖ ⊖ ⊖	**SHORTCUT** buttons	Press to activate the function shown above the button.
△▽▷◁	**ARROW** buttons	Press any of the **ARROW** buttons, then press any of the **SHORTCUT** buttons to open the main MENU.
		In the MENUS press the **ARROW** buttons to navigate.

The Indicator Menus

The Indicator has several menus that allow you to control how data is collected, managed, displayed, used, and stored.

Main menu	Display menu	Settings menu
Functions menu	Recording/Viewing menu	Environment menu
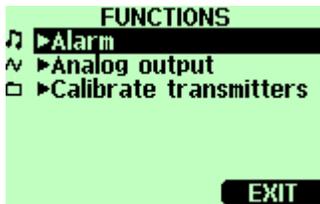
Display and navigate within these menus as follows:

To open the main menu
press any of the ⊘ ◁ ▷ △ buttons. Then press ⊖ OPEN within 5 seconds.

Otherwise, the basic display returns.
If this happens, start from step 1 again.

To move up or down in the menus
press either the △ or the ⊘ button.

To open a selected sub-menu
press ▷

To return to the previous menu
press ◁

To return to the main data display
press ⊖ EXIT

CHAPTER 9
CONFIGURING THE INDICATOR

This chapter contains information on configuring
the *DOMINO*® USS Indicator.

Topics in this chapter...

    Selecting The Interface Language

    Configuring Automatic Power Off

    Changing The Shortcut Keys

    Setting Button Press Sounds

    Setting Backlight On Button Press

    Setting The Date And Time

    Restoring The Factory Settings

Selecting The Interface Language

You can select any of the following languages as an user interface language: English, German, French, Finnish, Spanish or Swedish.

To select the user interface language:

1. Open the MENU: by pressing $\triangleright$ $\ominus$ OPEN.

2. Select ▶Settings, then press $\triangleright$.

3. Select ▶User interface, then press $\triangleright$.

4. Select Language, then press $\ominus$ SET.

5. Select the language you want, then press $\ominus$ SELECT.

6. Press $\ominus$ EXIT to return to the basic display.

If you accidentally select a wrong language, to change the setting:

1. Return to the basic display by pressing right most $\ominus$ key
    as many times as required.

2. Go to the language selection menu by pressing: $\triangleright$, then the middle $\ominus$ key.

3. Press $\triangle$, then press $\triangleright$, then press $\triangleright$, then press the middle $\ominus$ key.

4. Reselect the language.

Configuring Automatic Power Off

By default, the USS Indicator will turn off the power automatically after 15 minutes of inactivity to conserve the battery. You can leave the inactivity time setting at 15, change it to 60 minutes, or turn off the automatic power off function completely.

To change the automatic power off function setting:

1. Open the MENU: by pressing ⊳ ⊖ OPEN.

2. Select ▶Settings, then press ⊳

3. Select ▶User interface, then press ⊳.

4. Select Auto power off, then press ⊖ SET.

5. Select the choice you want, then press ⊖ SELECT.

6. Press ⊖ EXIT to return to the basic display.

Changing The Shortcut Keys

By default, the three shortcut keys refer to the functions Graphic, Hold/Save and ▶Record. You can change any of the shortcut keys to refer to functions that better suit your needs.

To change any of the shortcut key s functions:

1. Open the MENU: by pressing ▷ ⊖ OPEN.

2. Select ▶Settings, then press ▷.

3. Select ▶User Interface, then press ▷.

4. Select Program shortcut keys, then press ⊖ START.

5. Press the shortcut key you want to change, e.g. Hold/Save.

6. If you want to replace Hold/Save with alarm-function (as an example), select Alarm by using arrow buttons (▶Functions), press ⊖ SELECT.
    Answer YES to confirm your selection, otherwise answer NO and continue from item 4.

7. Press ⊖ EXIT to return to the basic display.

    The selected key is changed as specified. For example:

Hold/Save -shortcut key
(default)

Hold/Save -shortcut key
replaced by
alarm function -shortcut key
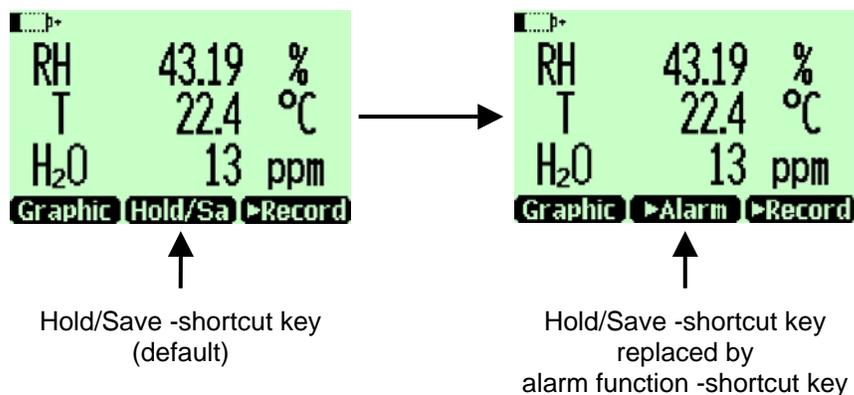
Setting Button Press Sounds

To turn on or off the sound effects for the buttons:

1. Open the MENU: by pressing Ⓓ ⊖ OPEN.

2. Select ▶Settings, then press Ⓓ.

3. Select User interface, then press Ⓓ.

4. To turn OFF or ON sound effect while pressing the buttons, select Key Click and then press ⊖ ON/OFF.

5. Press ⊖ EXIT to return to the basic display.

Setting Backlight On Button Press

To turn on or off the back light:

1. Open the MENU: by pressing Ⓓ ⊖ OPEN.

2. Select ▶Settings, then press Ⓓ.

3. Select User interface, then press Ⓓ.

4. To turn OFF and ON backlight while pressing the buttons, select Backlight on key and then press ⊖ ON/OFF.

5. Press ⊖ EXIT to return to the basic display.

Setting The Date And Time

The current date and time are used in the recorded data files.

By default the time format is based on the 24-hour clock but a 12-hour clock can be used. By default the date format is day.month.year, for example, 25.4.2004. The date format can be changed to month.day.year. or year.month.day.

To set the date or time or change the format of either one:

1. Open the MENU: by pressing ▷ ⊖ OPEN.

2. Select ▶Setting, then press ▷.

3. Select ▶Date and time, then press ▷.

4. To change the date, select Date and press ⊖ SET. Change the date by using arrow buttons. To confirm the date, press. ⊖ OK. The default date presentation format is *year-month-date,* e.g.2002-06-05. If you want to change the format, select Date format: Y-M-D, press SET ⊖, select either D.M.Y or M/D/Y, press SELECT .

5. To change the time, select Time and press ⊖ SET. Change the time by using arrow buttons. To confirm the time, press ⊖ OK. The default time presentation format is 24-hour clock. If you want to change the format, select 12-hour clock, press ⊖ ON/OFF.

6. Press ⊖ EXIT.

Restoring The Factory Settings

The factory settings can be restored to clear all the changed settings and clear data memory of the Indicator. Note that restoring the factory settings does not affect the probe calibration.

To revert to factory settings:

1. Open the MENU: by pressing ▷ ⊖ OPEN.

2. Select ▶Settings, then press ▷.

3. Select Factory settings, then press ⊖ REVERT.

4. Press ⊖ YES to confirm the reverting.

   The power turns off automatically.

   When switching on again, the factory settings are restored.

   Anything stored in the data memory is deleted.

   You will need to set the language (see page 40)
   and date and time (see page 44) again.

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CHAPTER 10
WORKING WITH DATA

This chapter contains information on working with
the data gathered by the *DOMINO*® USS Indicator.

Topics in this chapter...

Specifying The Displayed Quantities And Units

The Indicator can display up to three measured quantities at a time.

- The quantities that can be displayed for Moisture-In-Oil probes are listed in the topic Measured Variables on page 16.

- The quantities that can be displayed for Dewpoint Probes are listed in the topic Measured Variables on page22.

The unit of temperature quantities ($T_{d/f}$, T_d, or T) can be selected to be °C or °F. The default is °C.

To select a quantity to display or to specify displayed units:

1. Open the MENU by pressing $\triangleright$ $\ominus$ OPEN.

2. Select ▶Display, then press $\triangleright$.
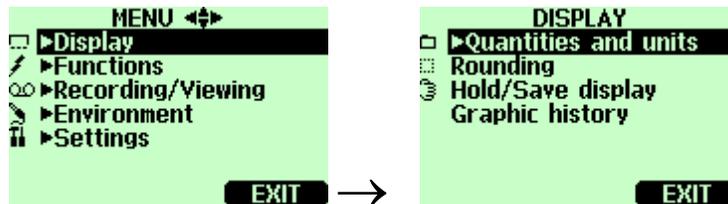
3. Select ▶Quantities and units, then press $\triangleright$.
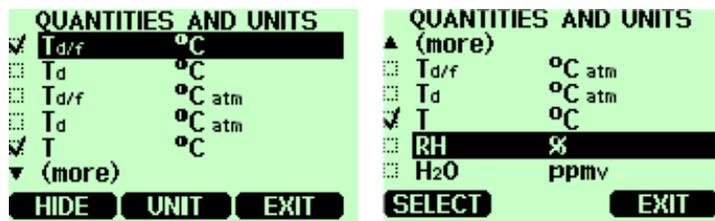
4. In the QUANTITIES AND UNITS screen you can do any of the following:

- To select a quantity, move on the quantity you want by using the arrow buttons, press $\ominus$ SELECT. Only three quantities and units can be visible on the display at one time.

- To change the unit, move on the quantity you want by using the arrow buttons, then press ⊖ UNIT (°C or °F.)

NOTE The units **°C atm** and **°F atm** indicate that the dewpoint or frost point is converted from process pressure to atmospheric pressure.

- To hide a quantity, move on the quantity you want to hide by using the arrow buttons, then press ⊖ HIDE.

5. To return to the basic display, press ⊖ EXIT.

6. If you want to check environment settings press ⊖ YES.
   If you do not want to check environment settings press ⊖ NO.

Specify Data Display Rounding

You can select a one- or two-decimal display using **Rounding**.
As a default, rounding is turned off, i.e. a two-decimal display is in use.

To specify rounding:

1. Open the **MENU** by pressing ▷ ⊖ OPEN.

2. Select the ▶Display, then press ▷ .

3. Select Rounding.

4. To have rounding on (one decimal display), press ⊖ ON.
   To have rounding off (two decimal display), press ⊖ OFF.

5. To return to the basic display, press ⊖ EXIT.

NOTE Rounding does not affect the measurement accuracy. Accuracy is defined separately for the Indicator, Moisture-In-Oil probe, and Dewpoint Probe in Chapter 27, Technical Specifications.

Viewing Data From Two Probes

The USS Indicator can be used with either one or two Moisture-In-Oil or Dewpoint Probes in any combination.

When using two probes (of either the same or different types)
the display shows the reading of the port I probe in the upper row(s)
and the reading of the port II in the lower row(s.)

Each variable is marked to indicate the port it is being read from:

- Variables measured with Port I are marked with **I**

- Variables measured with Port I are marked with **II**

For example if two dewpoint probes are connected to the Indicator
and each is set to display RH, the display will show:

NOTE	Always have the Indicator OFF when connecting or disconnecting probes.
	• Connecting a probe when the Indicator is on may interfere the Indicator recognizing the probe.
	• Disconnecting a probe when the Indicator is on may cause loss of settings and data.

NOTE	When using two Dewpoint Probes, if you are taking measurements from the same condition, check that the pressure settings of the two probes are the same.

Holding And Saving The Data Display

You can freeze a selected display reading and save it into the memory using the Hold/Save function.

Several readings can be saved. The reading saved first is called data point 1, the second saved reading is called data point 2 , and so on. All the individual readings (data points) are stored in the same file marked with ⬚. The file will remain in the Indicator memory even when the Indicator is switched off.

To freeze a display reading and save it into memory:

1. Open MENU by pressing ▷ ⊖ OPEN.

2. Select ▶Display, then press ▷.

3. Select Hold/Save display.

4. To freeze the display, press ⊖ HOLD.
   The frozen measurement data is displayed.

5. To save the displayed reading, press ⊖ SAVE.
   To return to the basic display, press ⊖ CANCEL.

   You can save several readings with HOLD-SAVE function. The data points are identified on the basis of the saving date and time. All the individual readings (data points) are stored in a same file marked with ⬚. The file remains in the Indicator memory even if the Indicator is switched OFF.

6. To view the saved readings, press ⊖ ▶Record, then select
   ▶View recorded data, then press ▷. Select the file marked with ⬚ ,
   press ▷. Now you can see the saved data readings.

7. To view the recording timestamps press ⊖ TIMES.

8. To return to the basic display, press ⊖ EXIT.

Displaying Data Graphically

You can display the data from the last hour graphically. The graphical display shows the curve of the uppermost quantity shown in the basic display.

From the curve, you can examine the data trend and history of the last minutes.

By default the data curve of the last hour is displayed. To see longer graphs, use the data recording function to save the data and then view it as a graph.

To display the data in graphical format:

- Press ⊖ GRAPHIC. Or,

- Open the MENU by pressing ▷ ⊖ OPEN. Select ▶Display, then press ▷. Select Graphic history, then press ⊖ SHOW.

When the graphic display is shown you can do any of the following:

**To get the statistical info on the graph area
(minimum, maximum and mean values)**

- Press ⊖ INFO.

**To get the curve of the NEXT quantity
that is displayed in the numerical display:**

- Press ⊖ NEXT.

**To get the curves of ALL quantities
that are displayed in the numerical display:**

- Press ⊖ NEXT until text ALL is shown instead of NEXT.
  Then press ⊖ ALL.

To zoom in on the curve:

- Press the arrow button △.

To zoom out:

- Press the button ▽.

To move the curve in horizontal directions:

- Press the buttons $\triangleright\triangleleft$.

To return to the basic display:

- If you entered the graphical display through the menu, press $\ominus$ BACK, then press $\ominus$ EXIT.

- If you entered the graphical display through the GRAPHIC shortcut key, just press $\ominus$ BACK.

Viewing Device Information

To view basic information about the Indicator and the attached probe(s):

1. Open the MENU: by pressing $\triangleright$ $\ominus$ OPEN

2. Select ▶Settings, then press $\triangleright$.
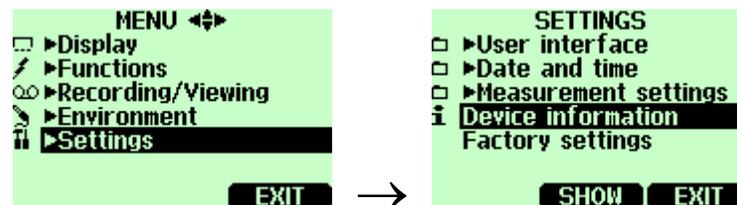
3. Select Device information, then press $\ominus$ **SHOW.**
   The first display gives the information on the Doble USS Indicator.
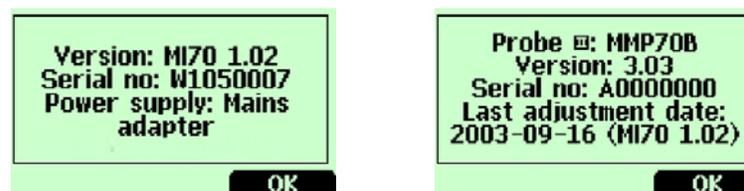
      Indicator information   Probe information

4. To get the information on the probe, press $\ominus$ MORE.

5. To return to the basic display, press $\ominus$ OK and the press $\ominus$ EXIT.

Setting Alarm Levels

The *DOMINO®* USS Indicator alarms by beeping and blinking the backlight. The alarm turns on when the measured value is not between the alarm limits (permissible area.) Alarm level(s) can be set for only one quantity at a time.

To set the alarm levels:

1. Open the MENU: by pressing ▷ ⊖ OPEN**.**

2. Select ▶Functions, then press ▷.

3. Select ▶Alarm, then press ▷.
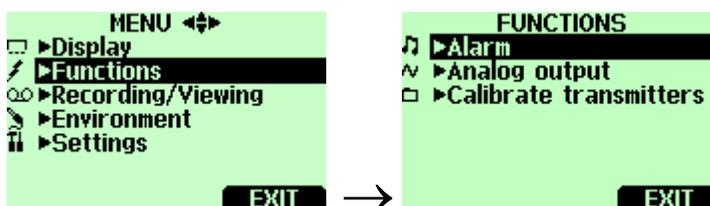
4. Select Quantity and press ⊖ SET to choose a quantity.

