



Extent of Adoption of Inspection and Testing Practices in Domestic Electrical Installation in Minna, Niger State

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ABSTRACT

The study investigated the extent of adoption of inspection and testing practices in domestic electrical installation in Minna, Niger State. Two objectives and two research questions were raised. A cross sectional survey research design was adopted. The population of the study consists of 165 electricians. A 26 – item questionnaires developed by the researcher, validated by three experts was used for data collection. Mean and standard deviation were used in answering the research questions. The findings of the study revealed among others that; verifying that switch or receptacles are installed correctly at their correct position and verifying the functional testing of residual current devices were practices adopted at high and a low extent respectively. Based on the findings, it was recommended among others, that the Niger State Government should organize Capacity Building Workshop for the electricians on practices for ensuring safety of lives and installations.

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INTRODUCTION

One of the major problems facing developing countries like Nigeria which has defied all solutions is frequent fire incidences which affect lives and properties worth billions of Naira in different states of the federation. Linsley (2018) defined fire as a chemical reaction which will continue if fuel, oxygen and heat are present. Generally, fire incidents can be classified in many ways depending on the cause of the fire outbreak. Specifically, fires are divided into five classes namely; class A, B, C, D, and K (University of Pennsylvania, 2014). In Nigeria, there are several electrical fire related incidences, some of which include; the Westminster Market located in the Trinity area of Apapa Lagos, the Sabon-Gari Market at Kano State as well as the Kure Market in Minna, Niger State, all gutted by fire which most a time had been attributed to electricity (Ochiaka, 2016). In March, 2022 an estimated cost of properties worth 9.8Million Naira were lost to electrical fire in Minna (Niger State Fire Service,

NSFS, 2023). In order to protect the buildings and their contents from the risk of fire and to safeguard the occupants or users of electricity from electric shock and burns, there is a need for understanding the factors responsible for electrical fire incidence.

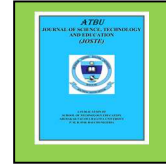
Babrauskas (2018) identified the factors responsible for electrical fires into two namely; (i) nature of the physical mechanism that led to ignition; and (ii) causative factors responsible for the fire incidence. The causative factors responsible for fire incidence are classified into two types: (i) distribution system and; (ii) domestic electrical installation practices (Hampson, 2017). Domestic electrical installation according to Linsley (2018) is the putting together of associated electrical equipment in a building, installed to fulfill a specific purpose or purposes and having coordinated characteristics. According to the National Electrical Contractor Association (NECA, 2024) domestic electrical installation practices consist of Designing, Selecting of Materials and

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Equipment, Installing, Inspecting and Testing of Equipment. This paper delimited to inspection and testing practices.

An inspection practice according to Scaddan (2023) is a detailed physical check-up made to ensure the following: all equipment is to a relevant British or Harmonized European Standard; erected/installed in compliance with the IEE Regulations; not damaged in such a way that it could cause danger. The inspecting practices visually carried out in an electrical installation includes: connection of conductor; identification of conductors; routing of cables in safe zones; selection of conductors for current carrying capacity and volt drop; connection of single - pole devices for protection or switching in phase conductors only; correct connection of socket outlets, lamp holders among others. If such inspection of electrical installations were not carried out, incorrect practices such as poor connections, defective design, wrong polarity of conductor, earthing as well as presence of short-circuit among other faults cannot be ascertained which invariably can lead to an electrical fire disaster (Patel, 2005). The electrical installation must be visually inspected by the electricians, before testing commences.

