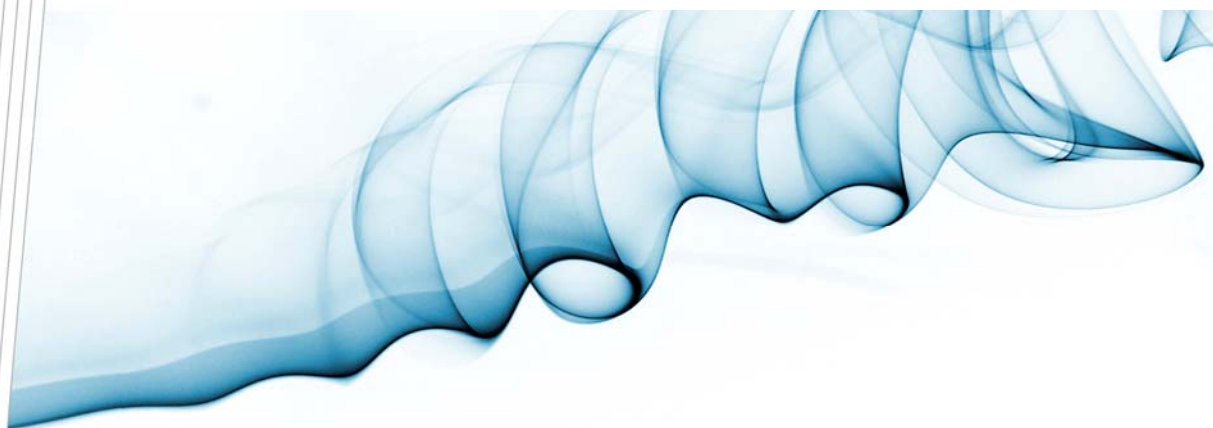




## Smoke Sensitivity Testing of Residential Smoke Alarms

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## 1 INTRODUCTION

Fire and Rescue NSW submitted samples of four different models of residential smoke alarm for Directional Dependence and Initial Sensitivity testing in accordance with AS 3786-2014.

## 2 TEST PROGRAM

The following activities were performed to evaluate the sensitivity of each model of residential smoke alarm:

- Directional Dependence (Clause 5.2) test (one test on one sample of each of the four models); and
- Initial sensitivity (alarm response threshold) test (Clause 5.3) on all samples of each model.

The results of these tests are detailed in Section 3 of this report.

### 2.1 Test Samples

A summary of the submitted samples are detailed in Table 1 of this report.

Table 1 Summary of the submitted samples of each of four models of residential smoke alarm.

| CSIRO sample identification | Client identification    | Smoke Alarm Type           |
|-----------------------------|--------------------------|----------------------------|
| XF3033/01 - XF3033/60       | P001 – P060              | Photoelectric              |
| XF3033/61 - XF3033/120      | M001 – M060              | Photoelectric              |
| XF3033/121 - XF3033/180     | D001 – D060 <sup>1</sup> | Photoelectric & Ionisation |
| XF3033/181 - XF3033/240     | I001 – I060              | Ionisation                 |

<sup>1</sup> Due to the enhanced photoelectric response to the presence of aspirated paraffin relative to ionisation chamber response, all results provided in this report related to samples D001 through D060 are expected to be due to the response of the photoelectric chamber, only. It is not possible to obtain the ionisation chamber response of this model without performing modifications to the alarm such that the photoelectric chamber is disabled prior to testing.

### 3 TEST RESULTS

#### 3.1 Directional Dependence Test Results

XF3033/01 (P001)

| Sample           | Orientation (°) | Response Threshold Value, m (dB/m) | Ambient Air Temp (°C) & Relative Humidity (%RH) | Maximum / Minimum orientation |
|------------------|-----------------|------------------------------------|---|-------------------------------|
| XF3033/01 (P001) | 0               | 0.145                              | 23/46   | Max                           |
|                  | 45              | 0.147                              | 23/45   | -                             |
|                  | 90              | 0.175                              | 23/45   | -                             |
|                  | 135             | 0.161                              | 23/46   | -                             |
|                  | 180             | 0.176                              | 23/45   | Min                           |
|                  | 225             | 0.145                              | 23/45   | -                             |
|                  | 270             | 0.153                              | 23/45   | -                             |
|                  | 315             | 0.155                              | 23/46   | -                             |

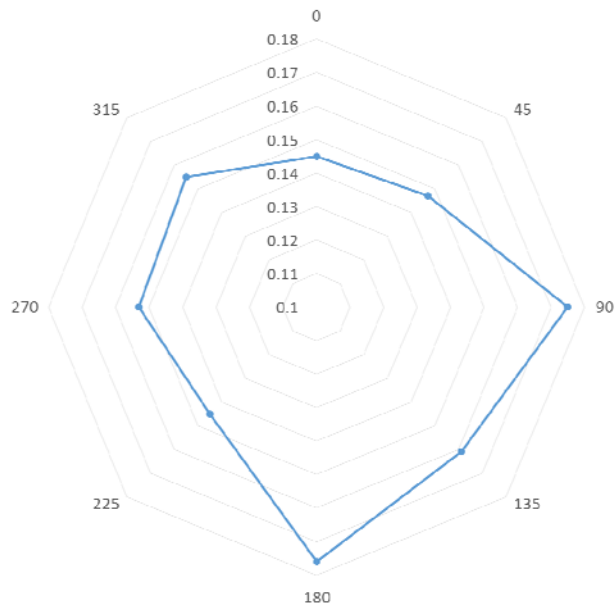


Figure 1. Polar chart of directional dependence test results of XF3033/01 (P001).

