

NATIONAL FEDERATION OF ENGINEERS FOR ELECTRICAL SAFETY



NFE CERTIFIED FLIT PROFESSIONAL

PUB: GB/002/1st Ed/2024

PART A REQUIREMENTS

REQUIREMENTS FOR THE FLIT PROFESSIONAL PROGRAM

1. **Introduction:** Accidents from electricity such as fire due to short circuit is a perennial problem in several nations. Disconnection of the fault (earth fault of negligible impedance or short circuits between live conductors) within the specified time ensures safety. The Fault Loop Impedance Test is a part of Verification to ensure efficiency of automatic disconnection of supply by over current protective device (OCPD). Verification is listed at Chapter 6 in IS 732: 2019 (Code of Practice for Electrical Wiring Installations). Further, similar to Earth Fault Loop Impedance test, another test between current carrying conductors can ensure automatic disconnection during a short circuit and identification of oversized protective devices or undersized conductors, to eliminate accidents Automatic disconnection of supply within the specified time ensures that some amount of safety is achieved against electric shock and thermal effects (fire) in Low Voltage Electrical Installations. Fault Loop Impedance Test (hereafter called as FLIT) is included in the Central Electricity Authority (Measures relating to Safety and Electric Supply) Regulations, 2023 (hereinafter called as Regulations or CEA Regulation 2023) as a mandatory test in every electrical installation. This test is thus necessary to be conducted in every Electrical Installation of voltage upto 1000 VAC.

1.1. Refer Regulation 43 (ix), (xi) and (xii)

(ix) All earthing systems shall have earth fault loop impedance sufficiently low to permit adequate fault current for the operation of protective device within the time stipulated in the relevant standards; and

(xi) earth fault loop impedance shall be tested to ensure the automatic operation of the protective device and a record of every earth test made and the result thereof shall be kept by the supplier for a period of not less than two years after the day of testing and shall be available to the Electrical Inspector when required;

(xii) earth fault loop impedance of each circuit shall be limited to a value determined by the type and current rating of the protective device used such that, on the occurrence of an earth fault, disconnection of the

supply shall occur before the prospective touch voltage reaches a harmful value.

2. Apart from the CEA Regulation 2023, IS 732:2019 (Code of Practice for Electrical Wiring Installations), SP 30: 2023 (National Electrical Code 2023 (NEC)) and IS 3043: 2018 (Code of Practice for Earthing), among other inspection and testing, also mandate measurement of fault loop impedance for ensuring protection of the circuit by the proper selection of over current protective devices.
3. The latest electrical safety standards for electrical equipment also demand verifying the efficiency of automatic disconnection during commissioning of the equipment. A few of these standards are listed below.
 - 3.1. IS17900: 2022 - Lift and Elevators, Clause 6.3.2.
 - 3.2. IS/IEC 61439-1 - Low Voltage Switchgear and control gear assemblies – Part 1: General Rules, Clause 8.4.3.2.
 - 3.3. IEC 62040-1 (extended version) (IS: 14242), Uninterruptible power system (UPS) Part 1: Safety requirements, Clause 4.4.4.4.
 - 3.4. IEC 62477-1 – Safety requirements of power electronic converter systems and equipment Part 1: General, Clause 4.4.4.4.
4. The FLIT ensures that the fault loop impedance of the circuit is low enough so that sufficient fault current flows in the circuit and the OCPD (e.g. Fuse / MCB) is able to disconnect the supply in case of an earth fault. This concept can also be used to verify the efficiency of disconnection of OCPD during short circuits between live conductors.
5. The NFE proposes to train and certify individuals in the measurement of Loop Impedance of a circuit and the validation of Automatic Disconnection of Supply. The NFE Certified Fault loop Impedance Testing Professional (NFE Certified FLIT) is a Person / Technician / Engineer who has knowledge in the subject of Fault Loop Impedance Testing. It is proposed to have 3 levels of FLITE as given below:
 - Level 1: Fault Loop Impedance Testing Technician (FLITT)
 - Level 2: Fault Loop Impedance Testing Engineer (FLITE)
 - Level 3: Fault Loop Impedance Testing Professional Engineer (FLITPE)All three positions are identified as FLIT Professional with their respective level.
6. Other measures for fault protection are also included in the standards and regulations. However, NFE Certified FLIT Professional scope is limited to the safety

measure “Fault Protection by Automatic Disconnection and / or Efficiency of automatic disconnection”.

7. There are 3 levels of FLIT Professional. The requirements of different levels of FLIT Professional are as given below. Candidates can appear for any level subject to meeting the requirements of the appropriate level. The type of Buildings and equipment covered in this document is applicable only for AC voltages.