Testing practices according to Scaddan (2023) implies the use of instruments to obtain readings. The testing practices that are carried out in a sequentially order includes: Continuity of protective conductor; testing for continuity of ring final circuit; insulation resistance test; polarity test; earth electrode resistance test; polarity-supply connected; earth fault loop impedance – supply connected; functional testing of Residual Current Devices (RCD)-supply connected. The absence of certain test or testing practices in an electrical installation such as main equipotential and supplementary bonding conductors among others may lead to a dangerous situation vis-à-vis electrical fire (National Electrical Contractor Association (NECA, 2024). If reasonable provision were not made in the installation process, there is a likely risk of injury to person or fire. So therefore, on completion of an installation or an extension of an installation, appropriate inspection and tests shall be made to verify so far that the requirements

of the Wiring Regulations have been met (Electrical and Mechanical Services Department (EMSD), 2015). The coordinated characteristics are carried out to prevent the occurrence of electrical fire incidence and to provide safety. Against this backdrop, a need arouses for the investigation on the extent of adoption to domestic electrical installation practices related to inspection and testing practices responsible fire incidence with a view to using this study for identifying appropriate method of addressing the menace.

STATEMENT OF THE PROBLEM

Electricity is a basic part of residential life in Minna, Niger State, Nigeria. It provides the energy for most powered items in a contemporary home, from lights to heating systems and to electrical appliances (Topical Fire Report Series, 2014). Today it is hard to imagine a residence without electricity as it has been part of our homes and our activities (Adekunle, *et al.*, 2016). However, no Nigeria citizen, Niger State, Minna in particular, is expected to lose their life and properties while assessing this electricity for their business and homes (Fashola, 2016).

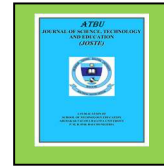
However, evidence from available literature reviewed that Minna town in Niger State has been recording tremendous increase in fire incidence while assessing electricity. The statistical data provided by the Niger State Fire Service (2023) for the period of six years commencing from 2018 to 2023 indicated that an estimated 362 fire incidence were reported, with electrical fires incidences having the highest incidence rate of 193 constituting 53 percent while 69 fire incidence constituting 19 percent are non-electrical fire whereas 28 percent representing 100 fire incidence are un-known fires. This increased trend according to NECA (2024) might be attributed to practices in domestic electrical installation work. Against this backdrop, a need arises for the investigation on the extent of adoption to domestic electrical installation inspecting and testing practices responsible for this fire incidence. Therefore, the problem of this study pose as a question is; what are the extent of

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adoption of inspection and testing practices in domestic electrical installation in Minna?

Aim and Objectives of the Study

The aim of this research work was to assess the extent of adoption of domestic electrical installation practices by electricians, with a view to ascertaining whether it is responsible for the rising incidence of fire in Minna, Niger State. Specifically, the objective of the study was to assess the extent of adoption of inspection and testing practices in domestic electrical installation (DEI) in Minna.

Research Questions

The following research questions were formulated to guide the study:

- i. To what extent are the inspection practices adopted by electricians in Minna?
- ii. To what extent are the testing practices adopted by electricians in Minna?

METHODOLOGY

The study adopted a Cross sectional survey research design. The study was carried out in Minna, Niger State, Nigeria. The population

for the study was made up of 165 registered electricians practicing domestic electrical installation work. No sampling was done due to the manageable population. A structured Questionnaire titled; An Instrument for Assessing Domestic Installation Inspection and Testing Practices (IADIITP) were used to answer the research questions. The instrument used for the study was content validated by three experts. Cronbach Alpha Statistics was used to determine the reliability coefficients of the pilot tested instrument which was found to be 0.89. A total of 165 instruments were distributed and 98.2 percent were retrieved by the researcher made up of 6 technicians, 35 craftsmen and 121 artisans. The data was analysed using mean and standard deviation obtained from responses on the four-point response categories as follows: very high extent, high extent, low extent and very low extent representing 4, 3, 2 and 1 respectively. The standard deviation was used to decide on the closeness or otherwise of the respondents to the mean in their responses. The decision for answering research questions was based on real limit of numbers.

Decision Rule

Table 1.0: True Limits of Real Numbers

Limits	Abbreviation	Interpretation
3.50 – 4.49	VHE	Very High Extent
2.50 – 3.49	HE	High Extent
1.50 – 2.49	LE	Low Extent
0.50 - 1.49	VLE	Very Low Extent

(Source: Vagias, Wade M., 2006)

RESULTS

Research Question One:

To what extent are the inspection practices adopted by electricians in Minna?