5. Select quantity, press ⊖ SELECT. Note that only one quantity can be chosen at a time and only active quantities can be selected. To change the active quantities, go to MENU→▶Display→▶Quantities and units.

6. Select the first limit, press ⊖ SET (if the alarm function is ON, take it OFF.) Set the alarm level by using arrow buttons. To select the sign for the alarm level, press ⊖ +/- button. Press ⊖ OK to save the setting.

7. Select the second limit, then follow instructions in step 6.

    The alarm will go off when the upper limit is exceeded or when lower limit
    is gone below.

    If you have only one limit, e.g. if you want to detect when a measured
    quantity exceeds a maximum, set the upper limit to that value and the lower
    limit so low that it never will be reached (for example 0.) For example:

    - If you are measuring Relative Saturation and want the alarm to sound
      when the RS reaches 90%, then set the upper limit to 90% and the lower
      limit to 0. The USS Indicator will alert when RS rises above 90%.

    - If you are measuring dewpoint and want the alarm to sound when the
      dewpoint rises above -40 °C, then set the upper limit to -40 °C and the
      value of the lower limit so low that it will never be reached, for example,
      to -80 °C. The USS Indicator will alert when the dewpoint rises -40 °C.

8. Select Alarm ON/OFF, press ⊖ ON to activate the alarm and return back to
    the basic display.

9. A note picture sign ♫ appears on the upper left corner of the display.

10. When the alarm level is reached, you can stop alarming by pressing ⊖ OK.
    To reactivate the alarm function, answer ⊖ YES. To stop the alarm
    function completely, answer ⊖ NO.

NOTE	The alarm is not in function when the device is turned off. Remember to turn off the automatic power off, see page 41.

Using The Analog Output

You can output one selected quantity as a scaled analog voltage
in the range 0 to 1.0V. The output can be scaled in any range of measurements,,
i.e. any measured values can be set as the 0 volt and 1.0 volt levels.

NOTE	To get analog measurement data, you need the analog output signal cable, Doble Part Number 181-0659.

NOTE	Because the analog output signal cable connects to one of the probe ports, you can only use one probe when using the analog output.

To select and scale the analog output:

1. Plug the probe into either Port I or Port II of the Indicator.

2. Install the probe in the measurement position.

3. Turn on the Indicator.

4. Plug the analog output signal cable circular connector to the Indicator base connector. Connect the screw terminal block as follows:

    Brown wire: common wire (-)
    Yellow-green wire: signal (+)

5. Open the MENU: by pressing ▷ ⊖ OPEN.

6. Select ▶Functions, press ▷.

7. Select ▶Analog output, press ▷.

```
        MENU ◄‡►                    FUNCTIONS              ANALOG OUTPUT
☐ ►Display                  ♫ ►Alarm                1. Quantity: RH
✐ ►Functions                ∿ ►Analog output        2. 0.0V: 0.00
∞ ►Recording/Viewing        ☐ ►Calibrate transmitters  3. 1.0V: 0.00
⚲ ►Environment                                      ▭ Analog output on/off
🍴 ►Settings
              ( EXIT )   →              ( EXIT )   →         ( SET )( EXIT )
```

8. Select Quantity and press ⊖ SET to choose a quantity.

9. Select Quantity, press ⊖ SELECT.

   Only one quantity can be chosen at a time.
   Only active quantities can be selected.
   To change the quantities, go to MENU→▶Display→▶Quantities and units.)

10. To set the value for the 0.0V output signal, select 0.0 V, then press ⊖ SET.
    (If the analog output is ON, take it OFF) Set the low value by using arrow
    buttons. Press ⊖ +/- button to choose the sign of the value. Press ⊖OK to
    confirm the setting.

11. To set the value for the 1.0V output signal, select 1.0V, then press ⊖ SET.
    Set the high value by using arrow buttons. Press ⊖ +/- button to choose the
    sign of the value. Press ⊖ OK to confirm the setting.

12. To activate the analog output and return back to the basic display, select
    Analog output on/off, then press ⊖ ON. A wave picture sign ∿ appears on the
    upper left corner of the basic display.

13. To deactivate the analog output function, go to MENU→▶Functions→▶Analog
    output→Analog output on/off and press ⊖ OFF.

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CHAPTER 11
RECORDING DATA

This chapter contains information on recording, saving, and transferring the data gathered by the *DOMINO*® USS Indicator.

Topics in this chapter...

Recording Data

Stopping Recording

Viewing Recorded Data

Checking The Memory Status

Deleting All Recorded Files

Transferring Recorded Data To A PC

Monitoring Real time Data On A PC

TIP	In addition to recording real-time data you can also record individual data points. For more information see the topic Holding And Saving The Data Display on page 51.

Recording Data

You can record the displayed quantities to a file
saved in the Indicator's memory.

To start recording:

1. Do one of the following:

    *   Press the shortcut ⊖ ▶Record. Or,

    *   Open the MENU by pressing ▷ ⊖ OPEN, then select ▶Recording/Viewing.

2. Select ▶Record data, then press ▷.

```
     MENU ◄♦►                      RECORDING/VIEWING
▭ ▶Display                    ▭ ▶Record data
✏ ▶Functions                  ▭ ▶View recorded data
∞ ▶Recording/Viewing          ℹ Memory status
↘ ▶Environment                  Clear data memory
♕ ▶Settings

          ▐ EXIT ▌    →                      ▐ EXIT ▌
```

3. To change the recording interval, select Interval, then press ⊖ SET.
    Then select the measurement interval with arrow buttons.
    Then press ⊖ SELECT.

    Measurement intervals and the maximum recording times
    are shown in the table below.

Recording interval	Maximum recording time (memory full)		
	1 quantity	2 quantities	3 quantities
1 seconds	45 minutes	22 minutes	15 minutes
5 seconds	3 hours	113 minutes	75 minutes
15 seconds	11 hours	5 hours	3 hours
30 seconds	22 hours	11 hours	7 hours
1 minutes	45 hours	22 hours	15 hours
5 minutes	9 days	4 days	3 days
15 minutes	28 days	14 days	9 days
30 minutes	56 days	28 days	18 days
1 hours	113 days	56 days	37 days
3 hours	339 days	169 days	112 days
12 hours	1359 days	678 days	451 days

4. To set the recording duration, select Duration, press ⊖ SET.
   Select a recording duration (1 min, 5 min, 15 min, 30 min, 1 h, 3 h, 12 h, 24 h, 7 d, 30 d, memory full) with the arrow buttons, then press ⊖ SELECT.

5. To start recording, select Start/Stop recording, then press ⊖ START.

   During recording the following symbols appear next to the battery indicator in the upper left corner of the display:

         Indicates recording is in progress.

         Displays the amount of recorded data in terms of the remaining memory (not the total memory) that is available.

TIP	You can switch the *DOMINO*® USS off during recording to save the battery.
	A message will appear on the display to inform you that recording will continue undisturbed even when the power is turned off. If the Indicator is switched off during recording, the progress bar is shown on the display every 10 seconds or continuously if the charger is connected.

CAUTION	Do not disconnect the probe when the data recording is on, even if the Indicator is off. This may cause loss of recorded data.

Stopping Recording

To stop recording:

1. Do one of the following:

   - Press the shortcut ⊖ ▶Record. Or,

   - Open the MENU by pressing ◁ ⊖ OPEN, then select ▶Recording/Viewing.

2. Select ▶Record data and press ◁

3. Select Start/Stop recording and press ⊖ STOP.

4. To view the recorded file, press ⊖ SHOW.

Viewing Recorded Data

To view recorded data:

1. Open the MENU: by pressing ▷ ⊖ OPEN .

2. Select ▶Recording/Viewing, then press ▷.

3. Select ▶View recorded data, then press ▷.

4. Select the file you want to view, then press ▷. The files are identified according to the starting date and time of recording.

5. To go to the graphical view, press ⊖ Graph. To view the recording time stamps, press ⊖ Times. To return to the recording values, press ⊖ Values.

6. To return to the basic display, press ⊖ EXIT .

Checking The Memory Status

To check how much free space is remaining in the memory:

1. Open the MENU: by pressing ▷ ⊖ OPEN .

2. Select ▶Recording/Viewing, press ▷.

3. Select Memory status, press ⊖ SHOW. The amount of memory in use and the estimated free space is displayed.

4. To return to the basic display, press ⊖ OK and ⊖ EXIT.

Note that the estimation of the free space is calculated based on the current number of active quantities. If you change the displayed quantities, this will effect the estimation of free space.

Deleting All Recorded Files

To delete all recorded files and clear the data memory:

1. Open the MENU**:** by pressing ▷ ⊖ OPEN**.**

2. Select ▶Recording/Viewing, then press ▷.

3. Select Clear data memory, then press ⊖ CLEAR**.**

4. Press ⊖ YES to confirm deletion of all recorded data files.

5. To return to the basic display, press ⊖ EXIT**.**

Transferring Recorded Data To A PC

The recorded data can be transferred to a PC by using the *DOMINO*® Connects program. You can examine the recorded data easily in the Microsoft Windows® environment and transfer it to a spreadsheet program (such as Microsoft® Excel) to be modified. For more information see the topic Chapter 26, Using *DOMINO*® Connects on page 157.

DOMINO® Connects is included with the USS Moisture-In-Oil System, the USS Dewpoint System, and the USS Complete System. It can also be ordered separately as Doble Part Number 401-0288.

Monitoring Real time Data On A PC

You can monitor the USS Indicator readings directly with a PC by using the *DOMINO*® Connects program. For more information see the topic Chapter 26, Using *DOMINO*® Connects on page 157.

DOMINO® Connects is included with the USS Moisture-In-Oil System and the USS Dewpoint System. It can also be ordered separately as Doble Part Number 401-0288.

CHAPTER 12
ERROR MESSAGES

This chapter contains information on the various error message
that may appear on the *DOMINO*® USS Indicator.

Topics in this chapter...

What To Do With Errors

Types Of Error Messages

What To Do With Errors

If the *DOMINO*® USS Indicator displays an error message:

1. Check that the sensor is connected properly.

2. Remove the probe. If there is condensed water in the probe let it dry.

3. If the error persists, contact the Doble Customer Service Center (see page 6.)

Types Of Error Messages

- Eeprom read/write error

- ADC malfunction

- Operating voltage out of range

- Analog voltage out of range

- Temperature/Humidity sensor open/short circuit

- Temperature sensor current leak

- Temperature/humidity measurement malfunction

- Temperature value out of range

- Relative humidity value out of range

- Sensor not found

- Amplifier chain malfunction

CHAPTER 13
INDICATOR MAINTENANCE

This changer contains information on
servicing the *DOMINO*® USS Indicator.

Topics in this chapter...

Viewing The Battery Level

Charging The Battery Pack

Replacing The Battery Pack

Using Alkaline Batteries

Viewing The Battery Level

To view the level of charge remaining in the battery:

- Turn on the Indicator.

  When the quantities display appears, a symbol in the top left side corner indicates the level of charge in the battery.

  The meaning of this symbol is:

   Full charge

   Partial charge

   No charge

Charging The Battery Pack

To charge the battery pack:

1. Ensure the Indicator is turned off.

2. Fit the proper plug insert based upon your location (Australian, European, United Kingdom, or American) to the recharger body.

3. Connect the recharger to a wall socket.

4. Remove the plug from the power inlet at the top of the Indicator and plug the recharger connector into the power inlet.

CAUTION	Do not use the Indicator during the first charging cycle.
	The Indicator CAN be used during subsequent charging cycles.

A battery symbol in the corner of the display will start to roll.

The duration of the recharging cycle depends on the charge level of the battery pack with 4 hours being typical.
However, the recommended first charging time is 6 hours.

When the battery symbol stops rolling, the battery pack is fully charged.

5. Disconnect the recharger from the Indicator and from the wall socket.

Replacing The Battery Pack

NOTE	The battery pack is Doble Part Number 903-0083.

To replace the battery pack:
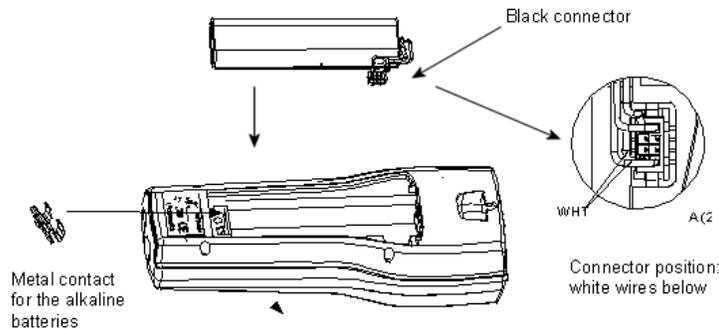
1. Unscrew the back plate of the Indicator and remove the back plate.

2. Lift out the old battery pack.

3. If you are replacing alkaline batteries with a battery pack,
   remove the metal contact.

4. Detach the black connector by pulling it up carefully by the wires.

5. Connect the black connector of the new battery pack.
   Make sure the red and black wires are on the upper edge of the connector.
   Do not push the connector with any conducting material.

6. Fit the battery pack into the Indicator.

7. Fit the back plate back on the Indicator and tighten the screw.

8. Charge the battery pack before use. For more information see the topic
   Charging The Battery Pack on page 69.

| | Dispose of batteries and the unit in accordance with all federal, state, and local regulations.

DO NOT dispose of with regular household refuse. |
| --- | --- |

Using Alkaline Batteries

The USS Indicator can also use four standard AA size alkaline batteries.

**To replace the battery pack with alkaline batteries
or change the alkaline batteries:**
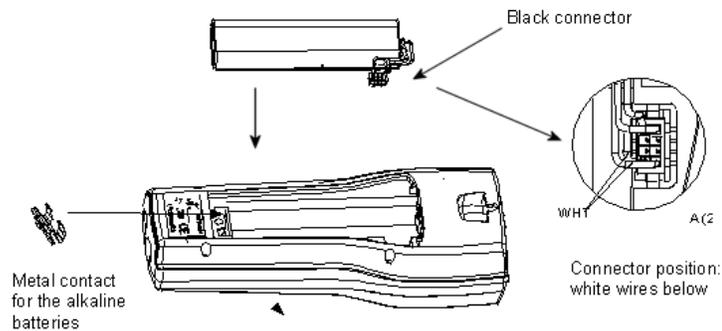
1. Unscrew the back plate of the Indicator and remove the back plate.

2. If you are replacing a battery pack, lift out the old battery pack.
   If you are replacing existing alkaline batteries, lift out the old batteries.

3. If you are replacing a battery pack,
   detach the black connector by pulling it up carefully by the wires.

4. If you are replacing the battery pack, install the metal contact.

5. Fit the new batteries into the Indicator following the diagram
   in the battery cavity..

6. Fit the back plate back on the Indicator and tighten the screw.

Dispose of batteries and the unit in accordance with
all federal, state, and local regulations.

DO NOT dispose of with regular household refuse.

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SECTION 3
MAKING MOISTURE-IN-OIL MEASUREMENTS

This section contains information on making moisture-in-oil (and related) measurements using:

- The *DOMINO*® USS Moisture-In-Oil System (Doble Part Number 03D-1647-01)

- The *DOMINO*® USS Complete System (Doble Part Number 03D-1686-01)

- The *DOMINO*® USS Dewpoint System (Doble Part Number 03D-1677-01) and a USS Moisture-In-Oil Probe(s) (Doble Part Number 03D-1678-01)

Chapters in this section...

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CHAPTER 14
MOISTURE-IN-OIL QUICK START

The *DOMINO®* USS Moisture-In-Oil System is a portable, simple to use system that enables reliable and high performance moisture-in-oil measurements.

The first time out of the case, follow these steps:

1. **Charge and set up the USS Indicator.**

   For more information see Chapter 7, Indicator Quick Start on page 31.

2. **Configure the Moisture-In-Oil Probe.**

   For more information see Chapter 17, Changing Moisture-In-Oil Settings on page 99.

3. **Select which measured variables to display.**

   For more information see the topic Specifying The Displayed Quantities And Units on page 48.

4. **Install the Moisture-In-Oil Probe.**

   For more information see Chapter 15, Installing The Moisture-In-Oil Probe on page 77.

5. **Take the moisture-in-oil reading.**

   For more information see Chapter 16, Taking Moisture-In-Oil Measurements on page 97.

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CHAPTER 15

INSTALLING THE MOISTURE-IN-OIL PROBE

This chapter contains information on several different methods of installing the *DOMINO*® USS Moisture-In-Oil Probe.

Topics in this chapter...