### XF3033/61 (M001)

| Sample           | Orientation (°) | Response Threshold Value, m (dB/m) | Ambient Air Temp (°C) & Relative Humidity (%RH) | Maximum / Minimum orientation |
|------------------|-----------------|------------------------------------|---|-------------------------------|
| XF3033/61 (M001) | 0               | 0.184                              | 23/46   | -                             |
|                  | 45              | 0.191                              | 23/45   | -                             |
|                  | 90              | 0.213                              | 23/45   | Min                           |
|                  | 135             | 0.205                              | 23/46   | -                             |
|                  | 180             | 0.205                              | 23/46   | -                             |
|                  | 225             | 0.185                              | 23/46   | -                             |
|                  | 270             | 0.180                              | 23/46   | -                             |
|                  | 315             | 0.176                              | 23/46   | Max                           |

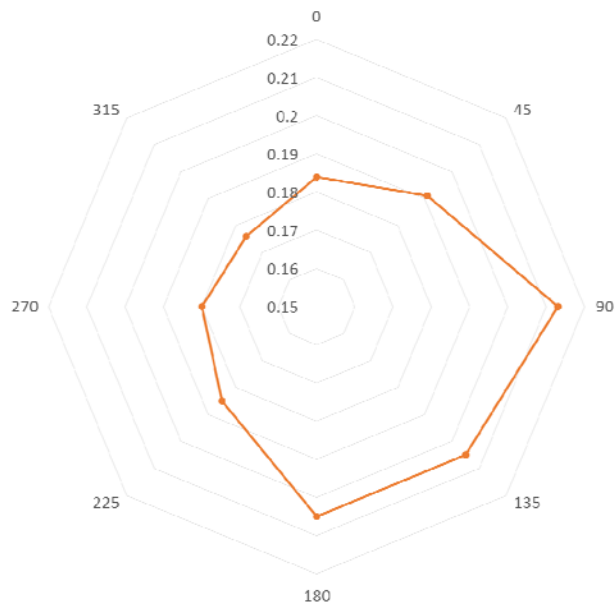


Figure 2. Polar chart of directional dependence test results of XF3033/61 (M001).

XF3033/122 (D002)

| Sample            | Orientation (°) | Response Threshold Value, m (dB/m) | Ambient Air Temp (°C) & Relative Humidity (%RH) | Maximum / Minimum orientation |
|-------------------|-----------------|------------------------------------|---|-------------------------------|
| XF3033/122 (D002) | 0               | 0.086                              | 25/41   | Max                           |
|                   | 45              | 0.094                              | 24/42   | -                             |
|                   | 90              | 0.094                              | 24/42   | -                             |
|                   | 135             | 0.096                              | 24/42   | -                             |
|                   | 180             | 0.091                              | 24/41   | -                             |
|                   | 225             | 0.110                              | 25/41   | -                             |
|                   | 270             | 0.104                              | 25/41   | -                             |
|                   | 315             | 0.111                              | 25/41   | Min                           |

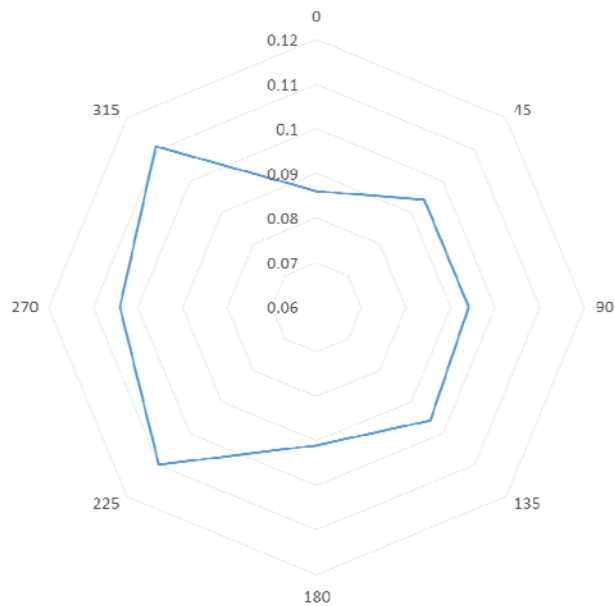


Figure 3. Polar chart of directional dependence test results of XF3033/122 (D002).

XF3033/182 (I002)

| Sample            | Orientation (°) | Response Threshold Value, y | Ambient Air Temp (°C) & Relative Humidity (%RH) | Maximum / Minimum orientation |
|-------------------|-----------------|-----------------------------|---|-------------------------------|
| XF3033/182 (I002) | 0               | 0.81                        | 24/36   | Min                           |
|                   | 45              | 0.73                        | 24/37   | -                             |
|                   | 90              | 0.72                        | 24/37   | -                             |
|                   | 135             | 0.71                        | 24/37   | -                             |
|                   | 180             | 0.70                        | 24/37   | Max                           |
|                   | 225             | 0.70                        | 24/39   | -                             |
|                   | 270             | 0.71                        | 24/41   | -                             |
|                   | 315             | 0.73                        | 24/43   | -                             |

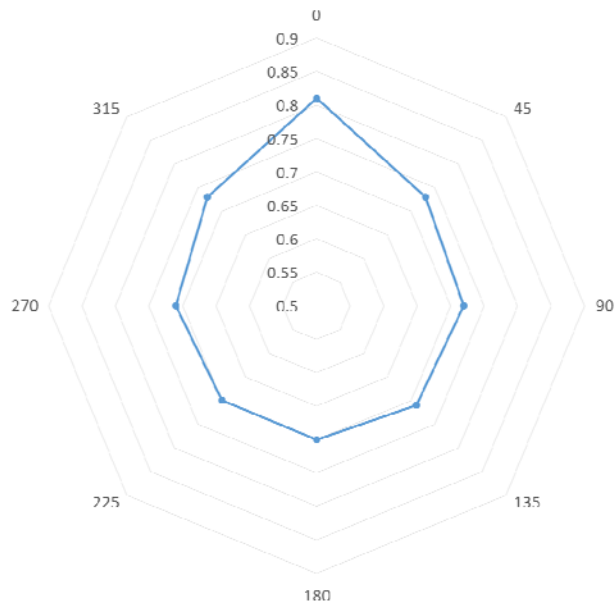


Figure 4. Polar chart of directional dependence test results of XF3033/182 (I002).