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Table 2.0: Mean Responses of Electricians on the Extent of Adoption of Inspection Practices.

S/N	ITEM	X _A	SD _A	RMK
	Inspection Practices			
1	Check lighting fixture outlet boxes for suitability, correct positioning and correct alignment.	2.81	0.63	HE
2	Verify that residuals current devices is provided at the correct place in bathroom, in kitchen, near sinks, on roof tops, in door wet areas, in locker room with shower and in garages.	2.33	0.53	LE
3	Check for continuity and completeness in metal or PVC raceways and enclosure.	2.35	0.59	LE
4	Check lighting and installation boxes used for support of ceiling suspended (paddle) fans.	2.38	0.71	LE
5	Verify that switch or receptacles are installed correctly at their correct position.	3.00	0.90	HE
6	Verify that metal switch boxes, switches and metal face plates are properly grounded.	2.86	0.64	HE
7	Verify that serviced disconnection means provided, suitable and located outside or inside nearest the part of entrance of the service conductor.	3.07	0.77	HE
8	Verify that service over current protection is provided, properly sized, and part of or adjacent to the disconnection means.	3.52	0.82	VHE
9	Check service conductor for adequate size and cable.	3.29	0.69	HE
10	Verify that the electrical equipment's on meter board are securely fastened and supported	2.94	0.65	HE
11	Verify that boxes are securely fastened and supported.	2.80	0.64	HE
12	Verify that earth rod is properly connected to bonding conductor	2.44	0.58	LE
13	Check the presence of danger notices and other warning notices.	2.40	0.51	LE
14	Check the presence of diagrams, instruction and similar information in the distribution board	2.22	0.65	LE
15	Verify the labeling of circuit, fuses and switches.	2.28	0.57	LE
16	Verify the closure of the earth chamber using concrete slab	2.47	0.62	LE
	GRAND MEAN	2.69		HE

VHE = Very High Extent; HE = High Extent; LE = Low Extent; VLE = Very Low Extent.

Table 2.0 shows the similarities and differences of respondents views on the extent of adoption of inspection practices. The respondents adopt item 8 to very high extent with mean value of 3.52. The respondent extent of adoption is high with items 1, 5, 6, 7, 9, 10, and 11, with mean scores ranging from 2.51 to 3.41. The extent of adoption is low with items 2, 3, 4, 12, 13, 14, 15, and 16 with mean scores ranging from 2.22 to 2.49. The grand mean of 2.69 indicated that inspection practices was adopted to high extent. The standard deviations ranged from a highest of

0.90 to a lowest of 0.51 which shows that the respondents mean responses do not differ significantly. The 16 items had their standard deviations less than 1.96, showing that the respondents were not far from the mean and were close to one another in their responses. The closeness of the responses add value to the reliability of the mean.

Research Question Two:

To what extent are the testing practices adopted by electricians in Minna?

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Table 3.0: Mean Responses of Electricians on the Extent of Adoption of Testing Practices.

S/N	ITEM	X _A	SD _A	RMK
Testing Practices				
17	Verify the test continuity for protective conductor.	2.38	0.67	LE
18	Verify the main and supplementary bonding test.	2.48	0.76	LE
19	Verify the continuity test of all ring circuit.	2.92	0.86	HE
20	Verify the insulation resistance test.	3.41	0.68	HE
21	Verify the Live polarity using continuity method or carries out Live polarity test.	3.51	0.67	VHE
22	Verify the rechecking of the polarity using voltmeter.	2.51	0.66	HE
23	Verify the earth electrode resistance test.	2.48	0.75	LE
24	Verify the functionality of the earth fault loop-impedance test.	2.25	0.67	LE
25	Verify the functional testing of residual current devices.	2.49	0.88	LE
26	Verify the functional testing of earth leakage circuit breaker.	2.46	0.63	LE
GRAND MEAN		2.68		HE