7.1. Requirement for NFE Certified Level 1 FLIT Technician

- 7.1.1. The Level 1 FLIT Professional is called as Fault Loop Impedance Testing Technician (FLITT)

7.1.2. Qualification: Not Applicable

- 7.1.3. Level 1 FLIT Professional shall be certified for carrying out the tests only in LT Residential or commercial buildings of height less than 15 meters (i.e., other than high rise-rise buildings as prescribed under Regulation 38) subject to a LT connected load upto 25 kW.

7.1.4. The person shall use PPE’s while carrying out the tests.

7.1.5. The person shall possess knowledge on faults, automatic disconnection of OCPD during an earth fault of negligible impedance and short circuit, disconnection time and maximum allowed loop impedance of different type of OCPD’s.

7.1.6. Practical skills on testing fault loop impedance and creating the result (whether the test is passed or failed).

7.1.7. Shall either own or be issued an instrument of minimum 12 amps suitable for testing of circuits up to 63 amps, Voltage up to 415 V, suitable for MCB’s up to 63 amps.

7.2. Requirement for NFE Certified Level 2 FLIT Engineer

7.2.1. The Level 2 FLIT Professional is called as Fault Loop Impedance Testing Engineer.

7.2.2. Qualification: Engineering Degree/Diploma with six months experience.

7.2.3. Level 2 FLIT professional shall be certified for carrying out the tests of FLIT in Residential or Commercial buildings not exceeding 60 meters and supply voltage not exceeding 650 V. They are also certified to test electrical equipment, which demands test for efficiency of automatic disconnection of supply during equipment commissioning (ref clause 3).

7.2.4. The person shall use PPE’s while carrying out the tests.

- 7.2.5. He shall possess knowledge on earth leakage, earth fault, automatic disconnection of OCPD during an earth fault of negligible impedance and short circuit, disconnection time and maximum allowed loop impedances of various type of protective device, all requirements of protection by automatic disconnection of supply, Type of RCD's and its applications.
- 7.2.6. Understanding of Fault Loop Impedance, Practical skills in testing Fault Loop Impedance. Practical skills in testing Residual Current Devices.
- 7.2.7. Make recommendations for reduction in the fault loop impedance of the installation or advise suitable protective measure against earth leakage, earth faults from installation or equipment and short circuits in the installation.
- 7.2.8. Shall either own or be issued an instrument of minimum 20 amps suitable for testing of circuits up to 125 amps, Voltage up to 415 V, suitable for OCPD's up to 125 amps and Type AC and Type A RCD's.
- 7.3. **Requirement for NFE Certified Level 3 FLIT Professional Engineer.**
- 7.3.1. The Level 3 FLIT Professional is called as Fault Loop Impedance Testing Professional Engineer
- 7.3.2. Qualification: Engineering Degree with Two years experience or Engineering Diploma with four years experience.
- 7.3.3. Level 3 FLIT professional shall be certified for carrying out the tests of FLIT for all type of Buildings and equipment.
- 7.3.4. The person shall use PPE's while carrying out the tests.
- 7.3.5. The person shall possess knowledge of basic protection, fault protection and additional protection by RCD.
- 7.3.6. The person shall have an understanding of Fault Loop Impedance and touch voltage, Practical skills in testing (a) Fault Loop Impedance (both earth faults and short circuits, and maximum allowed loop impedances of various type of protective device, (b) Residual Current Devices and (c) Touch voltage.
- 7.3.7. The person shall make recommendations for reduction in the fault loop impedance of the installation or advise suitable protective measure against earth leakage, earth faults in the installations or from equipment and short circuits in the installation. He shall also make recommendations for reduction of touch voltage and for improvement in fault protective measures.

- 7.3.8. Shall either own or be issued an instrument of minimum 200 amps, suitable for testing of circuits up to 2500 amps, Voltage up to 415 V, suitable for OCPD's up to 2500 amps. The meter shall be capable of testing shock voltages (e.g. touch voltage of simultaneously accessible metallic part) and Type AC, Type A, Type F and Type B RCD's.
8. Instrument:
- 8.1. The fault loop impedance tester / multi tester, hereinafter called the instrument, shall be required for obtaining all levels of certification. Individual applicants shall own their meters. The maximum number of professionals who can be certified with a common meter shall be restricted to 2 (two) for Level 1 FLIT Professional, 4 (four) for Level 2 FLIT Professional and 8 (eight) for Level 3 FLIT Professional.
- 8.2. The details of make, serial number, date of purchase, calibration date, validity of calibration etc. shall be furnished.
- 8.3. The instrument shall comply with IEC 61557-1, 3 and 6.
- 8.4. The owner of the Instrument shall keep the meter regularly calibrated as required. Valid test/ calibration certificate issued by the manufacturer or NABL accredited laboratory shall be furnished.
- 8.5. The certificate will be valid for 2 years, which must be renewed by submitting the calibration certificate and attending an ONLINE examination.
9. All FLIT Professional shall use NFE standard format for documenting the test carried out.
10. The Certification does not absolve the NFE Certified FLIT Personnel in obtaining the statutory requirements of relevant competency certification or license for working on the electric supply lines, if any, required by the appropriate government.