### 3.2 Initial Sensitivity Test Results

XF3033/01 (P001) through XF3033/60 (P060)

| Sample           | Orientation | Response Threshold Value (dB/m) | Ambient Air Temperature (°C) & Relative Humidity (%RH) | Requirement   |
|------------------|-------------|---------------------------------|--|---------------|
| XF3033/01 (P001) | 0°          | 0.151                           | 23/44  | m ≥ 0.05 dB/m |
| XF3033/02 (P002) | 0°          | 0.157                           | 23/44  | m ≥ 0.05 dB/m |
| XF3033/03 (P003) | 0°          | 0.137                           | 23/44  | m ≥ 0.05 dB/m |
| XF3033/04 (P004) | 0°          | 0.153                           | 23/45  | m ≥ 0.05 dB/m |
| XF3033/05 (P005) | 0°          | 0.141                           | 23/44  | m ≥ 0.05 dB/m |
| XF3033/06 (P006) | 0°          | 0.190                           | 23/44  | m ≥ 0.05 dB/m |
| XF3033/07 (P007) | 0°          | 0.136                           | 24/44  | m ≥ 0.05 dB/m |
| XF3033/08 (P008) | 0°          | 0.134                           | 24/43  | m ≥ 0.05 dB/m |
| XF3033/09 (P009) | 0°          | 0.155                           | 24/42  | m ≥ 0.05 dB/m |
| XF3033/10 (P010) | 0°          | 0.153                           | 24/44  | m ≥ 0.05 dB/m |
| XF3033/11 (P011) | 0°          | 0.186                           | 24/44  | m ≥ 0.05 dB/m |
| XF3033/12 (P012) | 0°          | 0.174                           | 24/45  | m ≥ 0.05 dB/m |
| XF3033/13 (P013) | 0°          | 0.154                           | 24/42  | m ≥ 0.05 dB/m |
| XF3033/14 (P014) | 0°          | 0.131                           | 24/42  | m ≥ 0.05 dB/m |
| XF3033/15 (P015) | 0°          | 0.135                           | 24/42  | m ≥ 0.05 dB/m |
| XF3033/16 (P016) | 0°          | 0.136                           | 24/42  | m ≥ 0.05 dB/m |
| XF3033/17 (P017) | 0°          | 0.143                           | 24/45  | m ≥ 0.05 dB/m |
| XF3033/18 (P018) | 0°          | 0.143                           | 24/43  | m ≥ 0.05 dB/m |
| XF3033/19 (P019) | 0°          | 0.156                           | 24/43  | m ≥ 0.05 dB/m |
| XF3033/20 (P020) | 0°          | 0.134                           | 24/43  | m ≥ 0.05 dB/m |
| XF3033/21 (P021) | 0°          | 0.133                           | 24/43  | m ≥ 0.05 dB/m |
| XF3033/22 (P022) | 0°          | 0.132                           | 24/43  | m ≥ 0.05 dB/m |
| XF3033/23 (P023) | 0°          | 0.141                           | 24/43  | m ≥ 0.05 dB/m |
| XF3033/24 (P024) | 0°          | 0.153                           | 24/43  | m ≥ 0.05 dB/m |
| XF3033/25 (P025) | 0°          | 0.141                           | 24/43  | m ≥ 0.05 dB/m |

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| Sample           | Orientation | Response Threshold Value (dB/m) | Ambient Air Temperature (°C) & Relative Humidity (%RH) | Requirement   |
|------------------|-------------|---------------------------------|--|---------------|
| XF3033/26 (P026) | 0°          | 0.143                           | 24/43  | m ≥ 0.05 dB/m |
| XF3033/27 (P027) | 0°          | 0.141                           | 24/43  | m ≥ 0.05 dB/m |
| XF3033/28 (P028) | 0°          | 0.168                           | 24/43  | m ≥ 0.05 dB/m |
| XF3033/29 (P029) | 0°          | 0.141                           | 24/43  | m ≥ 0.05 dB/m |
| XF3033/30 (P030) | 0°          | 0.146                           | 24/43  | m ≥ 0.05 dB/m |
| XF3033/31 (P031) | 0°          | 0.150                           | 24/43  | m ≥ 0.05 dB/m |
| XF3033/32 (P032) | 0°          | 0.134                           | 24/43  | m ≥ 0.05 dB/m |
| XF3033/33 (P033) | 0°          | 0.141                           | 24/44  | m ≥ 0.05 dB/m |
| XF3033/34 (P034) | 0°          | 0.142                           | 24/44  | m ≥ 0.05 dB/m |
| XF3033/35 (P035) | 0°          | 0.146                           | 24/44  | m ≥ 0.05 dB/m |
| XF3033/36 (P036) | 0°          | 0.147                           | 24/46  | m ≥ 0.05 dB/m |
| XF3033/37 (P037) | 0°          | 0.158                           | 24/46  | m ≥ 0.05 dB/m |
| XF3033/38 (P038) | 0°          | 0.158                           | 24/46  | m ≥ 0.05 dB/m |
| XF3033/39 (P039) | 0°          | 0.147                           | 24/46  | m ≥ 0.05 dB/m |
| XF3033/40 (P040) | 0°          | 0.164                           | 23/47  | m ≥ 0.05 dB/m |
| XF3033/41 (P041) | 0°          | 0.150                           | 23/45  | m ≥ 0.05 dB/m |
| XF3033/42 (P042) | 0°          | 0.134                           | 23/44  | m ≥ 0.05 dB/m |
| XF3033/43 (P043) | 0°          | 0.151                           | 23/44  | m ≥ 0.05 dB/m |
| XF3033/44 (P044) | 0°          | 0.132                           | 23/44  | m ≥ 0.05 dB/m |
| XF3033/45 (P045) | 0°          | 0.156                           | 23/45  | m ≥ 0.05 dB/m |
| XF3033/46 (P046) | 0°          | 0.157                           | 23/45  | m ≥ 0.05 dB/m |
| XF3033/47 (P047) | 0°          | 0.139                           | 23/45  | m ≥ 0.05 dB/m |
| XF3033/48 (P048) | 0°          | 0.147                           | 23/45  | m ≥ 0.05 dB/m |
| XF3033/49 (P049) | 0°          | 0.149                           | 23/45  | m ≥ 0.05 dB/m |
| XF3033/50 (P050) | 0°          | 0.153                           | 23/45  | m ≥ 0.05 dB/m |
| XF3033/51 (P051) | 0°          | 0.148                           | 24/44  | m ≥ 0.05 dB/m |
| XF3033/52 (P052) | 0°          | 0.147                           | 24/44  | m ≥ 0.05 dB/m |
| XF3033/53 (P053) | 0°          | 0.152                           | 24/44  | m ≥ 0.05 dB/m |

