International Testing of Smoke, Heat, CO and Multi Detectors

By Bill Rossiter, Managing Director of No Climb Products

A leading detector manufacturer recently recalled smoke/heat detectors that had been manufactured over a period of several months last year. The recall was necessary because an internal contact might have an insulating film preventing the detector from reporting a heat alarm signal to the control panel. Fortunately the detectors could still have detected smoke and this is a reputable manufacturer whose follow up will be excellent.

Its occurrence, however, underlines strongly the need for proper functional testing – both at installation/commissioning/acceptance and, on an annual basis. This paper clarifies what this means, using examples from the national codes of the UK, US, France and Germany. Many other countries have similar requirements but some could be clearer than they are now. The above product recall emphasises why such standards need to be adopted where they do not yet exist, clarified where they are misunderstood and upheld and enforced where they already exist unambiguously.

A functional check involves a physical stimulus:

"In the case of detectors (all types) tests must ensure that products of combustion are capable of passing unhindered from the protected area to the sensing chamber/elements of the detector and not simply test the ability of the detector to sample/verify the status of the atmosphere already in the sensing chamber."

BS 5839 1: 2002 Clause 45.3, December 2004 update

The US code agrees:

"The detectors shall be tested in place to ensure smoke entry into the sensing chamber and an alarm response."

NFPA 72 National Fire Table 10.4.2.2 (g) Smoke detectors

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But the UK's code also explains what is *not* acceptable. A functional check is not something that can be conducted only by checking analogue values. Neither is it something that can be accomplished with a magnet:

"Since stimulus of the sensing element through introduction of the phenomena or surrogate phenomena which the detectors are designed to detect forms part of the test(s), *use of a test button or a test magnet (for example) or compliance with 45(i)* (confirmation of analogue values) *does not satisfy the recommendations. . ."*

BS 5839 1: 2002 45.3 (Note 4)

In France Règle APSAD R7 Detection automatique d'incendie, Edition 02.1997.4 (fevrier 2003) also highlights the importance of a proper functional check:

5.2.2.3 Essai de fonctionnement des detecteurs
L'essai a pour but de verifier la reponse de chaque detecteur a la grandeur caracteristique qu'il doit detecter.

Or, put another way, the goal is to check that each detector has the capability of picking up that which it is designed to detect.

As to how the functional checks can be performed, R7 Section 5.2.2.3 explains that the person performing the work should be equipped with:

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". . . dispositifs necessaires non destructibles pour le materiel et compatible avec l'environnement des detecteurs pour produire les grandeurs caracteristiques d'excitation des detecteurs essayes (generateurs de chaleur, d'aerosols, de fumee, de rayons IR or UV, etc)"

or translated 'the necessary non destructive tools for the job that are compatible with the detectors and produce the appropriate stimuli to activate the detectors under test (heat, aerosol, smoke, IR or UV generators.)'

In a harmony rarely seen among these four nations the Germans concur and DIN 14675:2003-11 states:

8.2 Überprüfung
Die Funktionsprüfung der automatischen Brandmelder ist mindestens durch Simulation der relevanten physikalischen Brandkenngröße außerhalb des Melders durchzuführen (z.B. Verwendung von Prüfaerosolen für Rauch).

which translated, means that the functional testing of the automatic fire detectors is, at the very least, to be carried out through the simulation of the relevant physical characteristics of fire outside of the detector (e.g. using test aerosols for smoke).

Extending this theme many national standards now refer not only to the need to check the device but also the need to avoid danger or other damage to – or from – the environment in which the detector is installed. This is encapsulated by the UK's BS 5839:

Every heat detector should be functionally tested by means of a suitable heat source . . . the heat source should not have the potential to ignite a fire; live flame should not be used, and special equipment might be necessary in explosive atmospheres.
BS 5839 1: 2002 Clause 45.4, December 2004 update

The French and British are of one mind and France's R7 states that devices producing live flames, such as lighters, are prohibited:

"*sont exclus ici les generateurs a flamme vive tels que les briquets"*
R7 Section 5.2.2.3

The theme of avoiding damage is also explicitly recognised for other detectors. Smoke detectors, for example, might react to various stimuli but setting them off properly with a genuine physical functional check is only part of the art. Avoiding damage to them (with less than the best detector testers for example!) is another. Again, this is picked up by the British Standard:

"Point smoke detectors should be functionally tested by a method that confirms smoke can enter the detector chamber and produce a fire alarm signal (e.g.: by use of apparatus that generates simulated smoke or suitable aerosols around the detector). It should be ensured that the material used does not cause damage to, or affect the subsequent performance of the detector . . ."
BS 5839 1: 2002 45.4 (d)

In fact BS 5839, having recently been reviewed (the last update was December 2004) is refreshingly clear in many areas. It encapsulates the various possibilities for problems when it talks of the need for proper testing of CO fire detectors.

