Tech Tips for Smoke Detector
Sensitivity Testing

By Paul Jewett
I tried hard to get the most accurate information possible. But I apologize to all if any of the material is out of date.
Why Do We Have To Test Sensitivity?

If the smoke detectors lose their sensitivity, the advantage of early fire detection is lost.
In some cases, they may not function at any concentration. If too sensitive, the detectors may cause false alarms.
Agenda

• Myths
• Pre 1995 Conventional Detectors sensitivity testing
• Current Conventional Detectors sensitivity testing
• Addressable Detector Sensitivity Testing
• The Issues
Myths about Sensitivity Testing

• Myth 1
  – ULC Sensitivity measurement requirements started in 1997 when the ULC S536-97 was adopted.

• The Truth
  – ULC Sensitivity measurement requirements started in 1986 when the ULC S536-86 was adopted. However it was not required to record the results until ULC S536-97. This caused a huge outcry from companies who had not been doing the tests. They felt that it was unfair and cost them huge dollars to comply.

• Notes:
  – It just showed that most people did not read the standard but just looked at the appendix record form they had to fill out.
  – It took several years before most AHJ’s realized that it was part of the standard. In fact I still see inspection paper work that is based on the 1986 standards.
ISSUE:

CAN/ULC S536-04 “Inspection and Testing of Fire Alarm Systems,” the referenced standard for fire alarm system maintenance in the Alberta Fire Code 2006 Division B. Sentence 6.3.1.2.(1), states:

6.3.1.2. Inspection and Testing

1) Fire alarm systems shall be inspected and tested in conformance with CAN/ULC-S536, “Inspection and Testing of Fire Alarm Systems.”

Smoke Detector Sensitivity testing is noted in CAN/ULC S536-04 as an annual requirement in Clause 5.7.4.1.3

“Each smoke detector shall be tested to confirm that it is within its rated operating range using a test method described in Clause 5.7.4.1.6.”

While the requirement to conduct such testing has existed and evolved in the ULC S536 standard since the 1986 version such testing has not, until recently, been conducted in most Canadian jurisdictions and has not been a point of enforcement by the Authority Having Jurisdiction in Alberta.
Myths about Sensitivity Testing

• Myth 2
  – Many conventional smoke detectors which have been installed in Canada in the past did not have a sensitivity tool/meter/procedure to test them.

• The Truth
  – ULC has always required the manufacturer to have a method to test for sensitivity. In many cases to perform these tests required a special meter or interface tool.

• Myth 3
  – I can't put this on paper
Myths about Sensitivity Testing

Personal Notes
– The problem has always been for many independent service companies claimed they:
  • Cannot buying one
    – (mostly true)
  • They are very expense
    – (depends on how much you are going to use them)
  • Cannot find any information on how to perform the tests
    – (true)
Testing Conventional Smoke Detectors for Sensitivity before 1995

Method 1
- Using a special meter designed to work with only specific detectors to measure a voltage or current level to determine sensitivity.

Method 2
- Using a Standard Multimeter connected directly to the detector or to an adapter

Method 3
- Using a special smoke box
Method 4
– Using a special tool in the case of photoelectric detectors to partially block or reflect to simulate smoke.

Method 5
– Using a special universal test device similar to the smoke box concept
Method 1
Examples of Manufacturers Test Meters

This is not the oldest model I have used. The original model was a SCU-3 which was for high voltage detectors only (220 volt DC)

Note the year in the bottom right hand corner Aug 1970

Pyrotronic's recommended that detectors required annual sensitivity tests. And yes in my opinion it was definitely required.
Method 1
Examples of Manufactures Test Meters

Edwards 6277 Meter
Sometime in the 1980”s

It is the same basic design as the Pyrotronic's of the late 60’s and 70’s

Personal Note: This type of meter was not very durable. It constantly needed repairs on all the connection cables.
Notes on Method 1

• Does anybody really expect that a meter which has been carried around in a service vehicle for 20 or 30 years is going to give accurate readings?
• Don’t you think if it’s being used on a ladder constantly that it might have been dropped a few times.
• Calibration ????
Method 2
Example of using a standard multimeter with a manufacturer's adapter

Personal Note: This method sometimes required three hands.
Method 3 Example of the smoke box

The Hochiki America TSA-B110 Smoke Detector Sensitivity Tester

Personal Notes:
1. It was never easy to transport
2. It was only for Hochiki Detectors
3. Used punk sticks to produce the smoke.
Method 4
Example of using a special tool

Personal Note: Every Detector came with a card in the box. After a few years they became very hard to find.