Table 3.0 shows the similarities and differences of respondents' views on the extent of adoption of testing practices. The respondents adopt items 21 to very high extent with mean value of 3.51. The respondent extent of adoption is high with items 19, 20 and 22 with mean scores ranging from 2.51 to 3.41. The extent of adoption is low with items 17, 18, 23, 24, 25 and 26, with mean scores ranging from 2.22 to 2.49. The grand mean of 2.68 indicated that testing practices was adopted to high extent. The standard deviations ranged from a highest of 0.90 to a lowest of 0.51 which shows that the respondents mean responses do not differ significantly. The 10 items had their standard deviations less than 1.96, showing that the respondents were not far from the mean and were close to one another in their responses. The closeness of the responses add value to the reliability of the mean.

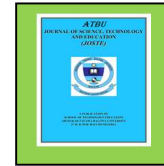
FINDINGS OF THE STUDY

The following findings emerged from the study based on the data collected and analyzed:

1. The following inspection practices revealed that the respondents: verify that service over current protection is provided, properly sized, and part of or adjacent to the disconnection means and to verify the live polarity using continuity method were practices adopted at very high extent. While to verify that boxes are securely fastened

- and supported and to verify the continuity test of all ring circuit were practices adopted at a high extent respectively. Whereas, check the presence of (diagrams, instruction and similar information) in the distribution board and to verify that: residual current device (RCD) is provided at the correct places in bathroom, in kitchen, near sinks, outdoors, on roof tops, in door wet areas, in locker room with shower and in garages; earth rod is properly connected to the bonding conductor; were practices adopted at a low extent.
2. The following testing practices revealed that the respondents: Verify the Live polarity using continuity method or carries out Live polarity test were practices adopted at very high extent. While to verify the continuity test of all ring circuit; Verify the insulation resistance test; and Verify the rechecking of the polarity using voltmeter were practices adopted at a high extent respectively. Whereas, and to verify that: residual current device (RCD) is provided at the correct places in bathroom, in kitchen, near sinks, outdoors, on roof tops, in door wet areas, in locker room with shower and in garages; earth rod is properly connected to the bonding conductor; the

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test for continuity of protective conductor; the functional testing of residual current device; functional testing of earth leakage circuit breaker were practices adopted at a low extent.

DISCUSSION OF FINDINGS

The answer to the research question one is presented in Table 2.0. The findings show that the extent of adoption is very high on this inspection and testing practices; verify that service over current protections provided, properly sized, and part of or adjacent to the disconnection means and to verify the live polarity using continuity method or carries out live polarity test. Very highly adoption of these practices are in line with Scaddan (2023) which identifies polarity test and to verify service over current protections provided, properly sized and part of or adjacent to the disconnection means as practice that is paramount after mains is connected.

The findings revealed that, checking of lighting fixture as well as service conductor, and to verify that; switches or receptacles are installed correctly at their correct position, service disconnection means provided, suitable, and located outside or inside the nearest part of entrance of the service conductor, electrical equipment's on meter board are securely fastened and supported, boxes are securely fastened and supported, continuity test of all ring circuit, insulation resistance test and the rechecking of the polarity using voltmeter were practices adopted at high extent. These high adopted practices were in-lined with the work of and suruhanjaya (2018) which both opined that, the following inspection and testing practices were recommended and relevant as they include; continuity of ring circuit conductor, insulation resistance and polarity test among others. In support of the findings, Linsely (2018) also suggested that all new installation should be inspected and tested before connection to mains, and all existing installation should be periodically inspected and tested to ensure that they are safe and meet the stipulated regulation. Such inspection and testing include the following; correct connection of sockets outlets, lampholder,

accessories and equipment; testing for continuity of ring final circuit conductor, insulation resistance test and polarity test among others.