PART B

FLIT TRAINING AND CERTIFICATION

Training and Certification Program for FLIT Professional

1. **Objectives of the Program:**
 - 1.1. The **NFE Certified Fault Loop Impedance Testing (FLIT Professional)** program focuses on training and certifying individuals in measuring the **Loop Impedance** of a circuit and validating **Automatic Disconnection of Supply**. The proposed **three levels** of FLIT certification:
 - 1.1.1. **Level 1:** Fault Loop Impedance Testing Technician (**FLITT**) (No qualification required): Introduces individuals to the basics of fault loop impedance testing.
 - 1.1.2. **Level 2:** Fault Loop Impedance Testing Engineer – (**FLITE**) (Engineer / diploma with six months experience) Provides more in-depth knowledge and skills for conducting fault loop impedance tests.
 - 1.1.3. **Level 3:** Fault Loop Impedance Testing Professional Engineer (**FLITPE**) (Engineer / diploma with two years' experience): Experienced professionals, offering advanced expertise in this field.
 - 1.2. Whether you're a Technician, an Engineer, or someone interested in electrical safety, FLIT Professional certification equip you with the necessary knowledge to ensure a basic safe electrical system.
2. **INTRODUCTION**
 - 2.1. The Training and Certification Program for FLIT Professional has been developed to provide guidance for the candidates under the NFE CERTIFIED FAULT LOOP IMPEDANCE TESTING PROFESSIONAL (FLIT Professional) program.
 - 2.2. The Fault Loop Impedance Test is a part of Verification to ensure efficiency of automatic disconnection of supply by Over Current Protective Device (OCPD). Verification is listed in Chapter 6 of IS 732: 2019 (Code of Practice for Electrical Wiring Installations) and Part 1 Section 17 of National Electrical Code of India 2023. Earth Fault Loop Impedance is included in the Codes of Practice as mandatory testing, however a similar test between current carrying conductors ensures automatic disconnection during a short circuit and identification of oversized protective devices or undersized conductors, which may lead to accidents.
 - 2.3. The protective measure called as “Protective Equipotential Bonding and Automatic Disconnection of Supply” within the specified time ensures that some amount of safety is achieved against an electric fault which may create electric

shock and thermal effects (fire) in Low Voltage Electrical Installations. Fault Loop Impedance Test (hereafter called as FLIT) is included in the Central Electricity Authority (Measures relating to Safety and Electric Supply) Regulations, 2023 (hereinafter called as Regulations or CEA Regulation 2023) as a mandatory test in every electrical installation. This test is thus necessary to be conducted in every Electrical Installation having a supply voltage of upto 1000 VAC. Other measures for fault protection are also included in the standards and regulations. However, NFE Certified FLIT Professional scope is limited to the safety measure “Fault Protection by Automatic Disconnection and / or Efficiency of automatic disconnection by OCPD or by RCD.

2.4. This document provides a framework for the effective management and delivery of competence-based training aimed at the overall development of trainees to become NFE Certified Professionals. The approval process establishes competence in delivering the requisite elements of relevant training, ensuring that trainees can effectively perform tasks as FLIT professionals. This process emphasizes learning and self-development, encouraging professionals to pursue excellence. It assists the professional program in achieving high performance, integrity, and quality, thereby earning the confidence of stakeholders and the community.

3. Purpose of this document

3.1. The purpose of this document is to define the criteria and process for approving the FLIT professionals Training and certification program to promote uniformity in competence standards. It provides a comprehensive framework for planning, establishing, operating, monitoring, and improving the training service for FLIT Professionals.

4. Scope

4.1. The **Scope** of this document outlines the system for NFE (also referred to as the Institution) to conduct training under the **FLIT program** and obtain certification from NFE. The approval granted through this process remains valid for a period of **Two years**.

5. Glossary

5.1. **Competence:** Ability to apply knowledge and skills to achieve intended results.

5.2. **Training:** The act or process of imparting or acquiring knowledge, skill, or judgment.

