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HANDHELD TERMINAL FOR MONITORING AND SETTING UR.40.. SENSORS

Terminal Unit
TUS40-40

INSTRUCTION MANUAL

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INDICE

1 GENERAL

This chapter provides some information on the characteristics of the gases and on the installation criteria for gas detection devices before the description of the TUS40-40 terminal unit.

It is not essential to read this chapter to install and commission the terminal unit described in this manual. Readers who already know the subject can skip this part.

1.1 Meaning of symbols

The symbols used in this manual have the following meaning:

- ppm: Parts Per Million of concentration of gas in the air
- L.E.L%: Lower Explosive Limit
- %VOL: concentration of gas measured in percentage by volume
- D: Detector
- t: threshold limit value
- Pr: pre-alarm threshold
- 1t: alarm threshold one
- 2t: alarm threshold two
- FA: fail

1.2 Hazardous gas threshold

For gases and for combustible vapours, the hazardous conditions begin from a threshold called "Lower Explosive Limit" (LEL) that is the lowest concentration (percentage) of a gas in air capable of producing a flash of fire in presence of an ignition source. This threshold changes from gas to gas. The Lower Explosive Limits for some of the most common gases are shown in the table below.

	LEL (100%)	
GAS	**ppm**	**%VOL**
METHANE (CH4)	50,000	5%
ISOBUTANE (iso-C4H10)	18,000	1.8%
BUTANE (C4H10)	18,600	1.86%
LPG	19,000	1.9%
HYDROGEN (H2)	40,000	4%

Table 1.1

For toxic gases such as carbon monoxide (CO), the hazard level must be considered also in relation to the duration of the person's exposure in the polluted environment. The table below shows risks from exposure to carbon monoxide (CO). Carbon monoxide is generated wherever combustion occurs and the lungs rapidly absorb it and spread it through the pulmonary alveolus where it reversibly binds with the haemoglobin as “carboxyhaemoglobin” (COHb). It is also colourless and odourless so it is not naturally detected. This is why CO-specific detection devices are necessary.

COHb in the bloodstream has the following effects on healthy adults.

% COHb	EFFECTS
0.3-0.7	Normal amount in non-smokers from the endogenous production of CO
0.7- 2.9	No detectable symptoms
2.9-4.5	Cardiovascular disorders in patients suffering from heart disease
4-6	Usual levels in smokers, some physical impairment in psychomotor tests
7-10	Ailments in patients without heart disease (increase in cardiac output and in blood flow in coronary arteries)
10-20	Slight headache, weakness, possible effect on foetus
20-30	Strong headache, nausea, loss of movement in hands
30-40	Strong headache, irritability, confusion, loss of vision, nausea, muscle weakness, dizziness
40-50	Convulsions and loss of consciousness
60-70	Coma, respiratory arrest, death

Table 1.2

This issue is covered in other similar tables and a wide range of literature. In its document, "Air quality for CO", the US department of Health, Education and Welfare refers to an observed weakening in vision observed with 3% of COHb and in other psychomotor tests with 5% of COHb.
More recently, subjects exposed to a dose of 100 ppm CO for one hour have shown a loss of motor skills.

