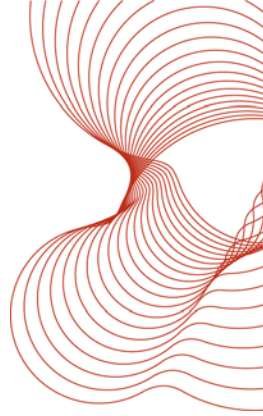


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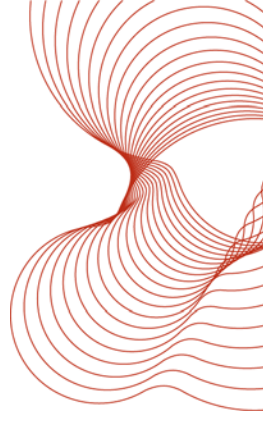
**Technical evaluation of  
the Ningbo Longmax  
Electronic Co., Ltd  
LM-201A battery  
operated carbon  
monoxide (CO)  
Detector Type B to  
EN 50291-1:2010.**

Prepared for:  
LPCB  
Bucknalls Lane  
Garston  
Watford  
WD25 9XX

13 July 2015  
Test report number  
TE274114



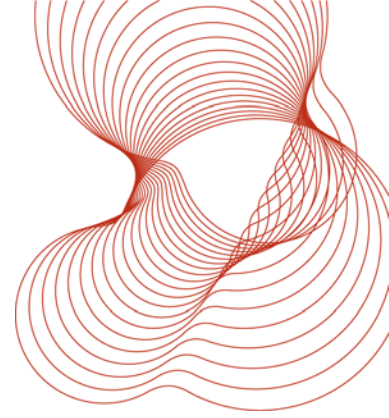
in association with  
ABI and Lloyd's



**Technical evaluation of  
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Prepared for:  
LPCB  
Bucknalls Lane  
Garston  
Watford  
WD25 9XX

13 July 2015  
Test report number  
TE274114 Rev 1



**Prepared on behalf of BRE Global by**

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Name Ray Wainwright

Position FDET Technician

Signature

**Authorised on behalf of BRE Global by**

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Name A. J. Dodkin

Position International Business Development Manager

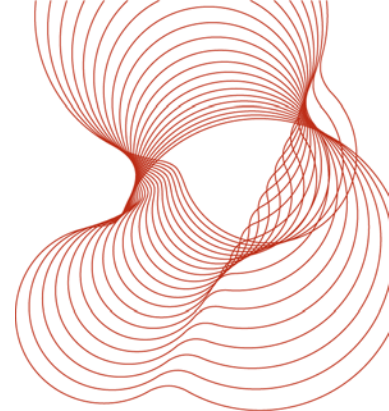
Date 13 July 2015

Signature

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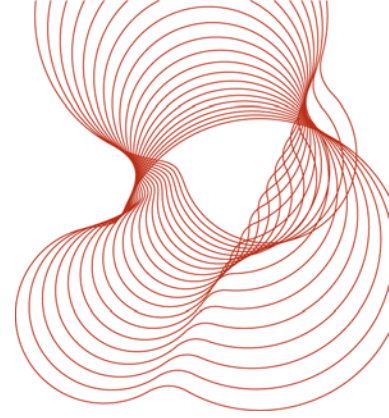
This report may only be distributed in its entirety and in accordance with the terms and conditions of the contract. Test results relate only to the items tested. We have no responsibility for the design, materials, workmanship or performance of the product or items tested. This report does not constitute an approval, certification or endorsement of the product tested.

This report is made on behalf of BRE Global. By receiving the report and action on it, the client accepts that no individual is personally liable in contract, tort or breach of statutory duty (including negligence). No third party has any right to rely on this report.

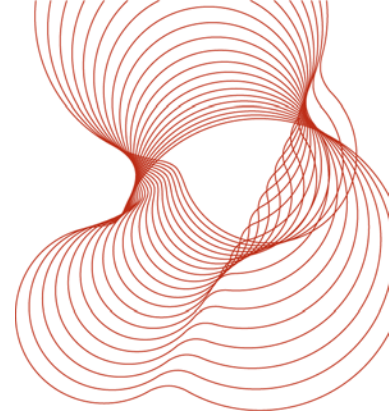


## Contents

<b>1</b>	<b>Introduction.....</b>	<b>5</b>
1.1	Object .....	5
1.2	Origin of Request.....	5
1.3	Client.....	5
1.4	Applicant/Manufacturer.....	5
<b>2</b>	<b>Equipment and data submitted .....</b>	<b>6</b>
2.1	First Submission .....	6
2.2	Second Submission .....	6
2.3	Third Submission .....	6
<b>3</b>	<b>Photograph of Equipment.....</b>	<b>7</b>
<b>4</b>	<b>Test Programme .....</b>	<b>8</b>
<b>5</b>	<b>Observations and Results .....</b>	<b>9</b>
5.1	General Requirements .....	9
5.2	Construction.....	10
5.3	Indicators and alarms .....	11
5.4	Fault Signals .....	12
5.5	Output Signals .....	13
5.6	Software controlled apparatus.....	14
5.7	Labelling .....	15
5.8	Caution .....	16
5.9	Instruction Booklet .....	17
5.10	Packaging .....	19
5.11	Unpowered storage .....	20
5.12	Alarm Conditions .....	21
5.13	Alarm during warm-up .....	28
5.14	Response and recovery to a high test gas volume ratio .....	29
5.15	Temperature effects .....	30
5.16	Humidity effects .....	35
5.17	Speed of gas test .....	36
5.18	Electromagnetic compatability.....	37
5.19	Response to mixtures of CO and other gases .....	38
5.20	Effects of other gases.....	39
5.21	Long term stability .....	40
5.22	Alarm Sound Level .....	42
5.23	Degree of protection .....	43
5.24	Mechanical strength .....	44
5.25	Battery fault warning.....	45
5.26	Battery capacity .....	48
5.27	Battery reversal.....	49
5.28	Battery connections .....	55



<b>6</b>	<b>Non Compliances .....</b>	<b>56</b>
6.1	Clause 5.3.4 - Alarm Conditions.....	56
6.2	Clause 5.3.11 - Radiated Immunity .....	56
6.3	Clause 5.3.7.1 - Temperature Effects .....	57
6.4	Clause 5.3.13 - Effects of other Gases .....	57
6.5	Clause 5.3.8 - Humidity Effects .....	58
6.6	Clause 5.3.12 - Response to CO and other Gases.....	58
<b>7</b>	<b>Conclusion.....</b>	<b>59</b>
<b>8</b>	<b>References .....</b>	<b>60</b>



## **1 Introduction**

### **1.1 Object**

The object of this evaluation was to examine the construction and assess the performance of the Ningbo Longmax Electronic Co., Ltd LM-201A battery operated carbon monoxide (CO) Detector Type B (previously referred to as the KD-106E reference: Test Schedule E122394/1.2) to the requirements of EN 50291-1:2010 as specified in LPCB Test Schedule No: E122394/1.3.

### **1.2 Origin of request**

The evaluation was undertaken for the Loss Prevention Certification Board (LPCB).

Project No: E122394.

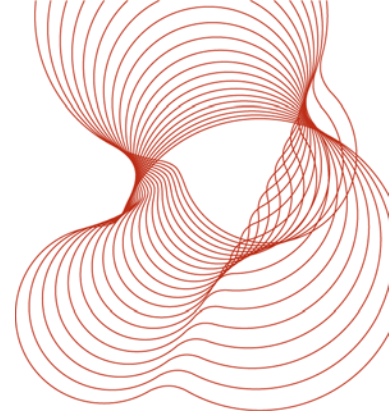
Test schedule: E122394/1.3.

### **1.3 Client**

Loss Prevention Certification Board, Garston, Watford, WD25 9XX.

### **1.4 Applicant / Manufacturer**

Ningbo Longmax Electronic Co., Ltd,  
No.28 Fengyuan Road,  
South of Economic Development Area,  
Yuyao City,  
Zhejiang Province,  
China.



## 2 Equipment and data submitted

### 2.1 First submission

Equipment		
No.	Description	Receipt date
15	Ningbo Kingdun KD-106E Battery Operated CO Detector Type B	5/12/2011

### 2.2 Second Submission

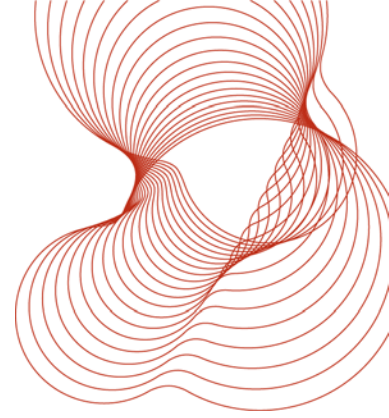
Equipment		
No.	Description	Receipt date
12	Ningbo Kingdun KD-106E Battery Operated CO Detector Type B modified samples due to the failures highlighted during testing to include Clause 5.3.4 Alarm Conditions, Clause 5.3.7.1 Temperature Effects, Clause 5.3.11 Radiated Immunity, Clause 5.3.13 Effects of other Gases, Clause 5.3.8 Humidity Effects, and Clause 5.3.12 Response to CO and other Gases (see Section 6, Sub-sections 6.1, 6.3, 6.2, 6.4, 6.5, and 6.6 respectively of this report).	9/01/2012

### 2.3 Third Submission

Equipment		
No.	Description	Receipt date
12	Ningbo Longmax LM-201A Battery Operated CO Detector Type B modified samples due to the failure highlighted during Clause 5.3.11 Radiated Immunity,(see Section 6, Sub-section 6.2 of this report).	*25/10/2012

\*The samples received for the third submission were now referred to as the Ningbo Longmax LM-201A CO detectors, after previously being called the Ningbo Kingdun KD-106E CO detectors.

