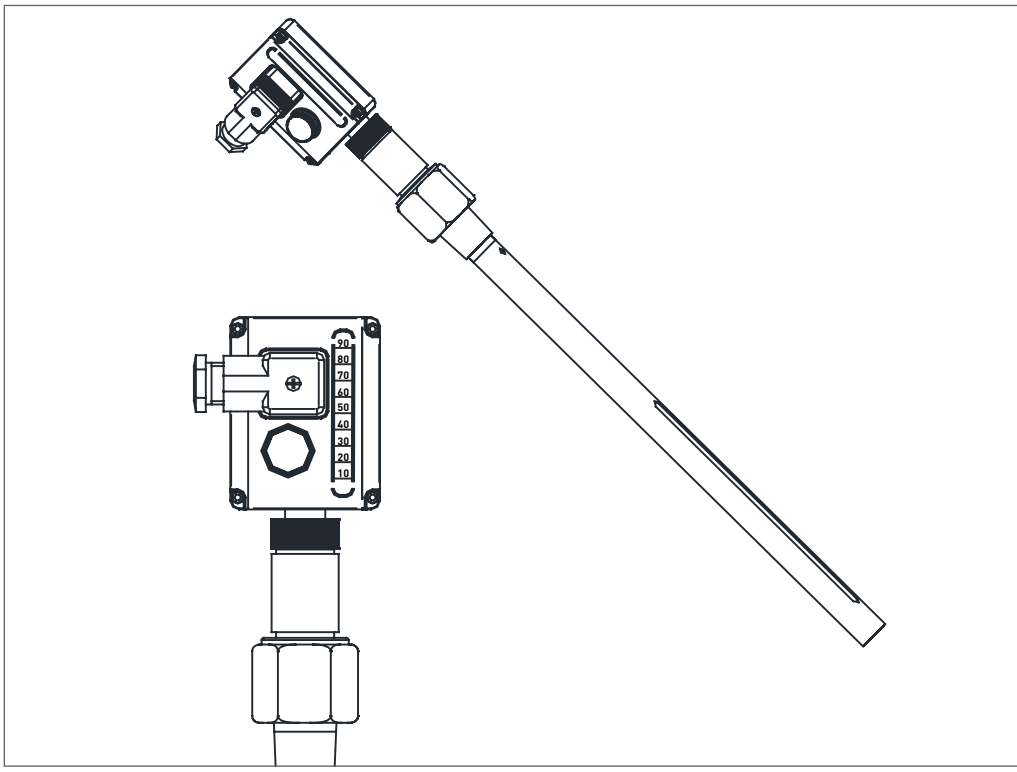
# Liquid Level Transmitter

Product Bulletin 61-60

Type: HBLT-A1/HBLT-A1-BSP

## Purpose:

HBLT capacitive liquid level transmitters are used to measure liquid levels in refrigerant vessels, receivers, accumulators, or other similar pressure vessels. Available in various lengths and factory calibrated for ammonia (R717).




## Contact Information:

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Exclusive distributors for the Americas

## Product Features:

- Suitable for ammonia, $CO_2$ and halocarbon refrigerants
- "Plug and Play" no calibration required when installed on ammonia systems
- "Service Friendly" electronic head and probe can be separated without emptying the vessel
- "Improved Calibration" range/signal output can be adapted to suit the actual application
- Optional LED bargraph for indication of liquid level
- Damping of output signal available

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## Technical Data

Liquid Temperature ..... -60°C to 80°C (-76°F to 176°F)

Ambient Temperature ..... -25°C to 55°C (-13°F to 131°F)

Maximum Rated Pressure ..... 100 bar (1450 psig)

Supply Voltage and Load ..... 24V AC/DC±10% (50/60 Hz) 1.5 W

Electrical Connection ..... 4-pole DIN connector

Maximum Load Resistance ..... 500 ohm

Signal Output ..... 4 - 20 mA

Enclosure ..... IP65

Connection

HBLT-A1 ..... ¾" NPT

HBLT-A1-BSP ..... 1" BSP

Approvals /Certificates..... EMC Emission EN61000-3-2
EMC Emission EN61000-4-2
GOST-R No. 0903044

**Note:**
Probes less than 305mm (12") are not compatible with halocarbons or $CO_2$. For halocarbons and $CO_2$ requiring probes less than 305mm (12") use the HBLC liquid level control sensors. Reference bulletin 61-90 for more detailed information on the HBLC sensors.