General Installation Considerations

Installation On A Drain Valve

Direct Installation On A Pressurized Process

Ball Valve Installation On A Pressurized Process

Unpressurized Installation

General Installation Considerations

Install In A Location That Gives
A True Picture Of The Process

As oil should circulate freely around the sensor; a rapid oil flow is recommended. Install the probe directly into the circulation system and not into the oil reservoir where the oil is stagnant. Below are suggested flow rates:

- A minimum flow rate of 0.6 liters/minute is required for all applications.

- When sampling from a transformer valve, a flow rate of 1 liter/minute has been found to be optimal.

- When sampling from a pipe or pump discharge, flow rates between 11 to 190 liters/minute (3 to 50 gallons/minute) have been found to be optimal.

The USS can withstand flow rates much greater than that listed above, such as those found on high velocity pumps on transformers.

Install In An Area Of Positive Pressure

Install the probe in an area of positive pressure such as:

- the discharge side of a pump such as an oil processor.
  Even in transformers where the whole system is under positive pressure, the area at the intake of the pump is at negative pressure so install the probe at the discharge end of the pump.

- a pressurized pipe.

- a drain valve.

Partial or full vacuum will not harm the sensor in any way so the sensor does not have to be removed when negative pressure is applied.

However the sensor will report low results when subjected to negative pressure because a vacuum system, when applied, attempts to remove moisture and gases from not just the oil but from all components that it is exposed to, including the probe sensor.

About The Quick Disconnect Plug Fitting

The Moisture-In-Oil Probe can be easily connected and disconnected using the included quick disconnect plug fitting.

Quick Connect Plug Fitting

The quick connect plug comes already mounted on the Moisture-In-Oil probe and can mate with:

- The *DOMINO*® USS Manifold assembly (Doble Part Number 03B-1653-01) that is used on a device's drain valve.

- A separate quick connect socket (Doble Part Number 09B-0824-01) that can be installed in various locations.

CAUTION	It is not recommended to use the quick connect fitting for permanent installations on transformers

NOTE	If the quick connect fitting is removed and then replaced it must be replaced at a certain distance away from the end of the probe in order to position the sensor in the correct position for minimal measurement response time. For more information see the topic Changing The Quick Connect Fitting on page 121.

About Direct Connection

The Moisture-In-Oil Probe is especially suitable for measurements in pipe. In these situations the quick connect fitting is removed and just the clasp nut and fitting body are used. The clasp nut and fitting body can be used to mount the probe in either of two ways:

Type of installation	**Permanent Mount**	**Ball Valve**
Depth of insertion into the process	Provides maximum depth of insertion	Provides lesser depth of insertion
Probe removal	Process **must be** shut down to remove probe	Process **does not have to be** shut down to remove probe

Pressurized Process Recommendations

Install the sensor head directly in the process through a sampling manifold,
a permanently installed fitting body, or a ball valve assembly.
Do not use the quick connect fitting method for pressurized applications.

To avoid having to empty the process vessel or shut down the process,
use the ball valve installation method.

To prevent loosening of the probe by the action of pressure,
tighten the clamp nut and fitting body (if used) very carefully

Pipe Installation Recommendations

Install the sensor head transversely against the direction of the process flow.

Avoid installing into a bend in the pipe.

Treat The Entire Probe With Care

Take care not to damage the probe body

CAUTION	If the probe body is damaged, it will either not go through the fitting body, or the sensor within may be damaged.

Take care not to damage the probe shaft.

CAUTION	If the probe shaft is damaged, it will either not go through the fitting body, be loose in the clasp nut, or leak through the clasp nut seal.

Make sure that the perforated stainless steel filter at the end of the probe
is tightly fastened.

CAUTION	If the perforated stainless steel filter is loose or comes off, damage to the sensor, the transformer, or the process being tested may result.

Installation On A Drain Valve

The *DOMINO*® USS Moisture-In-Oil Probe allows the user to measure the water content of mineral oil in a transformer or any other oil filled electrical device directly from the device's drain valve. Simply attach the *DOMINO*® USS Manifold Assembly and allow oil to flow past the *DOMINO*® sensor probe. Accurate readings are obtained in 2 to 3 minutes.

WARNING	Before using this device make absolutely certain there is positive pressure on the transformer. Opening the drain valve of a transformer under negative pressure will allow air to enter the transformer and may result in transformer failure and/or harm to personnel. If there is any doubt, use the procedure listed in ASTM D 923 or IEC 60475 to ascertain the condition.

CAUTION	Do not change the position of the quick connect plug on the oil probe. The quick connect plug is positioned to properly place the sensor element in the oil flow. Changing this position will increase the time it takes the sensor to stabilize and may damage the sensor.

To install and take readings on a drain valve:

1. Clean and prepare the drain valve as normally performed in order to take oil samples for analysis. To do this:

   a. Take out the drain plug.

   b. Wipe the inside of the valve with a clean cloth.

   c. Flush at least one liter of oil through the valve.

   If unsure how to perform this procedure
   consult ASTM D 923 or IEC 60475.

2. Connect the USS Manifold Assembly to the drain valve.

   The USS Manifold Assembly has a 2-inch NPT male thread bushing
   for use on drain valves with 2 inch NPT female threads.

   - If the drain valve has a 1 inch NPT female thread,
     remove the 2-inch NPT reducing bushing from the USS Manifold
     Assembly and replace it with the supplied 1-inch NPT reducing bushing.
     Then install the manifold on the drain valve.

   - If the drain valve has other size threads,
     remove the 2-inch NPT reducing bushing from the USS Manifold
     Assembly and replace it with a reducing bushing that fits the drain valve
     and has a 1/2 inch NPT female thread to fit the manifold. Then install
     the manifold on the drain valve.
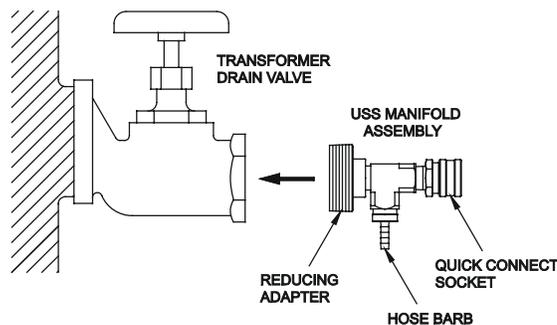
3. Attach the oil probe by pulling back the sleeve on the quick connect socket
   on the USS Manifold Assembly and inserting the quick connect plug on the
   oil probe. Then release the sleeve.
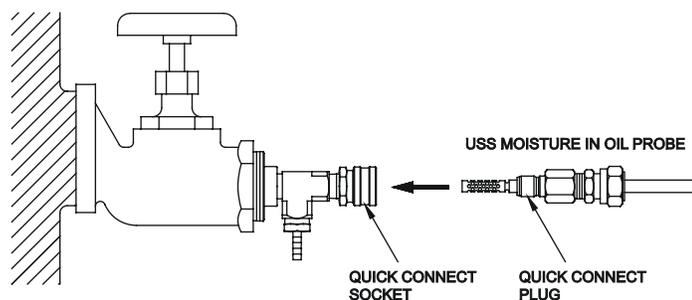
4. Attach a piece of ¼ inch (6mm) Tygon tubing to the USS Manifold
   Assembly hose barb. Place the other end in a waste container to capture the
   oil.

5. Plug the probe cable into either port on the bottom of the *DOMINO*® USS Indicator.

6. Turn on the Indicator. Make sure one of the parameters being displayed is "ppm". For more information see Chapter 16, Taking Moisture-In-Oil Measurements.

7. Open the drain valve so that oil is flowing past the sensor at a rate of approximately 1 quart or liter per minute.

TIP	Judge the rate with a quart or liter bottle and the second hand on your watch.

8. Continue to allow oil to pass by the sensor until a stable ppm reading is reached. That is the water content of the oil.

TIP	The graphing function on the *DOMINO*® USS Indicator is an ideal way to monitor when the unit reaches a stable reading.

9. Once the water content is determined close the drain valve.

    After closing the valve you can disconnect the USS Manifold Assembly to use it elsewhere.

CAUTION	DO NOT open the drain valve with the probe removed from the USS Manifold Assembly. If you do, oil will flow from both the hose barb AND the quick disconnect connector.

Direct Installation On A Pressurized Process

General Guidelines

The probe can be installed directly on a pressurized process or pipe through a permanently installed fitting.

NOTE	One drawback of this type of installation is that to remove the probe the process must be shut down and the fitting must be sealed. If you need to install and remove the sensor without shutting down the process, consider installing the probe to a permanently installed ball valve. For more information see the topic Ball Valve Installation On A Pressurized Process on page 89.

NOTE	The process pressure can be a maximum of 20 bars (290 psi.)

Procedure

To install the Moisture-In-Oil sensor directly:

1. Shut down the process.

NOTE	If you have already gone through this procedure once and a plugged threaded hole for the fitting body exists, remove the plug from the threaded hole and skip to Step 3.
	If you have already gone through this procedure once and a plugged fitting body is already installed, remove the plug from the fitting body and skip to Step 4.

2. Prepare a threaded hole for the fitting body as shown.

parallel thread
G1/2 ISO 228/1
(BS 2779, JIS B0202)

ø19mm drilling

≥10.5mm

≥40mm

Process or pipe wall
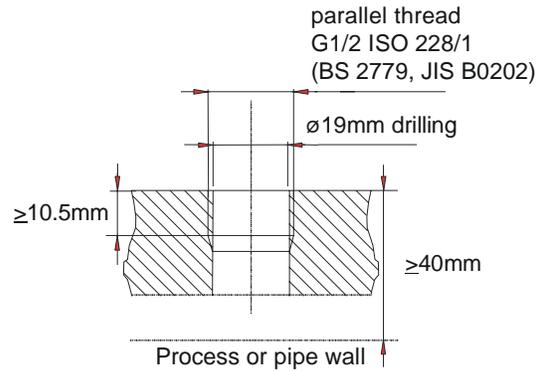
3. Remove the fitting body from the clasp nut on the probe
   and install and seal in the threaded hole prepared in step 2.

fitting body
hex = 24mm
tapered thread
R1/2 ISO 7/1

sealing with:
1. LOCTITE®   No 542 + activ. No 7649 (t=-55...+150 °C)
2. MEGA-PIPE EXTRA No 7188 (t=-55...+170 °C)
3. PTFE tape (t=-60...+210 °C) NOTE: the tape does not lock
the parts together. Therefore, use two fork spanners (hex 24 and
27 mm) for tightening and opening the clasp nut of the probe
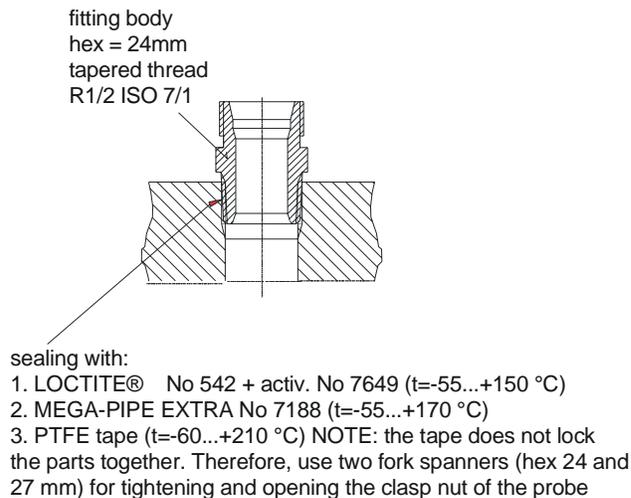
4. Fit the probe through the fitting body and tighten the clasp nut hand tight.
   The probe should be able to slide freely through the nut and fitting body.

CAUTION	**DO NOT** damage the probe body when inserting through the fitting body,. If the probe body is damaged, it will either not go through the fitting body, or the sensor within may be damaged.

5. Slide the probe into the measuring position.

CAUTION	The next several steps bleed the air from the system. To minimize oil loss, perform as quickly as possible.

6. Turn the process back on at a reduced pressure.

7. Slightly loosen the clasp nut.

    The air trapped in the system will escape around the probe shaft.

8. When oil starts to leak around the probe shaft,
    tighten the clasp nut hand tight.

    This should stop or greatly reduce the leakage.

9. Fully tighten the clasp nut as follows:

    a. Mark the fitting body and the clasp nut.

    b. Tighten the clasp nut an additional 30°-40°.

        • To avoid over tightening, use the plastic wrench
           supplied with the probe.

        • If you have torque wrench, tighten the nut to 35±5 Nm (25±4 ft-lbs.)

1. probe (13.5 mm (0.53 in) diameter)

2. clasp nut (27 mm hex)

3. pen

4. fitting body (24 mm hex)

NOTE	**DO NOT** overtighten as you will damage the probe shaft and it may leak.

10. Turn the process pressure fully on.

11. Take the measurement. For more information see Chapter 16, Taking Moisture-In-Oil Measurements.

12. Shut down the process.

13. Completely loosen the clasp nut.

14. Remove the probe.

15. Seal the system in one of the following ways:

    - remove the fitting body and install a plug in the hole.

    - cap the open end of the fitting body.
      To do this you can use the blanking plug and nut,
      Doble Part Number 230-0226

16. Clean the probe in one of the following ways:

    - slide the clasp nut down the probe shaft.
      Use the manual press tool if necessary. Or,

    - wipe the probe with soft cloth.

17. Restart the process.

Ball Valve Installation On A Pressurized Process

General Guidelines

The probe can be installed directly on a pressurized process or pipe through a permanently installed ball valve.

NOTE	One drawback of this type of installation is that the ball valve limits the distance that the sensor can extend into the process fluid. If you need to position the sensor further into the process than a ball valve installation permits, consider installing the probe to a permanently installed fitting. For more information see the topic Direct Installation On A Pressurized Process on page 85 .

NOTE	The process pressure can be a maximum of 20 bars (290 psi.)

Due to the tight sliding fit of the probe shaft in the clasp nut, once the Moisture-In-Oil Probe is installed and the ball valve opened, the probe can be easily inserted and removed from the pressurized process at pressures up to 10 bar (145 psi.)

CAUTION	At higher pressures (but below the sensor's maximum operational pressure of 20 bar (290 psi) the probe shaft to clasp nut seal may leak and the process must be shut down to insert the probe.

In a ball valve installation you can use:

- ball valve, Doble Part Number 230-0172

- a 1/2" NPT ball valve assembly
  with a ball hole of 14 mm diameter or more.

NOTE	When installing the ball valve: • In pipe installations, the nominal size of the pipe must be at least 1 inch (2.54 cm) to accommodate the sensor head. • The ball valve should be installed such that the sensor head is oriented transversely against the direction of the process flow.

Procedure

To install the Moisture-In-Oil sensor to a ball valve:

1. Probe

2. Clasp nut

3. Fitting Body

4. Ball valve

5. Pipe

6. Press tool

7. Groove indicating
   upper adjustment limit

Probe installed
on ball valve

Probe inserted
into process
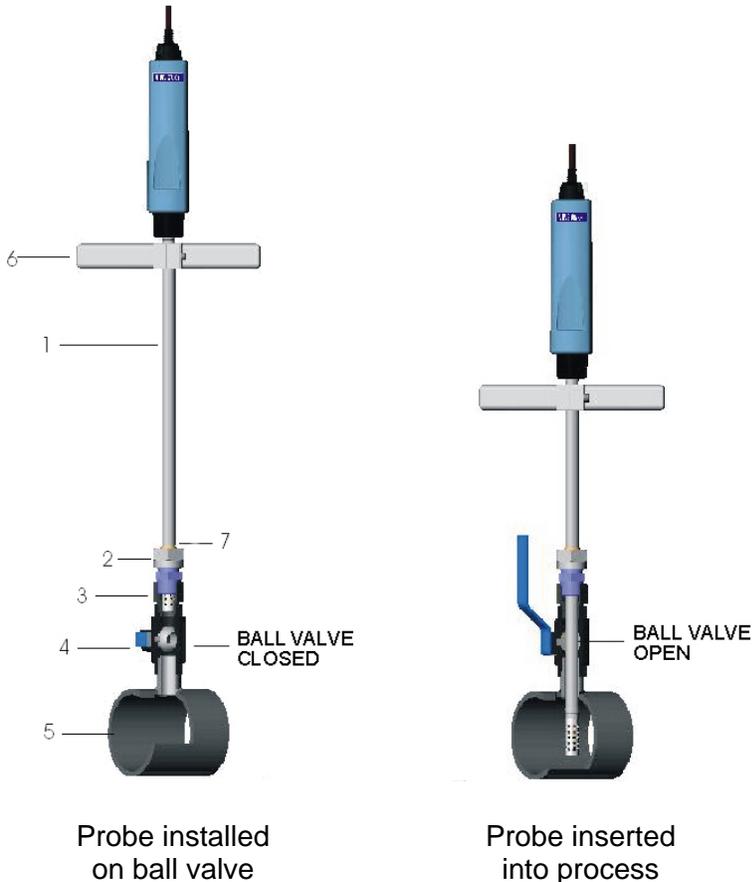
1. Do one of the following:

   - If the ball valve is not yet installed, shutdown the pressurized process
     or pipe, install the ball valve, close the ball valve, then restart the
     pressurized process. For more information, see the guidelines
     at the beginning of this section.