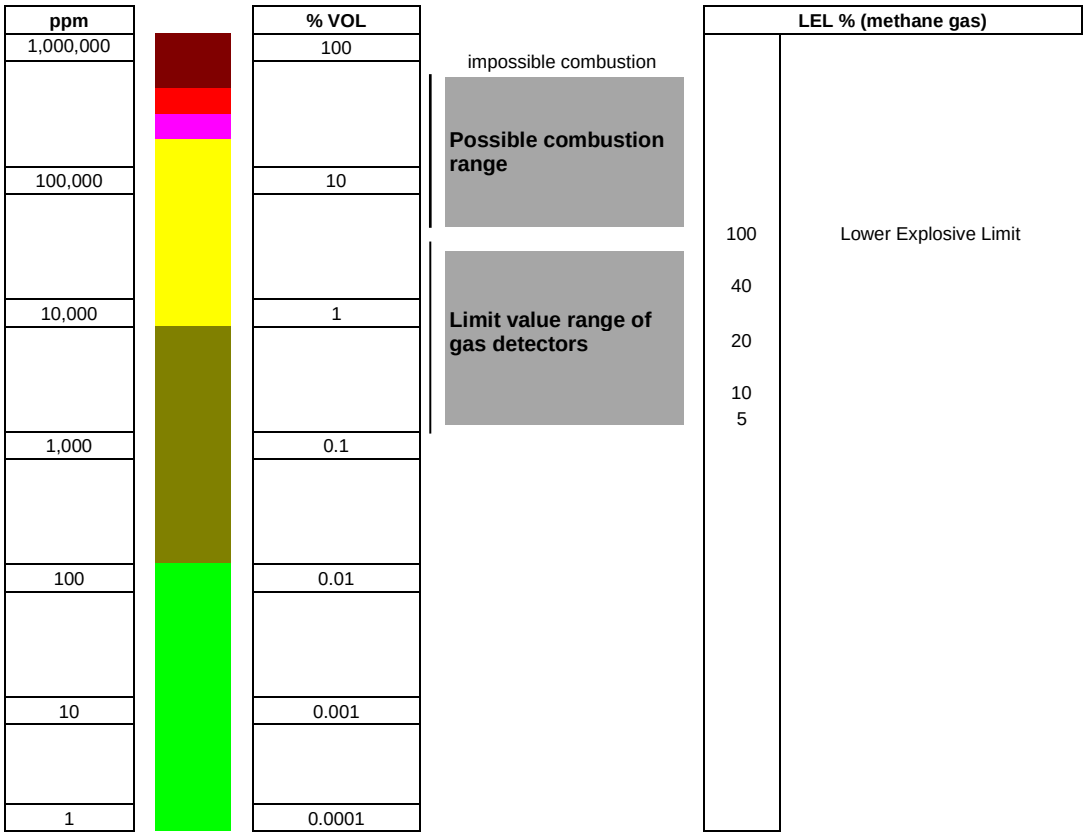

Fig. 1.1

2 DESCRIPTION OF TERMINAL UNIT

The **TUS40-40** is a terminal unit for monitoring and setting the UR.40. sensors and consists of:

- the**TUS40** handheld terminal
- the **UIC40** junction card
- the 3m long **CBL01** coiled cable
- "T" connector cable **CBL02**

the two units communicate through a dedicated master protocol.
The TUS40-40 terminal unit is necessary when a mobile monitoring system is required and/or for different settings of the gas detection threshold limit values from the ones that can be set using the DIP switch; it is also necessary for recalibrating sensors if standard factory calibration gas cylinders are not used.

NOTE: the words "detector" and "sensor" are used without distinction throughout this document and have the same meaning, except where this may create ambiguity.

The system structure is shown in Fig. 2.1.