## Function and Design

The electronic insert of the probe converts the measured change in capacitance, 4 to 20 mA, of the liquid to a signal in proportion to the level making it possible to control and/or regulate the liquid level when used in conjunction with a controller.

Capacitive level measurement is based on the change in capacitance of the capacitor due to the change in the level. A capacitor is formed when a level sensing electrode is installed in a vessel. The metal rod/electrode acts as one plate of the capacitor and the reference tube acts as the other plate.

As level rises, the air or gas normally surrounding the electrode is displaced by material having a different dielectric constant. A change in the value of the capacitor takes place because the dielectric between the electrodes has changed.

Capacitance instruments detect this change and convert it into a proportional output signal.

**Electronics**
The sensor transmits a current signal from 4 to 20 mA (4 mA when the transmitter does not register liquid - and 20 mA when the entire transmitter is surrounded by liquid).

The electronic head and sensor tube can be separated by hand without emptying the vessel/standpipe. This allows installation of the sensor tube and later mounting the electronics or easy replacement if needed.

**Sensor tube**
The tube consists of two pipes. An outer reference tube and an inner PTFE insulated rod. As the liquid will flow up between the rod and the reference tube the electrical capacitance throughout the length of rod immersed in the liquid is registered.

## Installation Instructions

The pipe column should be installed as shown in the dimensional layout diagram. The position and orientation of the column must be appropriate to the specific application and installation criteria. The pipe column must always be in a vertical position. In any case, it must be in a serviceable location and out of the way of any possible damage by material handling vehicles such as lift trucks.

It is important to have several sight glasses or liquid level switches well spaced along the height of the pipe column to determine the level of the liquid when setting the HBLT-A1 probe as well as to check its performance during operation of the system. These are an essential part of any well designed pressure vessel system and the use of an electronic liquid level control does not eliminate this need.

The pipe connection at the top of the pipe column, equalizing the vapor spaces, must be well above the highest switch point on the vessel upon which it is to be mounted. The piping for this line should never be trapped, as any liquid in such a trap can cause the pipe column to become vapor bound.

The liquid equalizing line at the bottom of the pipe column must be well below the lowest switch point level on the vessel on which it is to be mounted. This line must be free draining and offer no obstruction to a gravity flow of liquid. It should not be trapped, particularly on an ammonia system, as it would then become an ideal location for oil to accumulate and could cause false levels in the pipe column. It is recommended that a drain connection be installed at the low point on the pipe column so that the pipe column can be drained when service is required. Both the vapor and the liquid equalizer lines should be as short as possible.

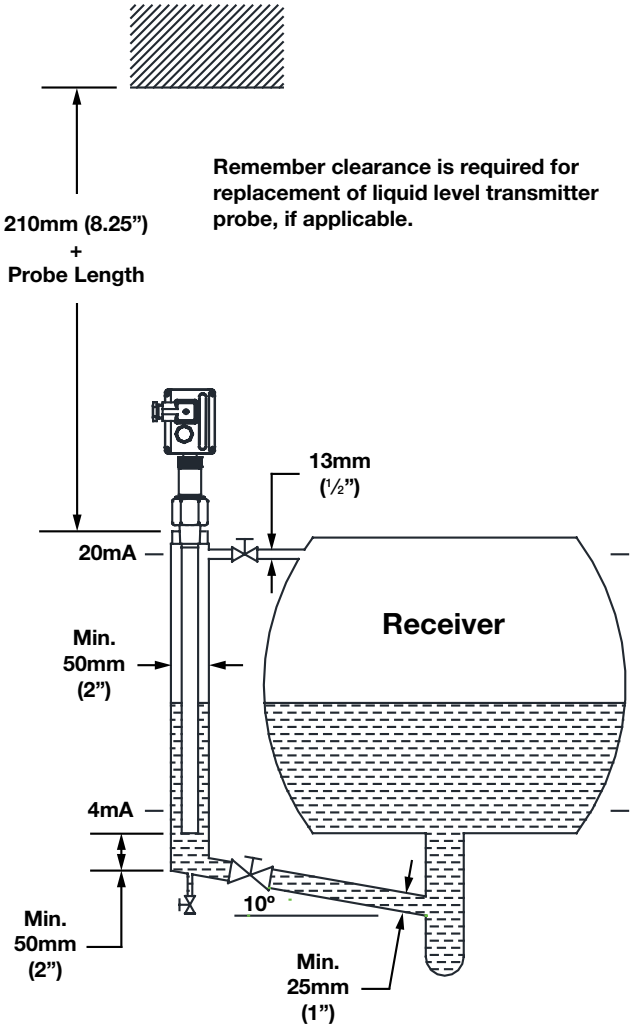
When selecting the appropriate probe length for a vessel, it is important to adequately identify all the level indicators, such as the high and low level switches; the pipe column height and fitting. Subtract the value of the minimum clearance from the probe bottom plus the typical engagement length from the vessel height to determine the maximum insertion length. Actual probe insertion length may be less than maximum length allowed. The probe insertion length must be long enough to measure the lowest receiver level desired.