NOTE	You can use any 1/2" NPT ball valve assembly with a ball hole of 14 mm (0.550 inch) diameter or more such as Doble Part Number 230-0172.

   - If the ball valve is already installed, go to the next step.

2. Do one of the following:

   - If the process pressure is greater than 10 bars (145 psi)
     then shut down the process.

   - If the pressure is lower than 10 bars (145 psi)
     there is no need to shut down the process. Go to the next step.

3. Install the manual press tool on the probe shaft near the probe body.

   To do this, remove the socket head cap screws from the press tool,
   fit the two halves over the probe shaft , and reinstall the screws.
   Tighten the screws alternately and evenly, taking care not to cross thread
   the plastic threads in the press tool. Note that the press tool halves
   will still show a gap between them when fully tightened.

4. Loosen the clasp nut and fitting body and slide them to the end
   of the probe shaft. There is a groove on the shaft that indicates
   the end of the clasp nut travel.

5. Install the fitting body tightly to the ball valve.

CAUTION	**DO NOT** damage the probe body when inserting through the ball valve. If the probe body is damaged, it will either not go through the ball valve, or the sensor within may be damaged.

6. Tighten the clasp nut hand tight.
   The probe should be able to slide freely through the nut and fitting body.

7. Open the ball valve.

8. Slide the probe into the measuring position using the manual press tool.

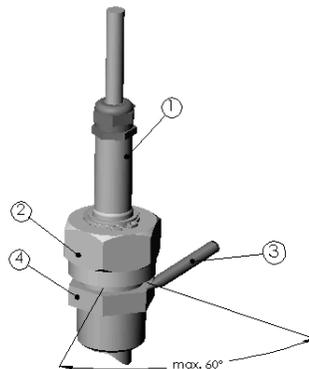| CAUTION	The next several steps bleed the air from the system. To minimize oil loss, perform as quickly as possible.

9. Do one of the following:

    - If you previously shut down the process,
      turn it back on at a reduced pressure.

    - If you did not shut down the process,
      you may want to reduced the pressure.

10. Slightly loosen the clasp nut.

    The air trapped in the system will escape around the probe shaft.

11. When oil starts to leak around the probe shaft,
    tighten the clasp nut hand tight.

    This should stop or greatly reduce the leakage.

12. Fully tighten the clasp nut as follows:

    a.   Mark the fitting body and the clasp nut.

    b.   Tighten the clasp nut an additional 30°-40°.

- To avoid over tightening, use the plastic wrench
  supplied with the probe.

- If you have torque wrench, tighten the nut to 35±5 Nm (25±4 ft-lbs.)
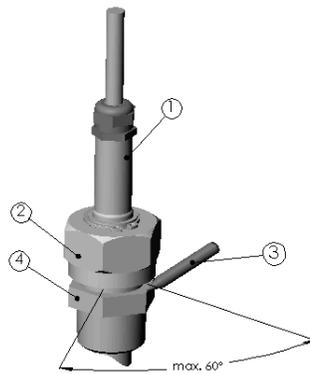
1. probe (13.5 mm (0.53 in) diameter)

2. clasp nut (27 mm hex)

3. pen

4. fitting body (24 mm hex)

NOTE	**DO NOT** overtighten as you will damage the probe shaft and it may leak.

13. If the process it not at full pressure, restore full pressure now.

14. Take the measurement. For more information see Chapter 16, Taking
    Moisture-In-Oil Measurements.

15. Do one of the following:

- If the process pressure is more than 10 bars (145 psi)
  then shut down the process.

- If the pressure is lower there is no need to shut down the process.

16. Loosen the clasp nut with the plastic wrench approximately 30°-40°.

17. Slide the probe out to expose the groove that indicates the
    upper probe position using the manual press tool on the probe shaft.

18. Close the ball valve.

19. If the process has been shut down you can turn it back on now.

20. Remove the fitting body from the ball valve.

21. Clean the probe in one of the following ways::

    - slide the clasp nut and fitting body down the probe shaft.
      Use the manual press tool if necessary. Or,

    - wipe the probe with soft cloth.

Unpressurized Installation

**To install the Moisture-In-Oil probe
when the sample oil is not under pressure:**

1. Loosen the clasp nut and fitting body just enough that
    they can slide on the probe shaft.

2. Slide the clasp nut and fitting body up the probe shaft.

3. Install the probe into measuring position.

4. Take the measurement. For more information see Chapter 16, Taking
    Moisture-In-Oil Measurements.

5. After stopping the measurement, clean the shaft. To do this:

    *   slide the clasp nut and fitting body down the probe shaft.
        Use the manual press tool if necessary. Or,

    *   wipe the probe with soft cloth.

Lift up the clasp nut
and fitting body
for installation

Pull down the clasp nut
and fitting body
to clean the probe
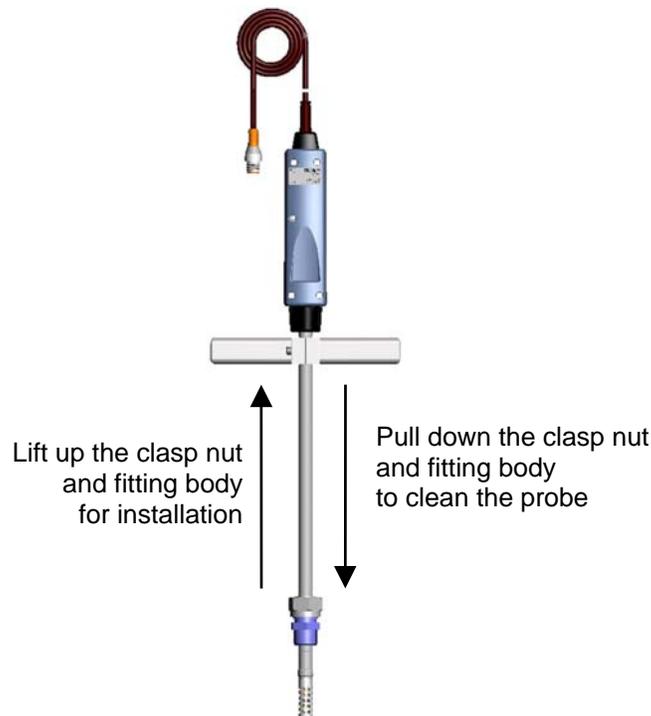
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CHAPTER 16

TAKING MOISTURE-IN-OIL MEASUREMENTS

This chapter contains information on taking measurements using the *DOMINO®* USS Moisture-In-Oil Probe.

TIP	If you are using the *DOMINO®* USS Moisture-In-Oil system for the first time see Chapter 14, Moisture-In-Oil Quick Start on page 75.

NOTE	The Moisture-In-Oil probe must be set for the specific oil type you are testing. For more information see Chapter 17, Changing Moisture-In-Oil Settings on page 99.

NOTE	You must set which of the measured variable you want to display. For more information see the topic Specifying The Displayed Quantities And Units on page 48.

CAUTION	Do not use the sensor in heavily chlorinated or fluorinated fluids as this may permanently damage the sensor's polyamide film.

The actual procedure starts on the next page.

To take a Moisture-In-Oil measurement:

1. Connect the Moisture-In-Oil Probe to Indicator.
   The Indicator should be off.

2. On the Indicator, press ⏻ POWER ON/OFF button.

NOTE	If you turn on the Indicator before connecting the probe, when you do attach the probe it will not be recognized by the Indicator.

3. Install the probe to the measuring position. For more information see Chapter 15, Installing The Moisture-In-Oil Probe starting on page 77

4. The basic display opens. Let the reading stabilize.

CAUTION	If you need to disconnect the probe from the Indicator, first press ⏻ POWER ON/OFF button to turn the Indicator OFF. This ensures that all settings and data are saved properly.

CHAPTER 17
CHANGING MOISTURE-IN-OIL SETTINGS

This chapter contains information on the various settings
that are necessary when taking moisture-in-oil measurements.

NOTE	The settings described in this chapter are stored in the *DOMINO*® USS Moisture-In-Oil Probe itself (not in the Indicator) and will be retained if the probe is used with a different Indicator.

Topics in this chapter...

About Oil Types

Changing The Default Oil Type

Testing New Oil Types

Adding New Oil Types

About Oil Types

The *DOMINO*® USS moisture-in-oil probe can be used in most hydrocarbon and silicone bases fluids.

CAUTION	Do not use the sensor in heavily chlorinated or fluorinated fluids as this may permanently damage the sensor's polyamide film.

Different types of transformer oils possess different water solubility characteristics. For maximum accuracy, the *DOMINO*® USS system uses an algorithm to calculate the moisture-in-oil ppm value. This algorithm uses two coefficients that are different for different types of oil. For more information on the calculation see the topic General Theory Of Operation on page 17.

The USS Indicator has been preset to four oil types:

Oil Type	**Description**	**Coefficient A**	**Coefficient B**
1	New and service-aged transformer mineral oil with a neutralization number < 0.18mg KOH/g.	-1567	7.0895
2	Very aged transformer mineral oil with a neutralization number >0.18 mg KOH/g.	-1469	7.1546
3	Silicone transformer oil	-1187	6.2906
4	Natural Ester transformer oil (such as Envirotemp® FR3 and Biotemp®.)	-743	5.5199

The default algorithm is Oil 1.

- If you are testing one of the other oil types listed, select that oil type. For more information see the topic Changing The Default Oil Type on page 101.

- If you are testing an oil type that is not listed you need to know and enter coefficients for that oil type. For more information see the topic Testing New Oil Types on page 102.

Changing The Default Oil Type

To change the default oil type:

1. Open the MENU by pressing ⊖ OPEN.

2. Select SETTINGS, then press ▷.

3. Select MEASUREMENT SETTINGS, then press ▷.

   The currently selected oil type and its coefficients display
   with the first row listing the currently selected oil type highlighted.

SETTINGS	MEASUREMENT SETTINGS	
▶User interface	H₂O$_{oil}$: 1	← Oil identification number 1-4
▶Date and time	A: -1567.00	
▶Measurement settings	B: 7.0895	
i Device information		
Factory settings		
EXIT	SET EXIT	
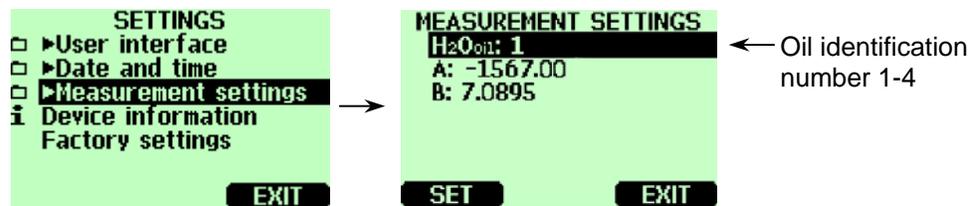
4. Press ⊖ SET, then select a different oil type
   by using the up or down arrows.

5. Press ⊖ OK.

6. To return to the basic display press ⊖ EXIT.

Testing New Oil Types

When testing fluids whose solubility characteristics are different than the four preset oils, different algorithm coefficients that are specific to the oil must be used.

NOTE	If the water solubility characteristics of a specific oil type are unknown, they should be assumed to be significantly different and should be determined experimentally.

When you encounter an oil that does not match one of the four preset oils, contact Doble Engineering.

- Doble has determined algorithm coefficients over 30 for different fluids. These known coefficients are available upon request.

- If algorithm coefficients do not exist, a sample must be sent to Doble for modeling. Doble will experimentally determine the specific coefficients for the oil. In some cases, a fee may be charged for this service.

The determined coefficients of the algorithm for the fluid must then be programmed into the USS Indicator as detailed in the next topic.

Adding New Oil Types

Once a set of new coefficients have been established for a new oil type
they must be programmed into the Indicator.

To add new coefficients to the Indicator:

1. Open the MENU by pressing $\triangleright$ $\ominus$ OPEN.

2. Select SETTINGS, then press $\triangleright$.

3. Select MEASUREMENT SETTINGS, then press $\triangleright$.

    The currently selected oil type and its coefficients display
    with the first row listing the currently selected oil type highlighted.
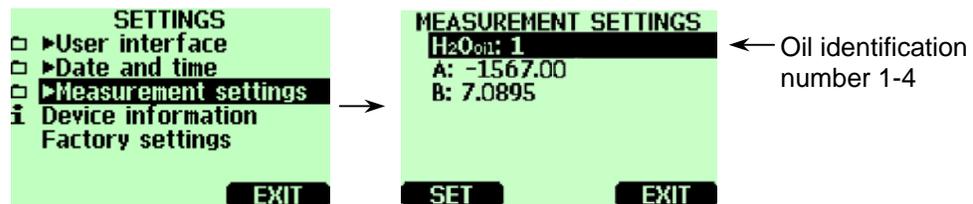
4. If you want to change the coefficients for a different oil type,
    press $\ominus$ SET, then select a different oil type by using the up or down
    arrows. Then press $\ominus$ OK.

5. Select the A value (A:0.0000), then press $\ominus$ SET.

6. Set the value A by using $\triangle\triangledown\triangleright\triangleleft$ buttons, press OK.

7. Select the B value (B:0.0000), then press $\ominus$ SET.

8. Set the value B by using the $\triangle\triangledown\triangleright\triangleleft$ buttons, press OK.

9. To change the coefficients for other oil types select that oil type
    per step 4 above and continue with the following steps.

10. To return to the basic display press $\ominus$ EXIT.

| **NOTE** | If you change the coefficients for one of the four preset oil types and want to test that oil type again then the coefficients for that oil type must be re-entered. |
| | See the topic About Oil Types earlier in this chapter for the list of default oil types and coefficients. |

| **TIP** | Remember to always select the correct oil type before measurements. |

CHAPTER 18
CALIBRATING MOISTURE-IN-OIL PROBES

This chapter contains information on calibrating
the *DOMINO*® USS Moisture-In-Oil Probe.

Topics in this chapter...

General Calibration Information

Preparations Before Calibration

About Temperature Calibration

Temperature Calibration Procedures

About Relative Humidity Calibration

Relative Humidity Calibration Procedures

Viewing Last Calibration Date

General Calibration Information

What Calibration Is

Calibration is the process of:

1. Placing the probe sensor in a known reference environment.

2. Comparing the reading against the reference value.

3. Adjusting the probe sensor's reading to correspond to the reference value.

NOTE	After this procedure, the previous calibration is no longer valid.

When To Do Calibration

The Doble *DOMINO*® USS moisture-in-oil sensor is fully calibrated
when shipped from factory.

The recommended calibration interval is 18 to 24 months.

If at any time there is a reason to believe that device is not within the accuracy
specifications, calibration should be done. It is recommended to send the sensor
probe to the Doble Customer Service Center. For contact information. See the
topic Doble Service Center on page 6.

You can also calibrate the *DOMINO*® USS moisture-in-oil sensor by following
the instructions given in this chapter.

What You Can Calibrate

The T (temperature) function is calibrated directly.

The RS (Relative Saturation) function is calibrated directly
as relative humidity (RH.)

The H2O (Mass concentration of water) function is not calibrated directly.

NOTE	When calibrating both relative humidity and temperature, make the temperature calibration first.

Preparations Before Calibration

The following steps should be performed before any type of calibration:

1. Clean the sensor. This will:

   - decrease response time.

   - to prevent contamination of the salt bath by a dirty sensor, and hence prevent any change of the reference condition.

   For more information see the topic Cleaning the Moisture-In-Oil Probe on page 122.

2. When using the Doble humidity calibrator, use the calibration adapter, Doble Part Number 03A-1672-01.

3. Take out the screw from the probe handle to expose the calibration button.

Calibration button
(under the screw)
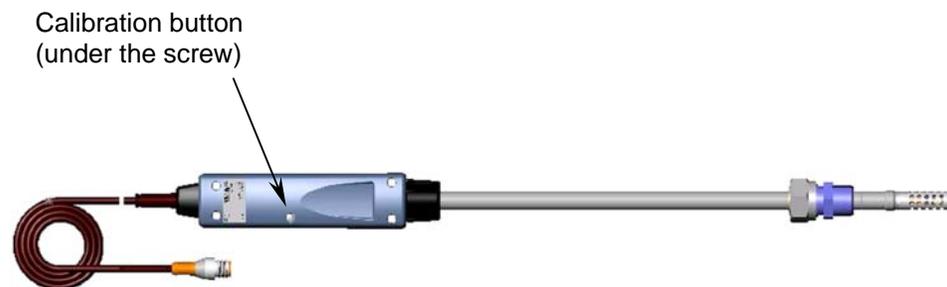
NOTE	During calibration mode, Automatic Power Off is disabled.
	Do not leave the Indicator and probe unattended as unintended discharge of the battery may result.