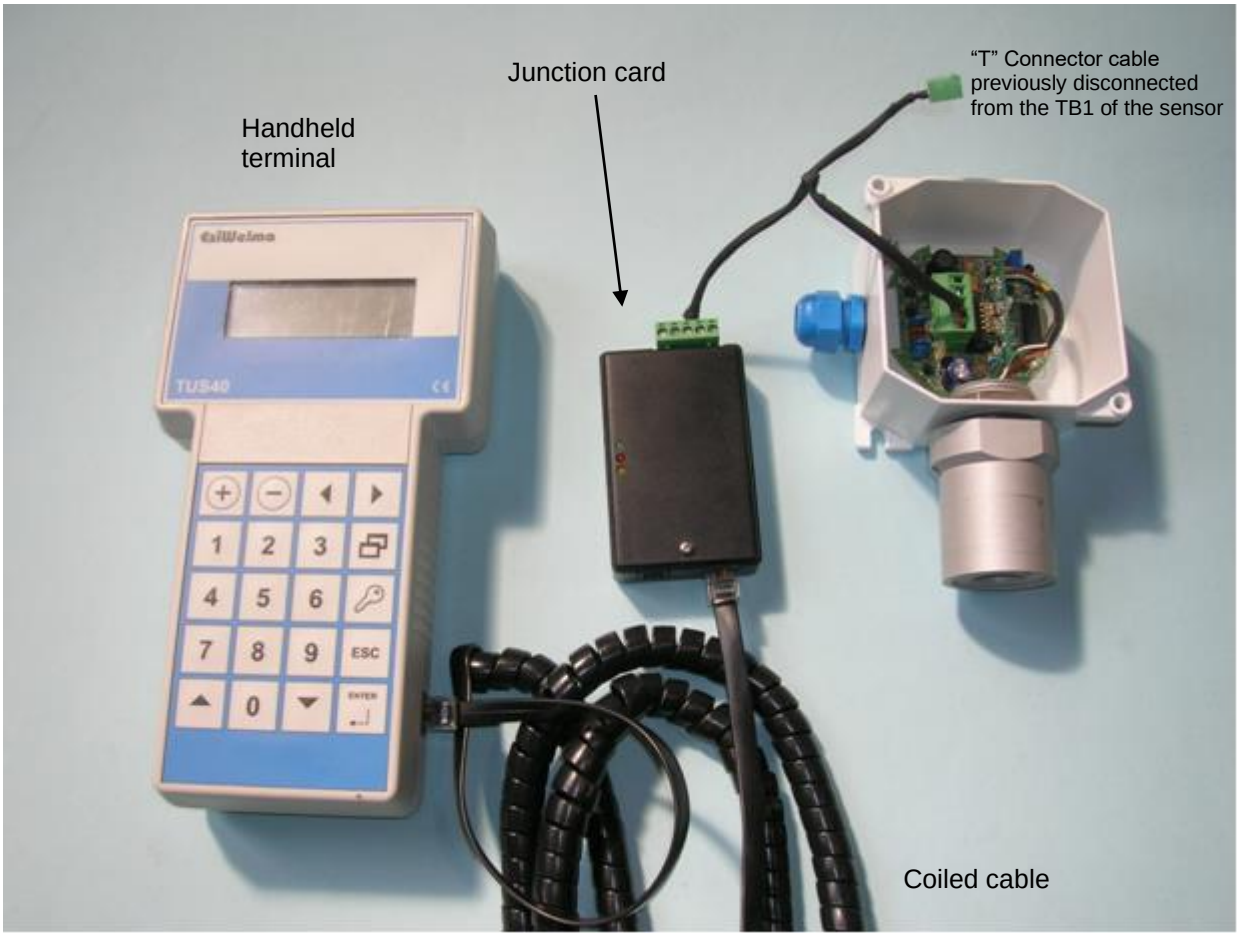

Fig. 2.1 – Terminal unit for monitoring and setting UR.40.. sensors

Under normal operating conditions (monitoring) the handheld terminal receives the information relating to measurements taken by the detector and the alarm status established by the

threshold limit values. Three threshold limit values and one fail condition can be defined, and they are respectively called:

- pre-alarm: **Preall.**
- alarm threshold one: **Treshold1**
- alarm threshold two: **Treshold2**
- device failure: **Fail**

The UR.40.. detectors come in five models (E, S, I, L, P) and their use depends on the protection mode required:

Application	Protection mode	Part number	
Classified (hazardous) areas (ATEX certification required)	Group II Category 2G Ex d IIC T6 T_{AMB}: -20 °C ÷ +50 °C	UR.40.**E**	
	Group II Category 3G Ex nA d IIC T6 T_{AMB}: -20 °C ÷ +50 °C	UR.40.**S**	
Unclassified (non-hazardous) areas (ATEX certification is not required)	Heavy-duty applications Construction conforming to Ex d requirements IP65	UR.40.**I**	
	Standard applications Construction conforming to Ex nA requirements IP55	UR.40.**L**	
	Car Parks applications Construction conforming to Ex nA requirements IP55	UR.40.**P**	

In turn, each model (E, S, I, L, P) has two possible executions:

with **S**tandard sensor (code S: UR.40**S**.)
with **P**rofessional sensor (code P: UR.40**P**.)

Two types of sensors are commonly used for the gases that most frequently require detection (methane, LPG, gasoline vapors, carbon monoxide etc.): catalytic (Pellistor) and electrochemical cell.
In both cases, the Professional execution is differentiated from the Standard execution by the use of sensors that are based on the same operating principle as the others but that over time have more measurement stability and higher poison resistance to the continuous presence of gas.

As you can see in the table below, the part number includes several fields for rapid identification in order to facilitate the choice of the detector according to the technical features described above:

	Detectable Gas	Sensing Element					
		Standard Catalytic	Pellistor Catalytic (Professional)	2-terminal Electr. Cell	3-terminal Electr. Cell	Semiconductor (1 or 2-thresholds	Non Dispersive infrared
Available models	Methane	URG40SL	URG40PL	---	---	URG40TL	---
	LPG	URP40SL	URP40PL	---	---	URP40TL	---
	CO	---	---	URO40SL	URO40PL	URO40TL	---
	Gasoline Vapours	URB40SL	URB40PL	---	---	URB40TL	---
	O_2	---	---	URS40SL	---	---	---
	CO_2	---	---	---	---	---	URD40SL
Models on request	Acetylene	URL40SL	URL40PL	---	---	URL40TL	---
	Hydrogen	URI40SL	URI40PL	---	---	URI40TL	---
	Ammonia	URM40SL	URM40PL	---	---	URM40TL	---
	Propane	URC40SL	URC40PL	---	---	URC40TL	---
	Octane	URT40SL	URT40PL	---	---	URT40TL	---
	Ethyl Alcohol	URE40SL	URE40PL	---	---	URE40TL	---

For other Gases, on request, please contact Customer Service.

Tab. 2.2 – Gas detector part numbers

3 INSTALLATION

3.1 Installation of the TUS40-40 Terminal Unit

The TUS40 handheld terminal is constructed in plastic housing and it plugs into the UIC40 junction box via the coiled cable to be powered by the junction box to the sensor connector.
A fold-out bar on the back of the TUS40 handheld terminal can be used to place it at a convenient tilt on a minimum surface area of 220x130 mm. Knurling at the sides of the keypad ensures an easy and secure grip.

The TUS40-40 terminal unit must be connected with the sensor power off (by UIC40 junction box), and in any case already "Affiliate" to a central unit UCE40; follow product and/or installation instructions before opening the sensor cover.
Proceed as follows to connect the TUS40-40 terminal unit:

1. Make sure the area is clear of gas and that the sensor is not powered up
2. Open the UR.40 sensor cover (Fig.3.1)
3. Identify the position of the TB1 connector on the diagram (Fig. 3.2)
4. Plug the junction card UIC40 into the socket by “T” connector cable CBL02, making sure it is properly lined up with the contacts (Fig. 3.3), then plug the cable CBL01 and handheld terminal into the junction card RJ45 connector.
5. Power up the sensor
6. Wait for the handheld terminal display to switch on; it will show a row of asterisks, followed by the sensor status page (Fig. 4.1 and 4.2)
7. At the same time, on the UIC40 junction box, the three leds will indicate the viability of the unit and attempts to communicate with the sensor and the terminal
8. Wait for the end of the warm-up phase (preheating, Fig. 4.3)
9. The handheld terminal will then show the basic display (Monitoring Mode).