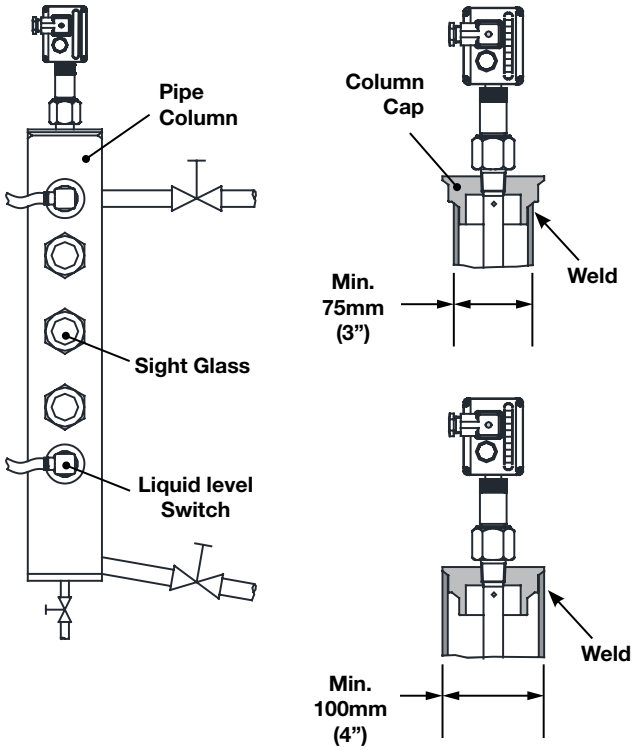
**Note:** the probe is not length adjustable.

Probe location should allow for adequate installation and removal without bending. Avoid locating near liquid inlet to receiver and should not interfere with dip tubes or other internal parts.

Heat will readily cause a volatile liquid, such as a refrigerant, to boil. Thus, it is important to impede the transfer of heat to a cold refrigerant whose level is being measured. A cold liquid refrigerant contained in an un-insulated pipe column that is located in a warm compressor room is a good example of an improper installation. It is important to properly insulate the pipe column and to use 100mm (4") pipe which will reduce the ratio of the pipe surface area to its internal volume. The larger the pipe size, the smaller will be this ratio and the less will be the tendency to boil refrigerant inside the pipe. The preferred pipe size is 100mm (4"), but in many cases (particularly where there is a relatively small temperature difference between the liquid and the ambient space) a 75mm (3") size should result in proper performance.

The HBLT level transmitter probes are also designed to be inserted directly into horizontal or vertical refrigerant vessels.




**Notes:** Column caps are only available in 75mm and 100mm (3" and 4") diameters.

**Installation Diagrams:** Column/Standpipe Installations

## Mounting Instruction

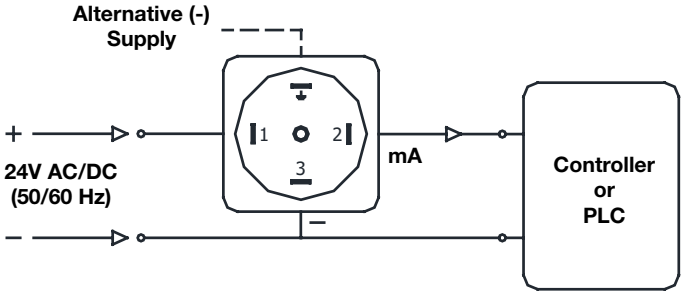
It is required to use Teflon tape/paste on NPT connections or sealing ring on BSP connections.