About Temperature Calibration

Temperature can be calibrated against a known reference in any of the following ways:

Two-point calibration calibrates the probe sensor at low and high temperature references. The difference between the temperature references must be more than 30 °C. This is the recommended method to yield the most accurate calibration.

One-point calibration calibrates the probe sensor at a single temperature reference. Optimum results are obtained when the selected reference represents the measuring environment.

Calibration to a known good probe calibrates the probe being calibrated to match a second probe. This method should not be used in place of calibration to one (or preferably two) primary standard(s), but it provides a convenient method of roughly calibrating a probe in the field. The accuracy is dependent upon the accuracy of the second probe.

Details and procedures on each of these methods follow.

Temperature Calibration Procedures

Two-Point Calibration

Two-point calibration calibrates the probe sensor at low and high temperature differences. This is the recommended method to yields the most accurate calibration.

To perform a two-point calibration:

1. Prepare the low and high temperature references.

2. Attach the Moisture-In-Oil Probe that is to be calibrated to the Indicator.

3. Turn the Indicator on.

4. Take out the screw from the probe handle to expose the calibration button.

    The calibration button is on a circuit board deep within the hole exposed.

5. Gently press the button with a very small screwdriver
    or the end of an unbent paper clip.

    The Indicator screen displays a confirmation message
    that it is starting calibration mode.

6. Press ⊖ OK.

    The calibration mode starts and a list of
    the measured variables is displayed.

7. Select T by using the arrow buttons, then press ⊖ SELECT.

    The temperature is displayed
    with the message ADJUSTMENT MODE flashing.

8. Press ⊖ ADJUST.

    A list of calibration methods is displayed.

9. Select 2-point adjustment, then press ⊖ SELECT.

    The recommended references are displayed.

10. Press ⊖ OK to continue.

11. Place the probe tip in the lower reference temperature.

12. Allow the reading to stabilize.
    You can follow the stabilization from the ⊖ GRAPH display.
    To return to the adjustment screen from the graphical display
    press ⊖ BACK.

13. When the reading is stabilized, press ⊖ READY.

    A screen displays to allow you to enter the actual reference value.

14. Enter the lower reference temperature value by using the arrow buttons,
    then press ⊖ OK.

15. Place the probe tip in the higher reference temperature.

16. Allow the reading to stabilize.
    You can follow the stabilization from the ⊖ GRAPH display.
    To return to the adjustment screen from the graphical display
    press ⊖ BACK.

17. When the reading is stabilized, press ⊖ READY.

    A screen displays to allow you to enter the actual reference value.

18. Enter the higher reference temperature value by using the arrow buttons,
    then press ⊖ OK.

    A confirmation message is displayed.

19. At this confirmation message you can accept or cancel the calibration:

    • To confirm the calibration, press ⊖ YES.

       The calibration is saved in the probe and the Last adjustment date
       is changed to the date currently stored in the Indicator.
       Continue with the next step.

    • To cancel the calibration, press ⊖ NO, then press ⊖ BACK,
       then press ⊖ EXIT.

       You will return to the main display

| **NOTE** | If the difference between two references is less than 30 °C, the calibration can not be done. An error message stating that the calibration points are too close is displayed. Press ⊖ OK to exit the error message, then press ⊖ BACK, then press ⊖ EXIT. You will return to the main display |

20. Press ⊖ BACK, then press ⊖ EXIT.

You will return to the main display

21. Replace the screw over the calibration button.

TIP	If your organization has a formal calibration program, you can attach a sticker on the calibration button screw to seal the calibration.

One-Point Calibration

One-point calibration calibrates the probe sensor at a single temperature reference. Optimum results are obtained when the selected reference represents the measuring environment.

To perform a 1-point calibration, prepare the temperature reference and then follow the procedure for a two-point calibration. When prompted for the calibration type, select 1-point adjustment and follow the displayed instructions.

Calibration To A Known Good Probe

This method should not be used in place of calibration to one (or preferably two) primary standard(s), but it provides a convenient method of roughly calibrating a probe in the field. The accuracy is dependent upon the accuracy of the second probe.

To perform a calibration to a known good probe, attach the second probe to the second port on the Indicator and then follow the procedure for a two-point calibration. When prompted for the calibration type, select To same as T (II) and follow the displayed instructions.

About Relative Humidity Calibration

Relative calibration can be calibrated against a known reference in any of the following ways:

Two-point calibration calibrates the probe sensor at low (0% to 11.3%) and high (75% to 97%) humidity references. The difference between the humidity references must be more than 50%. This is the recommended method to yield the most accurate calibration.

One-point calibration calibrates the probe sensor at a single humidity reference. Optimum results are obtained when the selected reference represents the measuring environment.

LiCl-NaCl (Lithium Chloride-Sodium Chloride) automatic calibration is a two-point calibration at reference humidities of 11.3 % (LiCl, Lithium Chloride) and 75 % (NaCl, Sodium Chloride.)

Calibration to a known good probe adjusts the probe being calibrated to match a second probe. This method should not be used in place of calibration to one (or preferably two) primary standard(s), but it provides a convenient method of roughly calibrating a probe in the field. The accuracy is dependent upon the accuracy of the second probe.

Details and procedures on each of these methods follow.

Relative Humidity Calibration Procedures

Two-Point Calibration

Two-point calibration calibrates the probe sensor at low (0% to 11.3%) and high (75% to 97%) humidity references. This is the recommended method to yields the most accurate calibration. Typical references are:

- Low humidity references: 0% (Nitrogen)
  or 11.3% (LiCl, Lithium Chloride)

- High humidity references: 75% (NaCl, Sodium Chloride)
  or 97% (K_2SO_4, Potassium Sulfate.)

Ensure that the difference between the humidity references is more than 50%.

To perform a two-point calibration, prepare the low and high humidity references and then follow the procedure below.

NOTE	When calibrating both relative humidity and temperature, make the temperature calibration first.

To make a two point temperature calibration:

1. Attach the Moisture-In-Oil Probe that is to be calibrated to the Indicator.

2. Turn the Indicator on.

3. Take out the screw from the probe handle to expose the calibration button.

   The calibration button is on a circuit board deep within the hole exposed.

4. Gently press the button with a very small screwdriver or the end of an unbent paper clip.

   The Indicator screen displays a confirmation message that it is starting calibration mode.

5. Press ⊖ OK.

   The calibration mode starts and a list of the measured variables is displayed.

6. Select RH by using the arrow buttons, then press ⊖ SELECT.

    The relative humidity is displayed
    with the message ADJUSTMENT MODE flashing.

7. Press ⊖ ADJUST.

    A list of calibration methods is displayed.

8. Select 2-point adjustment, then press ⊖ SELECT.

    The recommended references are displayed.

9. Press ⊖ OK to continue.

10. Place the probe tip in the lower reference relative humidity.
    When using the Doble humidity calibrator, use the calibration adapter,
    Doble Part Number 03A-1672-01.

11. Allow the reading to stabilize.
    You can follow the stabilization from the ⊖ GRAPH display.
    To return to the calibration screen from the graphical display
    press ⊖ BACK.

12. When the reading is stabilized, press ⊖ READY.

    A screen displays to allow you to enter the actual reference value.

13. Enter the lower reference relative humidity value by using the arrow
    buttons, then press ⊖ OK.

14. Place the probe tip in the higher reference relative humidity.
    When using the Doble humidity calibrator, use the calibration adapter,
    Doble Part Number 03A-1672-01.

15. Allow the reading to stabilize.
    You can follow the stabilization from the ⊖ GRAPH display.
    To return to the calibration screen from the graphical display
    press ⊖ BACK.

16. When the reading is stabilized, press ⊖ READY.

    A screen displays to allow you to enter the actual reference value.

17. Enter the higher reference relative humidity value by using the arrow
    buttons, then press ⊖ OK.

    A confirmation message is displayed.

18. At this confirmation message you can accept or cancel the calibration:

    • To confirm the calibration, press ⊖ YES.

      The calibration is saved in the probe and the Last adjustment date
      is changed to the date currently stored in the Indicator.
      Continue with the next step.

    • To cancel the calibration, press ⊖ NO, then press ⊖ BACK,
      then press ⊖ EXIT.

      You will return to the main display

NOTE	If the difference between two references is less than 50%, the calibration can not be done. An error message stating that the calibration points are too close is displayed. Press ⊖ OK to exit the error message, then press ⊖ BACK, then press ⊖ EXIT. You will return to the main display

19. Press ⊖ BACK, then press ⊖ EXIT.

    You will return to the main display

20. Replace the screw over the calibration button.

TIP	If your organization has a formal calibration program, you can attach a sticker on the calibration button screw to seal the calibration.

LiCl-NaCl Automatic Calibration

LiCl-NaCl (LiCl = Lithium Chloride, NaCl = Sodium Chloride) automatic calibration is a two-point calibration at a low reference humidity of 11.3 % (LiCl, Lithium Chloride) and a high reference humidity of 75 % (NaCl, Sodium Chloride.) You don't have to enter the reference values, the USS Indicator displays the accurate value based on the measured temperature and values stored in the memory of the Indicator.

To perform a LiCl-NaCl automatic calibration, prepare the low and high humidity references and then follow the procedure for a two-point calibration. When prompted for the calibration type, select LiCl-NaCl autom. and follow the displayed instructions.

One-Point Calibration

One-point calibration calibrates the probe sensor at a single humidity reference. Optimum results are obtained when the selected reference represents the measuring environment.

To perform a 1-point calibration, prepare the humidity reference and then follow the procedure for a two-point calibration. When prompted for the calibration type, select 1-point adjustment and follow the displayed instructions.

Calibration To A Known Good Probe

This method should not be used in place of calibration to one (or preferably two) primary standard(s), but it provides a convenient method of roughly calibrating a probe in the field. The accuracy is dependent upon the accuracy of the second probe.

To perform a calibration to a known good probe, attach the second probe to the second port on the Indicator and then follow the procedure for a two-point calibration. When prompted for the calibration type, select To same as RH (II) and follow the displayed instructions.

Viewing The Last Calibration Date

When a calibration is performed the current date (as stored in the Indicator) is stored in the probe. You can view this date in either of two ways:

- Follow the procedure for a two-point calibration.
  When prompted for the quantity to calibrate, select Last adjustment date, then press ⊖ SHOW. Press ⊖ OK to exit the date display, then press ⊖ EXIT. You will return to the main display.

- You can check this date from the Device information screen.
  For more information see the topic Viewing Device Information on page 53.

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CHAPTER 19
MAINTAINING MOISTURE-IN-OIL PROBES

This changer contains information on servicing and cleaning the *DOMINO*® USS Moisture-In-Oil Probe.

Topics in this chapter...

Changing The Filter And Sensor

Changing The Quick Connect Fitting

Cleaning the Moisture-In-Oil Probe

Changing The Filter And Sensor

To change the filter and/or sensor:
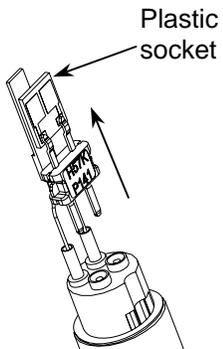
Plastic
socket

1. Unscrew the filter from the probe head.

2. Remove the sensor by pulling it straight out.
   Handle the sensor by the plastic socket only.

3. Insert a new sensor, Doble Part Number 212-0617.

4. Perform a relative humidity calibration on the probe. Refer to the topic
   Relative Humidity Calibration Procedures on page 113 for more
   information.

5. Screw a new filter, Doble Part Number 230-0209, on the probe head.
   Tighten the filter to 5.1 Nm (45 in-lbs.)

Changing The Quick Connect Fitting

The quick connect plug can be changed if it becomes worn or damaged.

NOTE	The quick connect fitting MUST be located at a precise distance away from the end of the probe in order to properly position the sensor when used with the USS Manifold.

To change the quick connect fitting:

1. Hold the fitting body and unscrew the quick connect plug.

2. Remove the remaining Teflon tape on the fitting body.

3. Apply a layer of new Teflon tape to the fitting body.

4. Screw on the new quick connect plug (Doble Part Number 09B-0825-01.)

5. Check the distance from the end of the filter to the end of the quick connect plug.

49 mm
1.94 inches

If the distance is not 49 mm (1.94 inches) as shown, then:

a. Loosen the clasp nut and fitting body.

b. Position the clasp nut, fitting body, and quick connect plug to achieve the dimension shown.

c. Tighten the clasp nut hand tight.

d. Tighten the clasp nut an additional 30°-40° using the plastic wrench

Cleaning the Moisture-In-Oil Probe

NOTE	It is important to clean the probe:
	• Before storing the probe.
	• Before calibration, as a dirty probe can contaminate the salt bath and change the reference condition.

To clean the Moisture-In-Oil Probe you need a solvent
(either heptane, hexane, or pentane liquid) and instrument air.

To clean the Moisture-In-Oil Probe :

1. Blow the probe head (with the filter on) with instrument air
   to remove the remains of the oil.

2. Immerse the probe head into either heptane, hexane, or pentane liquid
   and rinse out the oil.

CAUTION	DO NOT use acetone or similar solvents.

3. Blow the probe head with instrument air to dry it completely.

4. If you are going to calibrate the probe, then remove the filter
   and blow the sensor with instrument air. to dry it completely

5. Examine the sensor. If it is dirty,
   clean it per steps 3 and 4 above without replacing the filter.

NOTE	The sensor MUST be completely dry to prevent oxidation of the sensor. The oxidation of the sensor can cause extended response times or drifting.

6. Reinstall the filter on the probe.

SECTION 4
MAKING DEWPOINT MEASUREMENTS

This section contains information on making dewpoint (and related) measurements using:

- The *DOMINO®* USS Dewpoint System
  (Doble Part Number 03D-1677-01)

- The *DOMINO®* USS Complete System
  (Doble Part Number 03D-1686-01)

- The *DOMINO®* USS Moisture-In-Oil System
  (Doble Part Number 03D-1647-01)
  and a USS Dewpoint Probe(s)
  (Doble Part Number 03D-1681-01)

Chapters in this section...

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CHAPTER 20
DEWPOINT QUICK START

The *DOMINO®* USS Dewpoint System is a portable, simple to use system that enables reliable and high performance dewpoint measurements.

The first time out of the case, follow these steps:

1. **Charge and set up the USS Indicator.**

   For more information see Chapter 7, Indicator Quick Start on page 31.

2. **Configure the Dewpoint Probe.**

   For more information see Chapter 23,
   Changing Dewpoint Settings on page 137.

3. **Select which measured variables to display.**

   For more information see the topic
   Specifying The Displayed Quantities And Units on page 48.

4. **Install the Dewpoint Probe.**

   For more information see Chapter 21
   Installing The Dewpoint Probe, on page 127.

5. **Take the dewpoint reading.**

   For more information see Chapter 22,
   Taking Dewpoint Measurements on page 133.

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CHAPTER 21
INSTALLING THE DEWPOINT PROBE

This chapter contains information on several different methods of installing the *DOMINO®* USS Dewpoint Probe.

Topics in this chapter...

About the USS Dewpoint Sampling Cell

Installation On A Pressurized Process

About the USS Dewpoint Sampling Cell

The *DOMINO*® Dewpoint Sampling Cell is used to
sample gas from a pressurized process. The cell works as follows:

1. The process pressure forces the sample gas
   through an adapter into the sampling cell.

2. In the sampling cell the sample gas surrounds the probe sensor.

3. The sample gas exits the sampling cell at the leakage screw.

The leakage screw is used to control the rate of flow of the sample gas
over the probe sensor.

The sampling cell is supplied with three different adapters
to attach the sampling cell to a variety of process systems.