It is now possible to operate with the handheld terminal (Fig. 4.4).

The direction of the detector must always have the sensor facing downwards

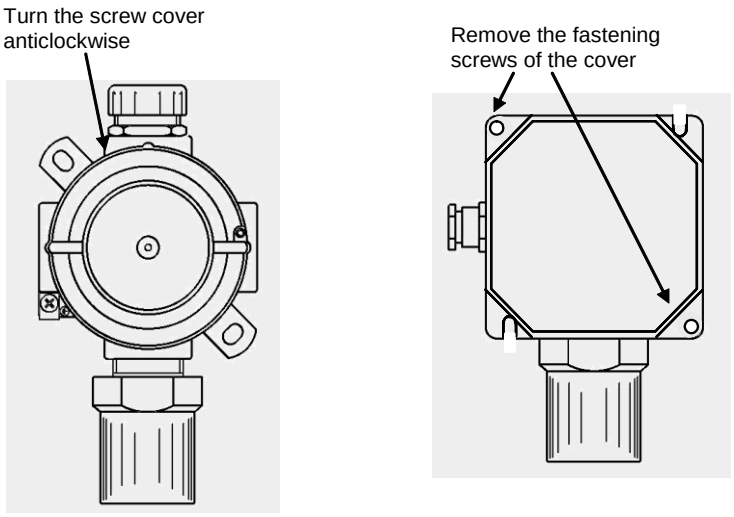

Fig. 3.1 – Removing the cover of the UR40 sensors

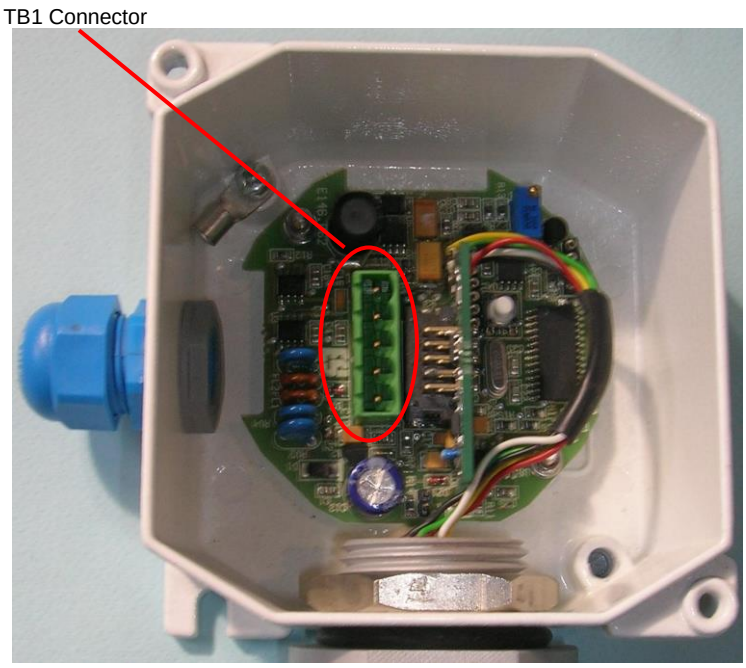

Fig. 3.2 – TB1 Position

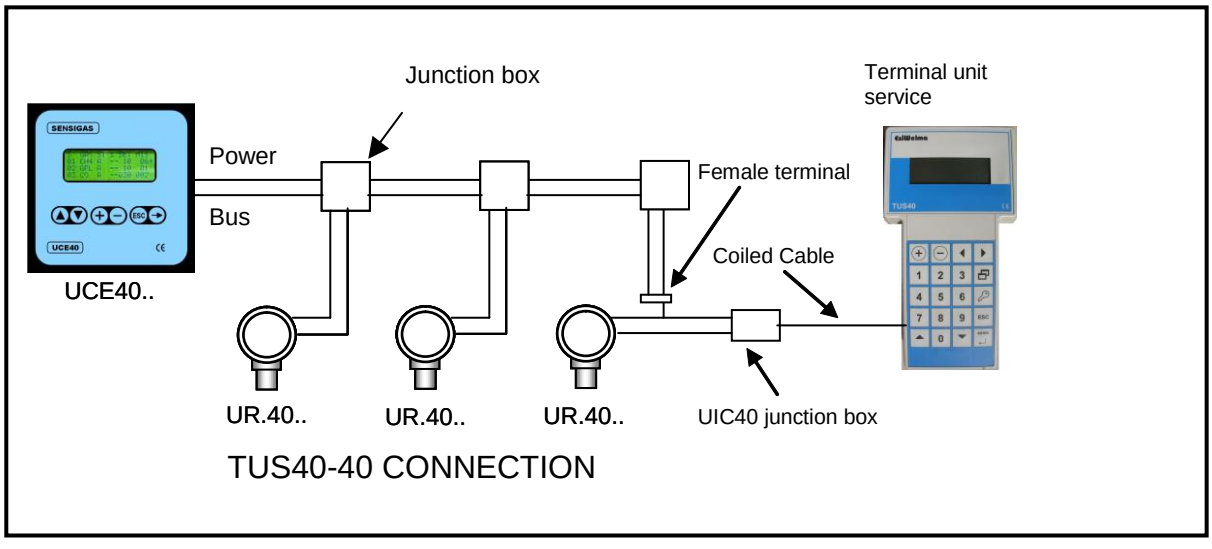

Fig. 3.3 – Terminals Connection

3.2 Types of detector installation for correct monitoring

The detectors must be wall-mounted at whatever height is appropriate for the type of gas to be detected (Fig. 3.4).

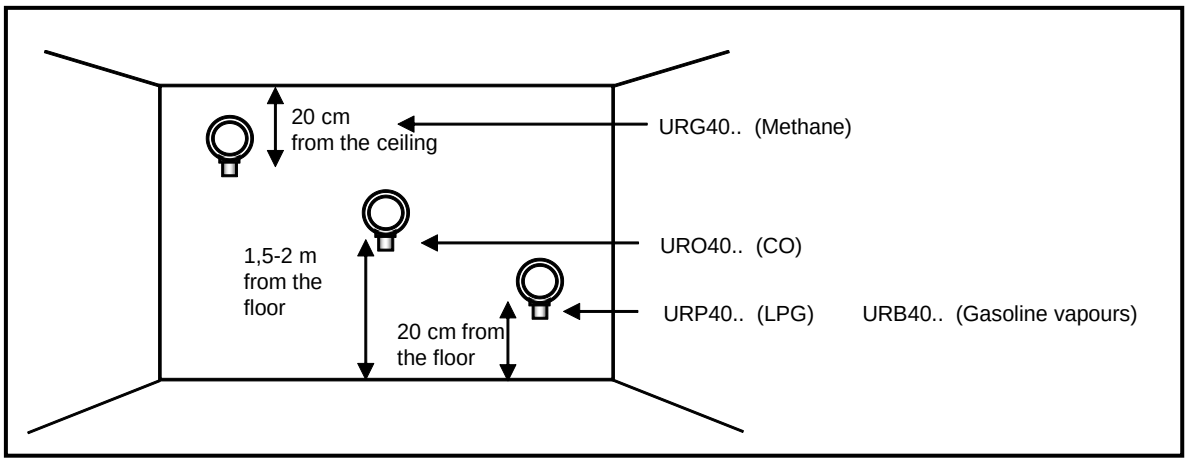

Fig. 3.4 – Sensors positioning example

For sensors positioning, please follow the next simple and generic rules:

Use the information below to correctly position the detectors:

- 40 cm from the floor to detect gases heavier than air (LPG or Gasoline Vapours)
- 40 cm from the ceiling to detect gases lighter than air (Methane)
- midway between floor and ceiling (1.5 - 2 m) to detect gases as heavy as air (CO)

The TUS40-40 termination kit comes with a 3 m coiled cable so it can operate correctly even at a considerable height and distance from the sensor.
The connection cable must not be stretched to its full length when it is plugged in to make sure it does not disconnect from the junction card.
Do not use extension cords on the cables and do not extend the cables themselves by cutting and joining as this may adversely affect the proper operation and safety of the device.

To guarantee correct gas detection, in addition to the instructions above, the positions of the detectors must take into consideration the following **specific installation guidelines**:

