	Instruction Manual **NRF Capacitance Level Probe**	**Document No. :** NRF-100_KM Rev. : 1.0	**Issue Date :** 16/04/2002
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DESCRIPTION

Fig 1.

Kobold two-wire **NRF** level transmitters are designed to measure either liquid or certain dry bulk media. The 12-36 VDC 4 mA base current is the supply to the unit. The NRF monitors level change by converting movement of media UP or DOWN the probe into pulse wave form which is proportional to changes in level. The amplifier converts this pulse wave into 4 to 20 mA output signal. The conversion of level movement to an electrical signal is due to changes in electrical capacitance. The probe and a ground reference electrode, usually the metal tank wall, have a certain capacitance in air. As the medium displaces the air, a change occurs because of the difference in the dielectric constants of the medium and air.

The **NRF** comes complete with the transmitter mounted in an enclosure, fitting and probe (Fig. 1). Micro-processor based electronics are protected and potted within a metal housing. Calibration is made via four push buttons (Fig. 3) as explained later. Variety of options including **Stainless** or **PVC** housings, rigid or flexible probes (bare or jacketed), **NPT**, sanitary or flange connections are available.

INSTALLATION

UNPACKING

Unpack the instrument carefully. Inspect all components for damage. Report any damage to **Kobold** within 24 hours. Check the contents of the packing slip and report any discrepencies to **Kobold**.

INSTALLATION LOCATION

The **Kobold NRF** level sensor should be located for easy access for service, calibration and monitoring. Sensors should not be exposed to ambient temperatures below -40°C (-40°F) or above +70°C (+160°F). Special precaution should be made to prevent exposure to corrosive atmosphere, excessive vibration, shock or physical damage. It is preferable that the **NRF** is not installed in proximity to high voltage wires or other sources of high electrical noise.

METAL WALLED TANKS

It is a common practice to use the metal tank wall as the reference electrode. In such cases, it is required that the probe housing makes a good electrical connection to the tank wall. If there is any doubt about this connection due to the use of PTFE thread tape, gaskets, paint, rust, or any other reason, a separate grounding wire should be installed between the probe and the tank housing. In case the probe housing is non-metalic, or if the connection fitting is non-metalic, a grounding wire must be connected from the tank to the G terminal on the transmitter.

CAUTION: This unit contains CMOS electronics which may be damaged by static electricity. Electronics may be accessed by removing the top cover of the enclosure (head). Do not remove the transmitter face plate (and touch the electronics). There are no servicable parts.

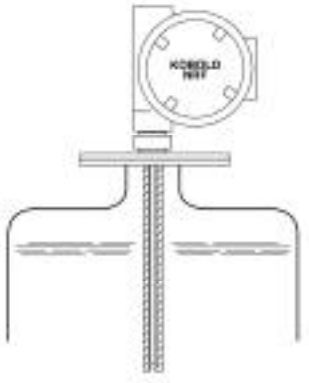

Fig 2.

NON-CONDUCTIVE TANKS / SILOS

With plastic, concrete, wood, or any other non-conductive walled vessels a reference electrode must be inserted into a tank. Most commonly, this electrode will be in the form of a concentric, ground tube (i.e. stilling well, Fig. 2) or a metal rod installed in parallel with the probe. In all cases, a good electircal connection must be made between the ground reference electrode and the G terminal of the transmitter (or probe housing).

CAUTION: When installing units with PTFE (or plastic) coated rods or cables, be careful not to damage the insulation. **NPT** threads have very sharp corners and PTFE (or plastic) can be easily cut. In acidic and/or conductive liquids damaged units may malfunction and the metal rods can corrode

WIRING

All wiring between the power supply and the transmitter should be done with 18 AWG to 22 AWG shielded twisted pair. The connection is made at the terminal strip within the transmitter enclosure.

CAUTION: Units are designed to operate on the 12 to 36 VDC power only. Application of 110 VAC will destroy the instrument.

