# How to undertake fixed wire testing effectively

**Michael Joubert, the 'architect behind', and head of operations for, EDIS (Electrical Distribution Information System), a system used by organisations to manage their electrical compliance, takes a look – based on his many years' experience in the field – at the priorities and requirements when undertaking fixed wire testing and reporting, and at some of the pitfalls if best practice is not followed.**

We have been tracking, recording, and managing fixed wire electrical inspection condition reporting for over 10 years, and during this time thousands of electrical certificates have been issued. In this article I will be describe our observations over this period, and the lessons we have learned while observing how fixed wire testing is planned, completed, and reported. Figure 1 illustrates the EDIS system that has been developed over the past 10 years, and supports the observations described in this article. My experience is that, in general, electricians complete their work to a good standard, that adheres to the various regulations. However, electrical risks often remain unresolved and unknown. It is, of course, the responsible person's duty to ensure that all electrical risks are identified, quantified, and addressed. In order to meet this requirement, fixed wire testing programmes need to provide three key deliverables:

- A completed and certified electrical inspection condition report. Without a completed certificate there is no record of the inspection, testing, and recommendations.
- If the condition report is 'unsatisfactory', the remedial work identified in the report needs to be completed. If the issues identified during inspection and testing are not addressed, the electrical infrastructure will remain non-compliant.
- An acceptable level of inspection and testing coverage needs to be achieved. If a reasonable sample of the installation is not tested, the risk cannot be fully assessed.

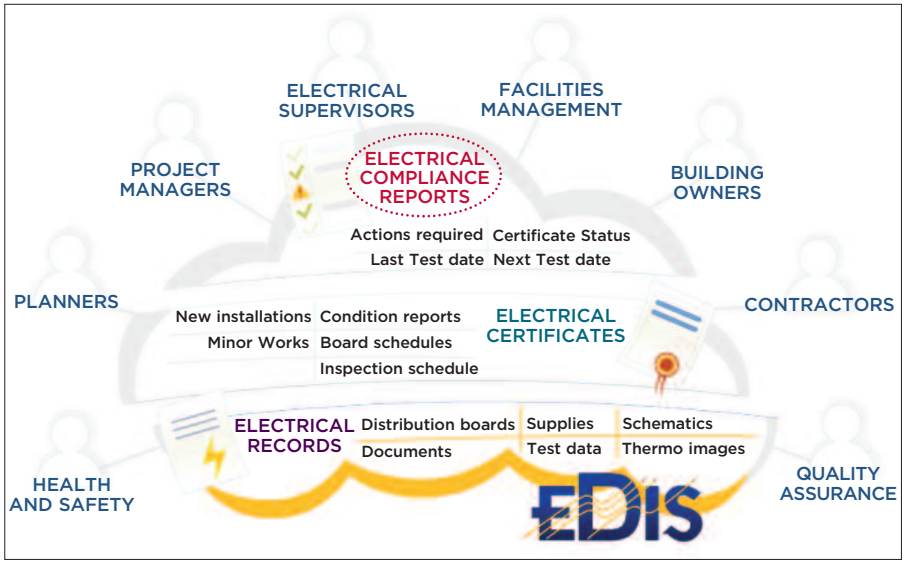


**Figure 1: The EDIS electrical compliance management system provides the process and automation to manage electrical compliance reporting – it supports stakeholders in creating electrical certificates, and managing, and reporting comprehensively on, electrical compliance.**

These deliverables are easy for a small building. However, where an estates manager, in say, a large acute hospital, is responsible for hundreds of electrical