Add Teflon tape/paste to the threads.

Mount the liquid level transmitter on the vessel and tighten to a torque specificaton of 80 - 150 Nm (59 - 110 ft. lb.)

## Electrical Instruction

HBLT probes are supplied with a 4-pole plug, DIN 43650, connector.




**Wiring Diagram:** DIN Connector

## Setting of Refrigerant

The HBLT probes are factory set for ammonia ($NH_3$), and water ($H_2O$). Settings for all other refrigerants or in case the electronics has been replaced, follow the procedure below.

1. To get in the refrigeration mode setting push the calibration push button and keep it pressed while 24 V/plug is connected and then release the push button.

2. Release the calibration push button. Observe the present refrigerant setting and measure the 4-20 mA output signal.

   1 - flash of Green LED - output signal is ~ 5 mA = R717 or R718 (factory setting)

   2 - flashes of Green LED - output signal is ~ 6 mA = R22

   3 - flashes of Green LED - output signal is ~ 7 mA = R404A

   4 - flashes of Green LED - output signal is ~ 8 mA = R134a

   5 - flashes of Green LED - output signal is ~ 9 mA = R744

3. Activate the calibration push button to select required refrigerant.

   Each activating will cause the HBLT to step to next refrigerant according to below sequence:

   ~ 5 mA = R717 or R718 (factory setting)

   ~ 6 mA = R22

   ~ 7 mA = R404A

   ~ 8 mA = R134a

   ~ 9 mA = R744

4. When the current corresponds to the required refrigerant, wait 10 seconds until the green LED is constant ON (not flashing). This indicates that the required refrigerant has been selected.

5. To leave the setting mode isolate the voltage supply to the level transmitter (disconnect plug from transmitter)

Go through step 1, 2 and 5 if you wish to control the setting.

**Note:**
This sequence must be observed. If the supply voltage is connected before the calibration push button is activated, the signal damping will be changed

## Signal Damping

Signal damping is factory set to 15 seconds. This setting can be altered by activating the calibration switch. The setting range is 1 to 120 seconds. Settings can be made while the system is operating

Procedure:

1. Connect the supply voltage.

2. Push the calibration push button once for each second by which you want to increase the damping.

Example:

1. push ⇒ 1 sec. 120. pushes ⇒ 120 sec.
2. pushes ⇒ 2 sec. 121. pushes ⇒ 120 sec.

10 seconds after the last push, the value will be saved in the memory and the green LED will start flashing again. After 10 seconds, a further push will start 1-second signal damping again. (If the damping setting is set too high, restart the procedure from step 1).

## Calibration

The HBLT probes are factory calibrated for ammonia ($NH_3$), and water ($H_2O$). Calibration is required for:

- If the default settings do not fit the maximum and minimum calibration points provided by the factory or if the points have to be adjusted.

  **Note:** The chosen factory calibration setting for the maximum point in 20 mA and minimum point is 4 mA. See dimensional diagram for more details.

- A refrigerant not all ready defined.

- If the electrical head is replaced on an existing/installed probe.

Usually the minimum calibration point is chosen to be 4 mA and the maximum calibration point to be 20 mA, but it is also possible to calibrate the transmitter at other calibration points.

This can be useful when calibrating on a plant with no possibility of bringing the level to the limit points.

Default factory setting is:

0% (HBLT free of liquid) output signal: 4 mA

100% (HBLT fully covered by liquid) output signal: 20 mA

The maximum/minimum levels can be set to any value.

| HBLT-A1/HBLT-A1-BSP Calibration Levels Milliamperes Vs. Level | |
|---|---|
| **Milliamperes** | **Percent Full** |
| 4 | 0.0 |
| 6 | 12.5 |
| 8 | 25.0 |
| 10 | 37.5 |
| 12 | 50.0 |
| 14 | 62.5 |
| 16 | 75.0 |
| 18 | 87.0 |
| 20 | 100.0 |

**Adjusting the Minimum and Maximum Calibration Points**

**Minimum calibration:**

1. Bring the liquid level to desired minimum level.
2. Press the calibration push button and keep it activated in approximately 5 seconds, until green LED stops flashing.
3. Activate, within the next 10 seconds, the calibration push button once

Green LED is ON in a few seconds, and then starts flashing.