Inserting the card one way should not cause an alarm. Inserting it the other way should cause an alarm.
Method 5
Examples of a Universal testers

- Manufacturers recommended Servicing intervals: 1 year recommended, but max interval 5000 tests

The Gemini 501A/Batt Smoke Detector

Tests all detectors

Meets all NFPA 72 requirements

Tests ceiling, side wall, under-floor detectors in place

Portable, fast, easy to use

Battery operated

Reaches detectors 27 ft high with Hi-Reach Kit
New Conventional Detectors

- ESL 511/518 Series

<table>
<thead>
<tr>
<th>Flashes</th>
<th>Obscuration (Approx)</th>
<th>Indication</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>N/A</td>
<td>Unserviceable hardware fault detected.</td>
<td>Reset unit and rerun sensitivity test. If the error persists, replace the unit.</td>
</tr>
<tr>
<td>2-3</td>
<td>N/A</td>
<td>Detector is not sensitive enough.</td>
<td>Clean the unit. Reset unit and rerun sensitivity test. If the error persists, replace the unit.</td>
</tr>
<tr>
<td>4</td>
<td>3.6%/ft</td>
<td>Detector is within normal sensitivity range.</td>
<td>N/A</td>
</tr>
<tr>
<td>5</td>
<td>3.1%/ft</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>2.6%/ft</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>2.1%/ft</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8-9</td>
<td>N/A</td>
<td>Detector is too sensitive.</td>
<td>Verify that the smoke chamber is snapped down securely. Clean unit.</td>
</tr>
</tbody>
</table>

Figure 5 - Test Magnet Placement
New Conventional Detectors

- 4098-9601 TrueAlarm Photoelectric

### LED Response to Magnetic Test *

<table>
<thead>
<tr>
<th>LED Indication</th>
<th>Followed By</th>
<th>Status</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>LED turns ON</td>
<td>Alarm is initiated</td>
<td>Normal, sensitivity is within compensation range</td>
<td>None</td>
</tr>
<tr>
<td>LED pulses quickly, 6 times in 3 seconds, then turns ON</td>
<td>Alarm is initiated</td>
<td>More sensitive, out of normal compensation range</td>
<td>Cleaning or other service is required</td>
</tr>
<tr>
<td>LED pulses slowly, 4 times in 8 seconds, then turns ON</td>
<td>Alarm is initiated</td>
<td>Less sensitive, out of normal compensation range</td>
<td>Service is required</td>
</tr>
<tr>
<td></td>
<td>Does not initiate Alarm</td>
<td>Detector is malfunctioning</td>
<td></td>
</tr>
</tbody>
</table>

* Testing requires placing a magnet at the designated location on the detector cover for 4 seconds. Refer to Application Manual 574-709 for further test and maintenance information.
New Conventional Detectors

LED Indicator Operation

<table>
<thead>
<tr>
<th>Flash Color</th>
<th>Condition</th>
<th>Flash Interval (in seconds)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green:</td>
<td>Normal supervisory operation.</td>
<td>10</td>
</tr>
<tr>
<td>Yellow:</td>
<td>Detector is in trouble and needs replacement.</td>
<td>5</td>
</tr>
<tr>
<td>Red:</td>
<td>Alarm condition.</td>
<td>2.5</td>
</tr>
<tr>
<td>No Flash:</td>
<td>Detector is not powered, or detector requires repair.</td>
<td>-- --</td>
</tr>
</tbody>
</table>
New Conventional Detectors

Table 3: EZ Walk Test Detector Modes

<table>
<thead>
<tr>
<th></th>
<th>Green LED</th>
<th>Red LED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proper Operation</td>
<td>Double blink 5 sec</td>
<td>—</td>
</tr>
<tr>
<td>Out of Sensitivity</td>
<td>—</td>
<td>Double Blink 5 sec</td>
</tr>
<tr>
<td>Freeze Condition</td>
<td>—</td>
<td>Double Blink 10 sec</td>
</tr>
</tbody>
</table>