The detector must be mounted:

- where accidental gas leakages are possible
- at least 1.5 metres from heat sources
- not in spaces where ventilation is poor and where gas pockets may form
- at least 1.5 metres from vent holes
- away from hindrances to natural gas flow
- in environments with a temperature range of -20°C to 50°C and relative humidity below 90% (non-condensing).

4 USING THE TERMINAL UNIT

After the wiring and connections between the sensor and the TUS40-40 terminal unit are complete, visually inspect them to make sure they are correct, ensure you are operating in a safe zone, then power up the sensor.

4.1 Operating modes

Only connect and disconnect the TUS40-40 junction box to and from the sensor if the sensor power is off, to avoid connection errors. This makes it possible to correctly activate communication between the two devices and their alignment.

The TUS40-40 terminal unit can be used for several checks and calibrations:

- Monitoring or normal operating mode
- Thresholds and calibration display mode
- Sensor calibration mode

When the unit is switched on, the following display sequences will appear:

1. The backlighting will switch on and the following words will appear on the handheld terminal display:

Fig. 4.1

1. The display then shows the following, where x.xxx stands for the firmware version:

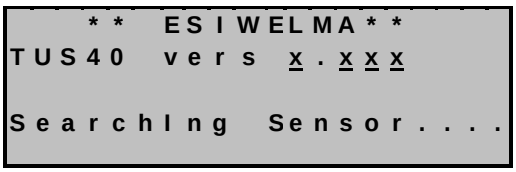

Fig. 4.2

In this phase, the sensors begin the warm-up phase and the operation can take a few minutes.