1. Make sure the power source is turned off.
2. Pull power supply wires through conduit connection.
3. Connect the positive supply wire to the (+) terminal, and the negative supply to the (-) terminal.
   Note: Leave shield unattached at transmitter. Connect the shield to ground at the power source.
4. Replace the transmitter enclosure (head) cover until time to calibrate.
5. Connect positive supply wire to the positive terminal of the transmitter. See Fig. 3.
6. Connect the loop current meter in series with the negative supply wire as follows:
   a. Negative transmitter wire to positive meter terminal. See Fig. 3.
   b. Negative meter terminal to negative power source termianl. See Fig.3.
7. Turn **ON** the power. The meter may read anywhere on the scale at either end. This is normal until calibra tion has been completed. Proceed to the calibration Instructions.

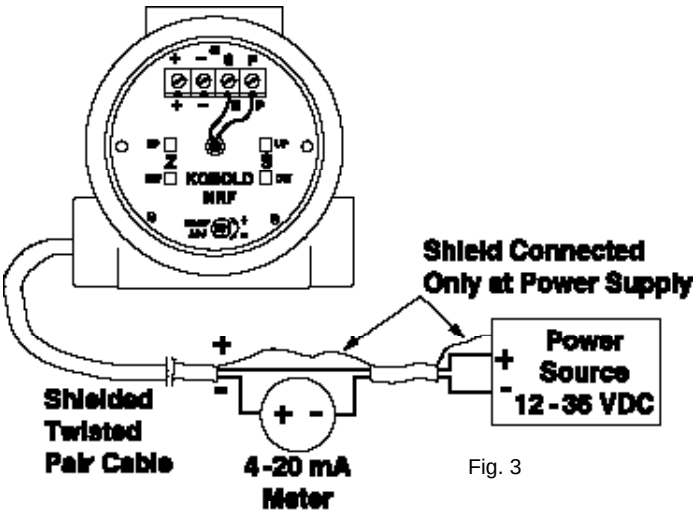

Fig. 3

CALIBRATION

CURRENT METER

In order to calibrate the transmitter, you must use the loop current meter. It should read currents in the range of 1.00 to 25.00 mA, with a resolution of .01 mA. Using a meter of less resolution will somewhat reduce the calibration accuracy. To calibrate the instrument :

1. Remove enclosure (head) cover.
2. Connect the loop current meter as per instructions in WIRING section(Fig. 3).
3. The loop current should now be in the range of 1.5 mA to 38 mA, which is normal at this point.

TWO POINT CALIBRATION – LEVEL INCREASE

Three calibration procedures are described. Follow the one which fits your application. Note the following definitions used in the calibration procedures, referring to Fig 4.

L = the level of material which corresponds to 4.00 mA of loop current, i.e., the 0%

L1 = a material level higher than L

H1 = a material level higher than L1, but less than H.

H = the level of material in the vessel which corresponds to 20.00 mA of loop current, i.e., the 100% level.

Note: To avoid the possibility of a “dead zone”, L must be at least two (2) inches above the end of the probe for (4) conductive media and four inches above for non-conductive media.

CALIBRATION L- H = when material in tank can be set to L (0%) and H (100%).

CALIBRATION L - H1 = when material in tank can be set to L (0%) and H1 (less than 100%).

CALIBRATION L1 - H1 = when material in tank can be set to L1 (greater than 0%) and H1 (less than 100%).

NOTE: Calibration procedure **L-H** gives the most accurate results and is the recommended procedure in all cases.

OFFSET AND RESET FUNCTIONS

OFFSET and **RESET** functions (or values) are factory set. They may have to be changed by the customer in special cases only. Follow the procedures below.

There may seem to be a malfunction with the transmitter when the 4-20mA power loop is activated for the first time. The mA reading may be below 4mA or above 20mA and pressing the **Z** and **S** push buttons does not change the output.

Note : Push button may have to be depressed for up to a minute before the value changes.

An **OFFSET** function may have to be performed. To **re-OFFSET** the transmitter, lower the level in the tank to below the probe. Press **Z UP** and **S UP** push buttons at the same time,then release in 1 or 2 seconds. The transmitter will now show a default value close to 4mA.

In very rare cases, a problem of calibration still may persist. This is because the values of the minimum and maximum are not properly distributed. The **RESET** function may have to be perfomed To **RESET** the transmitter, simply press **Z DW** and **S DW** push buttons at the same time,then release the two push buttons after 1 or 2 seconds. Then **re-OFFSET** the transmitter as per instructions above. The transmitter will now show a default value close to 4mA.

Note: When you **RESET** the transmitter, always perform the **OFFSET** after the **RESET**.