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| Sample           | Orientation | Response Threshold Value (dB/m) | Ambient Air Temperature (°C) & Relative Humidity (%RH) | Requirement        |
|------------------|-------------|---------------------------------|--|--------------------|
| XF3033/54 (P054) | 0°          | 0.155                           | 24/44  | $m \geq 0.05$ dB/m |
| XF3033/55 (P055) | 0°          | 0.140                           | 24/44  | $m \geq 0.05$ dB/m |
| XF3033/56 (P056) | 0°          | 0.142                           | 24/44  | $m \geq 0.05$ dB/m |
| XF3033/57 (P057) | 0°          | 0.154                           | 24/44  | $m \geq 0.05$ dB/m |
| XF3033/58 (P058) | 0°          | 0.120                           | 24/44  | $m \geq 0.05$ dB/m |
| XF3033/59 (P059) | 0°          | 0.130                           | 24/44  | $m \geq 0.05$ dB/m |
| XF3033/60 (P060) | 0°          | 0.147                           | 24/44  | $m \geq 0.05$ dB/m |

## XF3033/61 (M001) through XF3033/120 (M060)

| Sample           | Orientation | Response Threshold Value (dB/m) | Ambient Air Temperature (°C) & Relative Humidity (%RH) | Requirement   |
|------------------|-------------|---------------------------------|--|---------------|
| XF3033/61 (M001) | 315°        | 0.167                           | 24/42  | m ≥ 0.05 dB/m |
| XF3033/62 (M002) | 315°        | 0.179                           | 23/43  | m ≥ 0.05 dB/m |
| XF3033/63 (M003) | 315°        | 0.186                           | 24/42  | m ≥ 0.05 dB/m |
| XF3033/64 (M004) | 315°        | 0.206                           | 24/42  | m ≥ 0.05 dB/m |
| XF3033/65 (M005) | 315°        | 0.184                           | 24/41  | m ≥ 0.05 dB/m |
| XF3033/66 (M006) | 315°        | 0.175                           | 24/41  | m ≥ 0.05 dB/m |
| XF3033/67 (M007) | 315°        | 0.175                           | 24/41  | m ≥ 0.05 dB/m |
| XF3033/68 (M008) | 315°        | 0.223                           | 24/41  | m ≥ 0.05 dB/m |
| XF3033/69 (M009) | 315°        | 0.177                           | 24/40  | m ≥ 0.05 dB/m |
| XF3033/70 (M010) | 315°        | 0.152                           | 24/40  | m ≥ 0.05 dB/m |
| XF3033/71 (M011) | 315°        | 0.206                           | 24/40  | m ≥ 0.05 dB/m |
| XF3033/72 (M012) | 315°        | 0.181                           | 24/40  | m ≥ 0.05 dB/m |
| XF3033/73 (M013) | 315°        | 0.179                           | 24/40  | m ≥ 0.05 dB/m |
| XF3033/74 (M014) | 315°        | 0.165                           | 24/40  | m ≥ 0.05 dB/m |
| XF3033/75 (M015) | 315°        | 0.180                           | 24/40  | m ≥ 0.05 dB/m |
| XF3033/76 (M016) | 315°        | 0.180                           | 24/40  | m ≥ 0.05 dB/m |
| XF3033/77 (M017) | 315°        | 0.177                           | 24/40  | m ≥ 0.05 dB/m |
| XF3033/78 (M018) | 315°        | 0.171                           | 24/40  | m ≥ 0.05 dB/m |
| XF3033/79 (M019) | 315°        | 0.200                           | 24/40  | m ≥ 0.05 dB/m |
| XF3033/80 (M020) | 315°        | 0.191                           | 23/43  | m ≥ 0.05 dB/m |
| XF3033/81 (M021) | 315°        | 0.177                           | 24/40  | m ≥ 0.05 dB/m |
| XF3033/82 (M022) | 315°        | 0.173                           | 24/40  | m ≥ 0.05 dB/m |
| XF3033/83 (M023) | 315°        | 0.197                           | 24/40  | m ≥ 0.05 dB/m |
| XF3033/84 (M024) | 315°        | 0.174                           | 24/40  | m ≥ 0.05 dB/m |
| XF3033/85 (M025) | 315°        | 0.174                           | 25/40  | m ≥ 0.05 dB/m |
| XF3033/86 (M026) | 315°        | 0.169                           | 25/40  | m ≥ 0.05 dB/m |