Output is now 4 mA and the HBLT is in normal operation.

**Maximum calibration:**

1. Bring the refrigerant liquid level to desired maximum level.
2. Press the calibration push button and keep it activated in approximately 5 seconds, until green LED stops flashing.
3. Activate, within the next 10 seconds, the calibration push button two times, with 1 second in between

Green LED is ON in a few seconds, and then starts flashing.

Output is now 20 mA and HBLT is in normal operation.

**Note:**
Maximum calibration is only required if in other refrigerants than ammonia best possible accuracy is required alternative if a non pre-calibrated electronic part is mounted!

**Minimum calibration when minimum level must be different from 4 mA:**

1. Bring the liquid level to desired minimum level.
2. Press the calibration push button and keep it activated in approximately 5 seconds, until green LED stops flashing.
3. Activate, within the next 10 seconds, the calibration push button once and keep it activated. (If calibration push button is not activated within 10 seconds, it will automatically leave calibration mode and return to normal operation)
4. Observe the output mA signal increasing fast starting at 4 mA.
5. Release the calibration push button when the output signal is a approximately 0.5 mA from the desired point. 6. All the next activations will increase the output signal by approximately 0.05 mA
6. Approximately 10 seconds after the latest activation the LED starts flashing
7. Output now corresponds to the value measured at the latest activation.

**Maximum calibration when maximum level must be different from 20 mA:**

1. Bring the liquid level to desired maximum level.
2. Press the calibration push button and keep it activated in approximately 5 seconds, until green LED stops flashing.
3. Activate, within the next 10 seconds, the calibration push button two times, with 1 second in between, and keep it activated. (If calibration push button is not activated within 10 seconds, it will automatically leave calibration mode and return to normal operation)
4. Observe the output mA signal decreasing fast starting at 20 mA.
5. Release the calibration push button when the output signal is approximately 0.5 mA from the desired point.
6. All the next activations will decrease the output signal by approximately 0.05 mA
7. Approximately 10 seconds after the latest activation the LED starts flashing
8. Output now corresponds to the value measured at the latest activation.

## Reset to Factory Settings

The HBLT can always be reset to factory default settings regardless of any revised calibration values.

1. Press the calibration push button and keep it activated in min. 20 seconds, until green LED starts flashing.
2. Release the calibration push button.
3. When LED starts flashing, reset to factory setting is completed.

All probes reset to the factory setting are pre-calibrated to ammonia with a sensor tube length of 1500 mm/59” and a signal damping of 15 seconds. See the calibrating on site section of this document for further instructions.

## LED Indication

When voltage is applied the LED will flash rapidly as many times as it has been calibrated through its lifetime. The current mA output is activated as soon as the flashing sequence has changed from rapid to slowly flashing.

**Normal operation:**
At normal operation the Green LED will be flashing slowly.

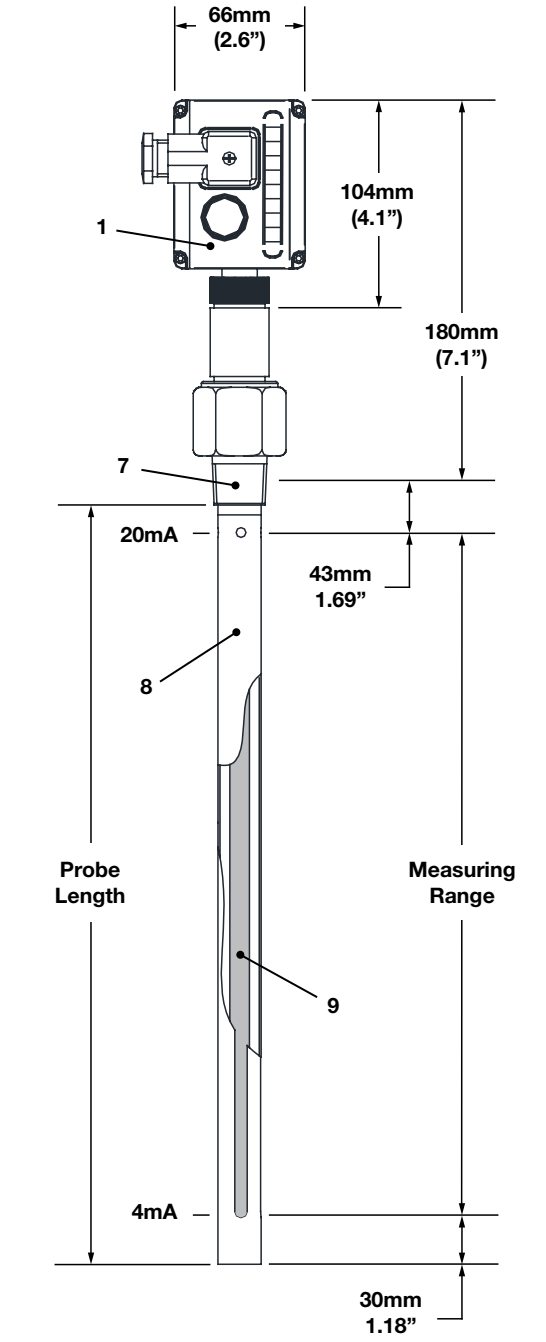
Generally the Green LED is ON every time calibration push button is activated.