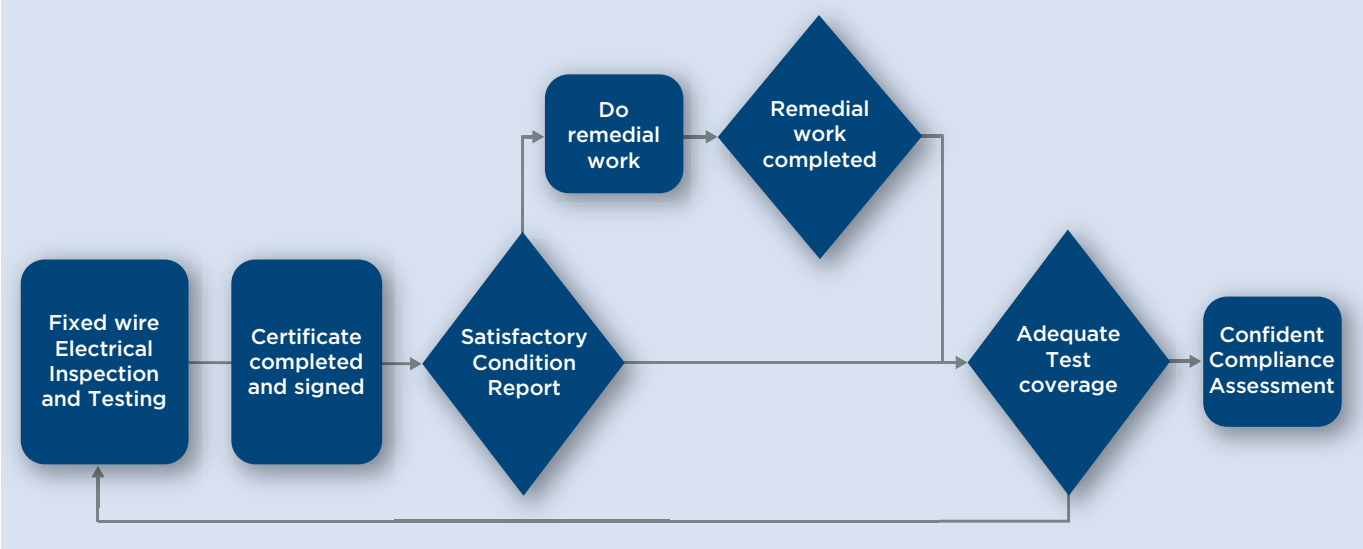


**Figure 2: The process flow above describes the steps required for a Confident Compliance Assessment. Importantly, it highlights the fact that a completed Condition Report is not in itself sufficient; the remedial work and test coverage must also be taken into consideration in order to make a confident assessment.**

distribution boards, numerous buildings, and perhaps thousands of circuits, the task is not straightforward. Figure 2 shows the process required to make a confident electrical compliance statement. Each of the three deliverables are further described below.

## Never signed off

One of the common issues that we have seen is that many electrical inspection condition reports are created, partially completed, and never signed off by the test engineers. This lack of record-keeping is difficult to track, and, as a result, the reports are not signed off – principally due to other 'higher priority' tasks that need to be undertaken at the expense of completed documentation. One solution is to insist that a draft report is created before the work is started, which in turn allows easy tracking of incomplete reports, as an incomplete draft can be monitored until is it completed. An alternative approach is to ensure that electrical work is only paid for after a certificate has been certified, received, reviewed, and filed. Without a completed and certified condition report, the responsible person has no proof that the testing has been carried out to the required standard.

## Addressing the recommendations

If the overall assessment provided by the electrician in the electrical inspection condition report is 'unsatisfactory', the observations and recommendations accompanying the electrical installation condition report must be addressed. Observations and recommendations are coded based on standard codes defined in the model forms of BS7671 – 18th Edition – IET Wiring Regulations, as follows:

| Overall Assessment in the Electrical Inspection Condition Report | Observations and Recommendations (Open C1, C2, and FI) | |
|---|---|---|
| | Open Actions | No Open Actions |
| Satisfactory | DEEMED NOT COMPLIANT | DEEMED COMPLIANT |
| Unsatisfactory | DEEMED NOT COMPLIANT | DEEMED COMPLIANT |

**Figure 3: The grid describes the status for an area that has undergone fixed wire testing; it assumes there are no limitations and adequate test coverage. If the test coverage is not adequate, a confident assessment of the electrical condition cannot be made.**

**Code C1 (Danger present. Risk of injury. Immediate remedial action required)**
Our observation is that C1 issues are usually promptly addressed as part of the electrical inspection and testing by making them safe as they are discovered.