5.3. **Training Process:** The process resulting in the provision of educational/ training services.

6. **Governance of the Program**

6.1. **General**

6.1.1. The NFE board shall institute a FLIT Program Management Committee (NFE FLIT PMC)/(or appoint a FLIT Program Head) responsible for the effective management of NFE Certified Professional FLIT Program. The committee shall comprise of at least two members, one of who shall be an expert on the subject. The Committee shall review adherence to laid down criteria in this document, performance of training, and certification of professionals under the FLIT program.

6.1.2. NFE FLIT PMC shall select a two to five member team called the NFE FLIT Team comprising of FLIT program training instructors/ tutors and Certification approvers.

6.1.3. NFE FLIT team shall be responsible for establishing and maintaining a documented training and certification system, continually improving its effectiveness in accordance with these criteria.

6.2. **Leadership**

6.2.1. The NFE FLIT PMC shall establish and follow methods to determine needs and expectations concerning effective delivery of curriculum and varied development of trainees.

6.2.2. The NFE FLIT PMC shall ensure that the following Program Goals are achieved:

- i. Development of the applicant to be effective Electrical Safety Professional.
- ii. Monitor that the training they deliver are as explained in the various Standards and are in compliance with the recommendation of the Standard.
- iii. Monitor that they are not making false commitments to the end users/ employers of the NFE Certified FLIT Professional.

6.2.3. **Responsibility and Authority:** The NFE FLIT Team comprising of Trainers and Approvers, shall define and document the responsibility and authority for all personnel involved in the FLIT professionals training program(s).

6.2.4. **Resources and Infrastructure:**

- i. The NFE FLIT TEAM shall have trainers with appropriate educational qualifications, experience, and training, supported by adequate staff and facilities. The learning environment shall include offices, safe classrooms, common spaces, and facilities with adequate illumination, ventilation, cleanliness, and safeguards against weather conditions and distractions.
- ii. The NFE FLIT TEAM shall provide financial resources to sustain a sound training program consistent with its mission and objectives for long-term stability.

6.2.5. **Qualification Process:** NFE shall have a process for qualifying tutors through evaluation by a senior professional or a valid “Certificate of Participation” in the “Train-the-Trainers” Program organized by the NFE. The institution shall review trainers’ performance periodically and upgrade their competence, as necessary.

6.2.6. **Competence of Trainers/ Tutor:** The trainer(s) shall have the following competence criteria:

- i. Education – Degree/Diploma in Electrical Engineering.
- ii. Work Experience – The Trainer shall have at least 5 years of working experience in electrical field.

6.2.7. **Competence of Certification Approver:** The Approver shall have the competence criteria:

- i. Education – Degree/Diploma in Electrical Engineering.
- ii. Work Experience – The Trainer shall have at least 5 years of working experience in electrical field.

6.2.8. **Continuous Evaluation:** NFE shall regularly monitor and evaluate trainer performance, reviewing the results of each training batch to ensure adequacy and accuracy.

6.3. **Control of Documents:** Documents should be adequately identified, described, reviewed, and approved, with access controls and version control implemented to ensure ongoing relevance and accuracy. Documents include Tutor and Approver Competence, Training program documentation, Candidates’ information, Examination related information and Certification documentation.

- 6.3.1. **Creating and updating** documented information with clear identification, description, format, and approval processes.
- 6.3.2. **Controlling** the documented information to ensure it's adequately protected, available, and remains up-to-date and suitable for use.
- 6.3.3. **Adequately identified, traceable** and described, which shall include a title, date, author, or reference number.
- 6.3.4. In a **format and media** that are suitable for use, whether it's paper-based or electronic.
- 6.3.5. **Reviewed and approved** for suitability by relevant authorities within the institution.
- 6.3.6. Implement **access controls** to restrict document editing and viewing.
- 6.3.7. Use of **version control** to track document revisions.
- 6.3.8. Establish a **review cycle** for documents to ensure ongoing relevance and accuracy.
- 6.3.9. FLIT Team shall ensure that relevant documents are available to all concerned within the Institution and to the interested parties.
- 6.4. **Control of Records**
 - 6.4.1. The NFE FLIT TEAM shall identify and maintain records to provide evidence of conformity to program criteria, including identification, indexing, storage, retention, and disposal. Records shall also comply with statutory and regulatory requirements.
- 6.5. **Compliance to Statutory and Regulatory Requirements**
 - 6.5.1. The FLIT training and certification program shall identify and comply with applicable statutory and regulatory requirements on the services provided.
 - 6.5.2. Design, Development and Delivery of Training Program
7. **Course Design and Structure:** The course will be so designed to cover all necessary inputs for achieving the course objectives. The structure will have a judicious mix of theory, concepts, exercises, and case studies, to illustrate and provide an opportunity to have a hands-on practice for application. Since the training is a kind of vocational training, adequate component of practice, evaluation and feedback cycle needs to be incorporated.