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| Sample            | Orientation | Response Threshold Value (dB/m) | Ambient Air Temperature (°C) & Relative Humidity (%RH) | Requirement   |
|-------------------|-------------|---------------------------------|--|---------------|
| XF3033/87 (M027)  | 315°        | 0.185                           | 25/40  | m ≥ 0.05 dB/m |
| XF3033/88 (M028)  | 315°        | 0.180                           | 25/40  | m ≥ 0.05 dB/m |
| XF3033/89 (M029)  | 315°        | 0.166                           | 25/40  | m ≥ 0.05 dB/m |
| XF3033/90 (M030)  | 315°        | 0.174                           | 25/40  | m ≥ 0.05 dB/m |
| XF3033/91 (M031)  | 315°        | 0.165                           | 25/40  | m ≥ 0.05 dB/m |
| XF3033/92 (M032)  | 315°        | 0.184                           | 25/40  | m ≥ 0.05 dB/m |
| XF3033/93 (M033)  | 315°        | 0.185                           | 25/40  | m ≥ 0.05 dB/m |
| XF3033/94 (M034)  | 315°        | 0.170                           | 25/40  | m ≥ 0.05 dB/m |
| XF3033/95 (M035)  | 315°        | 0.159                           | 25/40  | m ≥ 0.05 dB/m |
| XF3033/96 (M036)  | 315°        | 0.197                           | 25/40  | m ≥ 0.05 dB/m |
| XF3033/97 (M037)  | 315°        | 0.174                           | 25/40  | m ≥ 0.05 dB/m |
| XF3033/98 (M038)  | 315°        | 0.170                           | 25/40  | m ≥ 0.05 dB/m |
| XF3033/99 (M039)  | 315°        | 0.194                           | 25/40  | m ≥ 0.05 dB/m |
| XF3033/100 (M040) | 315°        | 0.185                           | 25/40  | m ≥ 0.05 dB/m |
| XF3033/101 (M041) | 315°        | 0.171                           | 24/43  | m ≥ 0.05 dB/m |
| XF3033/102 (M042) | 315°        | 0.160                           | 24/43  | m ≥ 0.05 dB/m |
| XF3033/103 (M043) | 315°        | 0.190                           | 24/43  | m ≥ 0.05 dB/m |
| XF3033/104 (M044) | 315°        | 0.185                           | 24/43  | m ≥ 0.05 dB/m |
| XF3033/105 (M045) | 315°        | 0.173                           | 23/43  | m ≥ 0.05 dB/m |
| XF3033/106 (M046) | 315°        | 0.172                           | 23/43  | m ≥ 0.05 dB/m |
| XF3033/107 (M047) | 315°        | 0.171                           | 23/43  | m ≥ 0.05 dB/m |
| XF3033/108 (M048) | 315°        | 0.158                           | 23/43  | m ≥ 0.05 dB/m |
| XF3033/109 (M049) | 315°        | 0.175                           | 23/43  | m ≥ 0.05 dB/m |
| XF3033/110 (M050) | 315°        | 0.184                           | 23/43  | m ≥ 0.05 dB/m |
| XF3033/111 (M051) | 315°        | 0.187                           | 23/43  | m ≥ 0.05 dB/m |
| XF3033/112 (M052) | 315°        | 0.167                           | 23/43  | m ≥ 0.05 dB/m |
| XF3033/113 (M053) | 315°        | 0.174                           | 23/43  | m ≥ 0.05 dB/m |
| XF3033/114 (M054) | 315°        | 0.163                           | 23/43  | m ≥ 0.05 dB/m |

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| Sample            | Orientation | Response Threshold Value (dB/m) | Ambient Air Temperature (°C) & Relative Humidity (%RH) | Requirement        |
|-------------------|-------------|---------------------------------|--|--------------------|
| XF3033/115 (M055) | 315°        | 0.183                           | 23/43  | $m \geq 0.05$ dB/m |
| XF3033/116 (M056) | 315°        | 0.175                           | 23/43  | $m \geq 0.05$ dB/m |
| XF3033/117 (M057) | 315°        | 0.163                           | 23/43  | $m \geq 0.05$ dB/m |
| XF3033/118 (M058) | 315°        | 0.173                           | 23/43  | $m \geq 0.05$ dB/m |
| XF3033/119 (M059) | 315°        | 0.203                           | 23/43  | $m \geq 0.05$ dB/m |
| XF3033/120 (M060) | 315°        | 0.161                           | 23/43  | $m \geq 0.05$ dB/m |

XF3033/121 (D001) through XF3033/180 (D060)

| Sample            | Orientation | Response Threshold Value (dB/m) | Ambient Air Temperature (°C) & Relative Humidity (%RH) | Requirement   |
|-------------------|-------------|---------------------------------|--|---------------|
| XF3033/121 (D001) | 0°          | 0.129                           | 25/37  | m ≥ 0.05 dB/m |
| XF3033/122 (D002) | 0°          | 0.124                           | 25/37  | m ≥ 0.05 dB/m |
| XF3033/123 (D003) | 0°          | 0.116                           | 25/37  | m ≥ 0.05 dB/m |
| XF3033/124 (D004) | 0°          | 0.098                           | 25/37  | m ≥ 0.05 dB/m |
| XF3033/125 (D005) | 0°          | 0.085                           | 25/37  | m ≥ 0.05 dB/m |
| XF3033/126 (D006) | 0°          | 0.100                           | 25/37  | m ≥ 0.05 dB/m |
| XF3033/127 (D007) | 0°          | 0.109                           | 25/37  | m ≥ 0.05 dB/m |
| XF3033/128 (D008) | 0°          | 0.085                           | 25/37  | m ≥ 0.05 dB/m |
| XF3033/129 (D009) | 0°          | 0.104                           | 25/36  | m ≥ 0.05 dB/m |
| XF3033/130 (D010) | 0°          | 0.076                           | 25/36  | m ≥ 0.05 dB/m |
| XF3033/131 (D011) | 0°          | 0.091                           | 25/36  | m ≥ 0.05 dB/m |
| XF3033/132 (D012) | 0°          | 0.076                           | 25/36  | m ≥ 0.05 dB/m |
| XF3033/133 (D013) | 0°          | 0.073                           | 25/36  | m ≥ 0.05 dB/m |
| XF3033/134 (D014) | 0°          | 0.069                           | 25/36  | m ≥ 0.05 dB/m |
| XF3033/135 (D015) | 0°          | 0.073                           | 25/36  | m ≥ 0.05 dB/m |
| XF3033/136 (D016) | 0°          | 0.146                           | 25/39  | m ≥ 0.05 dB/m |
| XF3033/137 (D017) | 0°          | 0.071                           | 25/37  | m ≥ 0.05 dB/m |
| XF3033/138 (D018) | 0°          | 0.067                           | 25/37  | m ≥ 0.05 dB/m |
| XF3033/139 (D019) | 0°          | 0.102                           | 25/39  | m ≥ 0.05 dB/m |
| XF3033/140 (D020) | 0°          | 0.087                           | 25/37  | m ≥ 0.05 dB/m |
| XF3033/141 (D021) | 0°          | 0.075                           | 25/37  | m ≥ 0.05 dB/m |
| XF3033/142 (D022) | 0°          | 0.077                           | 25/37  | m ≥ 0.05 dB/m |
| XF3033/143 (D023) | 0°          | 0.109                           | 25/39  | m ≥ 0.05 dB/m |
| XF3033/144 (D024) | 0°          | 0.088                           | 25/39  | m ≥ 0.05 dB/m |
| XF3033/145 (D025) | 0°          | 0.105                           | 25/36  | m ≥ 0.05 dB/m |
| XF3033/146 (D026) | 0°          | 0.115                           | 25/36  | m ≥ 0.05 dB/m |