Data		
Drawing/ Document No.	Description	Issue
9381	LPCB Document Register	1

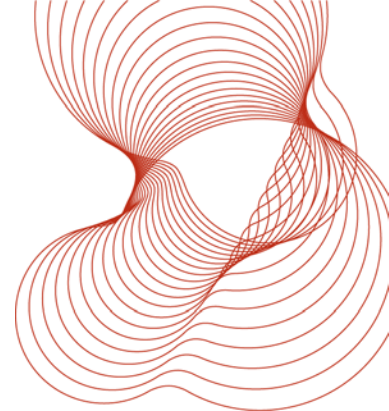


### 3 Photograph of equipment



**Plate 1:** Ningbo Longmax Electronic Co., Ltd LM-201A battery operated (CO) Detector Type B.

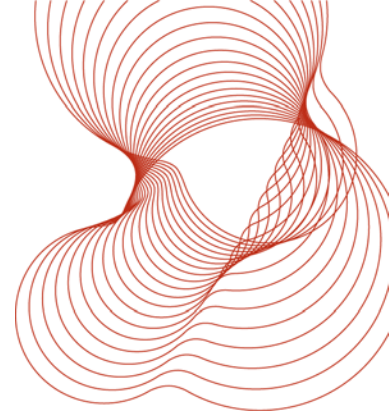




## 4 Test programme

Test Programme						
EN 50291: 2010 Clause – Title/Test	First Submission		Second Submission		Third Submission	
	Sample №	Result	Sample №	Result	Sample №	Result
4.1 - General	-	Pass	-		-	
4.2 – Construction	2, 3, 4	Pass	See Trac Test Report No. TRA-008598-34-00A			
4.3 - Indicators and alarms	-	Pass	-		-	
4.4 - Fault Signals	-	Pass	-		-	
4.6 – Software controlled apparatus	-	Pass	See BRE Test Report TE274114-SW			
4.6.2 - Labelling instructions and packaging	-	Pass	-		-	
5.3.2 – Unpowered storage	1 to 12	Pass	-		-	
5.3.4 - Alarm Conditions	1 to 12	Fail	1 to 12	Pass	-	
5.3.5 - Alarm during warm-up time	10,11,12	Pass	-		-	
5.3.6 - Response and recovery to a high test gas volume ratio	10,11,12	Pass	-		-	
5.3.7 - Temperature effects	10,11,12	Fail	10,11,12	Pass	-	
5.3.8 - Humidity effects	5, 6, 7	Fail	5, 6, 7	Pass	See Sira Test Report N0691 May 2013	
5.3.9 - Speed of test gas	10,11,12	Pass	-		-	
5.3.11 – Radiated Immunity	9	Fail	7	Fail	9	Pass
5.3.12 - Response to mixtures of CO and other gases	5, 6, 7	Fail	5, 6, 7	Pass	See Sira Test Report N0691 May 2013	
5.3.13 - Effects of other gases	5, 6, 7	Fail	5, 6, 7	Pass	See Sira Test Report N0685 November 2012	
5.3.14 - Long term stability	1	Pass	-		-	
5.3.16 - Alarm sound level	8	Pass	-		-	
5.3.17 - Degree of protection	9	Pass	-		-	
5.3.18 - Mechanical strength	8	Pass	-		-	
6.1 - Battery fault warning	10,11,12	Pass	-		-	
6.2 - Battery capacity	10,11,12	Pass	-		-	
6.3 - Battery reversal	10,11,12	Pass	-		-	
6.4 - Battery connections	10,11,12	Pass	-		-	

Testing commenced on the 16<sup>th</sup> January 2012 and was completed on the 17<sup>th</sup> July 2013.



## 5 Observations and Results

### 5.1 General Requirements

#### 5.1.1 Test procedure

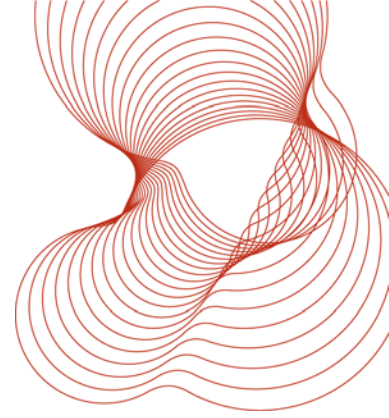
The requirements were assessed by inspection and test in accordance with Clause 4.1 of EN 50291-1:2010.

#### 5.1.2 Inspection

General requirements	
Type of apparatus	Type B
The apparatus reliably detected the presence of CO gas	Pass
The apparatus was designed for continuous operation	Pass
The apparatus produced an alarm	An audible tone and signal was detected when the alarm set points were exceeded.
The apparatus was not a class 0 appliance as defined in EN 60335-1:2002+A15:2011 Clause 3.3.7	Pass

#### 5.1.3 Assessment

The requirements of Clause 4.1 were met.



## **5.2 Construction**

### **5.2.1 Test procedure**

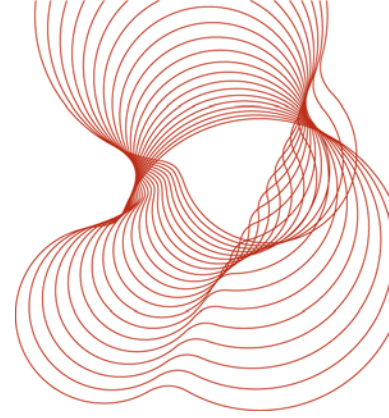
The requirements were assessed by inspection and test in accordance with Clause 4.2 of EN 50291-1:2010.

### **5.2.2 Inspection**

Compliance with the requirements of limited Clauses of EN 60335-1:2002+A15:2011 as referenced within EN 50291-1:2010 was determined by the Trac Testing Laboratory. The results of this assessment are to be found in the Trac Test Report TRA-008598-34-00A 23<sup>rd</sup> March 2012.

### **5.2.3 Assessment**

The requirements of Clause 4.2 were met.



## 5.3 Indicators and alarms

### 5.3.1 Test procedure

The requirements were assessed by inspection and test in accordance with Clause 4.3 of EN 50291-1:2010.

### 5.3.2 Inspection

Indicator	Colour	Illumination	Labelling
Power	Green	LED flashes Green once every minute	Yes
Alarm	Red	LED flashes Red when the device is in Alarm	Yes
Fault	Yellow	LED flashes Yellow when the device is in the Fault condition	Yes

### 5.3.3 Comments

The Operating Instructions reference: QSP0701-201A-02 Edition No.B/1 2<sup>nd</sup> September 2013, for the LM-201A battery operated carbon monoxide (CO) Detector Type B provides full details for each of the three above CO detector conditions.

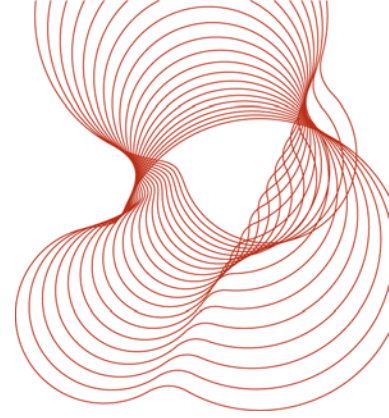
The CO detector was provided with an audible alarm.

Alarm indicators and audible alarms operated simultaneously at the set points listed in Table 2 – Alarm conditions, EN 50291-1:2010.

Once activated the CO detector remained in operation at carbon monoxide concentrations above 50ppm.

### 5.3.4 Assessment

The requirements of Clause 4.3 were met.



## **5.4 Fault Signals**

### **5.4.1 Test procedure**

The requirements were assessed by inspection and test in accordance with Clause 4.4 of EN 50291-1:2010.

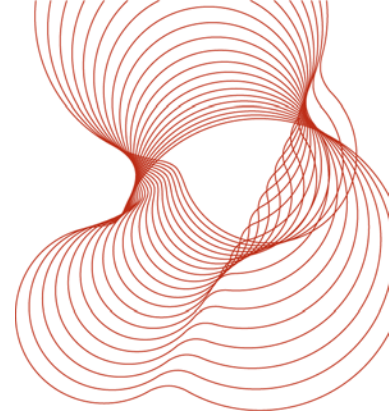
### **5.4.2 Inspection**

The LM-201A CO detector provided a fault signal when there was a loss of continuity (open circuit) or short circuit to the sensor.

The fault signal could be clearly identified and was different from the alarm that signalled the detection of carbon monoxide. When a fault signal was recognised the LED on the CO detector illuminated Yellow as well as an audible beep. The LCD screen on the CO detector also indicated "Err".

### **5.4.3 Assessment**

The requirements of Clause 4.4 were met.



## **5.5 Output Signals**

### **5.5.1 Test procedure**

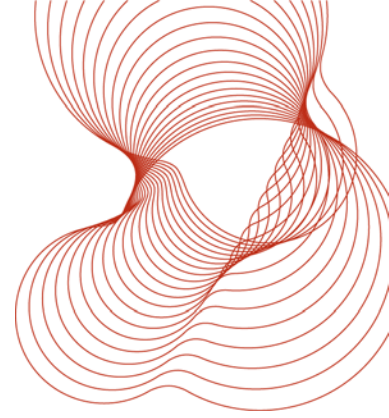
The requirements were assessed by inspection and test in accordance with Clause 4.5 of EN 50291-1:2010.

### **5.5.2 Inspection**

The LM-201A CO detector is a Type B device.

### **5.5.3 Assessment**

The requirements of Clause 4.5 were not applicable.



## **5.6 Software Controlled Apparatus**

### **5.6.1 Test procedure**

The requirements were assessed by inspection and test in accordance with Clause 4.6 of EN 50291-1:2010.

### **5.6.2 Inspection**

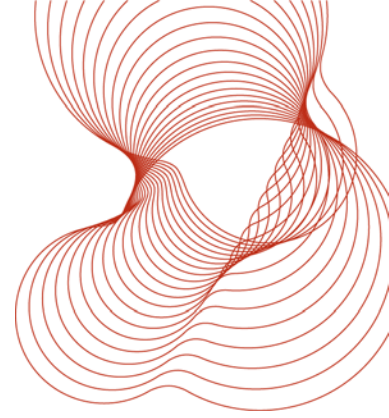
In the design of software controlled apparatus, the risks arising from faults in the programme shall be taken into account.

The LM-201A shall fulfil the requirements of EN 50271:2010.

Reference Software report: TE274114-SW.

### **5.6.3 Assessment**

The requirements of Clause 4.6 were met.



## 5.7 Labelling

### 5.7.1 Test procedure

The requirements were assessed by inspection in accordance with Clause 4.7.2 of EN 50291-1:2010.

### 5.7.2 Inspection

The assessment was based on the inspection of label drawing number: LM-201A-0013 Revision B/0

CO Alarm Marking		
Item	Marked	Details / Data Ref.
a) Name/trademark	Yes	Ningbo Longmax Electronic Co Ltd
b) Model designation and type of gas	Yes	LM-201A Carbon Monoxide
c) The European standard number	Yes	EN 50291-1:2010
d) Type A or B apparatus	Yes	Type B
e) Batch code	Yes	Oct 2012
g) Type and size of replacement batteries	Yes	LR6 Alkaline 1.5V Battery x 3
h) Recommendations for replacement procedures and lifetime of the apparatus	Yes	5 years

### 5.7.3 Comments

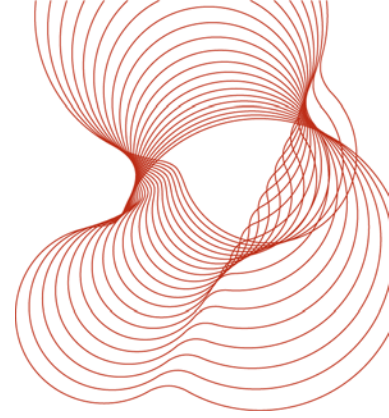
Markings on the device that used symbols or abbreviations not in common use were explained in the data supplied with the device.

The markings b) and h) were clearly visible with the apparatus in a typical installed position. The markings were legible and complied with Clauses 7.6 and 7.14 of EN 60335-1:2002+A15:2011.

### 5.7.4 Assessment

The requirements of Clause 4.7.2 were met.





## **5.8 Caution**

### **5.8.1 Test procedure**

The requirements were assessed by inspection in accordance with Clause 4.7.3 of EN 50291-1:2010.

### **5.8.2 Inspection**

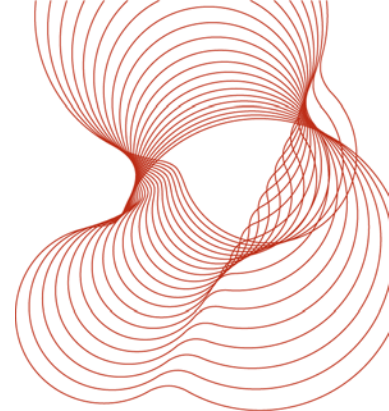
The inspection was based on an assessment of label drawing No LM-201A-0013 Revision B/0

The label contained the following warning:

<p>“Caution”.</p> <p>“Read these instructions carefully before operating or servicing”.</p>
---

### **5.8.3 Assessment**

The requirements of Clause 4.7.3 were met.