**Code C2 (Potentially dangerous – urgent remedial action required)**
Our observation is that these are ultimately addressed, albeit over a longer period. If a code C2 is found, the overall status identified in the electrical condition report will be 'unsatisfactory'.

**Code C3 (Improvement recommended)**
There is no immediate risk or danger, but an improvement will enhance the safety of the installation. A code C3 does not warrant an overall 'unsatisfactory' report.

**Code FI (Further investigation required)**
Further investigation is required if there is a reasonable expectation that there is a dangerous or potentially dangerous situation. Our observation is that the FI issues are not promptly addressed, and therefore risks remain unknown. Based upon our experience, we find it useful to include the following codes to provide additional clarity for the follow-on remedial work:

**Code FIO (For information only)**
THE FIO, 'For Information Only' code is provided as a convenience for the testers and their client if they want to make a note or statement that will assist the client at some future date.

**Code NCFF (Non-conformance found and fixed)**
If a Code C1 (Danger present. Risk of injury. Immediate remedial action required) is found, it should be attended to immediately. After it has been

attended to, the NCFF code provides a record that the danger has been made safe.

### Code LIM (Limitation)

The electrical inspection condition report includes a statement on the 'Extent of the installation and limitations of the inspection and testing', which covers specific areas that have prior agreed limitations. However, during testing, individual circuits often cannot be fully tested, and in these cases, we find it useful to set the code to LIM if further investigation is not required. The LIM should be accompanied by an explanation of the reason for the limitation in the inspection and testing. Our observation is that 'LIMs', which are not included in the extent of the installation statement, are recorded without explanation. Excessive use of LIM codes on circuits will reduce the test coverage.

Based on the observations and recommendations, an overall assessment of the installation in terms of its suitability for continued use is provided, in 'binary' terms: 'Satisfactory' or 'Unsatisfactory'. The notes accompanying each electrical installation condition report provide guidance to the electrician for determining the overall assessment – if there are any observations with codes C1, C2, or FI, the overall condition of the installation should be reported as 'unsatisfactory' (Fig. 3).

### Risk of 'ambiguous' text

In our experience, while the text accompanying the observations often makes sense when it is written, on review at a later date, where the context is no longer clear, it can be ambiguous. To address this potential pitfall, test engineers neeed to bear in mind that there may be hundreds of observations and recommendations across a large hospital estate that need to be addressed; thus careful recording of the description, location, and supporting information and 'evidence' – for instance photographs, accompanied by clear recommendations – need to be provided so that another engineer can easily plan the work to locate and remediate the issue or issues identified.

| Certificate description | Creation date | Status | Overall assessment | Actions required |
|---|---|---|---|---|
| Tower Block, 3rd floor, Riser A – condition report | 08/09/2015 | Signed original | Unsatisfactory | 2 |
| Essential information for electrical compliance | 21/08/2015 | Signed original | Unsatisfactory | 20 |
| Condition report northwest | 16/07/2015 | Signed original | Satisfactory | 0 |
| RCD testing DL for CR | 22/10/2016 | Signed original | Unsatisfactory | 3 |
| Periodic inspection – EIC | 16/04/2016 | Signed original | Unsatisfactory | 3 |
| Testing 5 May 2015 | 05/05/2015 | Signed original | Satisfactory | 0 |
| Periodic testing 4th floor, Area 2 | 17/08/2015 | Signed original | Unsatisfactory | 5 |

**Figure 4: The EDIS electrical certificate report allows managers to easily track the certificate details, assessment, and outstanding remedial works. It provides a list of all certificates, the assessment, and actions. The EDIS electrical compliance management system provides the workflows that will automate reports for tracking the certificate status, assessments, and actions required.**

### Key elements of accompanying text

Our suggestion for improving the observations and recommendations is that the text of each observation should include, at the very least, the following elements: (a) the distribution board reference, and, if relevant, the circuit reference, (b) location, (c) a headline or category of the issue, (d) a full description of the issue, and (e) a clear recommendation, and (f) if appropriate, a photograph. In this way the information will provide an unambiguous and convenient way to group the remedial work into work packages based on the nature of the work and the location. Figure 4 is a screenshot of an EDIS report that allows managers to easily track the certificate details, assessment, and outstanding remedial works.