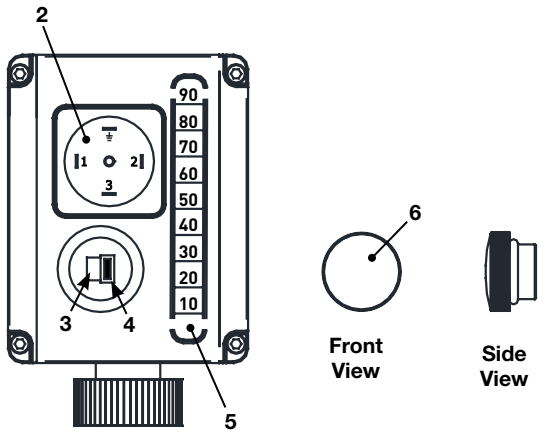
**Calibration mode:**
In calibration mode (Press the calibration push button and keep it activated in approximately 5 seconds) the Green LED is OFF.

**Change of refrigerant:**
In refrigeration mode setting (Push the calibration push button and keep it pressed while 24 V is connected and then release the push button) the green LED is OFF until the push button is released.

After this the green LED will flash according to the type of refrigerant.

When the refrigerant has been selected, the green LED is constantly ON.



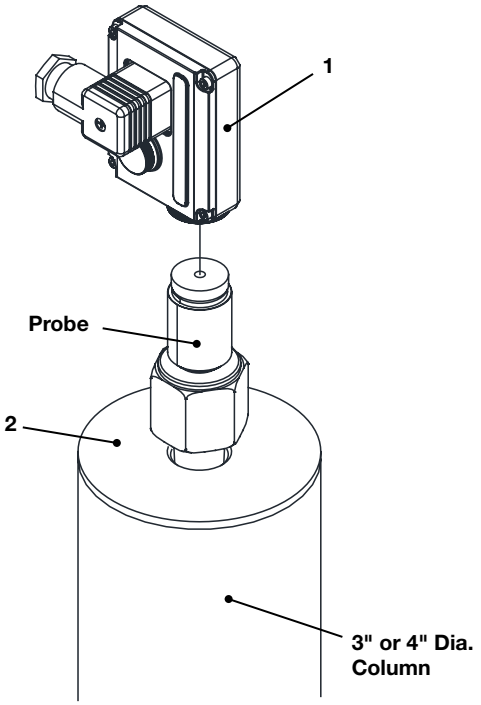




| HBLT-A1 Dimensions (¾" NPT Connection) | | | |
|---|---|---|---|
| Probe Lengths | | Measuring Range | |
| mm | inch | mm | inch |
| 152 | 6.0 | 79 | 3.13 |
| 203 | 8.0 | 130 | 5.13 |
| 305 | 12 | 232 | 9.13 |
| 389 | 15.3 | 316 | 12.43 |
| 488 | 19.2 | 415 | 16.33 |
| 587 | 23.1 | 514 | 20.23 |
| 762 | 30 | 689 | 27.13 |
| 889 | 35 | 816 | 32.13 |
| 1143 | 45 | 1070 | 42.13 |
| 1397 | 55 | 1324 | 52.13 |
| 1651 | 65 | 1578 | 62.13 |
| 2159 | 85 | 2086 | 82.13 |
| 2667 | 105 | 2594 | 102.13 |
| 3048 | 120 | 3029 | 119.25 |