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| Sample            | Orientation | Response Threshold Value (dB/m) | Ambient Air Temperature (°C) & Relative Humidity (%RH) | Requirement   |
|-------------------|-------------|---------------------------------|--|---------------|
| XF3033/147 (D027) | 0°          | 0.089                           | 25/36  | m ≥ 0.05 dB/m |
| XF3033/148 (D028) | 0°          | 0.124                           | 25/36  | m ≥ 0.05 dB/m |
| XF3033/149 (D029) | 0°          | 0.090                           | 25/40  | m ≥ 0.05 dB/m |
| XF3033/150 (D030) | 0°          | 0.074                           | 25/40  | m ≥ 0.05 dB/m |
| XF3033/151 (D031) | 0°          | 0.068                           | 25/40  | m ≥ 0.05 dB/m |
| XF3033/152 (D032) | 0°          | 0.064                           | 25/40  | m ≥ 0.05 dB/m |
| XF3033/153 (D033) | 0°          | 0.059                           | 25/40  | m ≥ 0.05 dB/m |
| XF3033/154 (D034) | 0°          | 0.070                           | 25/40  | m ≥ 0.05 dB/m |
| XF3033/155 (D035) | 0°          | 0.075                           | 25/40  | m ≥ 0.05 dB/m |
| XF3033/156 (D036) | 0°          | 0.078                           | 25/40  | m ≥ 0.05 dB/m |
| XF3033/157 (D037) | 0°          | 0.074                           | 25/40  | m ≥ 0.05 dB/m |
| XF3033/158 (D038) | 0°          | 0.061                           | 25/40  | m ≥ 0.05 dB/m |
| XF3033/159 (D039) | 0°          | 0.096                           | 25/40  | m ≥ 0.05 dB/m |
| XF3033/160 (D040) | 0°          | 0.077                           | 25/40  | m ≥ 0.05 dB/m |
| XF3033/161 (D041) | 0°          | 0.067                           | 25/40  | m ≥ 0.05 dB/m |
| XF3033/162 (D042) | 0°          | 0.067                           | 25/40  | m ≥ 0.05 dB/m |
| XF3033/163 (D043) | 0°          | 0.100                           | 25/40  | m ≥ 0.05 dB/m |
| XF3033/164 (D044) | 0°          | 0.070                           | 25/40  | m ≥ 0.05 dB/m |
| XF3033/165 (D045) | 0°          | 0.096                           | 25/40  | m ≥ 0.05 dB/m |
| XF3033/166 (D046) | 0°          | 0.098                           | 25/40  | m ≥ 0.05 dB/m |
| XF3033/167 (D047) | 0°          | 0.074                           | 25/40  | m ≥ 0.05 dB/m |
| XF3033/168 (D048) | 0°          | 0.075                           | 25/40  | m ≥ 0.05 dB/m |
| XF3033/169 (D049) | 0°          | 0.054                           | 22/44  | m ≥ 0.05 dB/m |
| XF3033/170 (D050) | 0°          | 0.043                           | 22/44  | m ≥ 0.05 dB/m |
| XF3033/171 (D051) | 0°          | 0.088                           | 22/44  | m ≥ 0.05 dB/m |
| XF3033/172 (D052) | 0°          | 0.071                           | 22/44  | m ≥ 0.05 dB/m |
| XF3033/173 (D053) | 0°          | 0.070                           | 22/44  | m ≥ 0.05 dB/m |
| XF3033/174 (D054) | 0°          | 0.061                           | 22/44  | m ≥ 0.05 dB/m |



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## Smoke Sensitivity Testing of Residential Smoke Alarms

| Sample            | Orientation | Response Threshold Value (dB/m) | Ambient Air Temperature (°C) & Relative Humidity (%RH) | Requirement        |
|-------------------|-------------|---------------------------------|--|--------------------|
| XF3033/175 (D055) | 0°          | 0.099                           | 22/44  | $m \geq 0.05$ dB/m |
| XF3033/176 (D056) | 0°          | 0.068                           | 22/44  | $m \geq 0.05$ dB/m |
| XF3033/177 (D057) | 0°          | 0.073                           | 22/44  | $m \geq 0.05$ dB/m |
| XF3033/178 (D058) | 0°          | 0.061                           | 22/44  | $m \geq 0.05$ dB/m |
| XF3033/179 (D059) | 0°          | 0.078                           | 22/44  | $m \geq 0.05$ dB/m |
| XF3033/180 (D060) | 0°          | 0.056                           | 22/44  | $m \geq 0.05$ dB/m |

## XF3033/181 (I001) through XF3033/240 (I060)

| Sample            | Orientation | Response Threshold Value (MIC y) | Ambient Air Temperature (°C) & Relative Humidity (%RH) | Requirement   |
|-------------------|-------------|----------------------------------|--|---------------|
| XF3033/181 (I001) | 0°          | 0.74                             | 24/52  | m ≥ 0.05 dB/m |
| XF3033/182 (I002) | 0°          | 0.76                             | 24/52  | m ≥ 0.05 dB/m |
| XF3033/183 (I003) | 0°          | 0.82                             | 24/52  | m ≥ 0.05 dB/m |
| XF3033/184 (I004) | 0°          | 0.77                             | 24/52  | m ≥ 0.05 dB/m |
| XF3033/185 (I005) | 0°          | 0.70                             | 24/52  | m ≥ 0.05 dB/m |
| XF3033/186 (I006) | 0°          | 0.71                             | 24/52  | m ≥ 0.05 dB/m |
| XF3033/187 (I007) | 0°          | 0.76                             | 24/52  | m ≥ 0.05 dB/m |
| XF3033/188 (I008) | 0°          | 0.83                             | 24/52  | m ≥ 0.05 dB/m |
| XF3033/189 (I009) | 0°          | 0.90                             | 24/54  | m ≥ 0.05 dB/m |
| XF3033/190 (I010) | 0°          | 0.81                             | 24/54  | m ≥ 0.05 dB/m |
| XF3033/191 (I011) | 0°          | 0.82                             | 24/54  | m ≥ 0.05 dB/m |
| XF3033/192 (I012) | 0°          | 0.73                             | 24/54  | m ≥ 0.05 dB/m |
| XF3033/193 (I013) | 0°          | 0.70                             | 24/54  | m ≥ 0.05 dB/m |
| XF3033/194 (I014) | 0°          | 0.73                             | 24/54  | m ≥ 0.05 dB/m |
| XF3033/195 (I015) | 0°          | 0.79                             | 24/54  | m ≥ 0.05 dB/m |
| XF3033/196 (I016) | 0°          | 0.78                             | 24/54  | m ≥ 0.05 dB/m |
| XF3033/197 (I017) | 0°          | 0.74                             | 22/53  | m ≥ 0.05 dB/m |
| XF3033/198 (I018) | 0°          | 0.73                             | 22/53  | m ≥ 0.05 dB/m |
| XF3033/199 (I019) | 0°          | 0.71                             | 22/53  | m ≥ 0.05 dB/m |
| XF3033/200 (I020) | 0°          | 0.78                             | 22/53  | m ≥ 0.05 dB/m |
| XF3033/201 (I021) | 0°          | 0.77                             | 22/52  | m ≥ 0.05 dB/m |
| XF3033/202 (I022) | 0°          | 0.77                             | 22/52  | m ≥ 0.05 dB/m |
| XF3033/203 (I023) | 0°          | 0.72                             | 22/51  | m ≥ 0.05 dB/m |
| XF3033/204 (I024) | 0°          | 0.72                             | 22/51  | m ≥ 0.05 dB/m |
| XF3033/205 (I025) | 0°          | 0.80                             | 22/51  | m ≥ 0.05 dB/m |
| XF3033/206 (I026) | 0°          | 0.76                             | 22/51  | m ≥ 0.05 dB/m |