Even after completion of the inspection, testing, and remedial works, the building may still not be deemed compliant if the test coverage is not acceptable. We regularly see that certificates have many

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| | TESTING DUE IN | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Building Name | Now | Next 3 months | Next 3-6 months | Next 6-9 months | Testing due and planned | Testing not due | Testing not due and planned | Spare circuits | Non-spare circuits | Total circuits |
| 202/2 | search | search | search | search | search | search | search | search | search | search |
| Build 202/2 | 611 | 0 | 0 | 1 | 0 | 1365 | 273 | 4172 | 1976 | 16148 |

**Figure 5: The EDIS Test Coverage Report provides tracking of tests on a circuit by circuit basis. Large estates and buildings often have rolling test programmes and ongoing installations and changes. If the test and inspection of each circuit cannot be easily reported on, the chance of not testing circuits, or unnecessarily testing circuits, becomes prevalent, increasing costs and risks.**

limitations and factors that prevent the required inspections and testing from being completed. These include contract limitations, circuits that cannot be traced, boards that cannot be de-energised, limitations due to operational requirements, and limitations preventing access to distribution boards and circuits. These limitations that prevent testing reduce the test coverage, sometimes to unacceptable levels. For example, we have observed test schedules that contained limitations for every circuit test due to lack of access and de-energising circuits that supplied a critical workspace; nevertheless, the report was submitted, with no tests undertaken, and no explanation of the limitation.

## Test limitations can apply to critical areas

Ironically, test limitations often apply to critical areas. Testing and inspection limitations therefore reduce the test coverage. In large buildings, where rolling tests are carried out, the compliance assessment is further complicated, as whole areas of the building may not be tested. Limitations of recent condition reports, and the status of the testing programme, combine to reduce the overall test coverage for a building.

Test coverage provides a measure of the amount of circuits tested compared with the total number of circuits. The test coverage should be within the acceptable limits based on the nature of the electrical installation. Older installations that have been modified and expanded over time may need a higher test coverage than a newer, more uniform, installation. Lack of adequate test coverage will prevent the responsible person from confidently asserting that they have met their duty of care.

Our recommendation to improve test coverage is to measure the number of circuits tested and the different tests completed per circuit. This report can be easily extracted from the electrical installation condition report. These measures can then be assessed, and a technical decision made on whether or not the coverage is adequate given the age and nature of the infrastructure.

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Figure 5 provides an example of how the EDIS system facilitates the management and tracking of test coverage.

Some further observations that support the above three requirements, and improve the management of fixed wire testing programmes, include:

- A clear and meaningful description of the certificate is required. Too often the report description is 'To meet the 5-yearly inspection and testing requirements', which is obvious, given the nature of the report. Useful details could include the area being tested, the target percentage of boards and circuits being tested, a purchase order number, contract references, a statement that observations categorised as C1s have been addressed, and any descriptive information that will assist the person reading the report five years after it was created.
- The completion of an accurate list that uniquely identifies the distribution boards, their location, and their electrical supply. This is often a precursor to a successful testing programme – without an inventory of all the distribution boards, panels, and power distribution units, the test coverage cannot be verified.
- Tracking tests on a circuit by circuit basis. Large estates and buildings often have rolling test programmes and ongoing installations and changes. If the test and inspection of each circuit cannot be easily reported on, the chance of not testing circuits or unnecessarily testing circuits becomes prevalent, increasing costs and risks.
- A certified electrical inspection condition report, with remedials completed, and acceptable test coverage, will provide the responsible person with the information to confidently and accurately report that the building is electrically compliant at a point in time. Without a verified certificate, accompanied by any remedial works and adequate test coverage, the compliance statement cannot be confidently made.

From our experience of fixed wire testing programmes, we believe the dissonance between completed fixed wire testing programmes and a confident statement of electrical compliance can be eliminated if the programme ensures that electrical certificates are fully completed, the remedial works are addressed, and a technically acceptable level of test coverage is achieved. hej

## Michael Joubert

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