Type 3/8" - 1/2"G
adapter

Type 3/8" - 1/4"G
adapter

quick connect adapter
(installed at factory)
see note below

Sampling cell

Dewpoint Probe
attaches here

Leakage screw
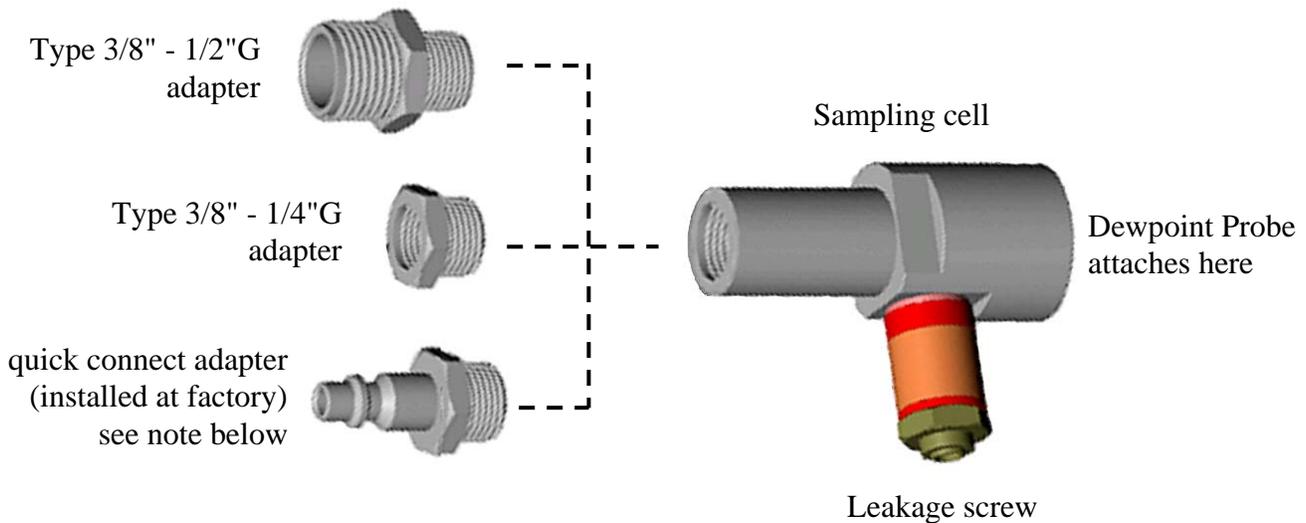
NOTE	The supplied quick connector adapter is known by several designations including 1/4 inch industrial, NIP08, and Type D.
	Use this designation to determine if a specific quick connect socket will accept the supplied connector, or, use one of the sockets availble from Doble.

Installation On A Pressurized Process

CAUTION	**When measuring the dewpoint of SF$_6$ (sulfur heaxaflouride) gas:** The small amount of SF$_6$ that is vented through the sampling manifold to the atmosphere may be unacceptable to some companies. If that is the case, **DO NOT** use the supplied sampling manifold. Do one of the following: • Install the probe directly into the apparatus to be sampled. Be certain that there is an adequate flow of the sample gas over the sintered filter. • Use a special sampling system that will not release gas to the atmosphere. For additional information contact Doble Engineering.

To connect the *DOMINO*® Dewpoint Probe to a pressurized process:

1. Verify the proper adapter that is necessary to attach to the process is assembled to the sampling cell.

TIP	To maintain the process pressure during the installation or removal of the sampling cell, use the quick connect adapter and a quick connect socket with a shutoff in the body. The Doble quick connect sockets (230-0224 and 230-0225) have this feature.

• If the quick connect fitting assembled to the sampling cell is acceptable, then go on to the next step.

TIP	If you want to use this quick connect fitting but your process will not accept it, you can use either: • Dewpoint Quick Disconnect Fitting Male Socket Doble Part Number 230-0224. • Dewpoint Quick Disconnect Fitting Female Socket, Doble Part Number 230-0225.

- If the quick connect fitting assembled to the sampling cell
  is not acceptable, then:

  a. Remove the quick connect fitting from the sampling cell.

  b. Select the appropriate fitting.

  c. Test the fit of the selected fitting and the sampling cell.
      The two parts must fully engage. then disassemble.

  d. Apply two layers of 1/2 wide Teflon tape
      to the threads of the selected fitting.

  e. Fully assemble the selected fitting to the sampling cell.

SAMPLING CELL   BARB FITTING
                                                          (FOR EXAMPLE)

APPLY TWO LAYERS
OF TEFLON TAPE
TO THREADS
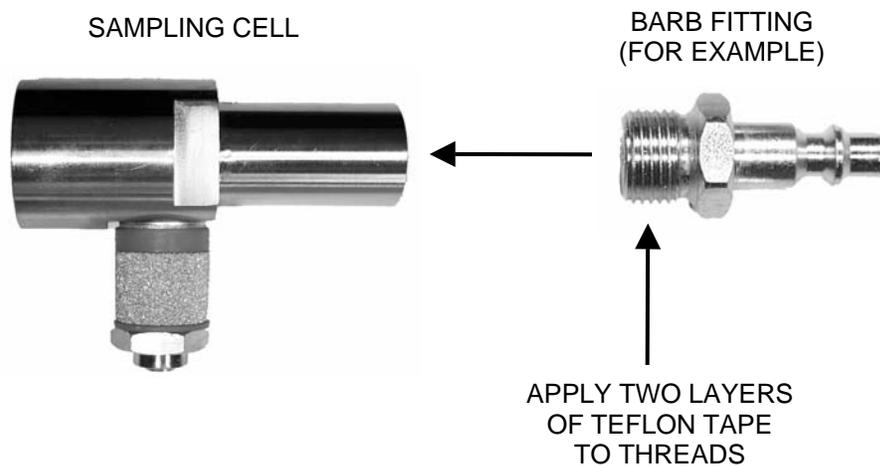
CAUTION	When the thread adapters are used, the process pressure has to be shut down or otherwise closed off for the installation or removal of the probe.

2. Assemble the sampling cell and fitting to the Dewpoint Probe.

   The Dewpoint Probe is supplied with the sampling cell already assembled. If the sampling cell is not assembled to the probe, assemble it as follows:
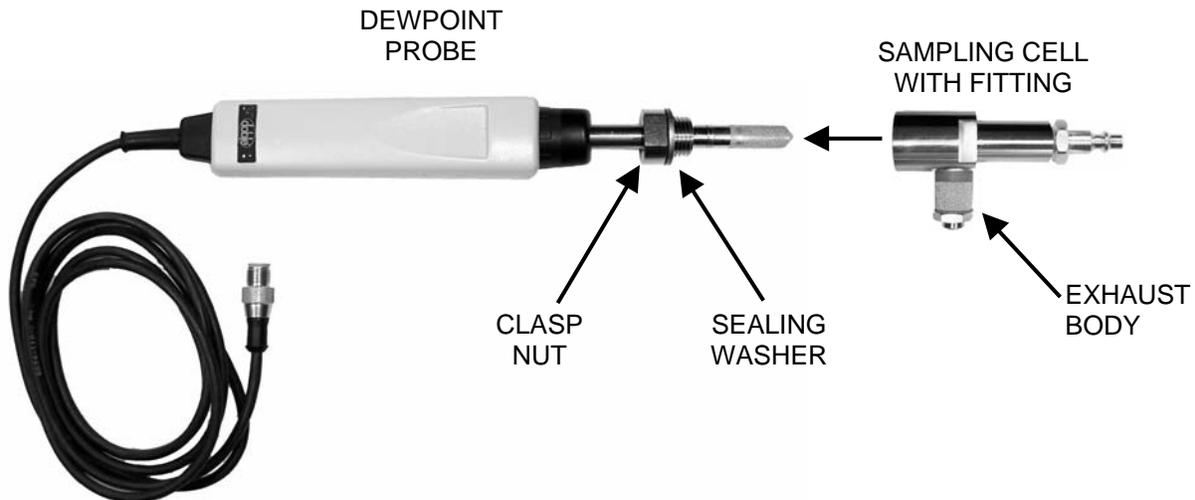
   a. Place the supplied sealing washer over the end of probe threads. Note that the rubber inside diameter of the sealing washer will be tight when pushed over the threads.

   b. If it is present, remove yellow plastic protective cap from probe tip to expose the sintered filter.

   c. Loosen the exhaust body (the sintered cylinder that the exhaust screw is in) at least one full turn.

CAUTION	If you do not loosen the exhaust body, then the exhaust screw will score the sintered filter.

   d. Assemble the sampling cell to the probe threads and tighten. Do not use Teflon tape on this connection. Do not turn using the probe handle, but rather grip both the sampling cell and the clasp nut by the flats on each.

   e. Tighten the exhaust body.

3. Make sure that the leakage screw of the sampling cell is open.
   To do this, first close the leakage screw , then turn it 1 turn open.

4. If you are not using a quick disconnect with a shutoff socket, then shut
   down the process or close off the pressure from the process fitting.

5. Connect the sample cell to the process fitting.

   - If you are using a quick disconnect, plug the plug adapter
     into the quick connect socket.

   - If you are using threaded fittings, attach the fitting on
     the sampling cell to the process. Use Teflon tape on
     the fitting threads that go into the process.

6. If you are not using a quick disconnect with a shutoff socket,
   then turn on the process or open up the pressure to the process fitting.

7. Verify that the installation is correct by checking for leaks.
   Do this by closing the leakage screw temporarily and listening for
   the hiss of the escaping process gas.

8. It is preferable, but not absolutely necessary, to fully ventilate
   the sampling cell by turning the leakage screw open several turns.
   This will allow the sensor to stabilize faster.

9. Adjust the leakage rate to allow a small leakage by
   closing the leakage screw and then opening it a small amount.

10. You care now ready to take a reading. For more information see the topic
    Taking Dewpoint Measurements on page 134.

CHAPTER 22
TAKING DEWPOINT MEASUREMENTS

This chapter contains information on taking measurements
using the *DOMINO*® USS Dewpoint Probe
including special considerations to be taken in very dry environments.

Topics in this chapter...

Taking Dewpoint Measurements

Measuring In Very Dry Environments

Taking Dewpoint Measurements

TIP	If you are using the *DOMINO®* USS Dewpoint system for the first time see Chapter 20, Dewpoint Quick Start on page 125.

NOTE	If you are measuring water content (H2O): • The Dewpoint Probe must be set for the pressure of the sample. For more information see the topic Changing Pressure Settings on page 138. • The Dewpoint Probe must be set for the molecular weight of the sample. For more information see the topic Changing Molecular Weight Settings on page 140.

NOTE	You must set which of the measured variable you want to display. For more information see the topic Specifying The Displayed Quantities And Units on page 48.

NOTE	Make sure that auto-calibration has taken place or in very dry environments perform a manual calibration. For more information see the topic Changing Auto-Calibration Settings on page 142.

NOTE	If you are just starting measuring after the probe has been stored or a sensor purge has not been performed within the last 24 hour, perform a sensor purge. For more information see the topic Changing Sensor Purge Settings on page 146.

The actual procedure starts on the next page.

To take a Dewpoint measurement:

1. Connect the Dewpoint Probe to the Indicator.
   The Indicator should be off.

2. On the Indicator, press ⏻ POWER ON/OFF button.

NOTE	If you turn on the Indicator before connecting the probe, when you do attach the probe it will not be recognized by the Indicator.

3. Install the probe to the measuring position. For more information see Chapter 21, Installing The Dewpoint Probe starting on page 127.

4. The basic display opens. Let the reading stabilize.

NOTE	When measuring low dewpoints, the stabilization times can be long, for example, one to two hours. Therefore, to ensure the stabilization can be monitored the entire time, turn off the automatic power-off function. For more information see the topic Configuring Automatic Power Off on page 41.

CAUTION	If you need to disconnect the probe from the Indicator, first press ⏻ POWER ON/OFF button to turn the Indicator OFF.
	This ensures that all settings and data are saved properly.

Measuring In Very Dry Environments

The following recommendations should be taken into account when measuring in very dry environments:

- A clean environment is always best for humidity measurements.

- The number of connections should be minimized to avoid leaks.

- The flow rate must be adequate.

- Dead ends must be avoided as they cannot be flushed easily.

- The tube temperature must never be below the dewpoint of the sample gas. This may lead to condensation and false results.

- The sample tubing should be of as short length as possible. The surface area should be minimized using the narrowest tubing that the flow conditions allow.

- The surface finish of the pipework is important. Polished or electro-polished steel is recommended for best results.

- Hygroscopic materials should be avoided in the sampling lines. Use stainless steel membranes instead of rubber membranes.

- Impermeable materials should be selected to avoid inward diffusion of moisture through the sampling tubes and enclosures. Such impermeable materials are, for example, high-quality stainless steel and metals. Avoid PVC or nylon tubes.

CHAPTER 23

CHANGING DEWPOINT SETTINGS

This chapter contains information on the various settings
that are necessary when taking dewpoint measurements.

NOTE	The settings described in this chapter are stored in the *DOMINO*® USS Dewpoint Probe itself (not in the Indicator) and will be retained if the probe is used with a different Indicator.

Topics in this chapter...

Changing Pressure Settings

Changing Molecular Weight Settings

Changing Auto-Calibration Settings

Changing Sensor Purge Settings

Changing Pressure Settings

NOTE	The actual process pressure value must be set to measure water content (H_2O.) This value is required to make the ppm calculation.

Either gauge pressure (the difference between the atmospheric pressure and the process pressure) or absolute pressure can be set in units of either bar or psi.

To set the process pressure value:

1. Open the MENU: by pressing $\triangleright$ $\ominus$ OPEN

2. Select ▶Environment, then press $\triangleright$.

    The Environment screen will display.
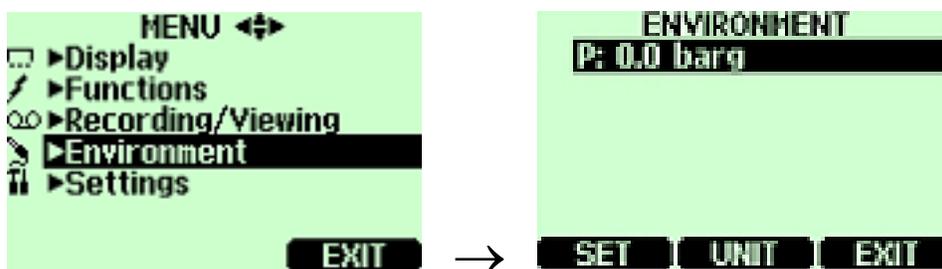
3. To change the type of pressure that is displayed and the units that are used, press $\ominus$ Unit. Each time you press $\ominus$ Unit, the selection will advance to the next type and unit combination as listed below.

    $P_{barg:}$ Gauge pressure is given in the unit of bar.

    $P_{bara:}$ Absolute process pressure is given in the unit of bar.

    $P_{psig:}$ Gauge pressure is given in the unit of psi.

    $P_{psia:}$ Absolute pressure is given in the unit of psi.

4. To change the pressure value, press $\ominus$ Set.

    The set pressure screen will display.

5. Set the value using the ⊖⊖⊖⊖ buttons.
   To change the sign of the pressure value, press ⊖ **+/-**.
   To save the value, press ⊖ OK.

6. To return to the basic display, press ⊖ Exit.

Changing Molecular Weight Settings

NOTE	The molecular weight of the sampled gas must be set to measure water content (H2O.) This value is required to make the ppm calculation.

To set the molecular weight value:

1. Open the MENU: by pressing $\triangleright$ $\ominus$ OPEN

2. Select ▶Settings, then press $\triangleright$.

    The Settings screen will display.
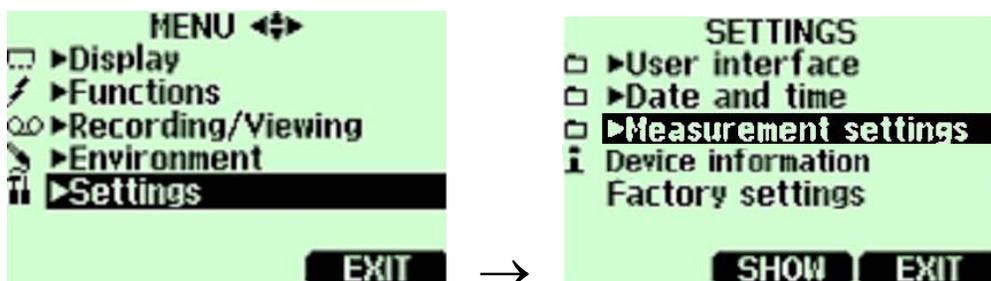
3. Select ▶Measurement Settings, then press $\triangleright$.

    The Measurement Settings screen will display.