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| Sample            | Orientation | Response Threshold Value (MIC y) | Ambient Air Temperature (°C) & Relative Humidity (%RH) | Requirement   |
|-------------------|-------------|----------------------------------|--|---------------|
| XF3033/207 (I027) | 0°          | 0.72                             | 22/50  | m ≥ 0.05 dB/m |
| XF3033/208 (I028) | 0°          | 0.72                             | 22/50  | m ≥ 0.05 dB/m |
| XF3033/209 (I029) | 0°          | 0.70                             | 22/50  | m ≥ 0.05 dB/m |
| XF3033/210 (I030) | 0°          | 0.83                             | 22/50  | m ≥ 0.05 dB/m |
| XF3033/211 (I031) | 0°          | 0.67                             | 22/50  | m ≥ 0.05 dB/m |
| XF3033/212 (I032) | 0°          | 0.74                             | 22/47  | m ≥ 0.05 dB/m |
| XF3033/213 (I033) | 0°          | 0.84                             | 22/50  | m ≥ 0.05 dB/m |
| XF3033/214 (I034) | 0°          | 0.70                             | 22/50  | m ≥ 0.05 dB/m |
| XF3033/215 (I035) | 0°          | 0.70                             | 22/50  | m ≥ 0.05 dB/m |
| XF3033/216 (I036) | 0°          | 0.81                             | 22/50  | m ≥ 0.05 dB/m |
| XF3033/217 (I037) | 0°          | 0.84                             | 22/50  | m ≥ 0.05 dB/m |
| XF3033/218 (I038) | 0°          | 0.76                             | 22/50  | m ≥ 0.05 dB/m |
| XF3033/219 (I039) | 0°          | 0.82                             | 22/50  | m ≥ 0.05 dB/m |
| XF3033/220 (I040) | 0°          | 0.72                             | 22/50  | m ≥ 0.05 dB/m |
| XF3033/221 (I041) | 0°          | 0.86                             | 22/52  | m ≥ 0.05 dB/m |
| XF3033/222 (I042) | 0°          | 0.74                             | 22/52  | m ≥ 0.05 dB/m |
| XF3033/223 (I043) | 0°          | 0.85                             | 22/51  | m ≥ 0.05 dB/m |
| XF3033/224 (I044) | 0°          | 0.89                             | 22/51  | m ≥ 0.05 dB/m |
| XF3033/225 (I045) | 0°          | 0.75                             | 22/51  | m ≥ 0.05 dB/m |
| XF3033/226 (I046) | 0°          | 0.76                             | 22/51  | m ≥ 0.05 dB/m |
| XF3033/227 (I047) | 0°          | 0.84                             | 22/50  | m ≥ 0.05 dB/m |
| XF3033/228 (I048) | 0°          | 0.81                             | 22/50  | m ≥ 0.05 dB/m |
| XF3033/229 (I049) | 0°          | 0.74                             | 22/50  | m ≥ 0.05 dB/m |
| XF3033/230 (I050) | 0°          | 0.80                             | 22/50  | m ≥ 0.05 dB/m |
| XF3033/231 (I051) | 0°          | 0.88                             | 22/50  | m ≥ 0.05 dB/m |
| XF3033/232 (I052) | 0°          | 0.79                             | 22/47  | m ≥ 0.05 dB/m |
| XF3033/233 (I053) | 0°          | 0.71                             | 22/50  | m ≥ 0.05 dB/m |
| XF3033/234 (I054) | 0°          | 0.76                             | 22/50  | m ≥ 0.05 dB/m |

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| Sample            | Orientation | Response Threshold Value (MIC y) | Ambient Air Temperature (°C) & Relative Humidity (%RH) | Requirement        |
|-------------------|-------------|----------------------------------|--|--------------------|
| XF3033/235 (I055) | 0°          | 0.71                             | 22/50  | $m \geq 0.05$ dB/m |
| XF3033/236 (I056) | 0°          | 0.82                             | 22/50  | $m \geq 0.05$ dB/m |
| XF3033/237 (I057) | 0°          | 0.84                             | 22/50  | $m \geq 0.05$ dB/m |
| XF3033/238 (I058) | 0°          | 0.86                             | 22/50  | $m \geq 0.05$ dB/m |
| XF3033/239 (I059) | 0°          | 0.84                             | 22/50  | $m \geq 0.05$ dB/m |
| XF3033/240 (I060) | 0°          | 0.79                             | 22/50  | $m \geq 0.05$ dB/m |

## 4 REFERENCE INFORMATION

The following information is provided to assist in the interpreting of the results detailed in this report.

### 4.1 Obscuration vs. Ionisation data

The data shown in Figure 5 demonstrates the relationship between smoke density measured by the reference IR obscurometer (measured in dB/m) and by the reference measuring ionisation chamber (MIC, measured in terms of “MIC y”). Refer to Section C2 of AS 3786:2014 for details of the MIC and its response values.