| HBLT-A1-BSP Dimensions (1" BSP Connection) | | | |
|---|---|---|---|
| Probe Lengths | | Measuring Range | |
| mm | inch | mm | inch |
| 280 | 11.02 | 207 | 8.15 |
| 500 | 19.69 | 427 | 16.81 |
| 800 | 31.50 | 727 | 28.62 |
| 1000 | 39.37 | 927 | 36.50 |
| 1200 | 47.24 | 1127 | 44.37 |
| 1500 | 59.06 | 1427 | 56.18 |
| 1700 | 66.93 | 1627 | 64.05 |
| 2200 | 86.61 | 2127 | 83.74 |
| 3000 | 118.10 | 2927 | 115.24 |

| HBLT-A1/HBLT-A1-BSP Parts List | |
|---|---|
| Item | Part Description |
| 1 | Electronic Head |
| 2 | Connection, DIN |
| 3 | LED, Green |
| 4 | Calibration Push Button |
| 5 | LED Level Bar Graph |
| 6 | Cover, Calibration Push Button |
| 7 | Thread Connection |
| 8 | Reference Pipe |
| 9 | Inner Electrode |

**Diagram:** Dimensions and Parts List




**Explosion View:** Probe Replacement Kits

| Item | Kit Description | Kit |
|---|---|---|
| 1 | Electronic Head, Assembly | 209329 |
| 1 | Electronic Head, Assembly with Bar Graph | 209330 |
| 2 | Column Cap, Pipe (3" or 4" Diameter Column) | 205873 |

## Calibrating On-Site

All replacement electronics, or probe assemblies reset to the factory setting are pre-calibrated to ammonia with a sensor tube length of 1500 mm/59" and a signal damping of 15 seconds. When installed on all other lengths it has to be re-calibrated on site.

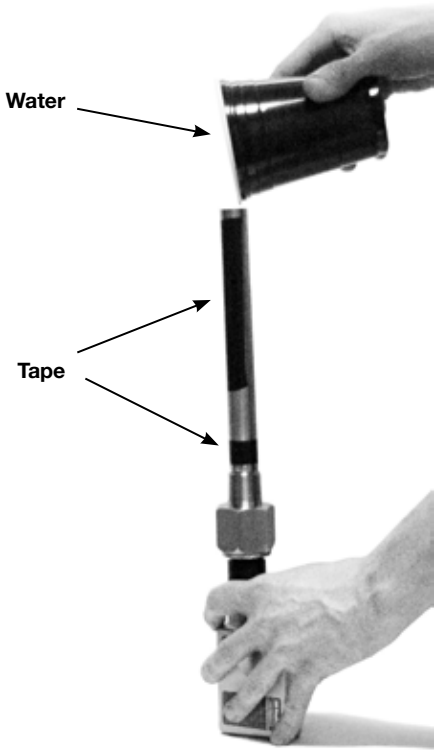
**Calibrating for ammonia on site:**
HBLT probes straight from the factory are pre-calibrated to the manufactured probe length, so there is no need to re-calibrate. Probe assembles that have been reset to the factory settings must follow the ***adjusting the minimum and maximum calibration points*** instructions described earlier in this document.

The benefit of ammonia is water can be used as a substitute. Ammonia and water have the same properties with the respect to capacitive measurements. This is very convenient as water is much easier and safer than dealing with ammonia.

For the low level calibration, stick the bottom of the probe into a small container. Fill the water level to the desired low level height and follow calibration instruction for minimum level described earlier in this document under the calibration section.

When it comes to calibrating the height level it is much more difficult, because finding a container/tube long enough, especially for length greater than 1397 mm (55"), is not quite so easy. A work around to this problem can be solved by following these steps.

1. Turn the HBLT probe upside down.
2. Tape all hole on the sleeve, otherwise known as reference pipe, to prevent any water from leaking out. The 4-20 mA output signal is not inverted despite the upside down position.




3. Fill the pipe with water according to your calibration needs. With the sleeve full of water at the high level desired calibration can be carried out by following the maximum calibration instructions described earlier in this document under the calibration section.