"Carbon monoxide fire detectors should be functionally tested by a method that confirms that carbon monoxide can enter the detector chamber and produce a fire alarm signal (e.g. by use of apparatus that generates carbon monoxide or a gas that has a similar effect on the electro-chemical cell as carbon monoxide). WARNING: Carbon monoxide is a highly toxic gas and suitable precautions should be taken in its use".
BS 5839 1: 2002 Clause 45.4 (d), December 2004 update

As regards when all these tests should be conducted, the answer is both:

1) At commissioning
   and,
2) Annually (though the annual tests are often split over the course of two or more occasions).

In the US, National Fire Alarm Code NFPA 72 2002 Edition, Table 10.4.3 Testing Frequencies requires both Initial/Reacceptance and Annual functional checks. Similarly, the UK's National Code, states:

"At commissioning, the entire system should be inspected and tested to ensure that it operates satisfactorily and that, in particular, . . .

1) all manual call points and automatic fire detectors function correctly in accordance with the recommendations in 45.4;
BS 5839 Part 1: 2002 39.2 c:

where 45.4 clarifies the 'physical nature' of the functional check.

Germany too requires, at commissioning, that 100% of all installed system components be tested and that, in the case of automatic fire detector tests, the alarm be triggered by simulating the characteristics of fire at the detector.

Anhang 1 – 1.2.5 Funktionsprüfungen
Die nachfolgenden Funktionsprüfungen bilden den Abschluss der Inbetriebsetzungsarbeiten für eine BMA. Sie sollten daher als 100%-Prüfungen mit allen installierten Anlagenbestandteilen durchgeführt werden . . . aller automatischen Brandmelder . . . sollten geprüft werden. . . . Für diese Prüfungen sollte die Alarmauslösung der automatischen Brandmelder durch Simulation der relevanten Brandkenngröße am Melder . . . vorgenommen werden."
DIN 14675:2003-11

In France Règle APSAD R7 Detection automatique d'incendie, Edition 02.1997.4 (fevrier 2003) also highlights the importance of the commissioning tests. In Section *5.2 Operation de visite de conformite* (the commissioning visit) it states:

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5.2.2 Verification fonctionelle de l'installation
La verification fonctionelle d'installation a pour but de s'assurer que toutes les fonctions sont correctement remplies. . . .

And cross refers this, in 6.3.3, to the periodic annual checks (while confirming in 6.4 that that the annual checks can be split into two six monthly checks though, in common with most countries, indicating that the period must not be less frequent than six monthly).

Six monthly visits by a Competent Person to every detector are, of course, a wise step for a number of reasons. Not only can a proper functional check on an ongoing basis highlight the inability of a detector to raise an alarm (for reasons which may range from component failure through wiring damage to dust covers or other barriers to detection). It also provides an opportunity for an expert to assess building, usage and other changes that may impact the reliability or suitability of the detector relative to its installed environment.

So, with all this clarity, what confusion can remain?

One area concerns the ongoing sensitivity of a detector. This is something that cannot be assessed at all with most conventional detectors without a specialist test device. It is also one where even the faith in analogue detectors – assessing as they do only the sensors as opposed to the ability of them to receive stimuli – is flawed. As the French R7 notes (with reference to the functional checks):

5.2.2.3 Essai de fonctionnement des detecteurs
En aucun cas ce test ne doit etre considere comme une mesure de sensibilite . . . il ne peut etre confondu avec la verification du niveau de performance efffectuee au moyen des foyers-types de site.

Which translated, means that, in no instance can this (functional) test be mistaken for a sensitivity check nor confused with site performance checks (carried out separately and according to strict controls).

This, at least, goes to show that the French and Americans agree on some things – as the US Code NFPA 72 confirms:

"10.4.3.2.6 The detector or smoke alarm sensitivity shall not be tested or measured using any device that administers an unmeasured concentration of smoke or other aerosol into the detector or smoke alarm"

and the American code is equally clear on how sensitivity checks can – and must – be performed as it is on how they cannot be:

10.4.3.2.4 To ensure that each smoke detector or smoke alarm is within its listed and marked sensitivity range, it shall be tested using any of the following methods:
(1) Calibrated test method
(2) Manufacturer's calibrated sensitivity test instrument
(3) Listed control equipment arranged for the purpose
(4) Smoke detector/control unit arrangement whereby the detector causes a signal at the control unit where its sensitivity is outside its listed sensitivity range
(5) Other calibrated sensitivity test methods approved by the authority having jurisdiction
10.4.3.2.5 Detectors or smoke alarms found to have a sensitivity outside the listed and marked sensitivity range shall be cleaned and recalibrated or be replaced.

Finally, the other area looking for clarification is that of multi sensor detectors. Or multi criteria detectors (even the names and definitions are not clearly understood or agreed). In the opinion of the author the 'multi confusion' has a 'single clarification' – that, for the purpose of field testing it does not matter whether one defines them as multi criteria or multi sensor. Neither does it matter how they are configured or when. Wherever possible (sometimes limited by the test modes available) each of their separate sensing abilities must be tested in the same real functional manner and at the same (commissioning and annual) times as described throughout this document. The logic behind this, however, needs another paper. . .

Solo Detector Removal Tool from No Climb

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