System Sensor
C2W-BA

Optional Sensitivity Reader
Addressable Smoke Detector Sensitivity

• In almost all addressable systems the sensitivity is set in the system program. (software)
• In general the smoke detectors will automatically adjust/compensate as the detector get older or dirtier to maintain the programmed sensitivity. When the system can no longer maintain the programmed obscuration the control panel will give a system trouble.
• Most addressable panels are capable of producing Dirty Detector Reports
4.6.1 Dirty Fault Indication

A sensor specific "dirty" fault condition is reported any time the average value on an individual sensor reaches a set threshold. At this point in time the 4100 FIP is still compensating for environmental factors and holding the set sensitivity level. The sensor should be scheduled for cleaning.
4.6.2 Excessively Dirty Fault Indication

An "excessively dirty" fault indication is reported anytime an individual sensor's average value reaches a slightly higher threshold level. At this point the 4100 FIP can no longer compensate for dirt and dust contamination and the sensitivity level may begin to drift. Because false alarms are possible with this condition, sensors must be cleaned as soon as possible. Although an "excessively dirty" fault condition is reported, the sensor will continue in operation and will report an alarm condition if one is detected.

LEVEL 2 - ROOM 74
SMOKE DETECTOR      EXCESSIVELY DIRTY
The Issues

1. How do you sensitivity test old conventional detectors which are discontinued? (This is the big one)

   • Find a 20 to 30 year old manufacturers tester unit and hope that it will still give an accurate reading. Sometime the hardest thing is to find the manual. I had very little success in finding any information online.
   • Use a Universal tester. Not a bad option however there is a large cost involved in buying the equipment and maintenance. There is also the time it takes to test the detectors. Another issue is the units are not ULC tested. Some AHJ do not except them.
   • Replace the detectors with the new generation of self testing. This was addressed by Alberta two years ago.
It is anticipated that there are a significant number of smoke detectors on systems currently in service which have exceeded this service life. These detectors cannot continue to remain in place past the end of their service life without additional testing.

All smoke detectors on fire alarm systems within Alberta shall therefore be required to either be replaced within ten years of their manufacture, with a smoke detector listed for use with the fire alarm system and appropriate for the location, or they shall be, from the time they reach ten years and forward, tested for sensitivity in conformance with the methods prescribed in ULC S536-04 on an annual basis.

In those instances where smoke detectors are already older than ten years the owner must, within 12 months from the issuance of this Variance, successfully sensitivity test or replace all such detectors.

The above is attracts from the Alberta Municipal Affairs – Safety Services-Standata
The Issues

2. If the conventional detectors are self-testing, how do you fill out the inspection report?

From Can/ULC S536-04 Appendix E3.1
“Note 1. Smoke detector sensitivity confirmation or measurement should be recorded in the remarks column”

My recommendation
• Add a column to the device report that says “Detector Sensitivity Confirmed”
• Remember that the device testing record form in the appendix is only informative. You can modify it if you want.
<table>
<thead>
<tr>
<th>REFERENCE NUMBER</th>
<th>LOCATION</th>
<th>DEVICE</th>
<th>CORRECTLY INSTALLED</th>
<th>SMOKED DETECTOR SENSITIVITY</th>
<th>MISSING DEVICE</th>
<th>ALARM CONFIRMATION</th>
<th>Device Loop</th>
<th>Device Address</th>
<th>DEVICE ZONE</th>
<th>ANNUNCIATION CONFIRMED</th>
<th>SUPERVISORY &amp; GROUND FAULT DETECTION OF WIRING TO DEVICE CONFIRMED</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>2</td>
<td></td>
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</tbody>
</table>
The Issues

3. Since detector sensitivity in addressable systems are programmed in the software, how do we confirm the detectors sensitivity as stated in ULC-S536-04 Appendix E3.1?

“Note 1. Smoke detector sensitivity confirmation or measurement should be recorded in the remarks column”
3. My Recommendation is it is not required. Again the appendix is only informative. The body of the standard does not require it.

5.7.4.1.6 Acceptable methods of determining the smoke detector sensitivity are:

5.7.4.1.6 B Installed control units or transponders designed to test the sensitivity of individual smoke detectors;
Personal Observations

• Since almost all smoke detectors made since the year 2000 have some form of sensitivity test built in to them, the problem is disappearing quickly.

• If building owner do not replace detectors then unfortunately they will have the pay a premium to do the tests.

• Remember these tests have been required since 1986!!
Hope this Helped a Little

Paul Jewett