The display shows the following during the warm-up phase:

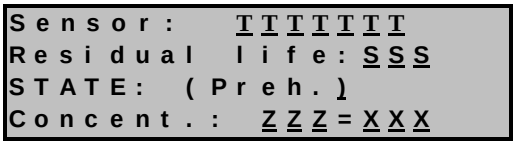

Fig. 4.3

4.2 Monitoring mode

At the end of the warm-phase, the sensor shows the following display:

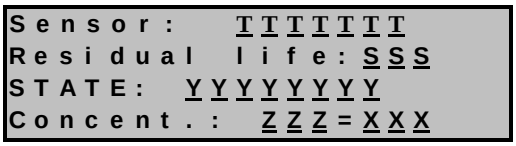

Fig. 4.4

Where:

- TTTTTT = Abbreviation of sensor type
- SSS= residual operational lifetime in weeks
- YYYYYYYY = Abbreviation of sensor status
- ZZZ= Unit of measure of the concentration (ppm for CO or LEL for explosive gases)
- XXX= Concentration detected by the sensor

Abbreviations used for the sensor status:

- **(Preh.)**: only during Preheating
- **OK**: during normal operation
- **Preall**: if the sensor has exceeded the pre-alarm threshold
- **Threshold 1**: if it has exceeded the 1st threshold
- **Threshold 2**: if it has exceeded the 2nd threshold
- **Fail**: if a fault of any kind is detected.

In questa fase il terminale visualizza costantemente la concentrazione misurata e ne aggiorna il valore costantemente ogni pochi secondi.

4.3 Display Mode

With the UR40, setting is possible after the warm-up phase is complete.

Press the SETTING key to enter Check Alarm Mode or press key **0** (zero) to enter in Assignment and Calibration mode.
In Display mode is possible to read a set of alarm data which characterize the detector:

Enter setting and the display will show the set point thresholds:

```
Sensor:    TTTTTTT
Threshold1: ZZZ = XXX
Threshold2: ZZZ = XXX
Threshold3: ZZZ = XXX
```

Fig. 4.5

Where:
TTTTTTT = Abbreviation of sensor type
ZZZ = Unit of measure of the concentration (PPM, LEL or %)
XXX = Threshold limit values set in the configurable set point for each threshold
Threshold 1 is the pre-alarm threshold
Threshold 2 is the 1st alarm level
Threshold 3 is the 2nd alarm level.

0 Enter setting and the display will show the value of Assignment and Calibration (complete display only after run one time the sensor calibration procedure otherwise you will only see the first 2 lines).

```
I.D. CAN: XX
System code: 0xSSSS
v0    v500    bal
YYYY  ZZZZ    KKK
```

Fig. 4.6

Where:
XX = device address of the system which is installed in the detector itself
SSSS = number of the central system in hexadecimal set at the factory
YYYY = Converter steps number of 1st calibration point
ZZZZ = Converter steps number of 2nd calibration point
KKK= Value of the correction factor calibration of the sensor

While for the infrared sensors can only view the end of scale and the calibration data:

```
I.D. CAN: XX
System code: 0xSSSS
Max:   ppm   20000
```

Fig. 4.7

At the end of the display of values, press ESCAPE key for comeback to normal view.

4.4 Calibration mode

The UR40 is calibrated by two measurement values. The first of the two values is always zero - no gas measured, make exception O_2 that in free air has a concentration of 20,9%; the second is the factory-calibrated set point of:

- 50% of LEL (full scale) for explosive gases
- 500 PPM (full scale) for toxic gases
- 0,5% Vol. only for CO_2 sensor
- 4,0% Vol. Only for O_2

If the gas used comes in different concentrations from 50% LEL or 500 PPM, it is possible to change the correspondence of the LEL percentage in the 2nd calibration set point, operation to be performed if necessary prior to the operations of calibration.

Press key **2** from the Display Mode and the following screen will appear:

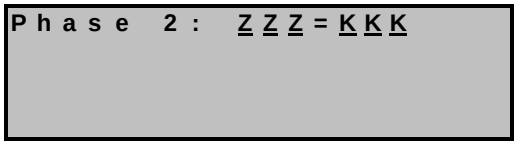

Fig. 4.8

Where:
ZZZ = Unit of measure of the concentration (PPM, LEL or %)
KKK = Value of concentration of 2nd calibration set point

Press keys from **0** to **9** to set the correspondence of the LEL (or PPM) percentage in the 2nd calibration set point.