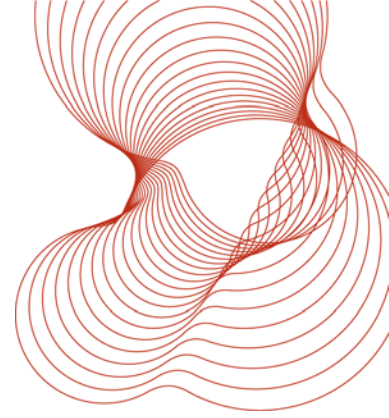
## Instruction Booklet

### 5.8.4 Test procedure

The requirements were assessed by inspection in accordance with Clause 4.7.4 of EN 50291-1:2010.

### 5.8.5 Inspection

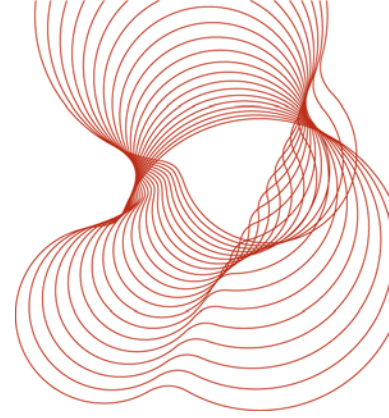
Instruction booklet		
Item	Marked	Details / Data Ref.
a) For mains powered apparatus:- operating voltage, frequency, fuse rating and method of connection.	N/A	Battery operated
b) Type and size of batteries, normal operating life, battery replacement instructions, info on low battery conditions.	Yes	Reference:QSP0701-201A-02 Edition No. B/1 2 <sup>nd</sup> September 2013 LM-201A Operating Instructions
c) Guidance on installation of apparatus.	Yes	Reference:QSP0701-201A-02 Edition No. B/1 2 <sup>nd</sup> September 2013 LM-201A Operating Instructions
d) Actions to take when in alarm.	Yes	Reference:QSP0701-201A-02 Edition No. B/1 2 <sup>nd</sup> September 2013 LM-201A Operating Instructions
e) Explanation of all warning indicators (visual and audible).	Yes	Reference:QSP0701-201A-02 Edition No. B/1 2 <sup>nd</sup> September 2013 LM-201A Operating Instructions
f) List of materials which may affect the reliability of the apparatus.	Yes	Reference:QSP0701-201A-02 Edition No. B/1 2 <sup>nd</sup> September 2013 LM-201A Operating Instructions
g) Warning of tamper hazards.	Yes	Reference:QSP0701-201A-02 Edition No. B/1 2 <sup>nd</sup> September 2013 LM-201A Operating Instructions
h) Instructions on test procedures.	Yes	Reference:QSP0701-201A-02 Edition No. B/1 2 <sup>nd</sup> September 2013 LM-201A Operating Instructions
i) The expected lifetime of the apparatus.	Yes	Reference:QSP0701-201A-02 Edition No. B/1 2 <sup>nd</sup> September 2013 LM-201A Operating Instructions
j) Instructions for output signal (Type A only).	N/A	Type B device
k) Working ranges of temperature and humidity.	Yes	Reference:QSP0701-201A-02 Edition No. B/1 2 <sup>nd</sup> September 2013 LM-201A Operating Instructions
l) The alarm conditions.	Yes	Reference:QSP0701-201A-02 Edition No. B/1 2 <sup>nd</sup> September 2013 LM-201A Operating Instructions
m) The effects of CO on the human body.	Yes	Reference:QSP0701-201A-02 Edition No. B/1 2 <sup>nd</sup> September 2013 LM-201A Operating Instructions



Instruction booklet		
Item	Marked	Details / Data Ref.
n) Warning on the correct maintenance of fuel burning appliances.	Yes	Reference:QSP0701-201A-02 Edition No. B/1 2 <sup>nd</sup> September 2013 LM-201A Operating Instructions

#### 5.8.6 Assessment

The requirements of Clause 4.7.4 were met.



## Packaging

### 5.8.6.1 Test procedure

The requirements were assessed by inspection in accordance with Clause 4.7.5 of EN 50291-1:2010.

### 5.8.6.2 Inspection

The LM-201A apparatus packaging reference: Document LM-201A-0041 Version V1.0 28<sup>th</sup> November 2012 included the following:

- A warning that the apparatus should be installed by a competent person.
- Relevant information regarding storage and transport.

Warning: To ensure that the apparatus can be correctly used, it must be installed by a competent person.  
Storage temperature: -20°C to 50°C ± 2°C  
Storage humidity: 0%RH to 70%RH

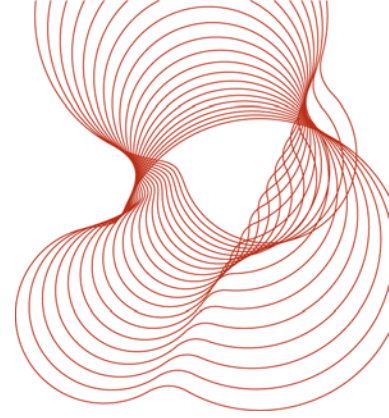
Air should be kept clean. Transport vehicles should maintain clean sanitation. The apparatus cannot be transported with pollutants. Please pay attention to prevent the apparatus from drop, knock, extrusion during handling process.

The LM-201A apparatus packaging also clearly displayed the following:

The apparatus is designed to protect individuals from the acute effects of carbon monoxide exposure. It will not fully safeguard individuals with specific medical conditions. If in doubt consult a medical practitioner.

### 5.8.6.3 Assessment

The requirements of Clause 4.7.5 were met.



## **Unpowered storage**

### **5.8.6.4 Test procedure**

The requirements were assessed by inspection in accordance with Clause 5.3.2 of EN 50291-1:2010.

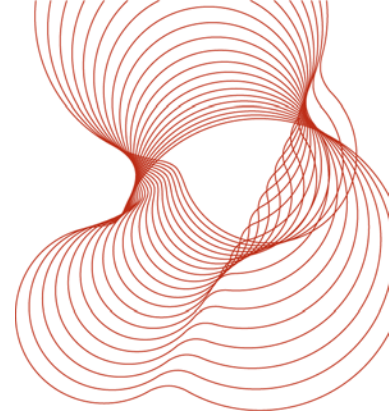
### **5.8.6.5 Inspection**

All 12 samples were subjected to the test temperatures specified.

The above samples were then used for testing to Clauses 5.3.4 to 5.3.13.

### **5.8.6.6 Assessment**

The requirements of Clause 5.3.2 were met.



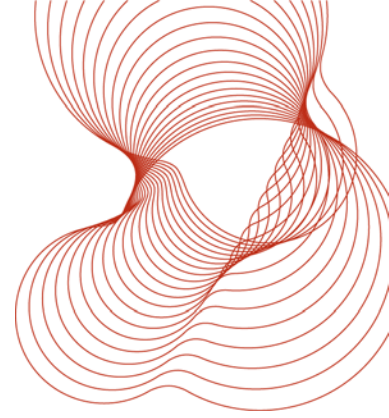
## 5.9 Alarm Conditions

### 5.9.1 Test procedure

The test was carried out in accordance with Clause 5.3.4 of EN 50291-1:2010.

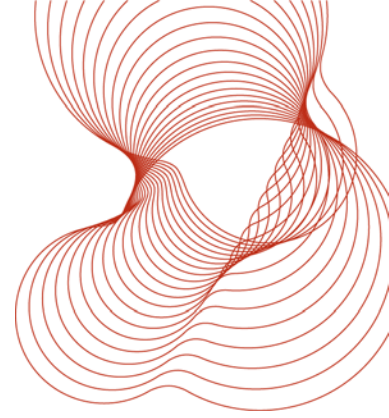
### 5.9.2 Inspection

Alarm Conditions						
Specimen № 1						
Nominal CO concentration (ppm)	Actual CO concentration (ppm)	Exposure period (min)	Required response and time	CO alarm response	Time of Response (hrs:min:s)	Pass/Fail
30	30	120	Alarm >120mins	No Alarm	-	Pass
Clean air	0	15	Recover <6min	Quiescent	-	Pass
50	52	90	Alarm 60-90min	Alarm	1:15:07	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass
100	100	40	Alarm 10-40min	Alarm	0:19:35	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass
300	302	3	Alarm < 3min	Alarm	0:01:22	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass



Alarm Conditions						
Specimen № 2						
Nominal CO concentration (ppm)	Actual CO concentration (ppm)	Exposure period (min)	Required response and time	CO alarm response	Time of Response (hrs:min:s)	Pass/Fail
30	30	120	Alarm >120mins	No Alarm	-	Pass
Clean air	0	15	Recover <6min	Quiescent	-	Pass
50	50	90	Alarm 60-90min	Alarm	1:18:22	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass
100	102	40	Alarm 10-40min	Alarm	0:21:30	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass
300	306	3	Alarm < 3min	Alarm	0:01:57	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass

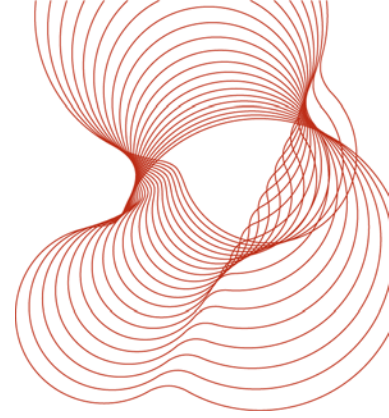
Alarm Conditions						
Specimen № 3						
Nominal CO concentration (ppm)	Actual CO concentration (ppm)	Exposure period (min)	Required response and time	CO alarm response	Time of Response (hrs:min:s)	Pass/Fail
30	30	120	Alarm >120mins	No Alarm	-	Pass
Clean air	0	15	Recover <6min	Quiescent	-	Pass
50	50	90	Alarm 60-90min	Alarm	1:15:23	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass
100	100	40	Alarm 10-40min	Alarm	0:20:33	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass
300	300	3	Alarm < 3min	Alarm	0:01:29	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass



Alarm Conditions						
Specimen № 4						
Nominal CO concentration (ppm)	Actual CO concentration (ppm)	Exposure period (min)	Required response and time	CO alarm response	Time of Response (hrs:min:s)	Pass/Fail
30	30	120	Alarm >120mins	No Alarm	-	Pass
Clean air	0	15	Recover <6min	Quiescent	-	Pass
50	53	90	Alarm 60-90min	Alarm	1:17:10	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass
100	100	40	Alarm 10-40min	Alarm	0:22:02	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass
300	302	3	Alarm < 3min	Alarm	0:02:12	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass

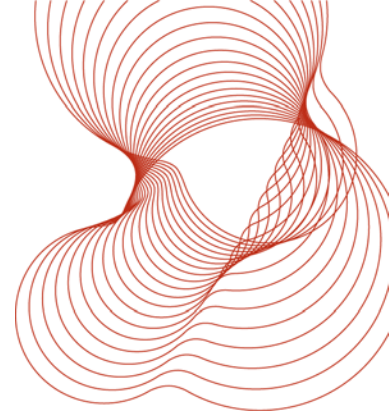
Alarm Conditions						
Specimen № 5						
Nominal CO concentration (ppm)	Actual CO concentration (ppm)	Exposure period (min)	Required response and time	CO alarm response	Time of Response (hrs:min:s)	Pass/Fail
30	30	120	Alarm >120mins	No Alarm	-	Pass
Clean air	0	15	Recover <6min	Quiescent	-	Pass
50	52	90	Alarm 60-90min	Alarm	1:12:12	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass
100	100	40	Alarm 10-40min	Alarm	0:20:11	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass
300	302	3	Alarm < 3min	Alarm	0:01:02	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass





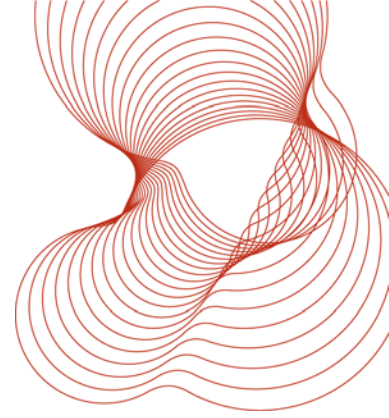
Alarm Conditions						
Specimen № 6						
Nominal CO concentration (ppm)	Actual CO concentration (ppm)	Exposure period (min)	Required response and time	CO alarm response	Time of Response (hrs:min:s)	Pass/Fail
30	30	120	Alarm >120mins	No Alarm	-	Pass
Clean air	0	15	Recover <6min	Quiescent	-	Pass
50	52	90	Alarm 60-90min	Alarm	1:10:33	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass
100	100	40	Alarm 10-40min	Alarm	0:22:33	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass
300	302	3	Alarm < 3min	Alarm	0:02:10	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass

Alarm Conditions						
Specimen № 7						
Nominal CO concentration (ppm)	Actual CO concentration (ppm)	Exposure period (min)	Required response and time	CO alarm response	Time of Response (hrs:min:s)	Pass/Fail
30	30	120	Alarm >120mins	No Alarm	-	Pass
Clean air	0	15	Recover <6min	Quiescent	-	Pass
50	52	90	Alarm 60-90min	Alarm	1:16:12	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass
100	100	40	Alarm 10-40min	Alarm	0:21:15	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass
300	302	3	Alarm < 3min	Alarm	0:01:38	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass



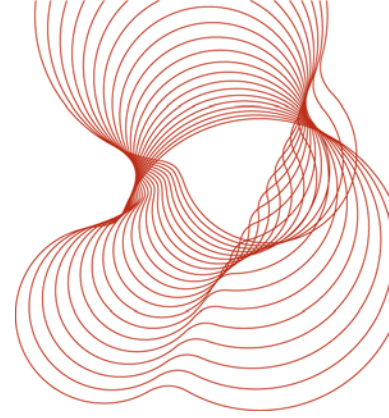
Alarm Conditions						
Specimen № 8						
Nominal CO concentration (ppm)	Actual CO concentration (ppm)	Exposure period (min)	Required response and time	CO alarm response	Time of Response (hrs:min:s)	Pass/Fail
30	32	120	Alarm >120mins	No Alarm	-	Pass
Clean air	0	15	Recover <6min	Quiescent	-	Pass
50	52	90	Alarm 60-90min	Alarm	1:18:15	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass
100	100	40	Alarm 10-40min	Alarm	0:20:34	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass
300	302	3	Alarm < 3min	Alarm	0:02:46	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass

Alarm Conditions						
Specimen № 9						
Nominal CO concentration (ppm)	Actual CO concentration (ppm)	Exposure period (min)	Required response and time	CO alarm response	Time of Response (hrs:min:s)	Pass/Fail
30	30	120	Alarm >120mins	No Alarm	-	Pass
Clean air	0	15	Recover <6min	Quiescent	-	Pass
50	52	90	Alarm 60-90min	Alarm	1:10:22	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass
100	100	40	Alarm 10-40min	Alarm	0:22:02	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass
300	302	3	Alarm < 3min	Alarm	0:01:52	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass



Alarm Conditions						
Specimen № 10						
Nominal CO concentration (ppm)	Actual CO concentration (ppm)	Exposure period (min)	Required response and time	CO alarm response	Time of Response (hrs:min:s)	Pass/Fail
30	30	120	Alarm >120mins	No Alarm	-	Pass
Clean air	0	15	Recover <6min	Quiescent	-	Pass
50	52	90	Alarm 60-90min	Alarm	1:17:44	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass
100	100	40	Alarm 10-40min	Alarm	0:22:42	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass
300	302	3	Alarm < 3min	Alarm	0:02:33	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass

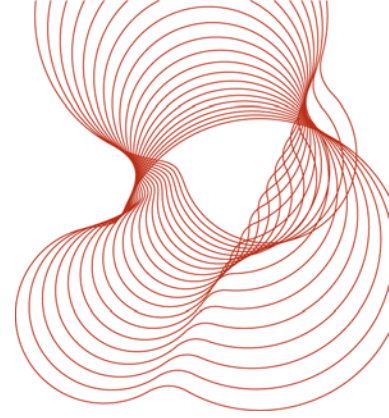
Alarm Conditions						
Specimen № 11						
Nominal CO concentration (ppm)	Actual CO concentration (ppm)	Exposure period (min)	Required response and time	CO alarm response	Time of Response (hrs:min:s)	Pass/Fail
30	30	120	Alarm >120mins	No Alarm	-	Pass
Clean air	0	15	Recover <6min	Quiescent	-	Pass
50	50	90	Alarm 60-90min	Alarm	1:11:12	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass
100	102	40	Alarm 10-40min	Alarm	0:21:29	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass
300	306	3	Alarm < 3min	Alarm	0:01:35	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass



Alarm Conditions						
Specimen № 12						
Nominal CO concentration (ppm)	Actual CO concentration (ppm)	Exposure period (min)	Required response and time	CO alarm response	Time of Response (hrs:min:s)	Pass/Fail
30	32	120	Alarm >120mins	No Alarm	-	Pass
Clean air	0	15	Recover <6min	Quiescent	-	Pass
50	50	90	Alarm 60-90min	Alarm	1:17:02	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass
100	102	40	Alarm 10-40min	Alarm	0:22:17	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass
300	308	3	Alarm < 3min	Alarm	0:02:44	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass

### 5.9.3 Assessment

The requirements of Clause 5.3.4 were met on Submission 2.



## 5.10 Alarm during warm-up

### 5.10.1 Test procedure

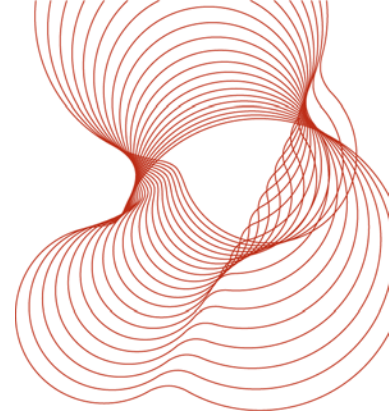
The test was carried out in accordance with Clause 5.3.5 of EN 50291-1:2010.

### 5.10.2 Inspection

Test requirements	Specimen №	Response Time (hrs:mins:secs)	Pass/Fail
Following the introduction of test gas D, the CO detector went into alarm < 15 minutes.	10	0:01:47	Pass
Following the introduction of test gas D, the CO detector went into alarm < 15 minutes.	11	0:03:08	Pass
Following the introduction of test gas D, the CO detector went into alarm < 15 minutes.	12	0:05:26	Pass

### 5.10.3 Assessment

The requirements of Clause 5.3.5 were met.



## 5.11 Response and recovery to a high test gas volume ratio

### 5.11.1 Test procedure

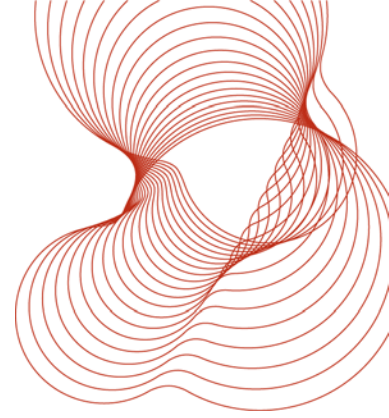
The test was carried out in accordance with Clause 5.3.6 of EN 50291-1:2010.

### 5.11.2 Measurements

Sample №	Response time (hrs:min:sec)			Recovery time (hrs:min:sec)	
	Clean air 15 minutes	5000ppm CO for 15 minutes	Test gas B for 90 minutes	Following 5000ppm CO test	Following Test gas B
10	No Alarm	Alarm < 0:3:0	1:16:22	0:01:25	<6:00
11	No Alarm	Alarm < 0:3:0	1:12:32	0:01:42	<6:00
12	No Alarm	Alarm < 0:3:0	1:18:10	0:02:05	<6:00

### 5.11.3 Assessment

The requirements of Clause 5.3.6 were met.



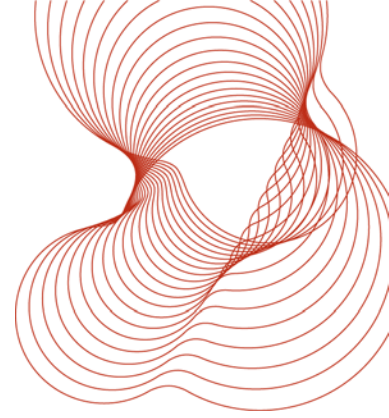
## 5.12 Temperature effects

### 5.12.1 Test procedure

The test was carried out in accordance with Clause 5.3.7 of EN 50291-1:2010.

### 5.12.2 Measurements

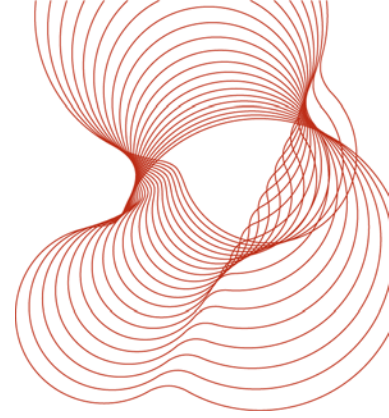
Test Temperature (-10±1°C)						
Specimen № 10						
Nominal CO concentration (ppm)	Actual CO concentration (ppm)	Exposure period (min)	Required response and time	CO alarm response	Time of Response (hrs:min:s)	Pass/Fail
30	30	120	Alarm >120mins	No Alarm	-	Pass
Clean air	0	15	Recover <6min	Quiescent	-	Pass
50	50	90	Alarm 60-90min	Alarm	1:17:50	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass
100	104	40	Alarm 10-40min	Alarm	24:18	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass
300	302	3	Alarm < 3min	Alarm	01:11	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass



Test Temperature (-10±1°C)						
Specimen № 11						
Nominal CO concentration (ppm)	Actual CO concentration (ppm)	Exposure period (min)	Required response and time	CO alarm response	Time of Response (hrs:min:s)	Pass/Fail
30	32	120	Alarm >120mins	No Alarm	-	Pass
Clean air	0	15	Recover <6min	Quiescent	-	Pass
50	52	90	Alarm 60-90min	Alarm	1:17:22	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass
100	104	40	Alarm 10-40min	Alarm	25:10	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass
300	300	3	Alarm < 3min	Alarm	01:12	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass

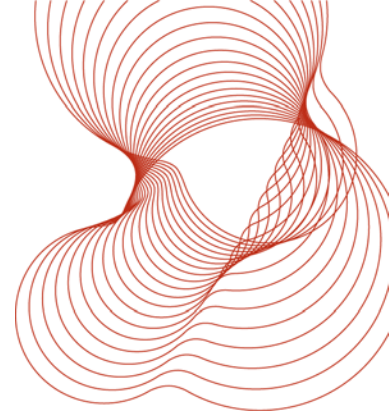
Test Temperature (-10±1°C)						
Specimen № 12						
Nominal CO concentration (ppm)	Actual CO concentration (ppm)	Exposure period (min)	Required response and time	CO alarm response	Time of Response (hrs:min:s)	Pass/Fail
30	30	120	Alarm >120mins	No Alarm	-	Pass
Clean air	0	15	Recover <6min	Quiescent	-	Pass
50	50	90	Alarm 60-90min	Alarm	1:18:12	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass
100	102	40	Alarm 10-40min	Alarm	24:35	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass
300	306	3	Alarm < 3min	Alarm	02:20	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass





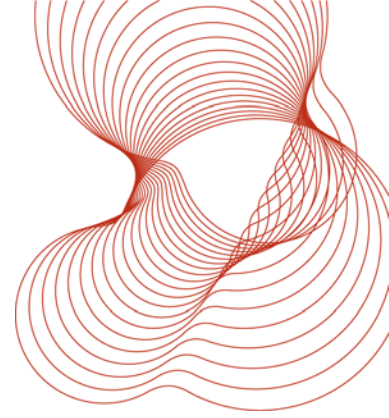
Test Temperature (21±1°C)						
Specimen № 10						
Nominal CO concentration (ppm)	Actual CO concentration (ppm)	Exposure period (min)	Required response and time	CO alarm response	Time of Response (hrs:min:s)	Pass/Fail
30	30	120	Alarm >120mins	No Alarm	-	Pass
Clean air	0	15	Recover <6min	Quiescent	-	Pass
50	54	90	Alarm 60-90min	Alarm	1:18:10	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass
100	102	40	Alarm 10-40min	Alarm	27:15	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass
300	304	3	Alarm < 3min	Alarm	0:48	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass

Test Temperature (21±1°C)						
Specimen № 11						
Nominal CO concentration (ppm)	Actual CO concentration (ppm)	Exposure period (min)	Required response and time	CO alarm response	Time of Response (hrs:min:s)	Pass/Fail
30	30	120	Alarm >120mins	No Alarm	-	Pass
Clean air	0	15	Recover <6min	Quiescent	-	Pass
50	52	90	Alarm 60-90min	Alarm	1:17:50	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass
100	102	40	Alarm 10-40min	Alarm	26:58	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass
300	306	3	Alarm < 3min	Alarm	0:49	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass



Test Temperature (21±1°C)						
Specimen № 12						
Nominal CO concentration (ppm)	Actual CO concentration (ppm)	Exposure period (min)	Required response and time	CO alarm response	Time of Response (hrs:min:s)	Pass/Fail
30	30	120	Alarm >120mins	No Alarm	-	Pass
Clean air	0	15	Recover <6min	Quiescent	-	Pass
50	54	90	Alarm 60-90min	Alarm	1:18:36	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass
100	100	40	Alarm 10-40min	Alarm	29:32	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass
300	300	3	Alarm < 3min	Alarm	02:34	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass

Test Temperature (40±1°C)						
Specimen № 10						
Nominal CO concentration (ppm)	Actual CO concentration (ppm)	Exposure period (min)	Required response and time	CO alarm response	Time of Response (hrs:min:s)	Pass/Fail
30	32	120	Alarm >120mins	No Alarm	-	Pass
Clean air	0	15	Recover <6min	Quiescent	-	Pass
50	52	90	Alarm 60-90min	Alarm	1:19:22	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass
100	104	40	Alarm 10-40min	Alarm	28:22	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass
300	304	3	Alarm < 3min	Alarm	01:09	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass

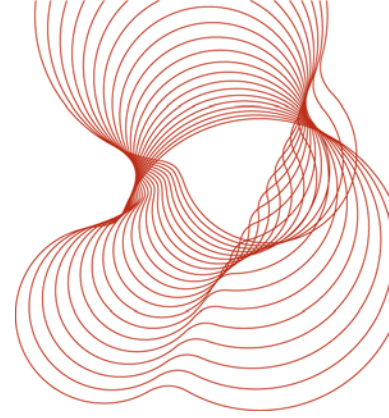


Test Temperature (40±1°C)						
Specimen № 11						
Nominal CO concentration (ppm)	Actual CO concentration (ppm)	Exposure period (min)	Required response and time	CO alarm response	Time of Response (hrs:min:s)	Pass/Fail
30	30	120	Alarm >120mins	No Alarm	-	Pass
Clean air	0	15	Recover <6min	Quiescent	-	Pass
50	50	90	Alarm 60-90min	Alarm	1:20:38	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass
100	102	40	Alarm 10-40min	Alarm	27:55	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass
300	302	3	Alarm < 3min	Alarm	01:26	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass

Test Temperature (40±1°C)						
Specimen № 12						
Nominal CO concentration (ppm)	Actual CO concentration (ppm)	Exposure period (min)	Required response and time	CO alarm response	Time of Response (hrs:min:s)	Pass/Fail
30	30	120	Alarm >120mins	No Alarm	-	Pass
Clean air	0	15	Recover <6min	Quiescent	-	Pass
50	52	90	Alarm 60-90min	Alarm	1:18:54	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass
100	104	40	Alarm 10-40min	Alarm	28:49	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass
300	304	3	Alarm < 3min	Alarm	02:10	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass

### 5.12.3 Assessment

The requirements of Clause 6.2 were met on Submission 2.



## **5.13 Humidity effects**

### **5.13.1 Test procedure**

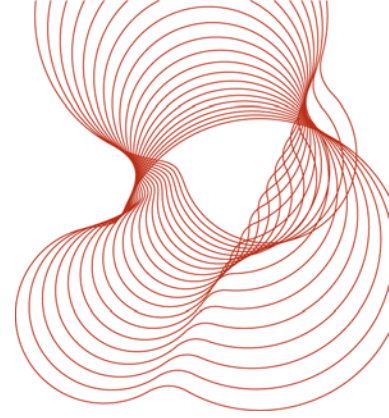
The test was carried out in accordance with Clause 5.3.8 of EN 50291-1:2010.

### **5.13.2 Inspection**

Compliance with the requirements of this Clause was determined by Sira Environmental Ltd under a sub contract to BRE. The results of this assessment are covered by the Sira Environmental Test Report N0691 May 2013. This report indicated that the LM-201A battery operated carbon monoxide (CO) Detector Type B to EN 50291-1:2010 was compliant with the requirements of Clause 5.3.8.

### **5.13.3 Assessment**

The requirements of Clause 5.3.8 were met on Submission 2.



## 5.14 Speed of gas test

### 5.14.1 Test procedure

The test was carried out in accordance with Clause 5.3.9 of EN 50291-1:2010.

### 5.14.2 Measurements

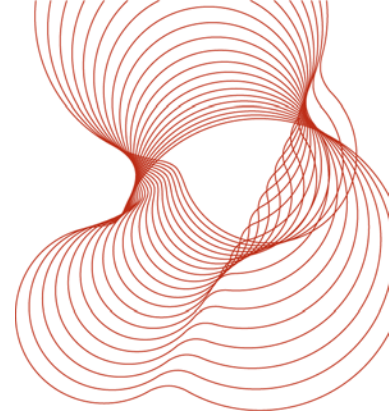
Specimen № 10 Air Speed $1.2 \pm 0.1$ m/s					
Nominal CO concentration (ppm)	Actual CO concentration (ppm)	Exposure period (min)	Required response and time	CO alarm response	Pass/Fail
30	32	120	No Alarm	No Alarm	Pass
Clean air	0	15	Recover <6min	Quiescent	Pass

Specimen № 11 Air Speed $1.2 \pm 0.1$ m/s					
Nominal CO concentration (ppm)	Actual CO concentration (ppm)	Exposure period (min)	Required response and time	CO alarm response	Pass/Fail
30	30	120	No Alarm	No Alarm	Pass
Clean air	0	15	Recover <6min	Quiescent	Pass

Specimen № 12 Air Speed $1.2 \pm 0.1$ m/s					
Nominal CO concentration (ppm)	Actual CO concentration (ppm)	Exposure period (min)	Required response and time	CO alarm response	Pass/Fail
30	30	120	No Alarm	No Alarm	Pass
Clean air	0	15	Recover <6min	Quiescent	Pass

### 5.14.3 Assessment

The requirements of Clause 5.3.9 were met.



## **5.15 Electromagnetic compatibility**

### **5.15.1 Test procedure**

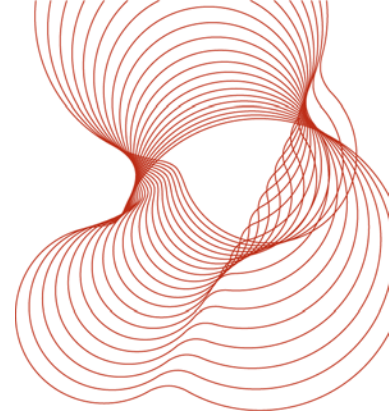
The test was carried out in accordance with Clause 5.3.11 of EN 50291-1:2010.

### **5.15.2 Measurements**

The LM-201A battery operated carbon monoxide (CO) Detector Type B met the requirements of Radiated Immunity, Radiated Emissions, and Electrostatic Discharge (ESD) tests in accordance with EN 50270:2010 on the third submission.

### **5.15.3 Assessment**

The requirements of Clause 5.3.11 were met on Submission 3.



## **5.16 Response to mixtures of carbon monoxide and other gases**

### **5.16.1 Test procedure**

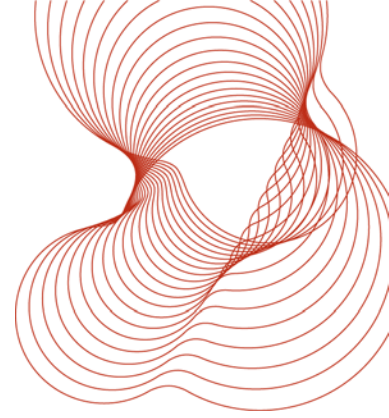
The test was carried out in accordance with Clause 5.3.12 of EN 50291-1:2010.

### **5.16.2 Inspection**

Compliance with the requirements of this Clause was determined by Sira Environmental Ltd under a sub contract to BRE. The results of this assessment are covered by the Sira Environmental Test Report N0691 May 2013. This report indicated that the LM-201A battery operated carbon monoxide (CO) Detector Type B was compliant with the requirements of Clause 5.3.12.

### **5.16.3 Assessment**

The requirements of Clause 5.3.12 were met on Submission 2.



## **5.17 The effects of other gases**

### **5.17.1 Test procedure**

The test was carried out in accordance with Clause 5.3.13 of EN 50291-1:2010.

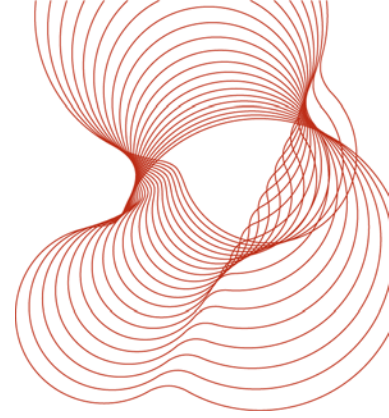
### **5.17.2 Inspection**

Compliance with the requirements of this Clause was determined by Sira Environmental Ltd under a sub contract to BRE. The results of this assessment are covered by the Sira Environmental Test Report N0691 May 2013. This report indicated that the LM-201A battery operated carbon monoxide (CO) Detector Type B was compliant with the requirements of Clause 5.3.13.