**Calibrating a replacement probe head for ammonia on site :**
Follow the procedures below to re-calibrate a replacement electronic heads:

1. Install the HBLT electronic head to the existing probe and connect power.
2. To calibrate the minimum level the column or vessel needs to be free of liquid. Follow the minimum calibration instructions described earlier in this document.
3. To calibrate the maximum level the column or vessel needs to be fully submerged by ammonia liquid. Follow the maximum calibration instructions described earlier in this document.
4. If methods 2 & 3 cannot be carried out use the on-site method, but before proceeding with this method the column/standpipe or vessel needs to be isolated and free of refrigerant.

**Calibrating for refrigerants other than ammonia on-site:**
When calibrating for refrigerants other than ammonia utilize the on-site calibration instructions. Calibrate the probe for ammonia and then change the refrigerant by following the ***set of refrigerant*** instructions described earlier in this document. If using the upside down method for calibrating the HBLT probe; make sure to remove all tape and clean/dry the probe prior to installation.

## Trouble Shooting

| Symptom | Probable Cause | How to Detect/Repair Defect |
|---|---|---|
| No function | No supply voltage<br>Wrong supply voltage | Check power supply and connection cable |
| It takes a long time after power up before the 4-20 mA signal is updated | Min./Max. calibration has been carried out several times on-site | After power up, the green LED flashes rapidly as many times as it has been calibrated through its lifetime. After the green LED flash slowls down, the 4-20 mA is updated |
| 4-20 mA output signal is to low | Oil has been accumulated in the column/standpipe<br>Oil falls to the bottom on ammonia systems | Drain oil out of column/standpipe. If a very large amount of oil is present it may be necessary to take out the sensor rod and clean it for oil |
| No 4-20 mA output | Not wired correctly | Green LED continues to flash rapidly. If 24 AC/DC supply: check polarity |
| 4-20 mA signal does not correspond to actual liquid level | Wrong refrigerant selected | Set correct refrigerant |
| No 4-20 mA output and green LED is off | Electronics defect | Replace HBLT electronics |
| 4-20 mA signal does not correspond to actual liquid level | Operator has incorrectly calibrated probe | Fulfill a factory reset |

**Safe Operation (See Bulletin RSBCV)**
People doing any work on a refrigeration system must be qualified and completely familiar with the system and the Refrigerating Specialties Division valves involved, or all other precautions will be meaningless. This includes reading and understanding pertinent Refrigerating Specialties Division Product Bulletins and Safety Bulletin RSB prior to installation or servicing work.

Where cold refrigerant liquid lines are used, it is necessary that certain precautions be taken to avoid damage which could result from liquid expansion. Temperature increase in a piping section full of solid liquid will cause high pressure due to the expanding liquid which can possibly rupture a gasket, pipe or valve. All hand valves isolating such sections should be marked, warning against accidental closing, and must not be closed until the liquid is removed. Check valves must never be installed upstream of solenoid valves, or regulators with electric shut-off, nor should hand valves upstream of solenoid valves or downstream of check valves be closed until the liquid has been removed.

It is advisable to properly install relief devices in any section where liquid expansion could take place. Avoid all piping or control arrangements which might produce thermal or pressure shock.

For the protection of people and products, all refrigerant must be removed from the section to be worked on before a valve, strainer, or other device is opened or removed. Flanges with ODS connections are not suitable for ammonia service.

**Warranty**
All Refrigerating Specialties products are under warranty against defects in workmanship and materials for a period of one year from date of shipment from factory. This warranty is in force only when products are properly installed, field assembled, maintained, and operated in use and service as specifically stated in Refrigerating Specialties Catalogs or Bulletins for normal refrigeration applications, unless otherwise approved in writing by the Refrigerating Specialties Division. Defective products, or parts thereof returned to the factory with transportation charges prepaid and found to be defective by factory inspection, will be replaced or repaired at Refrigerating Specialties option, free of charge, F.O.B. factory. Warranty does not cover products which have been altered, or repaired in the field, damaged in transit, or have suffered accidents, misuse, or abuse. Products disabled by dirt or other foreign substances will not be considered defective.

The express warranty set forth above constitutes the only warranty applicable to Refrigerating Specialties products, and is in lieu of all other warranties, expressed or implied, written including any warranty of merchantability, or fitness for a particular purpose. In no event is Refrigerating Specialties responsible for any consequential damages of any nature whatsoever. No employee, agent, dealer or other person is authorized to give any warranties on behalf of Refrigerating Specialties, nor to assume, for Refrigerating Specialties, any other liability in connection with any of its products.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