The findings revealed that, the extent of adoption of these practices; verify that Residual Current Devices (RCD) is provided at the correct places in bathroom, in kitchen, near sinks, outdoors, on roof tops, in door wet areas, in locker room with shower and in garages, verify the functional testing of residual current device and to verify the functional testing of earth leakage circuit breaker were low. These findings reveal that protective devices (RCD) were adopted to Low Extent in terms of inspection and testing of the installation work, and as such, if fault arises, the outcome will result to electrical fire, if no protective devices like (RCD) is been installed. The findings are in harmony with the work of Masterson (2022) which stated that the absence of RCD's is evident in most installation work and this give rise to electrical fire hazards. This result is in line with the findings of Orovwode (2016) which stated that, lack of installing protective devices contributes to electrical fire incidence. Orovwode, further stated that many electrical consumers look at the cost of installing electrical protective devices as a waste, since its functions is not evident on daily basis. Those who manage to install at the beginning do not bother to inspect, repair or replace them when they are faulty.

The findings also revealed as follows; verify that earth rod is properly connected to the bonding conductor, verify the closure of the earth chamber using Concrete Slab, Verify the test for continuity of protective conductor, Verify the Main and supplementary bonding test, Verify the earth electrode resistance test and to Verify the functionality of the earth fault loop-impedance test were practices adopted at a lower extent. Findings from these inspections and testing practices indicates improper earthing system in most domestic electrical installation work given rise to low extent of adoption which can definitely result to disaster if fault arises.

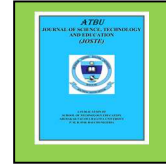
Improper earthing system is among one of the cause of electrical fire outbreak. This finding is in line with the findings of Linsley (2018) which stated that lack of proper earthing system causes

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danger which often arises from inadequate connections such as; an earth clip which has worked loose, a poorly made conduit connections or corrosion of parts of the earthing system. This finding is further supported with the work of Masterson (2022) which stated that the earthing system in most buildings are inadequate and even to the untrained eye this is obviously an extremely dangerous situation that leads to electrical fire incidence. Masterson concluded that Earthing and equipotential bonding are intrinsic in terms of electrical safety. Earthing clamps may be rendered useless if water-pipes are painted. Paint may run between the pipe and the clamp connection, since most paints have insulating properties this can in effect electrical conductivity and prevent fault current and spurious faults currents from flowing; these fault currents enable protective devices to operate. As such, if the fault current is unable to flow, such case invariable leads to electrical fire.

The findings further revealed that, the Presence of danger notices and other warning notices, to Check the Presence of (diagrams, instruction and similar information) in the Distribution Board and to verify the labeling of circuits fuses and switches were practices whose extent of adoption were low. If such information is not putting in place, this will lead to danger in terms of maintenance except handle by professionals. This finding is in consonance with the opinion of Masterson (2022) who reported that, there is no labelling present in practicing domestic electrical installation to indicate to the consumer the functionality of the protective devices (distribution board) and its danger. The findings are further supported by the work of Sulieman (2015) which stated that over 94 percent of practicing domestic electrical installation does not have instructional manual and other similar information as well as danger notice.

CONCLUSION

Based on the findings of the study and the discussions, the following conclusions were drawn. Firstly, the domestic electrical installation (inspection) practices were adopted to High Extent by electricians in Minna. Secondly, some of the

practices were adopted to low and very low extent and these are practices responsible for providing safety to installations. Consequently, this enabled the researcher to conclude that it contributes to the increasing fire incidence in Minna.

RECOMMENDATIONS

The study made the following recommendations in line with the findings:

1. The Niger State government should organize a Capacity Building Workshop for the electricians on those safety practices that were adopted to Low Extent.
2. NEMSA should assist in terms of procurement of electrical testing equipment's and training of members of the profession (LECAN) drawn from each association on how to carry out electrical inspection and testing in a domestic electrical installation.
3. LECAN members (Electricians) should adopt the practice of concrete chambers in burying of Earth rod so as to prevent corrosion/rusting and provide a better continuity to the electrical installation

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