7.1.1. **Development of Training course:** Once the subjects, topics and specific modules have been decided, the training provider will develop study material, exercises, case studies and plan for syndicate and or project work as applicable. Talks by experts and well known professionals, other than that available in the training institute, on key issues shall also be catered for.

7.1.2. **Course Delivery:**

- i. **Duration:** While training provider may decide about the duration of the course, the total contact hours for a course should be laid down as per the requirements stipulated by the domain expert/ NFE.
- ii. **Teaching/Training Methodology:** In order to make transfer of knowledge and skills effective, appropriate topic specific training methodology shall be adopted. A typical cycle of explain, demonstrate, imitate, feedback, practice, evaluate, problem solving related inputs will be followed. Where necessary, use of case studies, experiential learning will be resorted to. Talks by experts on relevant topics shall be taken up to add value to training. Adequate practice opportunities for operational skills shall be catered for and ethical issues of practices shall be highlighted.
- iii. Training methods shall be designed to have a high degree of interaction between trainees and the Faculty members/ Resource persons in order to meet the objective of the course. Training methods shall seek to involve and engage trainees throughout the duration of the course/program with a focus on active learning environment.
- iv. The training methods shall include both knowledge based (to facilitate understanding of concepts) and skill based sessions (application of knowledge and skills in practical activities).
- v. Training aids such as videos that are directly relevant may be used to supplement the training by the faculty members/ resource persons. These may be commercial training videos of the NFE Sponsors or videos produced during the course/ program to record and review the performance of trainees.
- vi. Trainees shall be required to attend at least the stipulated number of sessions in the course/ program to make them eligible to appear in the examination as per statutory and / or regulatory requirements, if any.

vii. Each trainee shall be provided with a necessary set of course notes to supplement the recommended text books.

7.1.3. **Design output:** NFE shall develop training material, exercises, case studies, and project work plans per the criteria. This includes a course timetable and curriculum delivery.

8. Learning Services Requirements

8.1. Communication

8.1.1. NFE FLIT Team shall notify trainees through appropriate means about the syllabus, fees, and commitment required to complete the training.

8.1.2. NFE FLIT Team shall communicate trainee responsibilities, ensuring availability and accessibility of training material through Information Technology (IT).

8.2. **Admission Procedure:** There shall be a policy and procedure for trainee admission, including policy on concessions, made publicly available. This includes information on program policies, trainee responsibilities, conduct/discipline, attendance norms, financial obligations, and assessment/qualifying criteria.

8.3. **Provision of Learning Services:** Each trainee shall be provided with a necessary set of course notes to supplement the recommended text books.

8.3.1. Course Material

i. Each Learner shall be provided with a complete set of study material (notes) to supplement the training program.

ii. The notes shall cover each session and shall include all-important points of the element being covered.

iii. Institute shall have a library/ repository of resources which the Learners can access

9. Performance Measurement and Improvement

9.1. **General:** NFE FLIT TEAM shall periodically monitor and measure training effectiveness and support processes as required.

9.2. **Feedback:** NFE shall obtain feedback from trainees and implement necessary corrective actions.

9.3. **Continual Improvement:** NFE FLIT TEAM shall regularly assess training effectiveness, implementing corrective and preventive actions. Management shall ensure effective data management to monitor performance and satisfaction, benchmarking with other institutions for improvement.

10. **Certification Process**

10.1. **Examination:** Every candidate should undergo an ONLINE test, including an online interview. Selected candidates shall do a live test in a test kit with their instrument. Multiple choice questions and examination will be used for the ONLINE test.

10.2. For level 1, the practical skills need to be demonstrated in the kit. For level 2, the practical skills need to be demonstrated in a residential house or a small installation. For level 3, the practical skills need to be demonstrated in an industry. NFE FLIT Team shall select these locations.

10.3. The certificate shall be valid for 2 years. The NFE CP FLIT shall have to submit the calibration certificate of the instrument and pass an interview to revalidate the certificate.

11. **Complaints and Appeals**

11.1. **Complaints:** Expression of dissatisfaction, other than an appeal, related to FLIT training activities.

11.2. **Appeals:** Request for reconsideration of any adverse decision related to FLIT Examination and certification results.

11.3. The NFE FLIT Team providing the training shall conduct the training independently and shall not subcontract it in part or full.