### **5.17.3 Assessment**

The requirements of Clause 5.3.13 were met on Submission 2.





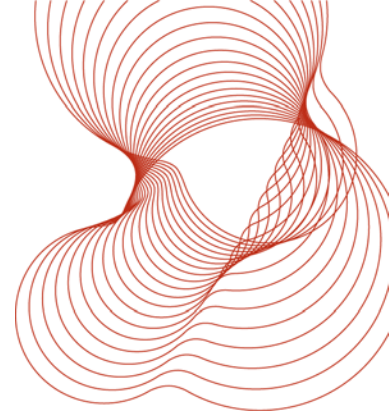
## 5.18 Long term stability

### 5.18.1 Test procedure

The test was carried out in accordance with Clause 5.3.14 of EN 50291-1:2010.

### 5.18.2 Measurements

Long Term Stability 1–30 days						
Specimen № 1						
Nominal CO concentration (ppm)	Actual CO concentration (ppm)	Exposure period (min)	Required response and time	CO alarm response	Time of Response (hrs:min:s)	Pass/Fail
30	30	120	Alarm >120mins	No Alarm	-	Pass
Clean air	0	15	Recover <6min	Quiescent	-	Pass
50	50	90	Alarm 60-90min	Alarm	1:16:22	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass
100	102	40	Alarm 10-40min	Alarm	0:27:35	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass
300	306	3	Alarm < 3min	Alarm	0:02:38	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass

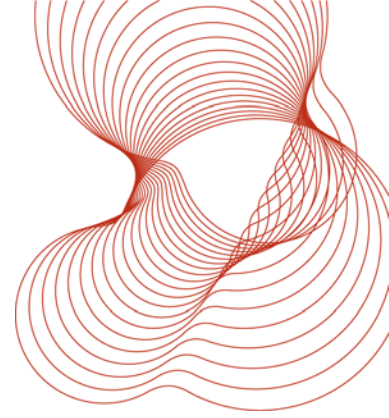


Long Term Stability 31–60 days						
Specimen № 1						
Nominal CO concentration (ppm)	Actual CO concentration (ppm)	Exposure period (min)	Required response and time	CO alarm response	Time of Response (hrs:min:s)	Pass/Fail
30	32	120	Alarm >120mins	No Alarm	-	Pass
Clean air	0	15	Recover <6min	Quiescent	-	Pass
50	50	90	Alarm 60-90min	Alarm	1:18:38	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass
100	104	40	Alarm 10-40min	Alarm	0:22:08	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass
300	300	3	Alarm < 3min	Alarm	0:02:49	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass

Long Term Stability 61–90 days						
Specimen № 1						
Nominal CO concentration (ppm)	Actual CO concentration (ppm)	Exposure period (min)	Required response and time	CO alarm response	Time of Response (hrs:min:s)	Pass/Fail
30	30	120	Alarm >120mins	No Alarm	-	Pass
Clean air	0	15	Recover <6min	Quiescent	-	Pass
50	52	90	Alarm 60-90min	Alarm	1:19:09	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass
100	102	40	Alarm 10-40min	Alarm	0:24:16	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass
300	304	3	Alarm < 3min	Alarm	0:02:41	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass

### 5.18.3 Assessment

The requirements of Clause 5.3.14 were met.



## **5.19 Alarm sound level**

### **5.19.1 Test procedure**

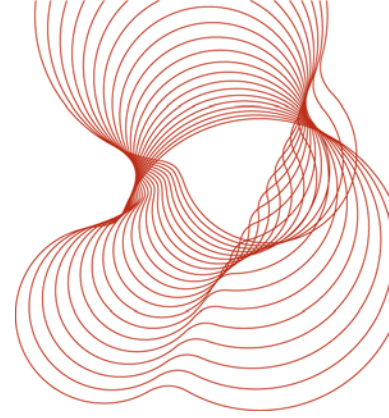
The test was carried out in accordance with Clause 5.3.16 of EN 50291-1:2010 and EN 60704-1.

### **5.19.2 Measurements**

The sound output level of Specimen № 8 when measured at a distance of 1m in accordance with Clause 5.3.16 and EN 60704-1:1997, measured a sound level of 89.8dB (A).

### **5.19.3 Assessment**

The requirements of Clause 5.3.16 were met.



## **5.20 Degree of protection**

### **5.20.1 Test procedure**

The test was carried out in accordance with Clauses 5.3.17 of EN 50291-1:2010.

### **5.20.2 Measurements**

The LM-201A battery operated carbon monoxide (CO) Detector met the requirements of the above Clause on the first submission.

#### **1. Protection against water as indicated by the second characteristic numeral.**

There were no signs of water in the enclosure of Specimen № 14 following the protection against water test.

Following the water ingress test there were miniscule droplets of water found within the LM-201A CO Detector. Using the acceptance conditions (Clause 14.3 – EN 60529:1991), the general consensus and interpretation is that although there was water present inside the battery compartment and a small quantity collected within the inner housing of the detector, due to the drainage slots provided, excess water would then drain out of the device before it would impair the correct operation of the CO detector.

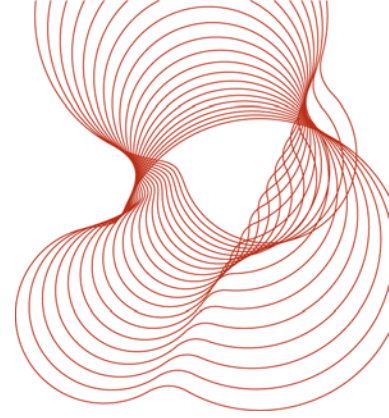
During conditioning the CO detector continued to operate correctly without interruptions.

#### **2. Protection against hazardous parts as indicated by the additional letter.**

It was not possible for a 1mm wire probe to access hazardous parts.

### **5.20.3 Assessment**

The requirements of Clause 5.3.17 were met.



## 5.21 Mechanical strength

### 5.21.1 Test procedure

The test was carried out in accordance with Clause 5.3.18 of EN 50291-1:2010.

### 5.21.2 Measurements

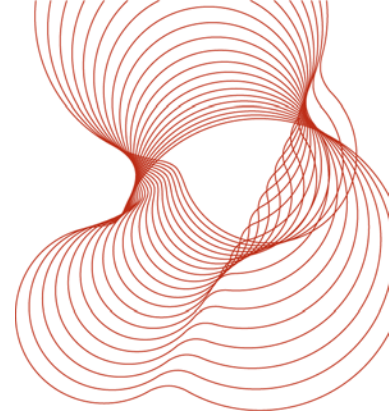
The LM-201A battery operated CO Detector Type B to EN 50291-1:2010 was tested in accordance with the test procedure specified in Clause 21 of EN 60335-1:2002+A15:2011.

Following the test there were no signs of any mechanical damage and the CO detector functioned correctly for the full duration of the test. There were no registered fault or false alarm conditions.

Mechanical Strength						
Specimen № 8						
Nominal CO concentration (ppm)	Actual CO concentration (ppm)	Exposure period (min)	Required response and time	CO alarm response	Time of Response (hrs:min:s)	Pass/Fail
30	30	120	Alarm >120mins	No Alarm	-	Pass
Clean air	0	15	Recover <6min	Quiescent	-	Pass
50	52	90	Alarm 60-90min	Alarm	1:12:44	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass
100	102	40	Alarm 10-40min	Alarm	0:22:38	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass
300	304	3	Alarm < 3min	Alarm	0:02:44	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass

### 5.21.3 Assessment

The requirements of Clause 5.3.18 were met.



## 5.22 Battery fault warning

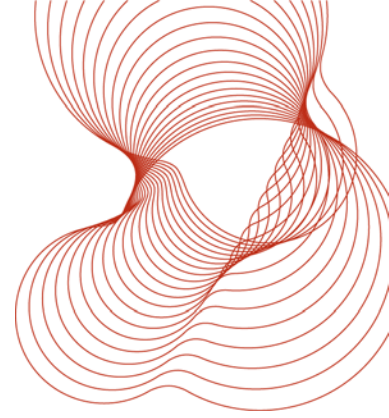
### 5.22.1 Test procedure

The test was carried out in accordance with Clause 6.1 of EN 50291-1:2010.

### 5.22.2 Measurements

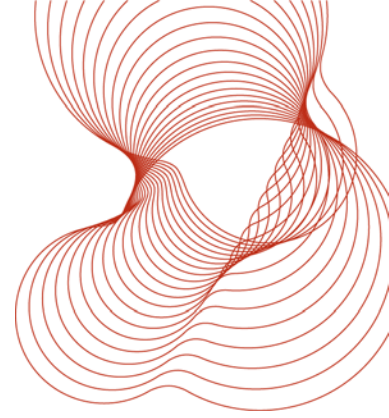
Specimen № 10	
Battery warning given by $U_E$ VDC	$U_E + 0.1$ VDC
$U_E = 3.6$ VDC	3.7 VDC

Alarm Conditions Test Voltage 3.7 VDC						
Specimen № 10						
Nominal CO concentration (ppm)	Actual CO concentration (ppm)	Exposure period (min)	Required response and time	CO alarm response	Time of Response (hrs:min:s)	Pass/Fail
30	30	120	Alarm >120mins	No Alarm	-	Pass
Clean air	0	15	Recover <6min	Quiescent	-	Pass
50	52	90	Alarm 60-90min	Alarm	1:14:12	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass
100	104	40	Alarm 10-40min	Alarm	0:21:40	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass
300	300	3	Alarm < 3min	Alarm	0:02:15	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass



Specimen № 11	
Battery warning given by $U_E$ VDC	$U_E + 0.1$ VDC
$U_E = 3.6$ VDC	3.7 VDC

Alarm Conditions Test Voltage 3.7 VDC						
Specimen № 11						
Nominal CO concentration (ppm)	Actual CO concentration (ppm)	Exposure period (min)	Required response and time	CO alarm response	Time of Response (hrs:min:s)	Pass/Fail
30	32	120	Alarm >120mins	No Alarm	-	Pass
Clean air	0	15	Recover <6min	Quiescent	-	Pass
50	50	90	Alarm 60-90min	Alarm	1:13:26	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass
100	102	40	Alarm 10-40min	Alarm	0:26:52	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass
300	302	3	Alarm < 3min	Alarm	0:02:52	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass



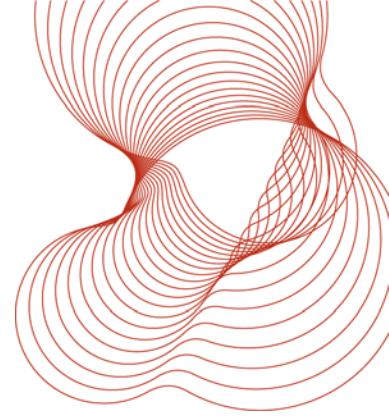
Specimen № 12	
Battery warning given by $U_E$ VDC	$U_E + 0.1$ VDC
$U_E = 3.6$ VDC	3.7 VDC

Alarm Conditions Test Voltage 3.7 VDC						
Specimen № 12						
Nominal CO concentration (ppm)	Actual CO concentration (ppm)	Exposure period (min)	Required response and time	CO alarm response	Time of Response (hrs:min:s)	Pass/Fail
30	30	120	Alarm >120mins	No Alarm	-	Pass
Clean air	0	15	Recover <6min	Quiescent	-	Pass
50	50	90	Alarm 60-90min	Alarm	1:20:11	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass
100	102	40	Alarm 10-40min	Alarm	0:27:12	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass
300	306	3	Alarm < 3min	Alarm	0:02:35	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass

### 5.22.3 Assessment

The requirements of Clause 6.1 were met.