Finally press the ENTER key if you want to store value 

From this screen you can go back to Monitoring Mode by pressing ESC key 

4.5 Calibrating the sensor

Hold down the KEY button for at least 5 seconds to enter this phase from the setting mode. The display will show the following:

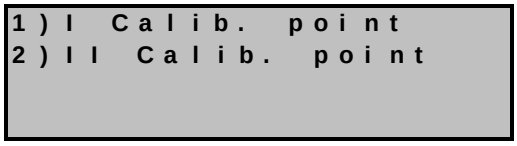

Fig. 4.9

And relative to the oxygen only for which is however not possible to change the calibration points:

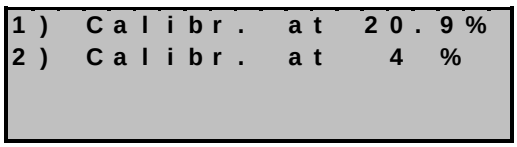

Fig. 4.10

Three successive steps are required for calibration:

- Possible change in the concentration of the calibration gas to be carried out before the actual calibration: Refer to chapter.(4.4)
- Calibrating the zero point (clean air for toxic and flammable gas, nitrogen for poison gas such as CO_2)
- Calibrating the factory-set concentration (default: 50% LEL for explosive gases, 500 PPM for CO, 5000 PPM for CO_2, 4%vol for O_2) as per the section above

Two successive steps are required for calibration:

- ESCAPE to take the sensor back to normal operation
- **1** to start up calibration of 0 (zero) set point in clean air (zero gas concentration)

Show on the display **Calibr. running…** , indicate to wait until the end of the procedure.

Fig. 4.11

At the end, if the calibrating procedure has been successful the display will show:

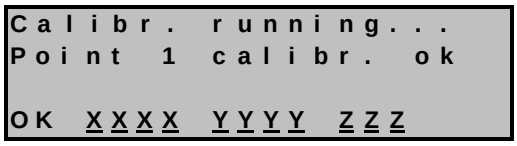

Fig. 4.12

Where:
XXXX= Converter steps number of 1st calibration point
YYYY= Converter steps number of 2nd calibration point
ZZZ= Value of the correction factor calibration of the sensor

The only exception is the infrared sensor that not allows the display of these values.

If a Zero calibration is not successful the display shows the message "**Calibration error**" on the third display line

Anyway at this point you can press:

- ESCAPE or ENTER which reports to the menu choice of calibration

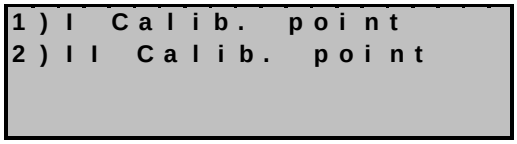

Fig. 4.13

Place the sensor in the flow of gas to the predetermined concentration and wait about three minutes for the measure has stabilized.

At this point is possible press:

- ESCAPE to take the sensor back to normal operation 

- **2** to start up calibration of 2nd set point in the predetermined concentration

The calibration takes only a few seconds the display will show **Calibration running…**
At the end appear:

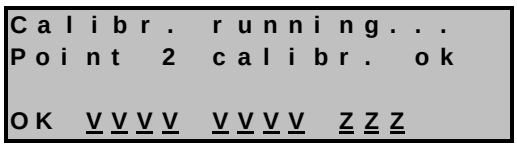

Fig. 4.14

If the calibrating procedure at the predetermined concentration has been successful the display will show:

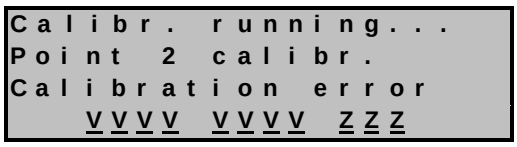

Fig. 4.15

Where:
VVVV = Converter steps number of 1st and 2nd set calibration point.

At this point you can press:

- ESCAPE or ENTER which reports to the previous menu

In the case of calibration error by pressing ESCAPE, the display returns to the state of the sensor without taking into account the calibration failed, then using the old values.

4.6 Troubleshooting

Cabling errors may show up as follows.

PROBLEM	POSSIBLE CAUSE	REMEDY
All the LEDs on units concerned are off	Inversion of power supply on peripheral units	Restore correct connection after switching off the detector
Components broken, peripheral units off	Power supply connections inverted	Replace damaged unit
Lack of communication between sensor and TUS40-40 terminal unit	Positioning of the TUS40-40 junction card inverted or misaligned	Restore correct BUS connection after powering off the sensor

Table 4.1 – Diagnosis of possible causes of fail

Some error sequences are reported by particular flashing in the visual alarms present on the UR.40. detector. For a complete table of sensor fail reporting signals, see the relative instruction manual.

The luminous alarms (LEDs) on the UR.40 detectors can be found in the figures below.