4. Select ppmw M, then press ⊖ Set.
    The Set value of ppmw M screen will display.

5. Set the value using the ⊕⊖⊕⊕ buttons.

For...	set the value to...
air	28.96
SF$_6$	146.06
nitrogen	28.01
argon	79.90
helium	8.00
vacuum	use the value for air or the value for the predominant gas that was present

6. To change the sign of the pressure value, press ⊖ **+/-**.

7. Press ⊖ OK to save the value.

8. To return to the basic display, press ⊖ Exit.

Changing Auto-Calibration Settings

Calibration is a procedure in which the probe's dry-end reading is adjusted to correspond to the calibrated values to ensure the best possible accuracy in measurements taken in low dewpoint (dry) environments.

Calibration can be performed automatically (auto-calibration) or initiated manually by the user. By default auto-calibration is turned on.

When it is enabled, auto-calibration will be performed automatically if the dewpoint or temperature changes significantly, typically more than 10 ℃. However, if there are no changes in the conditions, the auto-calibration will be performed one hour after the last auto-calibration.

If the correction determined by the auto-calibration reaches a preset, maximum value, or if the auto-calibration correction fails (for example in the case of unstable conditions), a new auto-calibration may take place later if the automatic auto-calibration is turned on.

The auto-calibration is performed **only if** all of the following criteria for the measurement environment are fulfilled:

- The relative humidity must be less than 2 %

- The temperature must be greater than 0 ℃ and less than 60 ℃.

- The humidity environment must be stable. The maximum change in the dewpoint can be 1 ℃ within 30 seconds.

Calibration can also be started manually, even if the automatic auto-calibration setting is on. Perform the manual calibration to check that auto-calibration has been performed to obtain the most accurate measurement in a very dry environment.

Turning Automatic Auto-Calibration On Or Off

You can change the automatic auto-calibration setting at any time.

To turn automatic auto-calibration on or off:

1. Open the MENU by pressing $\triangleright$ $\ominus$ OPEN

2. Select Settings, then press $\triangleright$.

3. Select Measurement settings, then press $\triangleright$.

4. Select ⬛Autom.AutoCal.

5. Select the automatic auto-calibration setting:

    - To turn automatic auto-calibration off, press $\ominus$ Off.
      The box next to Autom.AutoCal is cleared.

    - To turn automatic auto-calibration on, press $\ominus$ On.
      The box next to Autom.AutoCal is checked.

6. To return to the basic display, press $\ominus$ Exit.

NOTE	If the automatic auto-calibration is turned off, the auto-calibration should be started manually in the following situations:
	• when starting measuring after the probe has not been used for a while.
	• at least once every hour when measuring.

Performing Manual Auto-Calibration

You can manually initiate the auto-calibration at any time.
Perform the manual calibration to check that auto-calibration has been
performed to obtain the most accurate measurement in a very dry environment.

NOTE	The manual auto-calibration can be performed even if the automatic auto-calibration setting is on.

To start the auto-calibration manually:

1. Open the MENU by pressing $\triangleright$ $\ominus$ OPEN

2. Select Functions, then press $\triangleright$.

3. Select AutoCal, then press $\ominus$ Start.

4. Press Yes to confirm the selection.

   The auto-calibration process will begin.

NOTE	If it is too humid, auto-calibration will not start and a message displays that states that the calibration cannot be made.

Auto-calibration will take about 2 minutes to complete.

During auto-calibration an estimate of the measurement readings may
appear on the display. Messages concerning the remaining auto-calibration
time are shown periodically.
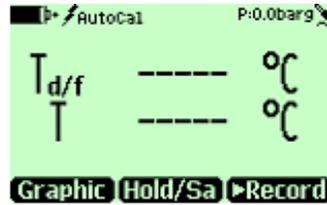
1. Display during the adjustment period (< 15 seconds)
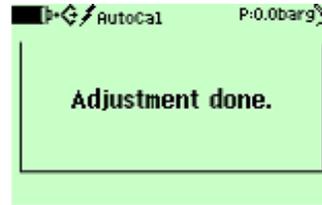
2. Adjustment period is completed and stabilization period will start.
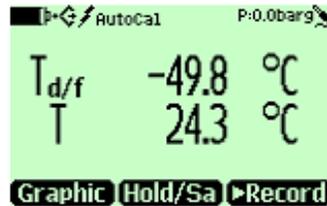
3. After successful auto-calibration, the corrected readings are shown during the stabilization period. If the auto-calibration fails, no readings are shown, only lines are displayed.

4. Display during the stabilization period (1 ... 2 minutes).

5. Auto-calibration is completed.

When the auto-calibration is completed, the display returns to the basic display automatically. The stabilization of the temperature reading can take a few minutes.

Changing Sensor Purge Settings

Sensor purge is a procedure in which the sensor is dried to ensure the fastest response time when installing the probe from an ambient to a dry gas. Along with auto-calibration, sensor purge will also ensure the best measurement accuracy and long-term stability.

Sensor purge can be performed automatically (automatic sensor purge) or initiated manually by the user. By default automatic sensor purge is turned on. It is recommended not to turn it off.

When it is enabled, the automatic sensor purge will be performed at an interval specified by the user. The default interval is 24 hours. If there are high chemical concentrations present in the measurement environment that are causing sensor drift, then it may be necessary to perform the sensor purge more often. Note that more frequent sensor purges will reduce battery operation time.

The automatic sensor purge is performed **only if** all of the following criteria for the measurement environment are fulfilled:

- The *DOMINO®* Indicator power is continuously turned on
  or the Indicator has been left in logging mode (display on or off.)

- The humidity changes significantly or quickly.

- The dewpoint is low enough.

The sensor purge can also be started manually.
Perform a manual sensor purge in the following situations:

- When starting measuring after the probe has been stored.

- If a purge has not been performed within the last 24 hours.

- Before calibration.

TIP	You can also change one of the shortcut keys to refer to start the manual sensor purge. For more information see the topic Changing The Shortcut Keys on page 42.

Turning Automatic Sensor Purge On or Off

You can change the automatic sensor purge setting at any time.

To turn automatic sensor purge on or off:

1. Open the MENU by pressing $\triangleright$ $\ominus$ OPEN

2. Select Settings, then press $\triangleright$.

3. Select Measurement settings, then press $\triangleright$.

4. Select � Autom.Purge.

5. Select the automatic sensor purge setting:

    - To turn the automatic sensor purge off, press $\ominus$ Off.
      The box next to Autom.Purge is cleared.

    - To turn the automatic sensor purge on, press $\ominus$ On.
      The box next to Autom.Purge is checked.

6. To return to the basic display, press $\ominus$ Exit.

Changing Automatic Sensor Purge Interval

You can change the interval at which the automatic sensor purge is performed. The purge interval can be set to between 1 to 48 hours. Note that more frequent sensor purges will reduce battery operation time.

If there are high chemical concentrations present in the measurement environment that are causing sensor drift, then perform the sensor purge more often.

To change the automatic sensor purge interval:

1. Open the MENU by pressing ⊳ ⊖ OPEN.

2. Select Settings, then press ⊳.

3. Select Measurement settings, then press ⊳.

4. Select Purge interval and press ⊖ Set.

5. Set the desired purge interval by using the △▽▷◁ buttons. Then press ⊖ OK to confirm.

6. To return to the basic display, press ⊖ Exit.

Performing Manual Sensor Purge

You can manually initiate the sensor purge at any time.
Perform the manual sensor purge in the following situations:

- When starting measuring after the probe has been stored.

- If a purge has not been performed within the last 24 hours.

- Before calibration.

NOTE	The manual sensor purge can be performed even if the automatic sensor purge setting is on.

To start the sensor purge manually:

1. Open the MENU by pressing ▷ ⊖ OPEN.

2. Select Functions, then press ▷.

3. Select Purge, then press ⊖ Start.

4. Press Yes to confirm the selection.

    The sensor purge process will begin.

    The purge will take up to 5 minutes to complete. During the purge:

- there are no readings on the display.

- a message appears on the display every 15 seconds to inform of the time required to complete the purge.

- the purge symbol appears in the upper left corner of the display.
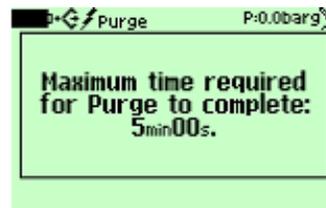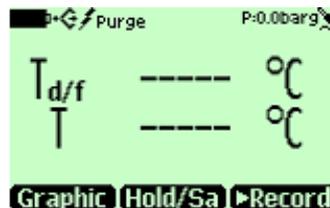
Display during the first minute.   Note message.

When the sensor purge is completed, the display returns to the basic display automatically. The stabilization of the temperature reading can take a few minutes.

NOTE	If the dewpoint is low, automatic auto-calibration will take place immediately after the sensor purge. For more information see the topic Changing Auto-Calibration Settings on page 142.

CHAPTER 24

CALIBRATING DEWPOINT PROBES

This chapter contains information on calibrating
the *DOMINO*® USS Dewpoint Probe.

General Calibration Information

What Calibration Is

Calibration is the process of placing the probe sensor in a known reference
environment and comparing the reading against the reference value.

Adjustment is the process of changing the probe sensor's reading
to correspond to the reference value.

NOTE	After the adjustment, the original calibration certificate shipped with the product is no longer valid.

When To Do Calibration

The Doble *DOMINO*® USS dewpoint sensor is fully calibrated
when shipped from factory.

The recommended calibration interval is 18 to 24 months.

If at any time there is a reason to believe that device is not within the accuracy
specifications, calibration should be done. It is recommended to send the sensor
probe to the Doble Customer Service Center. For contact information. See the
topic Doble Service Center on page 6.

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CHAPTER 25
MAINTAINING DEWPOINT PROBES

This chapter contains information on cleaning
the *DOMINO*® USS Dewpoint Probe.

Cleaning Dewpoint Probes

To clean the Dewpoint Probe you need a solvent
(either heptane, hexane, or pentane liquid) and instrument air.

To clean the Dewpoint Probe:

1. Remove the sintered filter.

2. Blow the sintered filter with instrument air to remove the remains of the oil.

3. Immerse the sintered filter into either heptane, hexane, or pentane liquid
    and rinse out the oil.

CAUTION	DO NOT use acetone or similar solvents.

4. Blow the sintered filter with instrument air to dry it completely.

5. Examine the sensor. If it is dirty, clean it per steps 3 and 4 above.

6. Reinstall the cleaned sintered filter on the probe.

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SECTION 5
USING *DOMINO*® CONNECTS

This section contains information on *DOMINO*® Connects, a software application that can monitor, control, and download data from, the USS Indicator.

Chapters in this section...

Chapter 26   Using *DOMINO*® Connects

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CHAPTER 26
USING *DOMINO®* CONNECTS

This chapter contains information on installing and using *DOMINO®* Connects, the Microsoft Windows® environment software for monitoring and controlling the USS Indicator.

Topics in this chapter...

About *DOMINO®* Connects

DOMINO® Connects Requirements

Installing *DOMINO®* Connects

Installing The USB-Serial Adapter

Using *DOMINO®* Connects

Uninstalling *DOMINO®* Connects

About *DOMINO*® Connects

DOMINO® Connects is a Microsoft Windows® environment software program that enables you to monitor, control, and download data from the USS Indicator. *DOMINO*® Connects enables you to:

- Configure most Indicator functions including all data gathering and recording functions.

- View real time data of selected variables in a tabular or graphical format.

- Print tabular data or save it in a number of formats including tab delimited or comma separated values (CSV.)

- Scale, zoom in and out of, and print graphical data.

- Open Indicator data files and view them in tabular or graphical format and save it in a number of formats including tab delimited or comma separated values (CSV.)

- Delete data files from the Indicator's memory.

DOMINO® Connects Requirements

The computer running *DOMINO*® Connects must meet the following requirements:

Hardware	IBM compatible computer with either:
	• A serial port (9 pin sub-D male connector), or,
	• A USB port (requires optional USB-Serial Adapter, Doble Part Number 401-0302)
Operating system	Windows NT® 4.0, Windows® 2000, Windows® XP, or Windows® Server 2003.

Installing *DOMINO*® Connects

DOMINO® Connects can be installed in either of two ways,
from the supplied CD or from a set of floppy disks you can create.

NOTE	Security settings may prevent regular users from installing new software. In case of problems, contact your local system administrator.

Installing *DOMINO*® Connects From CD

To install *DOMINO*® Connects from the supplied CD:

1. Insert the *DOMINO*® Connects CD-ROM into your CD-ROM drive.

   The *DOMINO*® Connects setup program will be launched automatically.

   If the setup does not start automatically, do one of the following:

   - Open My Computer, double-click the CD-ROM drive icon, then double-click the Setup icon in the opened CD-ROM window. Or,

   - Click **Start**, then click **Run**. In the **Open** box type D:\setup.exe where D is the drive letter of the computer's CD-ROM drive. Then click **OK**.

   The *DOMINO*® Connects setup program will start.

2. Follow the on-screen prompts to complete the installation.

Installing *DOMINO*® Connects From Floppy Disks

If you have to install *DOMINO*® Connects on a computer that has no CR-ROM drive but does have a floppy drive, you can create a set of 3 1/2 inch floppy disks that contain the setup program using the *DOMINO*® Connects Disk Wizard.

To create the installation floppies:

CAUTION	During the following procedure, all existing data on the disks will be erased.

1. Verify that you have two (2) formatted 1.44 MB 3 1/2 inch floppy disks.

2. Label the disks 1 and 2.

3. Insert the first floppy disk in the PC.

4. Insert the *DOMINO*® Connects CD-ROM into your CD-ROM drive.

   The *DOMINO*® Connects setup program will be launched automatically.

   If the setup does not start automatically, do one of the following:

   • Open My Computer, double-click the CD-ROM drive icon, then double-click the Setup icon in the opened CD-ROM window. Or,

   • Click **Start**, then click **Run**. In the **Open** box type D:\setup.exe where D is the drive letter of the computer's CD-ROM drive. Then click **OK**.

   The *DOMINO*® Connects setup program will start.

5. In the *DOMINO*® Connects Setup Welcome screen, click **Create 3 1/2-inch installation disks**.

6. Follow the instructions given by the Disk Wizard.

7. After the disks are created, click **Cancel** to exit the *DOMINO*® Connects Setup program.

To install *DOMINO*® Connects from the floppy disks:

1. On the PC where you want to install *DOMINO*® Connects, insert the first floppy disk.

2. Do one of the following:

   - Open My Computer, double-click the floppy drive icon, then double-click the **Setup** icon in the opened floppy drive window. Or,

   - Click **Start**, then click **Run**. In the **Open** box type a:\setup.exe, then click **OK**.

   The *DOMINO*® Connects setup program will start.

3. Follow the on-screen prompts to complete the installation.

Installing The USB-Serial Adapter

If you are going to connect the Indicator to the USB port on your computer you must use the optional USB-Serial Adapter, Doble Part Number 401-0302. This adapter requires the installation of a Windows device driver.

NOTE	Security settings may prevent regular users from installing new software. In case of problems, contact your local system administrator.

To connect the USB-Serial Adapter:

1. Place the USB-Serial Adapter driver CD in the computer's CD-ROM drive.

   The USB-Serial Adapter setup program will be launched automatically.

   If the setup does not start automatically, do one of the following:

   - Open My Computer, double-click the CD-ROM drive icon, then double-click the autorun icon in the opened CD-ROM window. Or,

   - Click **Start**, then click **Run**. In the **Open** box type D:\autorun.exe where D is the drive letter of the computer's CD-ROM drive. Then click **OK**.

   The USB-Serial Adapter setup program will start.

2. In the warning screen, select the language.

3. In the product listing screen, select USB 1.1 to RS232 Cable.

4. In the important notice screen, click the Setup.exe icon.

5. In the File Download dialog click **Open**.

6. In the InstallShield program follow the prompts to install the driver.

7. Click **Exit** to close the installation program.

8. Plug the USB end of the USB-Serial cable into the computer's USB port.

NOTE	In the Add/Remove Programs list the driver will appear as **PL-2303 USB-to-Serial**.

Using *DOMINO®* Connects

CAUTION	The real-time window requires continuous access to the Indicator. If the computer enters the standby (suspend) mode, the real-time window may stop and/or an error message may be shown.
	To avoid problems, check that you have disabled automatic system standby (suspend) in the power-saving settings of your computer before starting a real-time window.

NOTE	Because the *DOMINO®* Connects cable connects to one of the probe ports, you can only use one probe when using *DOMINO®* Connects.

To connect the Indicator:

NOTE	If you are going to connect the Indicator to the USB port on your computer first install the optional USB-Serial Adapter, Doble Part Number 401-0302. For more information see the topic Installing The USB-Serial Adapter on page 162.

1. Plug the 9 pin sub-D end of the connector cable into the serial port of the computer (or of the USB-Serial adapter if used.)