## **5.23 Battery capacity**

### **5.23.1.1 Test procedure**

The test was carried out in accordance with Clause 6.2 of EN 50291-1:2010.

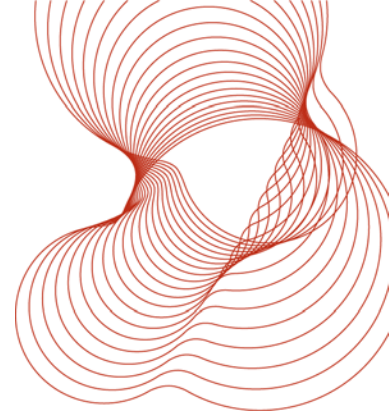
### **5.23.1.2 Inspection**

The following battery was recommended for use with the LM-201A battery operated CO Detector Type B to EN 50291-1:2010.

The latest specification of the LR6 1.5 VDC AA Alkaline Battery, was reviewed and compared with calculations and supporting data originally supplied by the manufacturer. It was confirmed that the battery capacity data and low voltage monitoring were within the performance requirements of Clause 6.2 of EN 50291-1:2010.

### **5.23.1.3 Assessment**

The requirements of Clause 6.2 were met.



## 5.24 Battery reversal

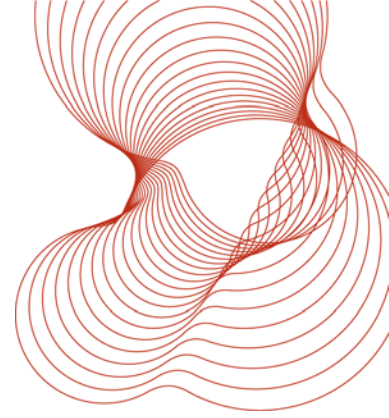
### 5.24.1 Test procedure

The test was carried out in accordance with Clause 6.3 of EN 50291-1:2010.

### 5.24.2 Measurements

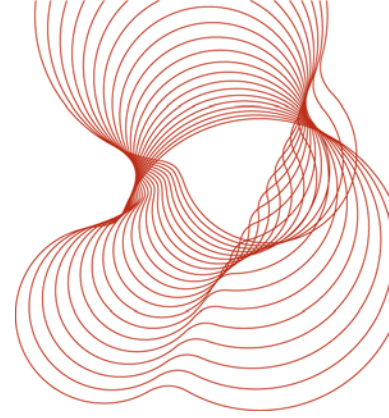
New Battery @ 4.5 VDC prior to reverse polarity						
Specimen № 10						
Nominal CO concentration (ppm)	Actual CO concentration (ppm)	Exposure period (min)	Required response and time	CO alarm response	Time of Response (hrs:min:s)	Pass/Fail
30	30	120	Alarm >120mins	No Alarm	-	Pass
Clean air	0	15	Recover <6min	Quiescent	-	Pass
50	50	90	Alarm 60-90min	Alarm	1:10:18	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass
100	100	40	Alarm 10-40min	Alarm	0:23:15	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass
300	302	3	Alarm < 3min	Alarm	0:02:55	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass

Voltage Applied ( $U_E$ 0.95)	Low Battery Warning Given Yes/ No	Pass/Fail
3.42 VDC	Yes	Pass



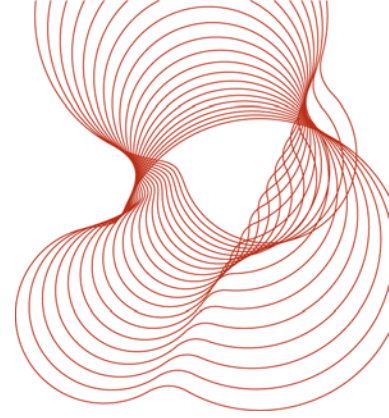
<b>New Battery @ 4.5VDC following reverse polarity for 15 seconds</b>						
<b>Specimen № 10</b>						
<b>Nominal CO concentration (ppm)</b>	<b>Actual CO concentration (ppm)</b>	<b>Exposure period (min)</b>	<b>Required response and time</b>	<b>CO alarm response</b>	<b>Time of Response (hrs:min:s)</b>	<b>Pass/Fail</b>
30	30	120	Alarm >120mins	No Alarm	-	Pass
Clean air	0	15	Recover <6min	Quiescent	-	Pass
50	52	90	Alarm 60-90min	Alarm	1:11:38	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass
100	104	40	Alarm 10-40min	Alarm	0:24:10	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass
300	300	3	Alarm < 3min	Alarm	0:02:53	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass

When the device was exposed to reverse polarity of the battery for 10-15 seconds, the power supply indicator was not activated.



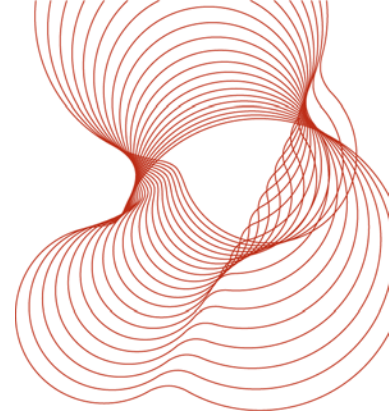
<b>New Battery @ 4.5 VDC prior to reverse polarity</b>						
<b>Specimen № 11</b>						
<b>Nominal CO concentration (ppm)</b>	<b>Actual CO concentration (ppm)</b>	<b>Exposure period (min)</b>	<b>Required response and time</b>	<b>CO alarm response</b>	<b>Time of Response (hrs:min:s)</b>	<b>Pass/Fail</b>
30	32	120	Alarm >120mins	No Alarm	-	Pass
Clean air	0	15	Recover <6min	Quiescent	-	Pass
50	50	90	Alarm 60-90min	Alarm	1:17:12	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass
100	104	40	Alarm 10-40min	Alarm	0:24:17	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass
300	306	3	Alarm < 3min	Alarm	0:02:57	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass

<b>Voltage Applied (U<sub>E</sub> 0.95)</b>	<b>Low Battery Warning Given Yes/ No</b>	<b>Pass/Fail</b>
3.42 VDC	Yes	Pass



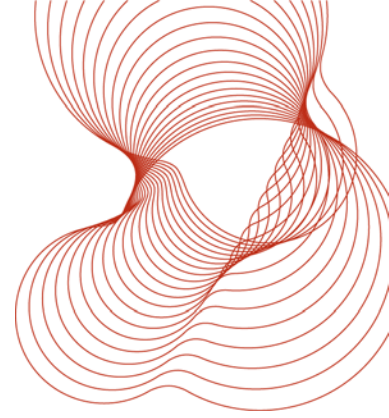
<b>New Battery @ 4.5 VDC prior to reverse polarity</b>						
<b>Specimen № 11</b>						
<b>Nominal CO concentration (ppm)</b>	<b>Actual CO concentration (ppm)</b>	<b>Exposure period (min)</b>	<b>Required response and time</b>	<b>CO alarm response</b>	<b>Time of Response (hrs:min:s)</b>	<b>Pass/Fail</b>
30	32	120	Alarm >120mins	No Alarm	-	Pass
Clean air	0	15	Recover <6min	Quiescent	-	Pass
50	50	90	Alarm 60-90min	Alarm	1:18:00	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass
100	100	40	Alarm 10-40min	Alarm	0:23:58	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass
300	306	3	Alarm < 3min	Alarm	0:02:49	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass

When the device was exposed to reverse polarity of the battery for 10-15 seconds, the power supply indicator was not activated.



<b>New Battery @ 4.5 VDC prior to reverse polarity</b>						
<b>Specimen № 12</b>						
<b>Nominal CO concentration (ppm)</b>	<b>Actual CO concentration (ppm)</b>	<b>Exposure period (min)</b>	<b>Required response and time</b>	<b>CO alarm response</b>	<b>Time of Response (hrs:min:s)</b>	<b>Pass/Fail</b>
30	30	120	Alarm >120mins	No Alarm	-	Pass
Clean air	0	15	Recover <6min	Quiescent	-	Pass
50	52	90	Alarm 60-90min	Alarm	1:12:25	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass
100	104	40	Alarm 10-40min	Alarm	0:23:56	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass
300	300	3	Alarm < 3min	Alarm	0:02:47	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass

<b>Voltage Applied (U<sub>E</sub> 0.95)</b>	<b>Low Battery Warning Given Yes/ No</b>	<b>Pass/Fail</b>
3.42 VDC	Yes	Pass

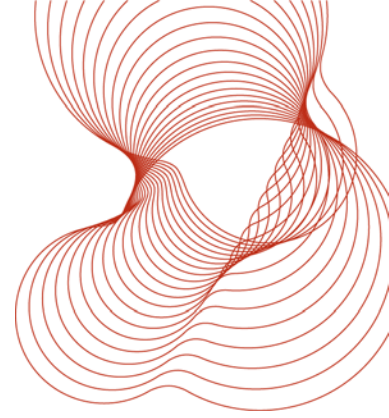


New Battery @ 4.5VDC following reverse polarity for 15 seconds						
Specimen № 12						
Nominal CO concentration (ppm)	Actual CO concentration (ppm)	Exposure period (min)	Required response and time	CO alarm response	Time of Response (hrs:min:s)	Pass/Fail
30	32	120	Alarm >120mins	No Alarm	-	Pass
Clean air	0	15	Recover <6min	Quiescent	-	Pass
50	52	90	Alarm 60-90min	Alarm	1:13:33	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass
100	102	40	Alarm 10-40min	Alarm	0:23:48	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass
300	302	3	Alarm < 3min	Alarm	0:02:56	Pass
Clean air	0	15	Recover <6min	Quiescent	<6:00	Pass

When the device was exposed to reverse polarity of the battery for 10-15 seconds, the power supply indicator was not activated.

### 5.24.3 Assessment

The requirements of Clause 6.3 were met.



## **5.25 Battery connections**

### **5.25.1 Test procedure**

The test was carried out in accordance with Clause 6.4 of EN 50291-1:2010.

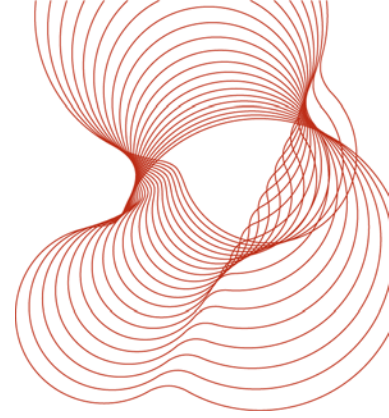
### **5.25.2 Measurements**

The LM-201A battery operated carbon monoxide (CO) Detector Type B does not contain flexible battery connecting leads therefore it was not possible to carry out the above test. The battery connecting terminals on the LM-201A battery operated carbon monoxide (CO) Detector Type B to EN 50291-1:2010 are soldered metal connectors fixed in position.