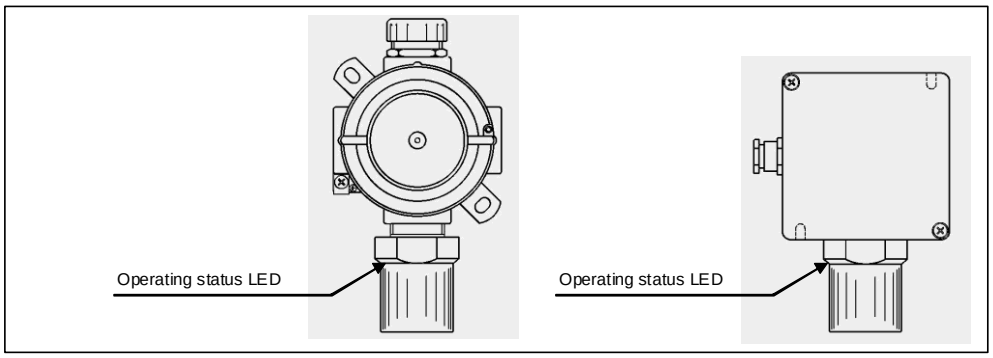

Fig. 4.16 – Function of the LEDs on the UR.40.. detectors

Sensor status	*Status LED on sensor body*
WARM-UP	Flashing at 2 Hz
OPERATING	1 flash about every 10 sec.
PRE-ALARM	Steady light
1st ALARM THRESHOLD	Steady light
2nd ALARM THRESHOLD	Steady light
SENSOR FAIL	Steady light

Table 4.2 – Operating significance of the LED on the sensor body

4.7 Sensor operation check

After the sensor is calibrated, it is necessary to make sure it is operating correctly. For this purpose, it is necessary to scrupulously perform the following in order to prevent incorrect test actions that could cause permanent damage to the sensing element.
We recommend using the TUL40 calibration and test case for this purpose. It consists of:

- One cylinder (12 l) of gas calibrated at 50% of the L.E.L. of the detected gas (e.g.: Methane)
- One pressure valve and flow regulator (the latter is optional)
- One flow chamber that will fit properly around the sensing element
- One hose between cylinder and adapter (~ 2 m long)

In any case, follow the checklist below to carry out the test:

1. for the test, use the same type of gas that the sensors will be detecting
2. the test cylinder must be calibrated with the concentration kept below the maximum levels of the detector measuring range
3. the test gas flow must spread to the sensing element or reach it at a low flow rate (max 0.5 litres / minute).
   For this purpose, use a specific flow measurement chamber that fits properly around the sensing element (Fig. 4.17), and if necessary a field flow meter
4. a few dozen seconds may pass from the time the test gas is released to the moment the detector senses its presence and precisely measures its concentration. This “delay” is caused by the action of the sintered filter located at the bottom end of the detector to protect the sensing element. The same delay may occur from the moment test gas release is terminated until the moment the detector no longer senses its presence.
5. the sensor must activate the alarm during the test: make sure the alarm is activated by controlling the LED status on the sensing element; this must be flashing as shown in table 4.2, according to the concentration level detected by the TUS40-20 terminal unit in the monitoring mode described above.

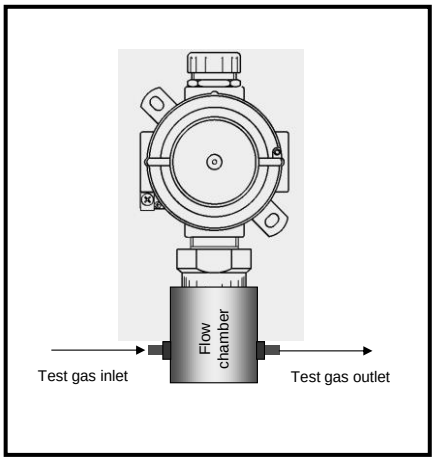

Fig. 4.17 – Flow chamber

WARNING

Repeated use of inappropriate or high concentrations of test gases causes permanent poisoning of the sensing element with a subsequent deterioration in performance, or permanent abnormality, of the detector.

4.8 Residual life

The TUS40-40 terminal unit can display the residual operational lifetime of the sensor in weeks: in figure 4.3 is shown in the sensor monitoring section as **Residual life**. When the operational lifetime descends to zero, the sign becomes negative and the system continues to operate and count down the weeks of operational lifetime but of course there is no guarantee that the sensor is operating correctly.

4.9 Display contrast adjust

Keep the ENTER key pressed down to switch on the sensor 
The display will show the following:

Fig. 4.18

Press keys  to adjust the contrast to how you want it.

Press ESC  to exit and continue with the normal operations of the TUS40-20 terminal unit.

5 INSTALLATION DATA

To be filled in by Installer		***Installer's stamp and signature***
Installation site and/or room:		
Product order number:		
Part Number:	Manufacturing date:	

DETECTORS					
No.	Gas detected	Position of detector	No.	Gas detected	Position of detector
1			26		
2			27		
3			28		
4			29		
5			30		
6			31		
7			32		
8			33		
9			34		
10			35		
11			36		
12			37		
13			38		
14			39		
15			40		
16			41		
17			42		
18			43		
19			44		
20			45		
21			46		
22			47		
23			48		
24			49		
25			50		

6 ROUTINE CHECKS

To be filled in by Installer/Service Personnel		*Signature*
Date	***Description***	

NOTES

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