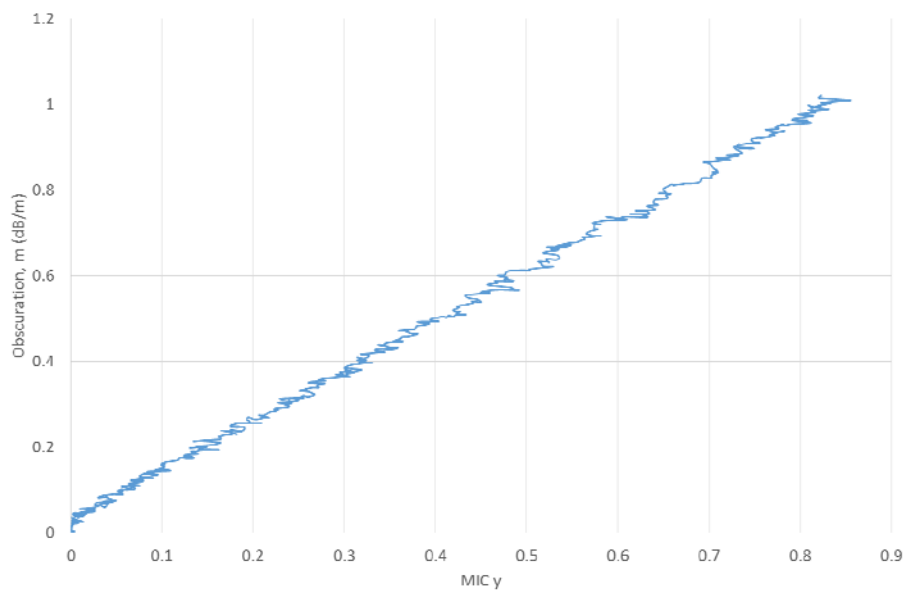


Figure 5. Typical response values of the reference obscurometer and MIC, as fitted to the CSIRO AS 3786 / AS 7240.2 test tunnel, to aspirated paraffin during tunnel sensitivity tests of smoke alarms and detectors.

### 4.2 Obscuration units

The data shown in Figure 6 and Figure 7 demonstrates the relationship between smoke density calculated in terms of the units of dB/m and %obscuration/m.

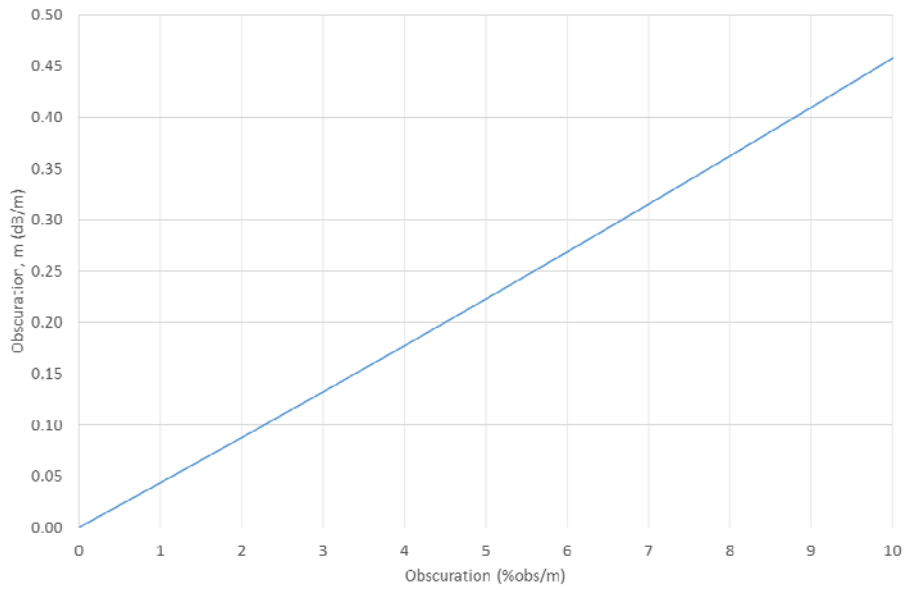


Figure 6. Relationship between smoke density as measured in dB/m and %obs/m to 10 %obs/m.

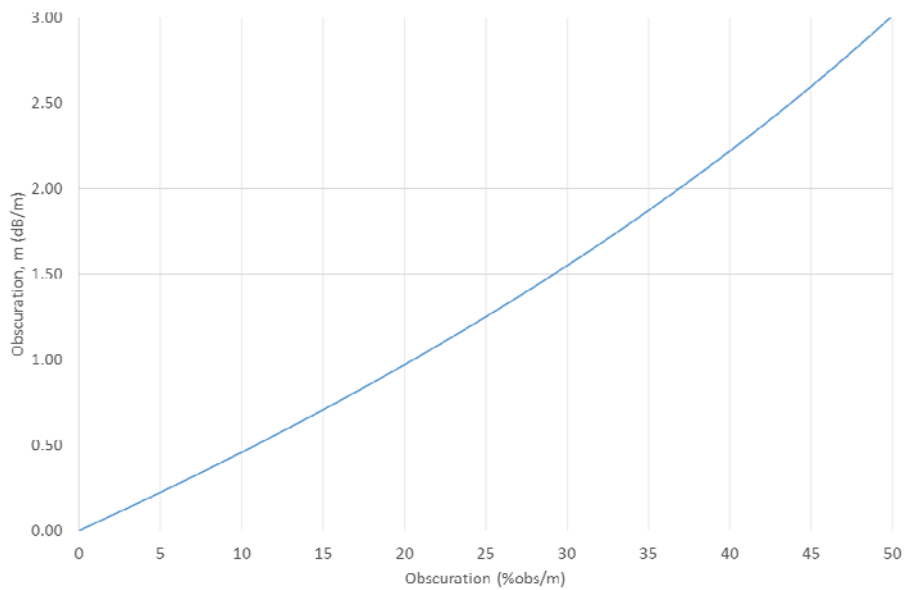


Figure 7. Relationship between smoke density as measured in dB/m and %obs/m to 50 %obs/m.