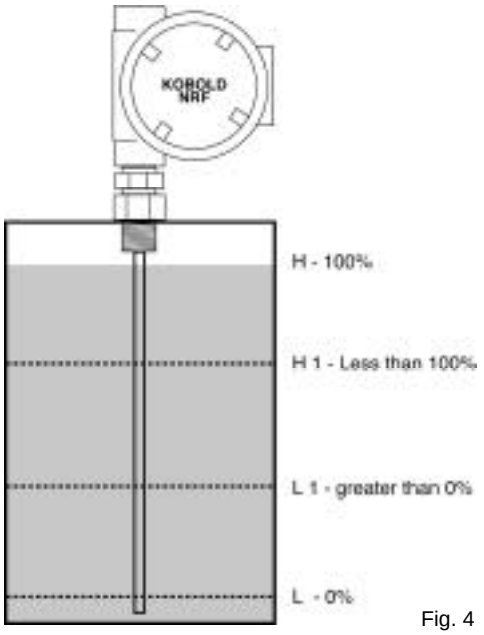

Fig. 4

DAMPING ADJUST

This feature, primarily designed for agitated tanks and factory set at 0 sec. (max. **CW**, neg. direction) via a single turn pot, sets a time delay on the output signal. The time delay range is 0-10 sec. approx. For non-agitated tanks a zero setting is fine. Increase the setting for agitated tanks by turning the pot **CCW**. This stabilizes the mA reading, but adds time delay. When performing calibration, always set pot to maximum **CW** direction (minimum time delay).

CALIBRATION PROCEDURE L– H

THE ZERO, TANK IN L (LOW) STATE, MUST ALWAYS BE CALIBRATED FIRST.

Turn the DAMP ADJ pot to max CW (neg.) direction.

1. Fill the tank to its **L** (0%) level (with probe covered).
2. Depress **UP** or **DW** buttons on **Z** until meter reads 4.00mA. Do not change the zero controls from now on. If changed, the material will have to be returned to the **L** (0%) level.

Note: If a 4.00mA value cannot be reached, then perform **OFFSET AND RESET** functions

3. Fill the tank to the desired **H** (100%) level.

Note: The loop current may not rise in proportion to the rising material level in tank. Instead it may ris more rapidly or more slowly than the material level. The span, **S**, **UP** or **DW** buttons may be used occasionally to maintain the loop current approximatelly proportional to the tank filling or just below the 20.00 mA reading.

4. After the tank has been filled to **H** (100%), depress **SPAN UP** or **DW** buttons as required to obtain a meter reading of 20.00 mA. If 20.00 mA reading has been obtained, the calibration is complete.

Note: If a 20.00mA value cannot be reached, then peform **OFFSET AND RESET** functions and re-start the calibration

CALIBRATION PROCEDURE L-H1

THE ZERO, TANK IN L (LOW) STATE, MUST ALWAYS BE CALIBRATED FIRST.

Turn the DAMP ADJ pot to max CW (neg.) direction.

1. Fill the tank to its **L** (0%) level (with probe covered).
2. Depress **UP** or **DW** buttons on **Z** until meter reads 4.00mA. Do not change the zero controls from now on. If changed, the material will have to be returned to the **L** (0%) level.

Note : If a 4.00mA value cannot be reached, then perform **OFFSET AND RESET** functions

3. Fill the tank to the highest point possible (under 100%), and record this level as **H1**. The most accurate calibration will be obtained with the greatest separation between **L** and **H1**.

Note : The loop current may not rise in proportion to therising material level in tank. Instead it may rise more rapidly or more slowly than the material level. The **SPAN**, **S- UP** or **S-DW** buttons may be used occasionally to maintain the loop current approximatelly proportional to the tank filling or just below the 20.00mA reading.

4. To determine the loop current at **H1** level use the following formula:

$$mA = \frac{(H1 - L)}{(H - L)} \times 16 + 4$$

Example: L = 12” (30.5 cm) from the bottom of the tank
H1 = 72” (183 cm) from the bottom of the tank
H = 96” (244 cm) from the bottom of the tank

$$mA = \frac{(72 - 12)}{(96 - 12)} \times 16 + 4 = 15.43$$

The correct loop current is **15.43mA**.