2. Plug the circular connector end of the connector cable into either Port I or Port II of the Indicator.

To start *DOMINO*® Connects:

1. Turn on the connected Indicator.

2. Do one of the following:

   - Double-click the *DOMINO*® Connects desktop icon, or

   - Click the **Start** button, then point to **Programs**, *DOMINO* **Connects**, then click *DOMINO* **Connects** .

TIP	When you access the Indicator from the PC, on the Indicator display the icon will display next to the battery indicator.

To get help with *DOMINO*® Connects:

- Press **F1**, or,

- On the **Help** menu, click **Contents and Index**, or,

- Click the **Start** button, then point to **Programs**, *DOMINO* **Connects**, then click *DOMINO* **Connects Help**.

To close *DOMINO*® Connects:

- On the **File** menu, click **Exit**, or

- Press **Alt-F4**, or

- Click ☒ **Close**.

Uninstalling *DOMINO*® Connects

NOTE	Security settings may prevent regular users from uninstalling new software. In case of problems, contact your local system administrator.

To uninstall the *DOMINO*® Connects program:

1. Open the **Add/Remove Programs** applet in the Windows Control Panel.

2. Select *DOMINO* **Connects** in the list.

3. Click **Remove**.

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SECTION 6
SPECIFICATIONS

This section contains specifications for the Ultimate Sampling System and its individual component, and a listing of the available spare and replacement parts.

Chapters in this section...

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CHAPTER 27
TECHNICAL SPECIFICATIONS

This chapter contains specifications for the entire
DOMINO® Ultimate Sampling System and the individual components.

Topics in this chapter...

DOMINO® USS System Specifications

Indicator Specifications

Moisture-In-Oil Probe Specifications

Dewpoint Probe Specifications

DOMINO® USS System Specifications

The following specifications apply to both:

- the *DOMINO*® USS Indicator and Moisture-In-Oil Probe

- the *DOMINO*® USS Indicator and Dewpoint Probe

General

Storage humidity range .... 0...100 % Non Condensing
Storage temperature .... -40 ... +70 ˚C (-40 ... +158 ˚F)
Housing material .... ABS/PC blend

Electromagnetic compatibility

Complies with IEC/EN 61326-1 Electrical equipment for measurement, control and laboratory use - EMC requirements - Basic immunity test requirements.

Indicator Specifications

The following specifications apply to the *DOMINO*® USS Indicator.

General

Operating temperature range	-10...+ 40 °C (+14 ... +104 ˚F)
Operating humidity	0...100 %RH , non-condensing
Menu languages	English, Finnish, French, German, Spanish, Swedish
Display	LCD with backlight Graphic trend display of any quantity Character height up to 16mm
Probe inputs	1 or 2
Power supply	Rechargeable NIMH battery pack, or 100-240 V, 47-63 Hz AC, or 4 x AA size alkalines, type IEC LR6
Analog output	0...1 VDC
Output resolution	0.6 mV
Accuracy	0.2 % full scale
Temperature dependence	0.002 %/°C full scale
Minimum load resistor	10 kohm to ground
Data interface	RS232C (EIA-232)
Data logging capacity	900...2700 real time data points,
Logging interval	1 s to 12 h
Logging duration	1 min ... memory full
Alarm	Audible alarm function
Housing classification	IP54
Weight	400 g
Housing material	ABS/PC-blend

Battery pack

Operation times in continuous use .... 48 h typical at +20 °C (68 ° F)

data logging use .... up to 30 days

Power consumption during charge .... 10W max

Charging time... 4 hours typical
6 hours first charging time

Indicator AC/DC Adapter

Power In.. 100-240 Vac, 47-63 Hz, 400 mA

Power Out .... 15 Vdc, 1A

Power In connector .... selectable

Power Out connector.................................... Coaxial, center +, outer -

Dimensional

Dimensions in mm (inches)

Moisture-In-Oil Probe Specifications

The following specifications apply to the *DOMINO*® USS Moisture-In-Oil Probe.

General

Humidity sensor..*DOMINO*® Moisture-In-Oil Sensor

Temperature sensor.......................................Pt100 IEC751 1/3 class B

Operating temperature range for electronics .-40...+60 °C, -40...+140 °F

Operation pressure range ....0...20 bar (0 to 290 psi)

Standard sensor protection............................Stainless steel grid

Housing classification....................................IP65 (NEMA 4)

Housing material...ABS/ PC blend

Probe material...Stainless steel (AIS316L)

Probe cable length ....1.9 m

Extension cable...10 m

Probe head diameter ....12 mm (0.47 inch)

Weight (incl. cap and press tool)...................520 g

Measured variables - Relative Saturation

Measurement range ....0...100% (@-40...+60 °C/ -40...+140 °F)

Accuracy (including nonlinearity and repeatability)

When calibrated against salt solutions (ASTM E104-85):

    between 0...90%.......................................±2.0%

    between 90...100%...................................±3.0%

When calibrated against high-quality, certified humidity standards:

    between 0...90%.......................................±1.0%

    between 90...100%...................................±2.0%

Response time (90%) at +20 °C (filter on) ...10 min at oil flow of 0.6L/minute

Humidity sensor..*DOMINO*® Moisture-In-Oil Sensor

Measured variables - Temperature

Measurement range .... -40...+100°C (-40...+212°F)

Typical accuracy at +20 °C (+68 °F) .... ±0.1 °C (±0.18°F)

Typical temp dependence of electronics .... ± 0.005°C/°C (±0.003°F/°F)

Temperature sensor .... Pt 100 RTD 1/3 Class B IEC 751

Dimensional

Dimensions in mm (inches)
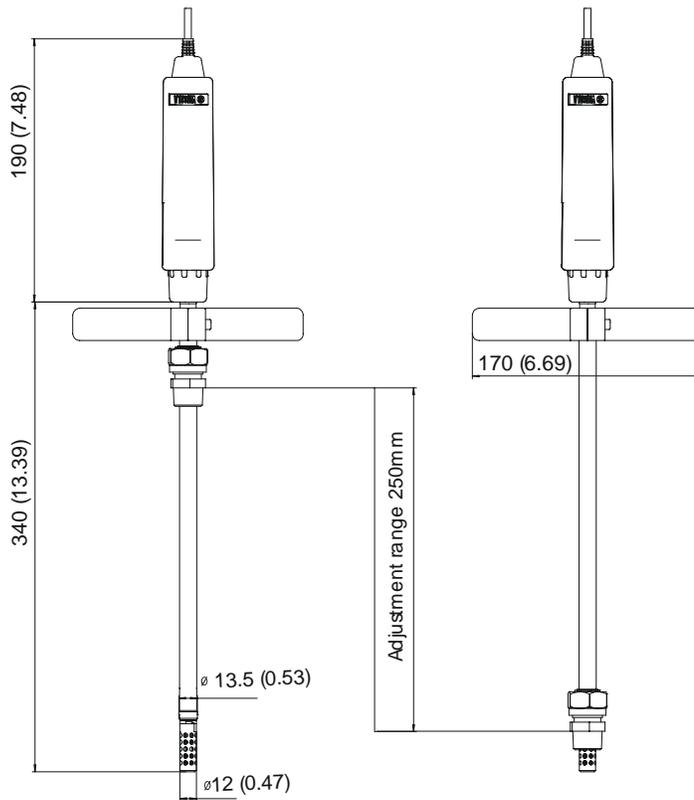
Dewpoint Probe Specifications

The following specifications apply to the *DOMINO*® USS Dewpoint Probe.

Probe General

Sensor ....*DOMINO*® Dewpoint Sensor
capacitive type

Probe material (wetted parts).........................Stainless steel (AISI 316L)

Sensor protection ....Sintered filter, (AISI 316L)

Mechanical connection ....G1/2" ISO2281 thread
with bonded seal ring (U-seal)

Housing classification....................................IP65 (NEMA4)

Storage temperature.......................................-40 ... +70 ˚C

Storage humidity..0 ... 100 % RH non-condensing

Weight ....350 g

Measured Variables - Dewpoint Temperature

Measurement range...-60 ˚C (-76 ˚F) up to +20 ˚C (+68 ˚F)

Accuracy (see graph below) ....±2 ˚C (±3.6 ˚F)
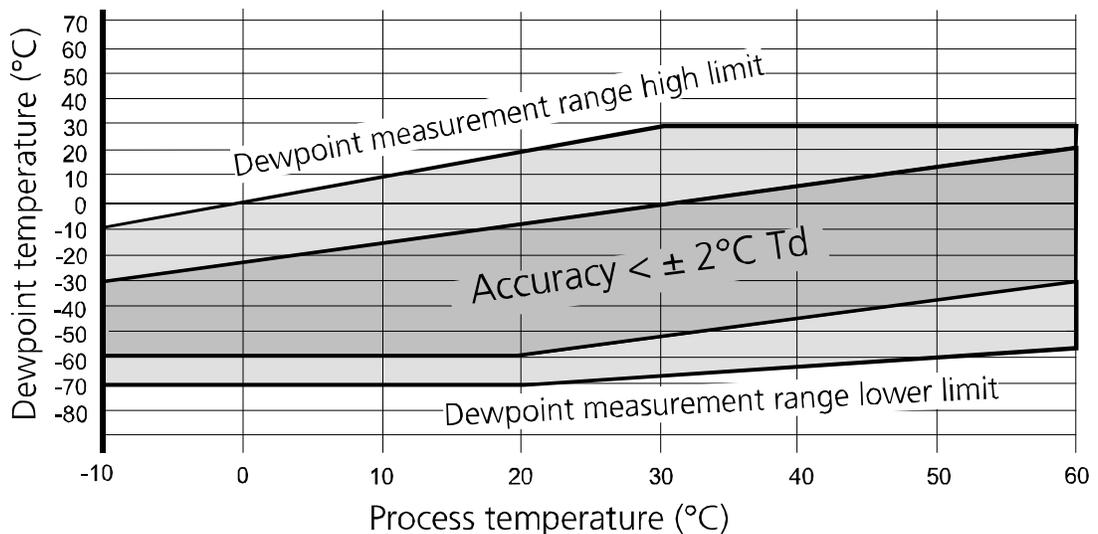
Dewpoint range for ±2 ˚C. Accuracy for pressure converted dewpoint
(dewpoint measured in pressure, calculated to 1 atm dewpoint value)
.... -80 ... +20 ˚C (-112 ... 68 ˚F)

Response time: 63 % (90 %) at flow rate 0.2 m/s, 1 bar absolute pressure, +20 ˚C

$0 \rightarrow$ -60 ˚C T_d (32 $\rightarrow$76 ˚F T_d)	50 s (340 s)
-60 $\rightarrow$0 ˚C T_d (-76 $\rightarrow$32 ˚F T_d)	10 s (20 s)

Measured Variables - Temperature

Measurement range .... -10 ˚C (14 ˚F) to 60 ˚C (140 ˚F)

Accuracy at +20 ˚C .... ±0.2 ˚C

Typical temperature dependence
of electronics .... ±0.005 ˚C/˚C

Temperature sensor .... Pt100 IEC751 1/3 class B

Measured Variables - PPM (ppm$_v$ or ppm$_w$)

Measurement range (typical) .... 10 ... 20000 ppm

Accuracy at +20 ˚C (+68 ˚F)

< 40 ppm	± (0.5 ppm + 25.4 % of reading)
> 40 ppm	± (7.3 ppm + 8.3 % of reading)

Measurement Environment

Temperature .... -10 ... +60 ˚C (+14 ... +140 ˚F)

Pressure .... 0 ... 20 bar$_a$ (0 ... 290 psi$_a$)

Sample flow rate .... No effect on the dewpoint accuracy

Sampling Cell

Inlet/outlet thread...ISO G 3/8"/G 1/4"

Quick connector included..............................Type D/NIP08/1/2 inch industrial

Thread adapters included...............................ISO G 3/8" to G 1/4" (female) and
ISO G 3/8" to G 1/2" (male)

Leak screw...Screwdriver operated

Pressure limit ....1 MPa, 10 bar$_g$, 145 psi$_g$

Material..Stainless steel AISI316

Weight ....300 g

Dimensional

Dimensions in mm (inches)
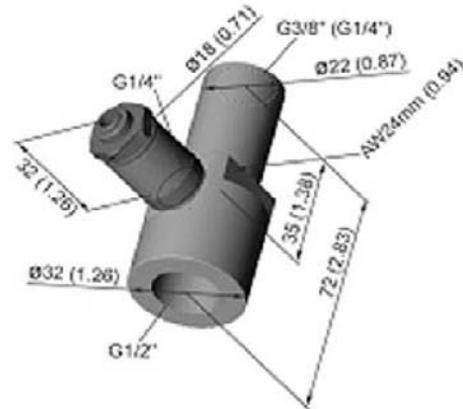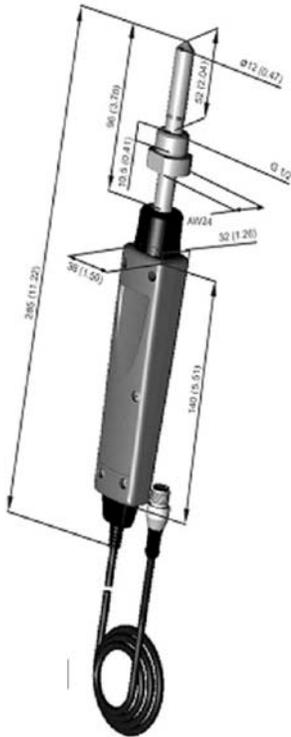
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CHAPTER 28

OPTIONS, ACCESSORIES, AND SPARES

This chapter contains information on options, accessories, and spares that are available for the *DOMINO*® USS Systems.

MOI Probe accessories

Description	Doble Part No.
Stainless steel filter	230-0209
Soft yellow plastic protective cap	230-0216
Hard white plastic threaded protective cap	230-0217
Manual press tool	230-0211
Plastic clasp nut wrench	230-0218
Calibration adapter	09A-0831-01
DOMINO® USS Manifold	03B-1653-01
1/2" NPT Female - 1" NPT Male Hex Bushing	230-0171
1" NPT Female - 2" NPT Male Hex Bushing	230-0170
Quick Disconnect Fitting Male Socket	09B-0824-01
Quick Disconnect Fitting Plug	09B-0825-01
Fitting body (M22 - 1/2 NPT)	230-0226
Fitting body (M22 - R1/2 ISO 7/1)	230-0181
ISO 7/1 Female - 1/2 NPT Male Adapter	230-0220
Blanking plug and nut	230-0221
Ball valve, stainless steel, 1/2 inch FNPT - 1/2 inch FNPT	230-0172
Nipple, stainless steel, 1/2 MNPT-1/2-14 BSP/ISO	09B-0761-01

DP Probe accessories

Description	Doble Part No.
Soft yellow plastic protective cap	230-0216
Sampling cell	230-0208
Sintered filter	230-0222
Bonded seal ring	230-0223
DP Quick Disconnect Fitting Male Socket	230-0224
DP Quick Disconnect Fitting Female Socket	230-0225

Indicator AC-Adapters

Description	Doble Part No.
Universal input AC/DC adapter with Australian, European, United Kingdom, and American plug inserts.	220-1381
Universal input AC/DC adapter with Australian plug insert.	220-1416
Universal input AC/DC adapter with European plug insert.	220-1417
Universal input AC/DC adapter with United Kingdom plug insert.	220-1418
Universal input AC/DC adapter with American plug insert.	220-1419
Rechargeable battery	903-0083

Cables

Description	Doble Part No.
Probe Extension Cable. Length 10 meters (32 ft 9 inches)	181-0658
Analog Output Signal Cable. Length 1 meter (3 ft 3 inches)	181-0659

Documentation

Description	Doble Part No.
DOMINO USS User Guide (English)	500-0591
DOMINO USS User Guide (Spanish)	500-0701
DOMINO USS Moisture-In-Oil Quick Start Guide	500-0592

Software

Description	Doble Part No.
DOMINO Connects software interface kit. Includes software CD and 1 meter (3 ft 3 inches) Indicator To PC cable.	401-0288
USB-Serial Adapter	401-0302

Others

Description	Doble Part No.
Small Doble Screwdriver	09B-0696-01

System Components

Description	Doble Part No.
USS Indicator. Includes rechargeable battery (903-0083) and Universal input AC/DC adapter with Australian, European, United Kingdom, and American plug inserts (220-1381)	401-0287
USS Moisture-In-Oil Probe. Includes quick disconnect male plug and set of probe accessories including manual press tool, hex wrench, protective cap, and plastic wrench	03D-1678-01
USS Dewpoint Probe. Includes assembled sampling cell and set of adapters.	03D-1681-01

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