### **5.25.3 Assessment**

The requirements of Clause 6.4 were not applicable.





## 6 Non Compliances

### 6.1 Clause 5.3.4 – Alarm conditions

The requirements of Clause 5.3.4 were not met on the first submission. This was due to Specimen No.'s #2, #7, #8, and #9 all failing to go into alarm at a CO concentration level of 50ppm  $\pm$  5ppm, within the permissible time i.e. no alarm before 60 minutes and to alarm before 90 minutes.

In order to rectify the failure the manufacturer made the following modification:

- The detection time was increased, this meant that compliancy was obtained between 60-90 minutes, when the CO concentration level reached 50ppm  $\pm$  5ppm.

The requirements of Clause 5.3.4 Alarm Conditions were subsequently met on the second submission.

### 6.2 Clause 5.3.11 – Radiated Immunity

The requirements of Clause 5.3.11 were not met on the first submission. This was due to the PPM reading on the display reading 50 to 58 across a frequency band of 858.5MHz to 884MHz at 2.5V/m. The unit was in the 90 degree position and the antenna was in a vertical orientation. According to the instructions supplied by the client if the PPM reading is above 30 PPM for 120 minutes then the unit will alarm, the unit was left for 25 minutes and the reading was still in the 50 to 58 region.

In order to rectify the failure the manufacturer made the following modifications:

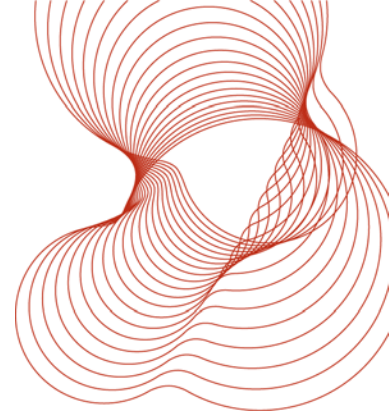
- Two capacitors C13 (1500pF), and C14 (1500pF) were positioned either side of the CO sensor U1 to alleviate the risk of RF radiation, an EMC shield was also added to the PCB, as well as three soldering pads, in order to increase the EMC performance against RF radiation.

The requirements of Clause 5.3.11 Radiated immunity were not met on the second submission. This was due to the 000 display values changing when RF was applied. The antenna was in vertical polarisation and the signal was amplitude modulated, 0deg position is when the EUT faces the antenna.

In order to rectify the failure the manufacturer made the following modifications:

- The values of C13, and C14 capacitors were changed to 470pF and 680pF respectively, as well as C11s value changing to 1500pF.
- 3 x 680nH inductors L1, L2 and L3, were added to the input of the CO sensor U1, in order to further enhance resistance to RF radiation.
- A modification was also made to the single sided side of the PCB board, which was made into a large area of double sided PCB board with an earthing lead included.

The requirements of Clause 5.3.11 Radiated Immunity were met on the third submission.



### 6.3 Clause 5.3.7.1 – Temperature Effects

The requirements of Clause 5.3.7.1 were not met on the first submission. This was due to Specimen No.10 failing to go into alarm at a CO concentration level of 300ppm  $\pm$  30ppm, within the permissible time of 3 minutes. This test took place during the -10°C phase of the test, where the actual device went into alarm at 5 minutes and 2 seconds.

In order to rectify the failures the manufacturer made the following modifications:

- The removal of the 10kohm variable resistor R18.
- Four additional components R17, R23, R6, and C12, were added to enable the temperature to be displayed on the LCD screen when the CO gas concentration is lower than 25ppm. It will display the environment temperature as well as 0ppm gas concentration, alternately when the CO concentration is higher than 25ppm, it will also lock the display gas density.
- An additional memory function was added, which shows the value, and the average value within a 24 hour period, this function is enabled by pressing the test button for a minimum of 5 seconds, which then enters into view program, the CLR key is used to clear the memory data. When the LCD screen display Ph = xxxppm, this is the highest detection value, when the LCD screen displays 24 hours = xxx this is the ppm average value of the last 24 hour period.

The requirements of Clause 5.3.7.1 Temperature effects were subsequently met on the second submission.

### 6.4 Clause 5.3.13 – Effects of other gases

The requirements of Clause 5.3.13 were not met on the first submission. This was due to Specimen No's 5 and 8 failing to operate correctly when exposed to the CO concentrations of 55ppm  $\pm$  5ppm and 330ppm  $\pm$  3ppm

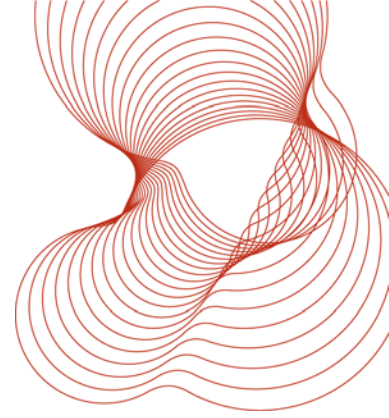
- 55ppm  $\pm$  5ppm CO concentration (alarm between 60 and 90 minutes) – Sample # 8 failed to alarm between 60 and 90 minutes (actual time was 105 minutes).
- 330ppm  $\pm$  3ppm CO concentration (alarm within 3 minutes) – Samples # 5 and # 8 both failed due to both devices failing to alarm before the 3 minutes ( Sample # 5 took 3 minutes and 7 seconds whilst Sample # 8 took 5 minutes and 15 seconds).

In addition once in alarm, when exposed to clean air the alarm must cancel within 6 minutes. Sample No. 5 failed as the alarm cancelled in 6 minutes 15 seconds after exposure to a CO concentration of 330ppm.

In order to rectify the failures the manufacturer made the following modifications:

- An amplifier was positioned into the internal sensor of U1, resulting in a gain decrease from 150 to 120, also the R11 value was changed from 510ohms to 330ohms.

The requirements of Clause 5.3.13 Effects of other gases were subsequently met on the second submission.



## 6.5 Clause 5.3.8 – Humidity Effects

The requirements of Clause 5.3.8 were not met on the first submission because Unit B failed to alarm at a CO concentration level of  $55\text{ppm} \pm 5\text{ppm}$ , also units A, B, and C failed to cancel within 6 minutes after exposure to a CO concentration level of  $330\text{ppm} \pm 3\text{ppm}$ .

In order to rectify the failures the manufacturer made the following modifications:

- The PCB was conformally coated on both sides.

The requirements of Clause 5.3.8 Humidity effects were subsequently met on the second submission.

## 6.6 Clause 5.3.12 – Response to CO and other gases

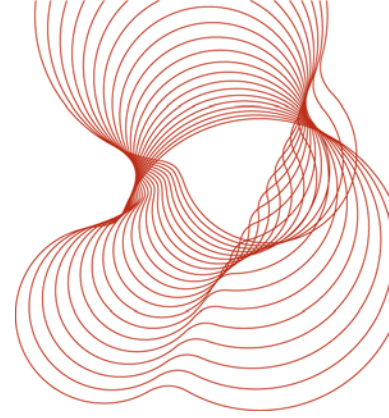
The requirements of Clause 5.3.12 were not met on the first submission. This was due to Specimen No. 8 failing to alarm within the permissible time of between (60 and 90 minutes) when exposed to the test gas CO concentration level of  $55\text{ppm} \pm 5\text{ppm}$

In addition Specimen No.6 failed to alarm between 60 and 90 minutes (actual alarm time was 97 minutes)

In order to rectify the failures the manufacturer made the following modifications:

- The PCB was conformally coated on both sides.
- The amplifier gain was modified, which resulted in the alarm time at a CO concentration level of  $55\text{ppm} \pm 5\text{ppm}$  being increased.

The requirements of Clause 5.3.12 Response to CO and other gases were subsequently met on the second submission.

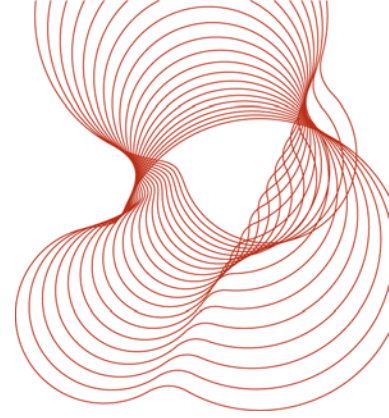


## 7 Conclusion

The Ningbo Longmax Electronic Co., Ltd LM-201A battery operated carbon monoxide (CO) Detector Type B met the requirements of a series of tests taken from EN 50291-1:2010 as specified in LPCB Test Schedule No.E122394/1.3 on the first submission, with the exception of clauses highlighted in Section 6, which were subsequently met on submissions two and three.

## Revisions

Please note that this is Revision 1 of report TE 274114. It removes an incorrect reference to a Sira report and inserts the correct reference.



## 8 References

1. EN 50291-1:2010. Electrical apparatus for the detection of carbon monoxide in domestic premises. European Committee for Standardisation. Central Secretariat: Rue de Stassart 35, B-1050 Brussels.
2. EN 60355-1:2002 + A15:2011. Safety of household and similar appliances – Part 1 General Requirements. Central Secretariat: Rue de Stassart 35, B-1050 Brussels.
3. BRE Test Report: TE274114. "Technical evaluation of the Ningbo Longmax Electronics Co., Ltd LM-201A Battery operated CO detector Type B to EN 50291:2010". BRE Global Ltd, Garston, Watford. August 2013.
4. BRE Test Report: TE274114-SW. "Software evaluation of the Ningbo Longmax Electronics Co., Ltd LM-201A Battery operated CO detector Type B to the requirements of Clause 4.6 taken from EN 50291:2010". BRE Global Ltd, Garston, Watford. August 2013.
5. E122394/1.3. Test schedule for the LPCB approval of the Ningbo Longmax Electronics Co., Ltd LM-201A Battery operated CO detector Type B to EN 50291:2010.

Trac Test Report No. TRA-008598-34-00A March 2012; "Test and evaluation report – EN60950-1:2006 Information Technology Equipment – Safety Part 1: General requirements and equivalent Clauses of EN 60335-1:2002 - Specification for safety of household and similar electrical appliances". 8 Century Court, Tolpits Lane, Watford, Hertfordshire, WD18 9RS May 2013.

6. Sira Environmental Test Report No N0685 November 2012; "BS EN 50291:2010 Effects of Other Gases for Ningbo Longmax Electronic Co Ltd Model LM201A Battery Operated Co Alarm". 12 Acorn Industrial Park, Crayford Road, Crayford, Dartford, DA1 4AL. May 2012.
7. Sira Environmental Test Report No N0691 May 2013; "BS EN 50291:2010 Performance Tests on the LM-201A Carbon Monoxide (CO) Detectors". 12 Acorn Industrial Park, Crayford Road, Crayford, Dartford, DA1 4AL. May 2013.
8. EN 60529:1991. Degree of protection provided enclosure (IP Code). Central Secretariat: Rue de Stassart 35, B-1050 Brussels.
9. EN 50271:2010 Electrical apparatus for the detection and measurement of combustible gases, toxic gases or oxygen – Requirements and test apparatus using software and/or digital technologies.
10. EN 60704-1:1997 Household and similar electrical appliances - Test code for the determination of airborne acoustical noise Part 1.General requirements. European committee for standardisation, Central Secretariat: Rue de Stassart 35, B-1050 Brussels.

=====**Report Ends**=====