Depress **SPAN S-UP** or **S-DW** buttons as required to obtain a meter reading of **15.43mA**. If **15.43mA** reading has been obtained, the calibration is complete.

Note : If a **15.43mA** value cannot be reached, then perform **OFFSET AND RESET** functions and re-start the calibration

CALIBRATION PROCEDURE L1-H1

THE ZERO, TANK IN L1 (LOW) STATE, MUST ALWAYS BE CALIBRATED FIRST.

Turn the DAMP ADJ pot to max CW (neg.) direction.

1. Fill the tank to its **L1**, some point above 0% level and record this level as **L1**. See Fig. 4. To determine the loop current at **L1** level use the following formula:

$$mA = \frac{(L1 - L)}{(H - L)} \times 16 + 4$$

Example: L = 12” (30.5 cm) from the bottom of the tank
L1 = 24” (61 cm) from the bottom of the tank
H = 96” (244 cm) from the bottom of the tank

$$mA = \frac{(24 - 12)}{(96 - 12)} \times 16 + 4 = 6.28$$

The correct loop current is **6.28mA**.

2. Depress **Z-UP** or **Z-DW** buttons on **ZERO** until meter reads **6.28mA**. Do not change the **ZERO** controls from now on. If changed, the material will have to bereturned to the **L** (0%) level.

Note: If a **6.28mA** value cannot be reached, then perform **OFFSET AND RESET** functions

3. Fill the tank to the highest point possible (under 100%), and record this level as **H1**. The most accurate calibration will be obtained with the greatest separation between **L** and **H1**.

Note: The loop current may not rise in proportion to the rising material level in tank. Instead it may rise more rapidly or more slowly than the material level. The **SPAN**, **S-UP** or **S-DW** buttons may be used occasionally to maintain the loop current approximatelly proportional to the tank filling or just below the 20.00mA reading

4. To determine the loop current at **H1** level use the following formula :

$$mA = \frac{(H1 - L)}{(H - L)} \times 16 + 4$$

Example: L = 12” (30 cm) from the bottom of the tank
H1 = 72” (183 cm) from the bottom of the tank
H = 96” (244 cm) from the bottom of the tank

$$mA = \frac{(72 - 12)}{(96 - 12)} \times 16 + 4 = 15.43$$

The correct loop current is is **15.43mA**.

Depress **SPAN S-UP** or **S-DW** buttons as required to obtain a meter reading of **15.43mA**. If **15.43mA** reading has been obtained, the calibration is complete.

Note: If a **15.43mA** value cannot be reached, then peform **OFFSET AND RESET** functions and re-start the calibration

Electrical Specifications :

Power :	12 VDC - 36 VDC
Output :	4 - 20 mA , 2-wire
Maximum Loop Resistance :	350Ω at 12VDC, 950Ω at 24VDC
Calibration :	Via 4 push-button switches
Capacitance range :	10 pF to 10000 pF
Resolution :	±0.1%
Linearity Due to Temperature :	Negligible (less than 100 ppm)
Minimum Span :	10 pF
Accuracy and Repeatability :	±1% of span or less
Output Damping :	One turn pot, 0 - 10 sec. delay
Sensing System :	Capacitance
Maximum Probe Frequency :	1.2 Mhz
Maximum Power at :	8 mW
Operating Temperature:	Electronics -40° to 70°C
Hazardous Areas:	Consult Factory

Mechanical Specifications :

Enclosures

Standard : NEMA 4 (Polyamide)

Optional: St. Steel
Aluminum w/Epoxy Paint

Process Connection : Many styles available, 3/4" NPT standard

Maximum Pressure:

316 SS Fitting : 500 PSI @ 70°F, 250 PSI @ 300°F
100 PSI @ 350°F

PTFE Fitting : 150 PSI @ 70°F, 0 PSI @ 300°F

Tri-Clamp : Per tri-clamp rating

KOBOLD INSTRUMENTS CANADA, INC.
9A de l’Aviation, Pointe-Claire, Qc H9R 4Z2
Telephone : (514) 428-8090 • FAX: (514) 428-8899
Web site : www.kobold.com

KOBOLD INSTRUMENTS, INC.
1801, Parkway View Drive, Pittsburgh, PA 15205
Telephone: (412) 788-2830 • FAX : (412) 788-4890
Web site : www.koboldusa.com